Introducing
Blender
Version 2.82a

blender

The Complete Guide to Blender Graphics
Computer Modeling & Animation

SIXTH EDITION

JOHN M. BLAIN

CRC Press
Taylor & Francis Group
AN A K PETERS BOOK

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Introduction

The Program and the Book

The Book – The Complete Guide to Blender Graphics - 6th Edition

The Complete Guide to Blender Graphics - 6th Edition provides instruction in the use of the Computer Graphics 3D Program **Blender.** The current version of the program is **2.82**. The manual is for those who wish to undertake a learning experience and discover a wonderful creative new world of computer graphics. The book also serves as a reference for established operators.

Instructions throughout the book introduce Blender's features with examples and diagrams referenced to the **Graphical User Interface (GUI).**

The Complete Guide to Blender Graphics originated when Blender's Graphical User Interface was transformed with the release of Blender version 2.50. Subsequent editions of the book have kept pace with developments to the program and have included new material. With the release of Blender 2.82 and its' new interface and operational philosophy, the Sixth Edition of The Complete Guide to Blender Graphics provides current instruction.

For new users this book provides a fantastic learning experience in **Computer Graphics** using **Blender,** by introducing the operation of the Blender program through the use of its' Graphical user Interface. The book is intended to be read in conjunction with having the program in operation, with the interface displayed on a computer monitor screen.

Instruction is presented using the tools displayed in the Graphical User Interface, with basic examples demonstrating results. Understanding where tools are located, their uses and how they are implemented will allow the reader to more easily follow detailed instruction in the many written and video tutorials available on the internet.

The Program - Blender

Blender is a 3D Computer Graphics Program with tools for modeling and animating objects and characters and creating background scenes. Scenes may be made into still images. Animated sequences may be used for video production. Models and Scenes are enhanced with color and texture producing brilliant realistic effects. The still images and video may be for artistic appreciation or employed as architectural or scientific presentations. There are also tools for 2D animation production. Stand alone models may be used for 3D Printing.

The Blender program is maintained by the **Blender Foundation** and released as **Open Source Software** which is available for download and **FREE** to be used for any purpose.

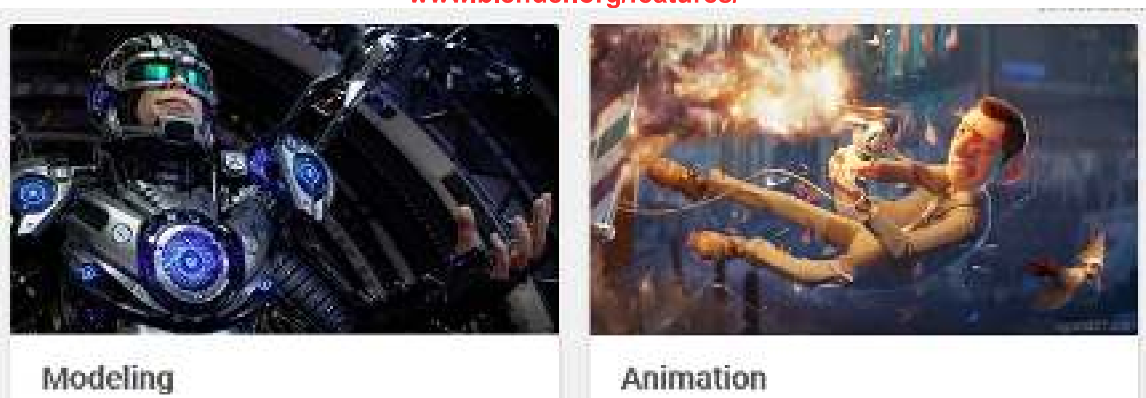
The program may be downloaded from:

www.blender.org

Blender Features

A comprehensive display of the Blender features is available at:

www.blender.org/features/



Blender Platforms

A **computing platform** or **digital platform** is the environment in which a piece of software is executed. It may be the hardware or the operating system (OS)

Blender is a cross platform application for **Windows Vista and above, Linux** and **Mac OSX 10.6** and above operating systems.

The operation of Blender in this manual is applicable to all operating platforms but operations ancillary to the program, such as, saving work to the computers hard drive, have been described exclusively using a Windows operating system.

System Requirements

Graphics

Blender 2.82 requires OpenGL 3.3 or above, with recent graphics drivers from your graphics card manufacturer.

Hardware

Minimum (basic usage) hardware

- 64-bit dual core 2Ghz CPU with SSE2 support.
- 4 GB RAM
- 1280×768 display
- Mouse or Trackpad
- Graphics Card with 1 GB RAM, OpenGL 3.3

Recommended hardware

- 64-bit quad core CPU
- 16 GB RAM
- Full HD display
- Three button mouse or pen+tablet
- Graphics card with 4 GB RAM

Optimal (production-grade) hardware

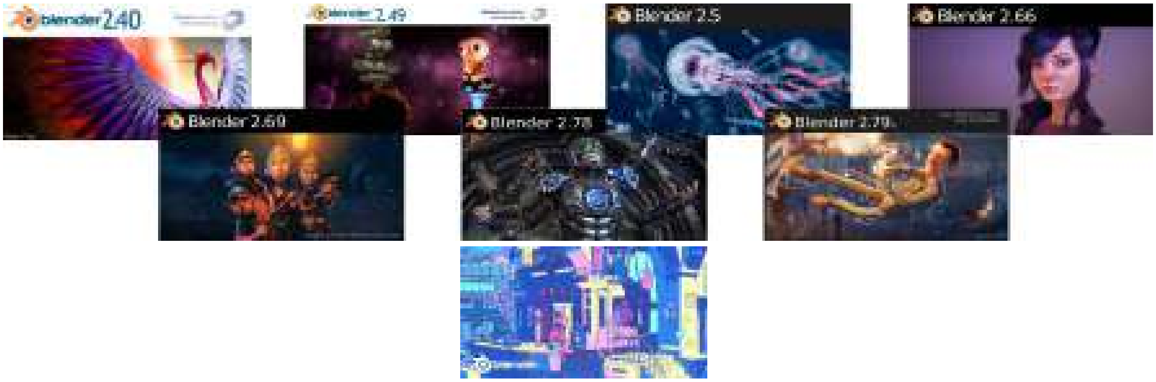
- 64-bit eight core CPU
- 32 GB RAM
- Full HD displays
- Three button mouse and pen+tablet
- Graphics card with +12 GB RAM

Supported Graphics Cards

- **NVIDIA**: GeForce 200 and newer, Quadro Tesla architecture and newer, with NVIDIA drivers (list of all GeForce and Quadro GPUs)
- **AMD**: GCN 1 1st gen and newer (list of all AMD GPUs)
- **Intel**: Haswell and newer (list of all Intel GPUs)
- **macOS**: version 10.12 or newer with supported hardware

Program Evolution

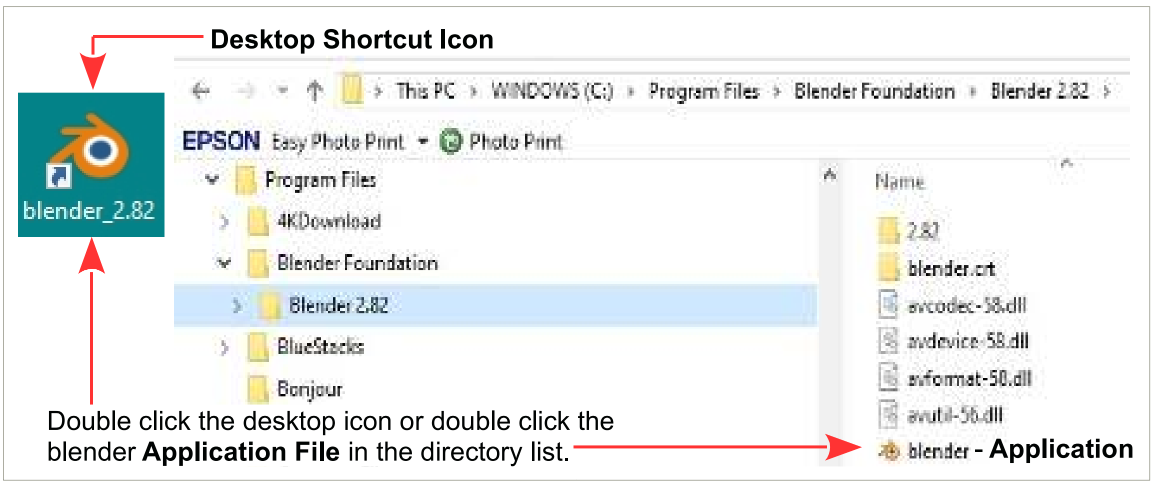
Blender is continually evolving. New versions of the program are released as additions and changes are incorporated, therefore, it is advisable to check the Blender website, from time to time.



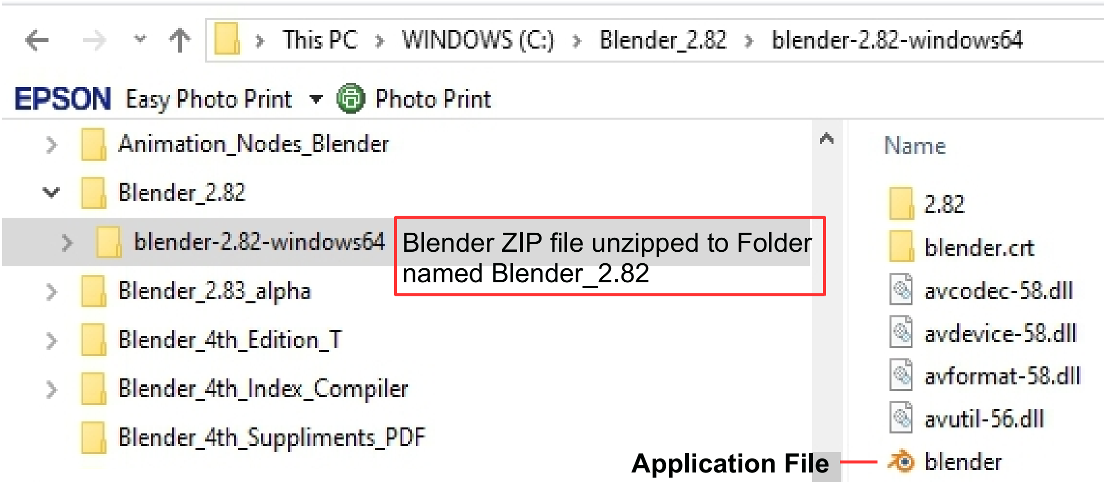
Earlier versions of the program and documentation may be obtained which provide valuable information when you are conversant with the current release of the program. Video tutorials available on the internet also provide valuable information but may not strictly adhere to the current user interface or work flow. Major transformations occurred when the program changed from version 2.49 to 2.50 and again at the change from version 2.79 to the current version 2.82. Being aware of this evolution will allow you to consider anomalies when viewing online tutorials.

Starting the Program

How you start Blender depends on how you have installed the program (see Download & Installation following). If you have used the **MSI installer option** for Windows, Blender will be in the Program Files directory on your C: Drive and a shortcut icon will have been placed on your desktop. If you have installed to a Window 10 operating system, Blender will be listed under, Program Files\ Blender Foundation\ Blender.



If you have downloaded and unzipped the compressed (ZIP) file for Blender the **blender.exe** application file will be located in the folder where you unzipped the compressed file. Open the folder and double click **blender.exe** or right click and select **Open**.



Note: By having one version of Blender installed via the Installer(.msi) option and another using the ZIP method you can have more than one Blender version installed on your computer at the same time. This is useful for version comparison or for development purposes.

Shortcut

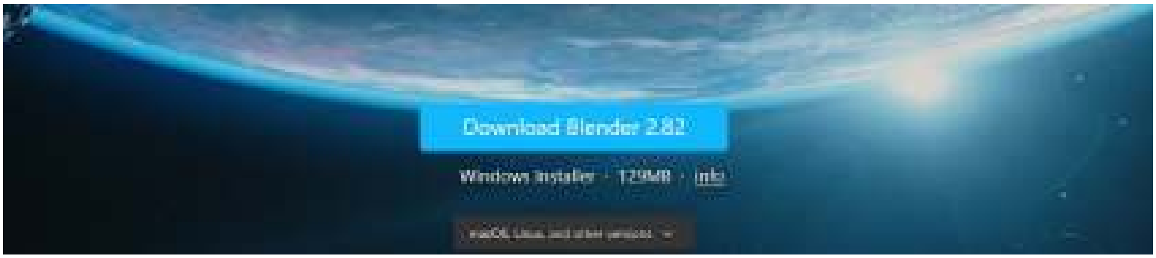
In the directory containing the **blender.exe** file create a shortcut and place it on the desktop.

The Manual Compilation

This manual has been compiled as the experimental builds of Blender 2.80 – 2.82 have been released. During that time numerous subtle changes improving the program's interface have been implemented. Every effort has been made to incorporate these changes in images which demonstrate operational features of the program.

Images used to construct diagrams may differ to what you see on your computer screen. The Blender screen display may be customized or modified to suit individual user preferences. There are several in built display themes which you can choose. In some cases the screen display has been altered to facilitate the construction of diagrams (Figures). When alterations have been made they do not detract from the instruction presented.

Download & Installation

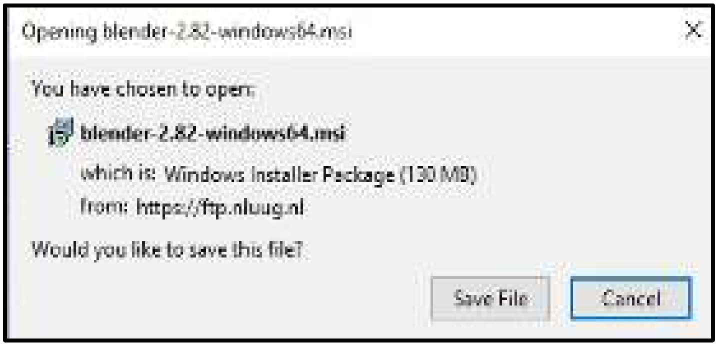


Download Blender

Download Blender from: **www.blender.org**

Select the current Blender version which is applicable to your operating system. Blender is available for Windows, MacOS, Linux and Steam.

The download options are shown in the previous diagram. Selecting the Windows Version presents the MSI Installer which you save to your PC.



With a Windows operating system the MSI Installer will be saved to the Downloads Folder.

Installation on a Windows Operating System

Installing with the Installer(.msi) Option

Double click on the file name in the Downloads folder, follow the prompts and Blender will be automatically installed to the **Program Files** folder on your computer and an icon will be placed on your **Desktop**.

Installing with the ZIP Option

In some cases you can download a compressed ZIP File instead of an MSI Installer.

With a ZIP file you have to unzip the file. You first create a new folder on your computers hard drive then use a program like 7-Zip or Win-Zip to unzip (decompress) the zip file into the new folder (see the note at the end of the chapter).

When the file is unzipped into the new folder you will see **blender.exe** as one of the entries. You double click on this to run Blender or you create a shortcut which places an icon on your desktop.

When using either installation option you double click the **blender.exe** file to run the program. Shortcuts on the Desktop are shortcuts to the blender.exe file.

Note: By having one version of Blender installed via the Installer(.msi) option and another using the ZIP method you can have more than one Blender version installed on your computer at the same time. This is useful for version comparison or for development purposes.

Installing Blender on a Linux Operating System

macOS

https://docs.blender.org/manual/en/latest/getting_started/installing/macos.html

Linux

https://docs.blender.org/manual/en/latest/getting_started/installing/linux.html

Preamble

The objective of the Preamble is to explain terminology and introduce diagrams which demonstrate instructions.

Basic Objective – Graphics Program

The fundamental objective in using a computer graphics program, such as Blender, is to produce a display on a computer Screen which converts (**Renders**) into a digital image or series of images for an animation sequence. The display may only contain a single inanimate model such as that used for 3D printing but will will usually contain multiple 3D models of animate and or inanimate Objects. The arrangement of **Objects** constitutes a **Scene**. Animate Objects (animated Objects) are the moving characters in animation sequences. Inanimate Objects are the components of a Scene with which the characters interact. These may be obstacles in a Scene such as, ground planes, terrain and background.

Assumption

Before you begin to read this book it is assumed you know how to operate a computer. In the past this assumption meant you knew how to operate using a keyboard and mouse. Today many of you will be more familiar with touch screens or laptop touch pads, therefore, although this may appear to be a retrograde step the first instruction will be to familiarise you with Mouse and Keyboard operations.

Blender has been designed to be operated using a Keyboard and Mouse and instruction will be provided using these devices. You may of course adapt a drawing tablet and stylus.

Formats Conventions and Commands

In writing this book the following format conventions have been adopted:

Paragraphs are separated by an empty line and have not been indented.

Key words and phrases are printed in **bold text** with the first letter of a component name specific to Blender capitalised.

Headings are printed in **Bold Olive Green.**

The following conventions will be used when giving instructions.

When using a Mouse connected to a computer, the commands will be:

Click or **Click LMB** – In either case this means make a single click with the left mouse button with the Mouse Cursor positioned over a control on the computer Screen.

In some instances it is explicit that the left mouse button should be used.

A Control: Is a designated area on the computer Screen represented by an icon in the form of a button or bar, with or without text annotation.

Double Click – Make two clicks in quick succession with LMB (the left mouse button).

Click, Hold and Drag – Click the left mouse button, hold it depressed while moving the mouse. Release the button at the end of the movement.

Click RMB – Click the right mouse button.

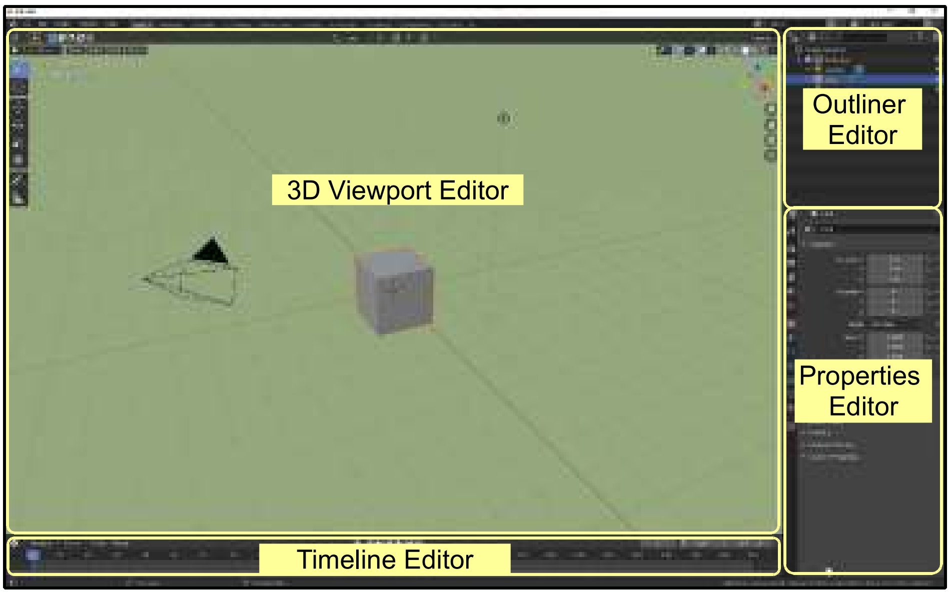
Click MMB – Click the middle mouse button (the middle mouse button may be the scroll wheel).

Scroll MMB – Scroll (rotate) the scroll wheel (MMB).

Clicking is used in conjunction with placing the Mouse Cursor over a button, icon or a slider which is displayed on the Screen.

The Graphical User Interface (GUI)

When Blender is first opened what you see on the computer Screen is the **Graphical User Interface (GUI)** for the program. This arrangement of panels is the interface which allows you, the user, to communicate with the program by entering commands (data) using the Keyboard and Mouse, previously described. The panels that you see are called **Editors**.



Editors

Editors (the panels in the **GUI**) are so named since the basic philosophy in operating the program is; You are presented with a set of default data producing a Screen display. You edit or modify the default data to create what you want.

There are numerous Editors for selection depending on the particular feature of Blender you wish to use. The different Editors will be introduced as features of the program are encountered.

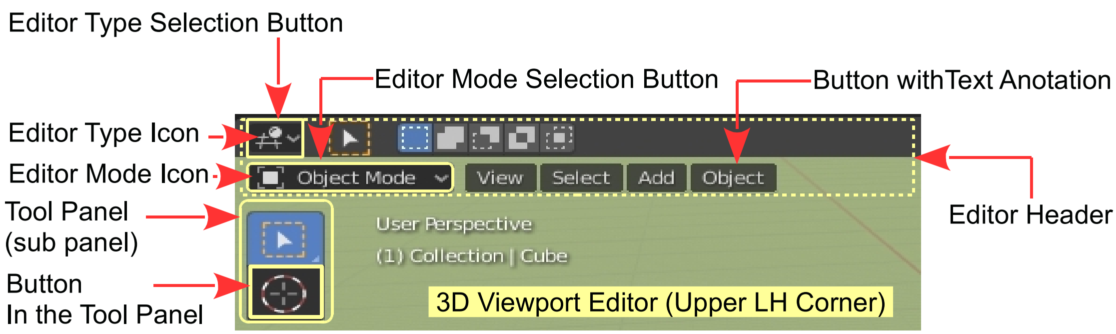
Editors interrelate since what occurs in one will affect what occurs in another. This interaction between Editors is particularly evident when considering the relationship between the 3D Viewport Editor and the Properties Editor. Editing data (entering or modifying) in the Properties Editor affects what is displayed in the 3D Viewport Editor.

Data is entered or modified by activating (clicking) controls in an Editor.

Controls - Buttons, Icons and Sliders

Each Editor in the **GUI** is a separate panel comprising a **Header** at the top of the panel and sub-panels which display within the Editor. The Header and sub-panels contain buttons which you click to activate functions or display menus for selecting functions. The buttons are displayed as text annotation, icons and panels. Each of these, relay data to the program to perform an action.

Example 1 : The 3D Viewport Editor (the default Screen display – **Upper LH Side**)

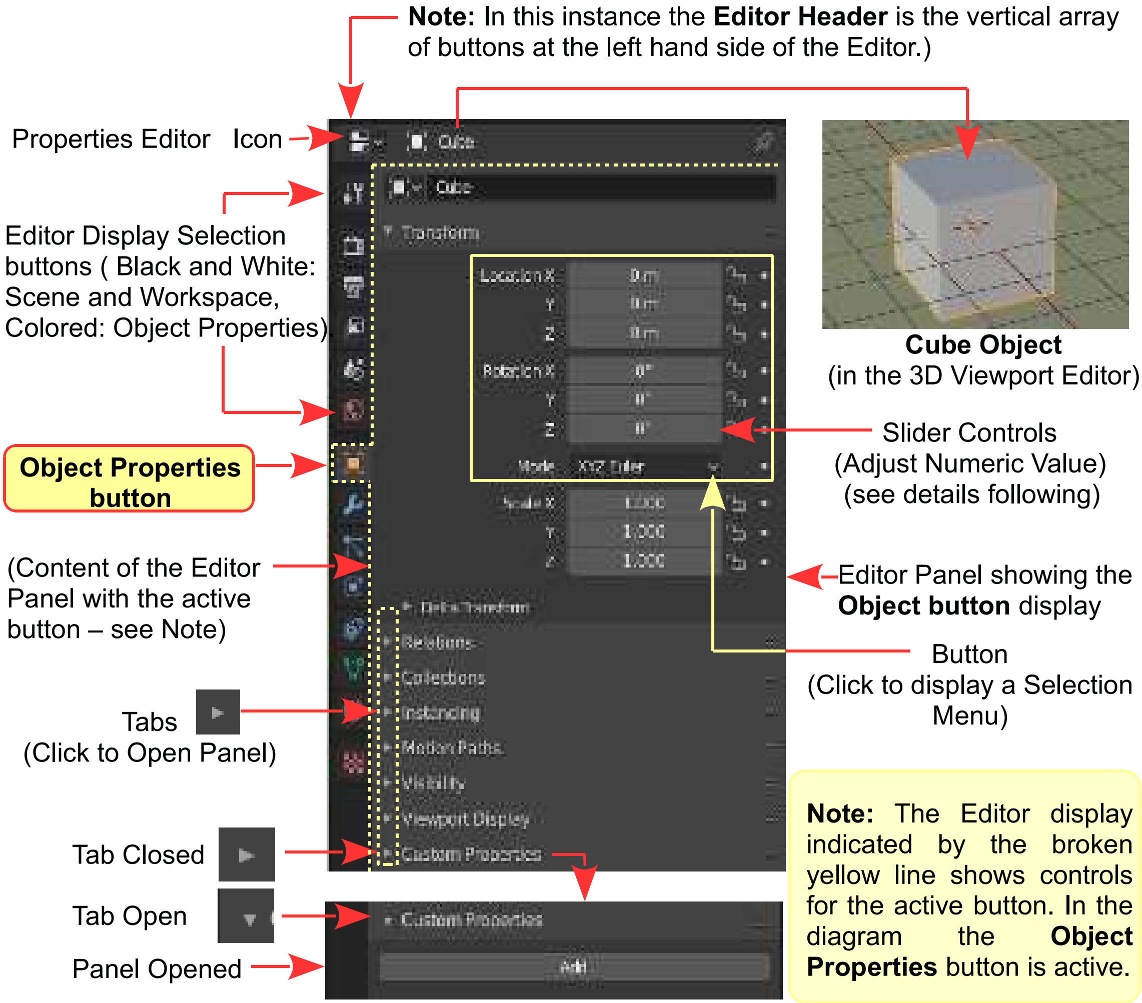


> **Note:** The buttons shown in the diagram can be seen in the panel at the upper left hand side of the **default** Blender Screen arrangement. A detailed description of the Screen Arrangement with its Editors and panels constituting **Blender's GUI** (Graphical User Interface) is presented in **Chapter 1**.

> **Note:**In giving instructions, **Default** means, that which is displayed on the computer Screen before any action is taken.

Example 2 : The Properties Editor (the default Screen display – Lower RH Side)

The default display shows the content of the **Properties Editor** with the **Object Properties button** active. In this state the controls affect the default **Cube Object** in the 3D Viewport Editor.



A **Button** in Blender can be a small square or rectangular area on the screen or an elongated rectangle in which case it may be referred to as a bar. Some buttons display with icons.

An **Icon** is a pictorial representation of a function. In the diagram the icon in the upper left hand corner indicates that the Properties Editor is displayed.

A **Slider** is an elongated area, usually containing a numeric value, which is modified by clicking, deleting and retyping the value, or clicking, holding and dragging the Mouse Cursor that displays on **Mouse Over**, left or right to decrease or increase the value. Some sliders have a small arrow at either end which display when the Mouse Cursor is positioned over the Slider (Mouse Over).

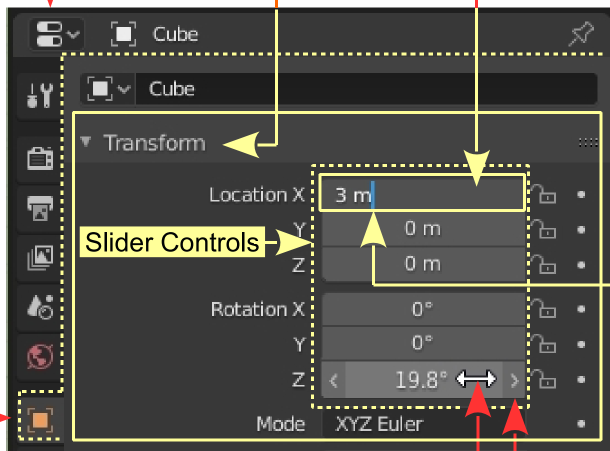
Click on an arrow to incrementally alter the value. Some sliders directly alter the display on the computer Screen.

Slider Control Detail

Properties Editor
Object Properties Button
Transform tab

Mouse over to display double headed arrow. Click to show Typing Cursor.

Slider Controls in the Transform Tab affect the position of the Cube (the selected Object) in the 3D Viewport Editor.

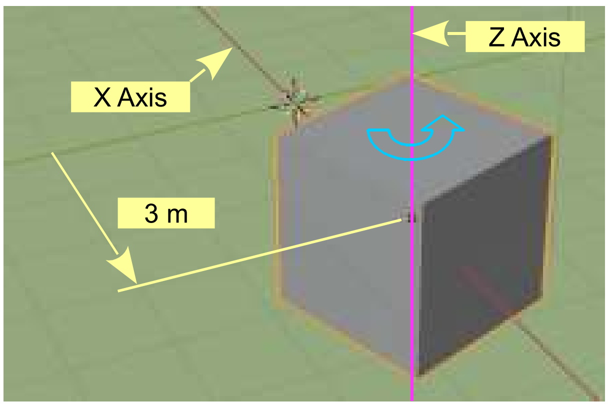


Typing Cursor. Delete, Backspace and retype a value. Press Enter.

Object Properties Button

Cursor displays on **Mouse Over**
Click, Hold and Drag Left or Right

Click Arrow to Increment the value.



With the Cube Object selected in the 3D Viewport Editor, altering the X Location Slider value to 3m and the Z Axis Rotation Slider to 19.8° moves the Cube forward along the X Axis (Red Line) and rotates the Cube on the vertical Z Axis.

For Keyboard input, a command is; to press a specific Key or a series of Keys. Press **Shift + Ctrl + T Key** means, press and hold both the **Shift** and **Ctrl** Keys simultaneously and tap the **T Key**. **Num Pad** (Number Pad) Keys are also used in which case the command is Press **Num Pad 0** to **9** or **Plus** and **Minus**.

Command Instruction Example:

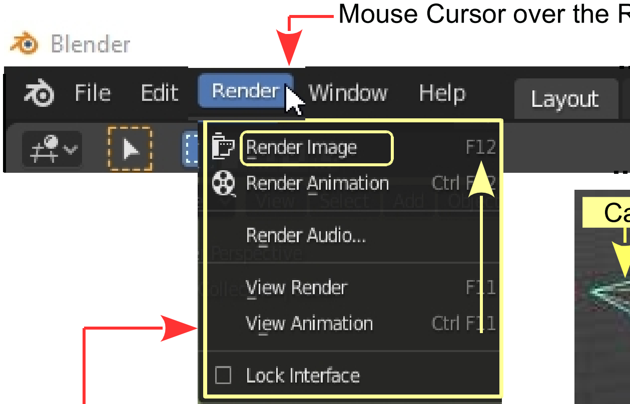
Go to the **Blender Screen Header, Render button,** click **Render Image:**

Remember: A control button, icon or slider which is displayed, indicates a specific location on the computer Screen. Positioning the Mouse Cursor at this location and clicking the Mouse button or depressing a keyboard button, inputs a signal to the computer. The interpretation , made by by the computer is; signal received at specific location = perform explicit computation and export result.

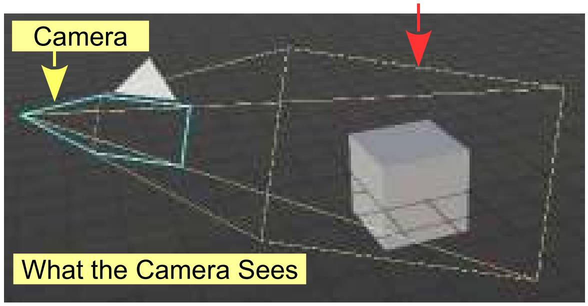
The example above means, in the **Blender Screen Header,** position the **Mouse Cursor** over the **Render button** and click the left mouse button, clicking once. In this case the signal received by the computer with the Mouse Cursor at the position of the Render Button tells the computer to display the **Render Options Sub Menu**. Positioning the Mouse Cursor over **Render Image** in the sub menu and clicking once renders an image of **Camera View** (what the camera sees). The rendered image is displayed in a new Editor panel, the **Image Editor**. The image may be saved from this location but for the time being press **Esc** on the Keyboard to cancel the render and return to the 3D Viewport Editor.

Mouse Cursor over the Render Button

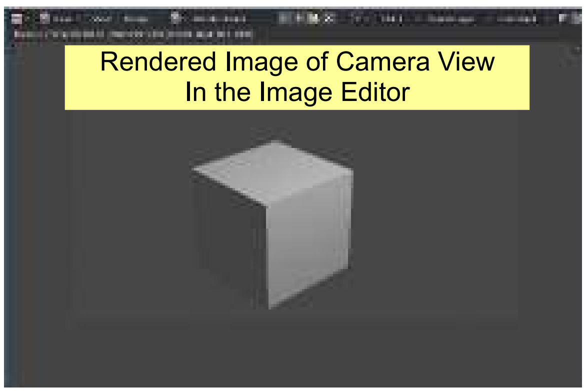
Blender Screen Header
Upper LH portion of Screen



Camera View



Render Options Sub Menu



Note: The annotation **F12** adjacent to **Render Image** is a **Keyboard Shortcut**. Pressing F12 on the Keyboard will also Render the Camera View.

Remember: The purpose of exercises in this preamble are to familiarise you with commands and diagrams not to provide instruction an any particular task. Full instruction will be provided later.

Book Work Flow

The initial work flow in the book will introduce the Editors and panels which make up the **Graphical User Interface (GUI)** and familiarise you with basic control operations. During the initial introduction detailed explanation of the Blender processes will be limited to a need to know basis. To start with, you will have to blindly follow along without understanding why. Explanation will be given as you progress and are made aware of the different Blender features.

In demonstrating one of the previous **Command Examples** the command was; **Click the Render button**.

Rendering

Rendering: The Definition from the Wiki when specifically applied to computer graphics follows. The Wiki? The Free Encyclopedia **Wikipedia.**

Https://en.wikipedia.org/wiki/Rendering_(computer_graphics)

Rendering or **Image Synthesis** is the automatic process of generating a photo realistic or non-photo realistic image from a 2D or 3D model (or models in what collectively could be called a Scene file) by means of a computer program. Also, the results of displaying such a model can be called **Rendering**. A Scene file contains objects in a strictly defined language or data structure; it would contain geometry, viewpoint, texture, lighting, and shading information as a description of the virtual Scene. The data contained in the scene file is then passed to a rendering program to be processed and output to a digital image or raster graphics image file. The term "rendering" may be by analogy with an "artist's rendering" of a Scene.

Render Engines - GUI Versions in Blender

Render Engines are the parts of the Blender program that convert the display into an image or sequence of images. Image sequences generate animations which in turn produce movie files.

In Blender 2.82 there are three **Render Engine options**. With the selection of each Render Engine type the Graphical User Interface (GUI) is displayed in a slightly different manner. Which option you chose depends on the particular process, to which the engine type is suited.

The Render Engines in Blender 2.82 are named; **Eevee Render, Cycles Render, Workbench Render.**

Eevee Render

The default Render Engine presented when Blender starts is **Eevee**. This is an acronym for "*Extra Easy Virtual Environment Engine".* Eevee displays a real time rendered view. In other words, what you see on the Screen as you make changes, is a good approximation of what you get in your final image view. Eevee quickly renders the Scene as you work but the quality of the render can incur a time disadvantage in the advanced stages of modeling.

Cycles Render

Cycles Rendering is specifically designed to produce a photo realistic high quality display of an image or frame in an animation incorporating colors, textures and special lighting. The quality of the display is adjustable since high resolution rendering comes at a cost with respect to time.

Workbench Render

Workbench Rendering uses the 3D View's drawing for quick *preview* renders. This allows you to inspect your animation (for object movements, alternate angles, etc.). This can also be used to preview your animations – in the event your Scene is too complex for your system to play back in real-time in the 3D View. You can use Workbench to render both images and animations.

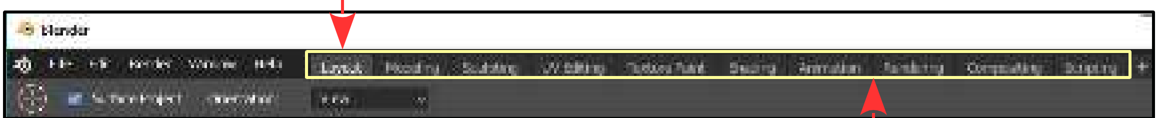
> **Note: Workbench Render** was formerly **OpenGL Render**. The definition has been taken from the Blender Manual. Each Render Engine type displays the view in the computer Screen in different ways depending on the **Viewport Shading** method that you select. This will be explained as you progress through the book.

Workspaces

A **Workspace** is the arrangement or configuration of **Editor** panels on the computer Screen. Blender includes numerous Editors for specific functions and these Editors are selected and arranged to facilitate particular operations.

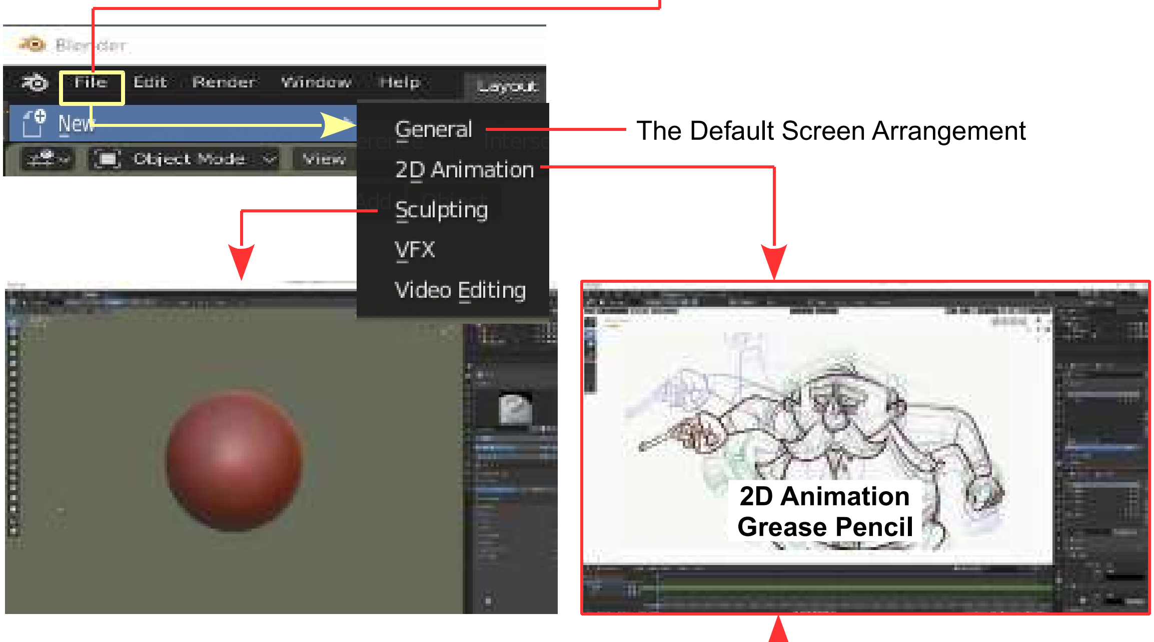
Several Workspaces (Editor arrangements) are provided and may be selected in the Blender Screen Header. There is also the facility for users to build and save specialised arrangements of Editors to suit their working environment for specific tasks.

Layout displays the default **Workspace** in the default Screen Arrangement



Workspace options in the Blender Screen Header

Although not designated as Workspaces there are five other Screen arrangements for specific tasks. In the Header at the top of the Screen, click on **File** then **New** to display the option menu.



2D Animation – Grease Pencil

Blender incorporates a dedicated Workspace for creating 2D Animation called **The Grease Pencil**.

This environment provides 2D Animation tools within Blender's 3D Pipeline. 2D Animation creates characters, storyboards, and backgrounds in two-dimensional environments which may be used in advertisements, films, television, computer games, or websites and is just a fun thing to do.

The content and operation of the Grease Pencil is covered in a separate dedicated publication, in PDF format, FREE to download, from the Author's website.

https://www.tamarindcreativegraphics.com

1

Understanding the Interface

1.1	Interacting with the Interface	1.9	Working in the 3D Viewport Editor (Object Mode)
1.2	First Interaction	1.10	3D Viewport Editor Modes
1.3	Second Interaction	1.11	Working in the 3D Viewport Editor (Edit Mode)
1.4	Getting Help	1.12	Coloring Using the Properties Editor
1.5	Examine the Interface	1.13	Simple Animation
1.6	Rotating in the 3D Space	1.14	Explode – Quick Method Example
1.7	Other Objects	1.15	Summary
1.8	Using the Outliner Editor		

The Interface

When Blender opens you are presented with a Screen arrangement displaying multiple windows. This arrangement is called the **Graphical User Interface (GUI)** (Figure 1.1). Windows in **Blender** are called **Editors.**

To get you started using Blender, this chapter will show you how to interact with the interface. This introduction will make you familiar with the Editors, entering command using the controls and give you an insight into how the different Editors interrelate. The Preamble preceding this chapter introduced controls, command instructions and presented example diagrams (**Figures**) touching on a sample of this material.

Of necessity, at this point, very few of the functions available in Blender will be explained in detail. This is just the beginning and it is assumed you are looking at Blender for the first time. Too much information may be confusing. In following chapters the information in Chapter 1 will be repeated and expanded.

By following the instructions with reference to diagrams you will see how Blender works and experience examples. Understanding the Interface and knowing what tools are available, which buttons to press and what to expect is the key to understanding Blender.

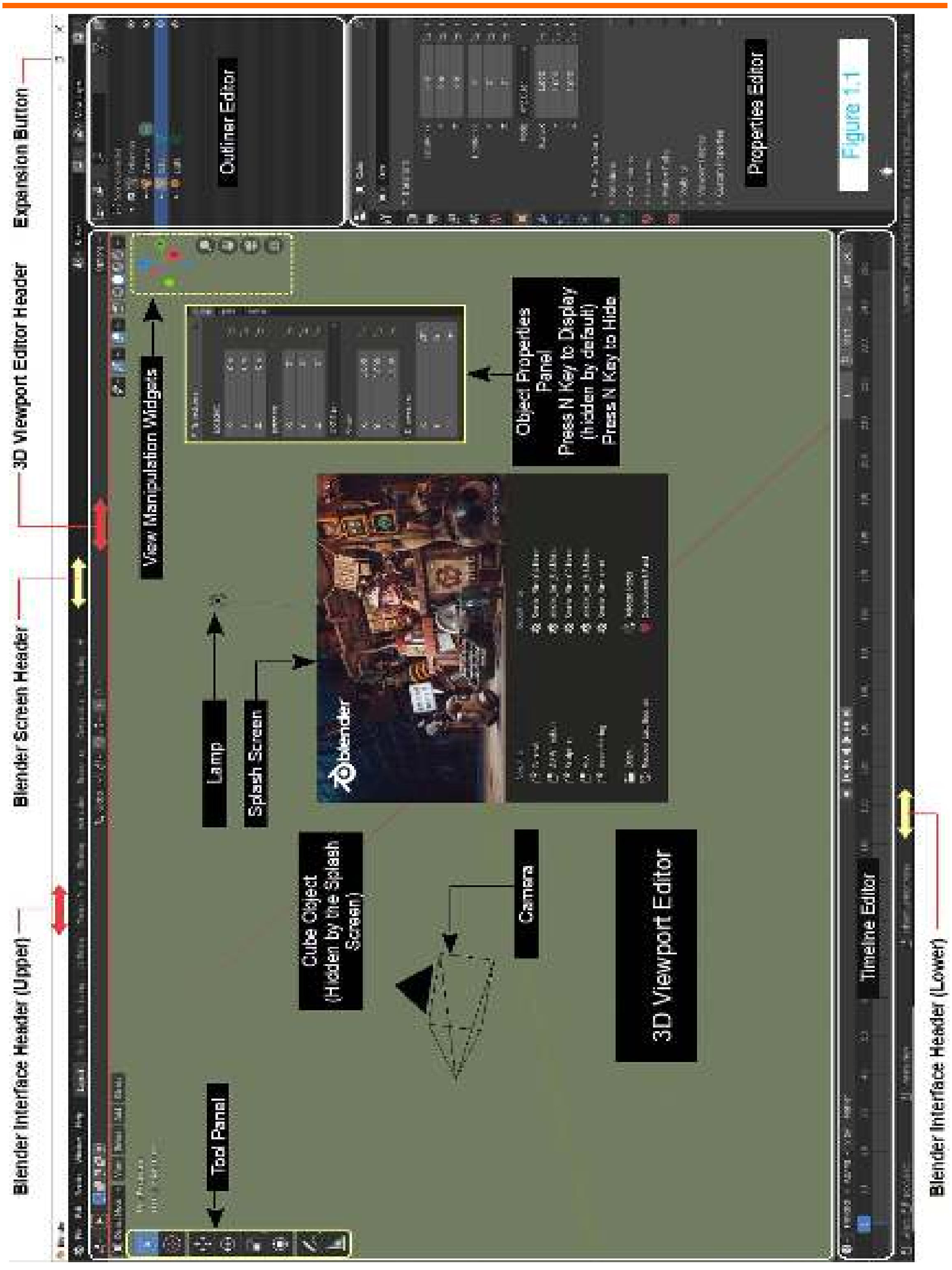

Blender Interface Header (Upper)
Blender Screen Header
3D Viewport Editor Header
Expansion Button
Outliner Editor
Properties Editor
View Manipulation Widgets
Object Properties Panel
Press N Key to Display
(hidden by default)
Press N Key to Hide
Lamp
Splash Screen
Cube Object
(Hidden by the Splash Screen)
Camera
3D Viewport Editor
Tool Panel
Timeline Editor
Blender Interface Header (Lower)

Figure 1.1

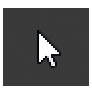
1.1 Interacting with the Interface

Before you can explore the Blender interface you have to know the fundamental procedures for entering commands to the program via the Keyboard and Mouse. Refer to the section titled **Formats Conventions and Commands** in the Preamble.

When Blender first opens, the Screen displays the **Graphical User Interface (GUI)** as shown in Figure 1.1. (**Note:** In Figure 1.1 Panels have been delineated with borders and the background color of the 3D Viewport Editor has been altered).

The Blender **GUI** opens with the **Splash Screen** panel in the center, showing which version of Blender you have opened (Figure 1.2). There are links included in the **Splash Screen** and buttons which you click to access Screen arrangements for working with specific aspects of the program.

Figure 1.2



Note: In Figure 1.1 borders have been added to distinguish the Editors and background colors have been changed. Figure 1.2 shows the Splash Screen for Blender Version 2.80 against the default dark gray background. The Splash Screen for Version 2.82 is different.

Note: As features are introduced, detailed instruction will be deferred until you have acquired sufficient knowledge to understand the usage. In the early stages of learning Blender this will occur frequently, therefore, a reference will be given to detailed explanation.

1.2 First Interaction

Oops! You clicked the Mouse Button and the **Splash Screen** disappeared?

This is your first interaction with the **GUI**.

Clicking the left Mouse button with the **Mouse Cursor** in the **3D Viewport Editor** cancels the Splash Screen. Should you wish to reinstate it, position the Mouse Cursor over the little black and white Blender logo (button) in the upper left hand corner of the Screen (Figure 1.3).

Position the Mouse Cursor over the Black and White Blender Logo (highlights blue on Mouse Over)

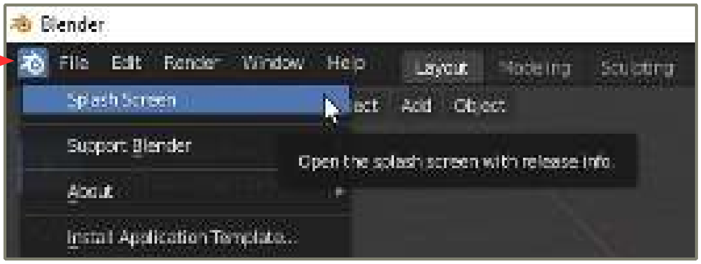


Figure 1.3

Click the Left Mouse Button (LMB), drag the mouse placing the cursor over **Splash Screen** (highlights blue) and click LMB again. The Splash Screen is reinstated.

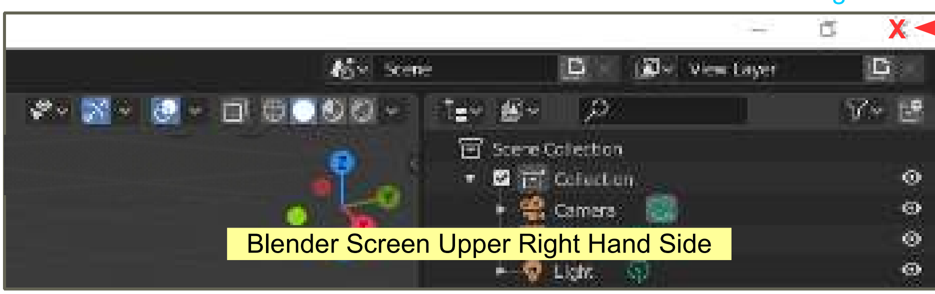
1.3 Second Interaction

When you start something it's a good idea to know how to quit. Blender is no exception. This may be stating the obvious but inevitably things will get messed up and, at some stage, you will want to start over fresh. There are two ways of doing this.

Close the Program and Restart

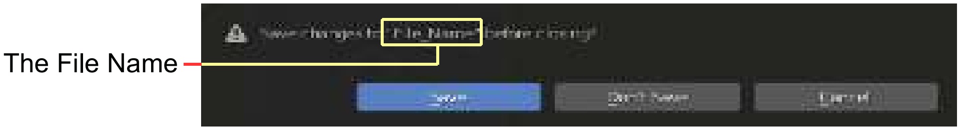
To close Blender click the **Cross** in the upper right hand corner of the Screen (Figure 1.4). **Click the Cross** means, place the Mouse Cursor over the Cross (Quit button) and click LMB.

Figure 1.4



Before **Blender** shuts down a panel displays with a reminder to save changes (Figure 1.5). At this point you can Save, Discharge Changes you have made (Don't Save) or Cancel quitting.

Figure 1.5

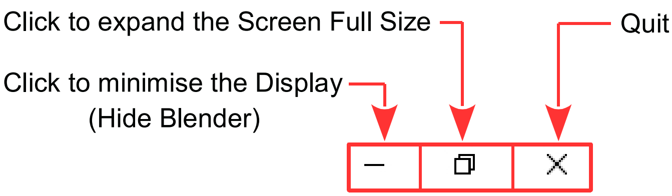


> **Note:** When you click the Quit button at the top of the Screen the warning only displays when you have performed an operation. If you haven't done anything the warning does not display.

To Restart the Program double click the Blender Icon on your **Desktop**.

Note the two buttons adjacent to the **Quit button**.

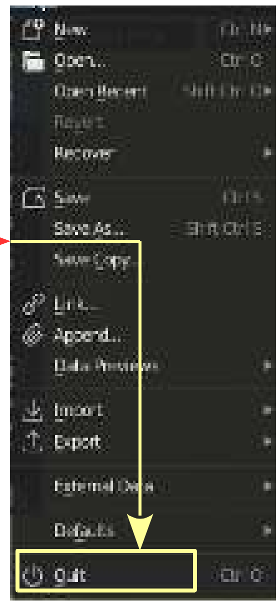
Figure 1.6



Closing the Program - Alternative Method

You may also close **Blender** by clicking on **File** in the upper left hand corner of the Screen and selecting (click) **Quit** in the menu that displays.

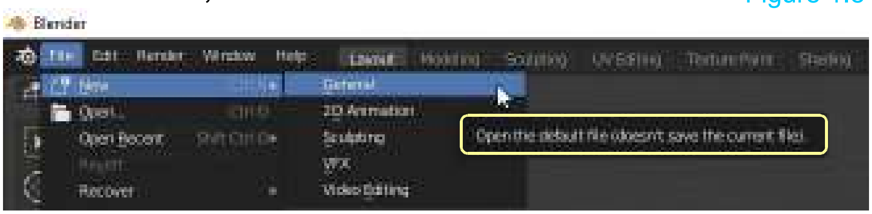
Figure 1.7



Start Over - Restart Without Closing

To restart **without closing** Blender, click (LMB) on **File** in the upper left hand corner of the Screen (highlights blue) (Figure 1.8), drag the Mouse Cursor over **New,** then **General** and click LMB.

Figure 1.8



This method opens a new default Blender Screen Arrangement.

1.4 Getting Help:

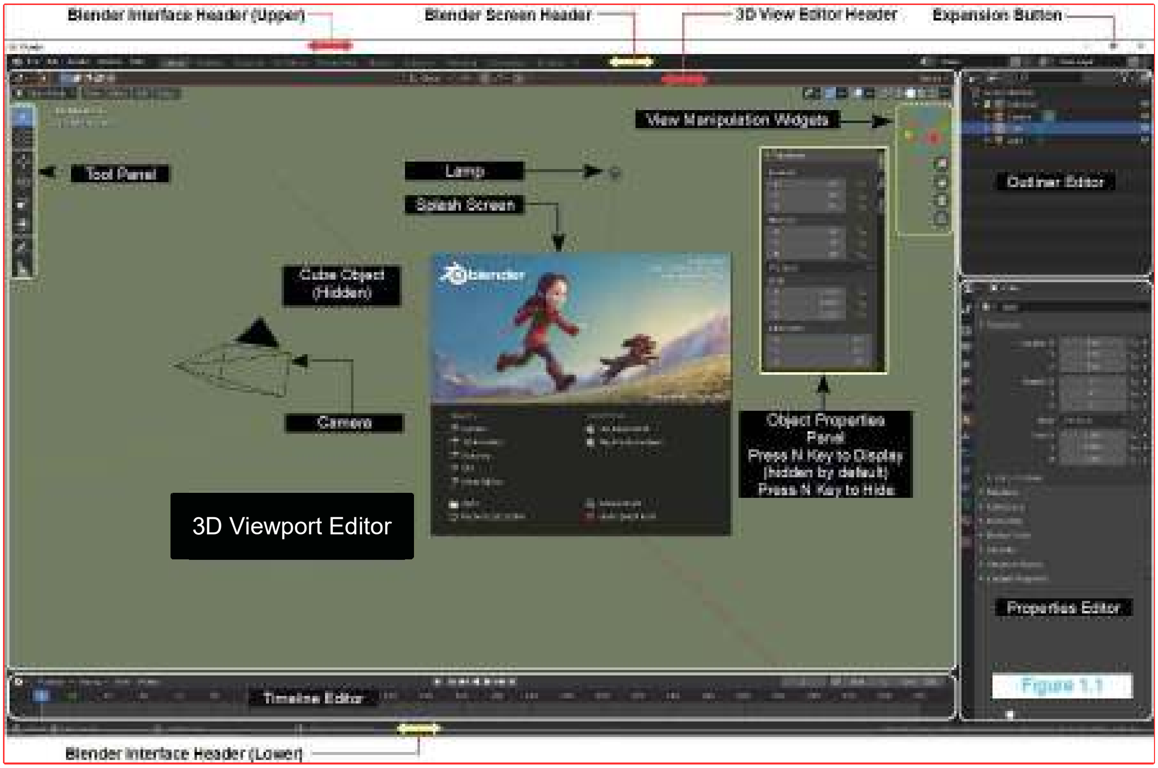
Figure 1.9

If you need help there is always the **Blender Manual**, **Tutorials**, **Support** etc. on the internet.

Opens in your Web Browser.

1.5 Examine the Interface (Figure 1.1)

Figure 1.10



The **Blender Graphical User Interface** (GUI) is made up with four (4) Panels called **Editors** and four (4) **Headers**. In addition each Editor Panel also has its own Header which is usually at the top of the Panel. Headers contain icons and text notations which are buttons for selecting or activating functions.

Consider **Functions** as the computer code working behind the Scene which make things happen.

When Blender is first opened the Interface displays with the **Splash Screen** in the center of the display in the **3D Viewport Editor** Panel. As you may have discovered, clicking the left Mouse button cancels the Splash Screen leaving the Interface displaying the Blender **Interface Header** (Upper - the white strip across the top of the Screen), the Blender **Screen Header** (the black strip below the Interface Header), and the Blender **Interface Header – Lower** (the strip at the bottom of the Screen). Between the Headers are the four default Editor Panels; the main panel, the **3D Viewport Editor**, the **Outliner Editor** and the **Properties Editor** (at the right hand side of the Screen) and the **Timeline Editor** below the 3D Viewport Editor.

With the Splash Screen removed you see a gray **Cube** in the center of the 3D Viewport Editor.

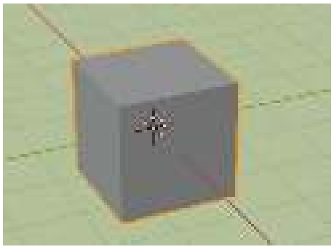
The 3D Viewport Editor is showing the Cube, suspended in 3D (three dimensional) Space. For convenience the Space is provided with a horizontal **Mid Plane Grid** for reference when positioning Objects in Space. The Grid is marked with the Horizontal X Axis (red line) and the Horizontal Y Axis (green line). By default the Vertical Z Axis is not displayed.

In Blender, the **Cube** is said to be an **Object**. In the default Scene there is also a **Camera** Object and a **Lamp** Object. There are many Objects of different types which may be added to a Scene.

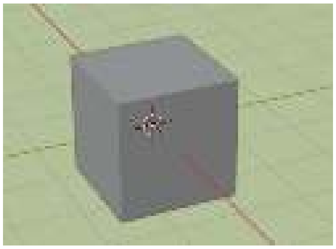
The Cube is one of several basic building blocks from which to commence modeling. The orange outline indicates that the Cube is **selected** which means you can work on it to create something.

By clicking **LMB** (left mouse button) with the **Mouse Cursor** over an empty part of the 3D Viewport Editor you will **deselect the Cube**. The orange outline disappears. To re-select the Cube or select another Object you place the Mouse Cursor over the Object and click **LMB**.

Figure 1.11



Cube Selected



Cube De-Selected

Note: In Figure 1.1 the background color of the 3D Viewport Editor has been changed from the default gray. You will be shown how to do this at a later stage (see Chapter 2 - 2.18).

Note: Default means, that which is displayed or occurs without any action being taken.

1.6 Rotating in the 3D Space

Rotating the Object (Cube)

In the default Scene, The Cube Object is located at the center of the 3D Space. **Have the Cube selected**. Place the Mouse Cursor, in the 3D Viewport Editor to one side of the Cube. Press the **R Key** (rotate) on the Keyboard and drag the Mouse to rotate the Cube. Click LMB to set in position.

Rotating the 3D Space (Viewport)

With the Mouse Cursor positioned in the 3D Viewport Editor, click and hold the **Middle Mouse Button** (Scroll Wheel) and drag the Mouse. The Scene in the 3D Viewport Editor is rotated. Release the Mouse button.

This exercise has distinguished between rotating an Object and rotating the View which is advantageous when modeling. Of course you have messed up the View and may wish to get back to square one. At this stage the options are to restart Blender or restart without closing as described in Section 1.3. There are Keystrokes for rotating the View and Manipulation Widgets for rotating the Object or the View. These will be explained later (see 1.9 and Chapter 2 – 2.7).

1.7 Other Objects

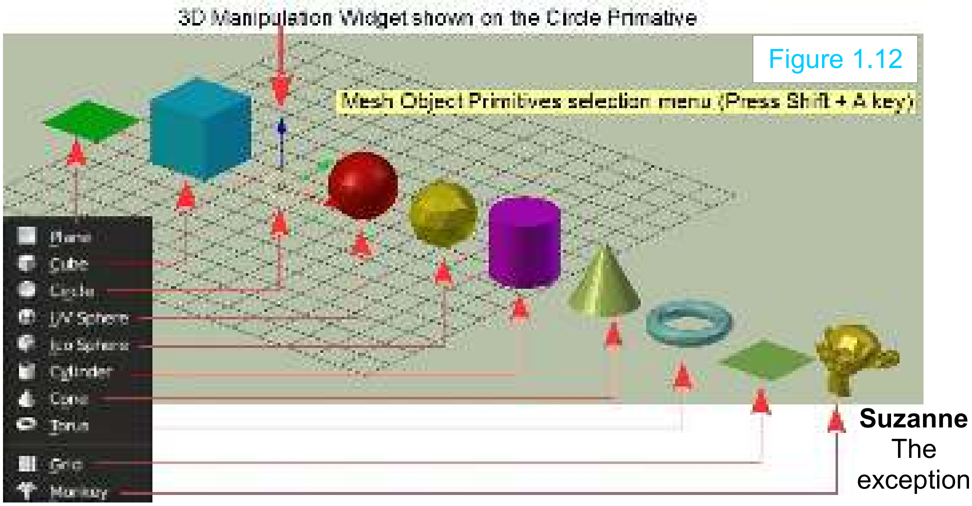
Besides the Cube Object, the default Scene contains a Lamp Object and a Camera Object.

The Lamp represents a light source which illuminates the Scene, determining how you will see the View when it is converted into an Image (see Chapter 15).

The Camera determines what part of the Scene is captured for Rendering (Chapter 15 – 15.3).

The Lamp and the Camera have Properties which may be modified to produce effects. How to do this will be placed on hold for the time being.

There are many Object which you can add to the Scene. With one exception the Objects are not pre-constructed models of characters but mesh shapes (Primitives) from which you begin modeling.



To demonstrate adding an Object, the one exception, the pre-constructed Mesh model of a Monkey, affectionately named **Suzanne**, will be added to the default Scene.

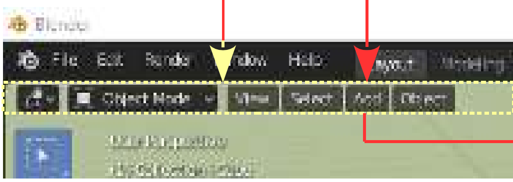
> The basic principle in Blender, when modeling, is to add one of the basic Mesh Objects, sometimes called Primitives, then modify (model) that shape into whatever you want. You may combine several primitives if you wish.

To Add a new Object you either click the **Add button** in the 3D Viewport Editor Header or with the Mouse Cursor in the 3D Viewport Editor, press the **Shift Key + the A Key** (keyboard) to display the **Add Menu**.

3D Viewport Editor Header

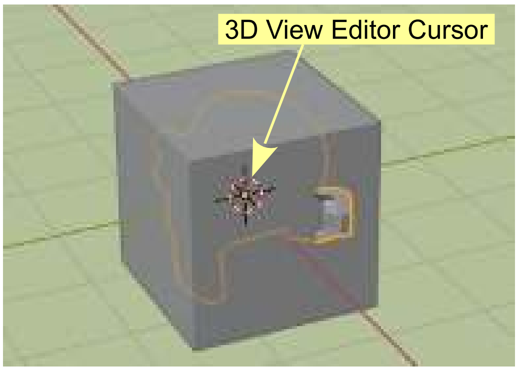
Click the **Add** Button

Figure 1.13



The Add Menu

To add **Suzanne** (the Monkey Object), mouse over on **Mesh** then in the Mesh sub menu click **Monkey**.



All New Objects added into a Scene are entered at the position of the **3D Viewport Editor Cursor. Yes!** There is another Cursor. By default the 3D Viewport Editor Cursor is located at the center of the 3D Space. The default Cube Object is also located at the same position and when Suzanne (Monkey) is entered she is also located at this position.

When a new Object is added to the Scene, the new Object becomes the selected Object, hence you see the orange outline and in this particular case you see part of Suzanne's Ear protruding from the surface of the Cube. To see Suzanne clearly hide the Cube using the **Outliner Editor**.

1.8 Using the Outliner Editor

Figure 1.14

The **Outliner Editor** lists all the Objects in the Scene and provides a means of organising Objects into groups. This is a great help when compiling complicated Scenes.

In Figure 1.14 you see the Objects in the Scene listed in a group named **Collection**.

How to organise Collections will be explained in Chapter 12 but for the moment, click on **Cube**, then click on the little **Eye Icon** adjacent to Cube (Figure 1.15) to hide the Cube in the Scene. This does not delete the Cube, it merely cancels the display. You click the eye icon a second time to reinstate the Cube in the 3D Viewport Editor. If you click the eye icon adjacent to Collection the display of every Object in the Collection is cancelled.

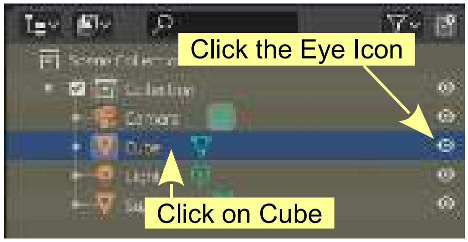
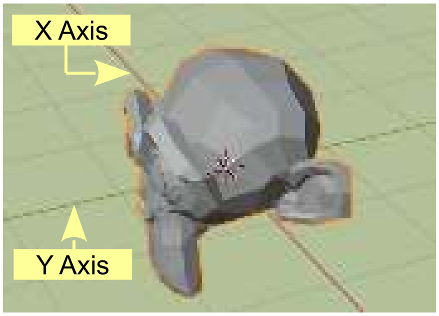


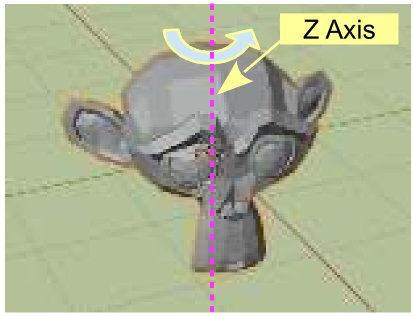
Figure 1.15

1.9 Working in the 3D Viewport Editor (Object Mode)



Suzanne with the Cube hidden

Figure 1.16



With Suzanne selected, press the **R Key + the Z Key** and drag the Mouse to see her pretty face.

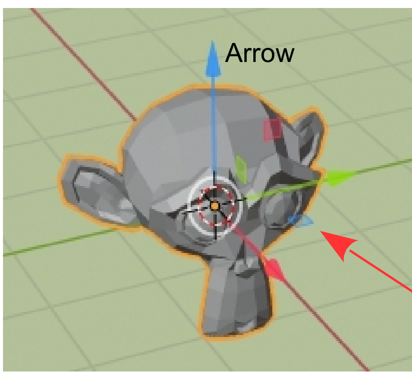
Rotation: R Key + Z Key means, Rotate about the **Vertical Z Axis.**

There are many functions which can be employed in the 3D Viewport Editor. Rotating an Object is one. You also **Scale** the selected Object (Press the S Key and drag the Mouse) (S Key + X confines the Scale operation to the X Axis). You **Translate** (move and reposition) the Object in the 3D Viewport Editor (Press the T Key and drag the Mouse) (T Key + Y confines the movement to the Y Axis).

The function of the Keystrokes are replicated by **Widgets** which are activated from the **Tool Panel in the 3D Viewport Editor**.

Figure 1.17

Move



The **Move** (Transform) Widget

The colored **arrows** and **rectangles** are **Widget Control Handles** which you click (LMB), hold and drag to Translate (move) the selected Object in the Scene. Clicking an arrow confines the movement to an Axis in the Scene. Clicking a rectangles confines the movement to either the X,Y or Z Plane.

Rectangle

Widgets are explained in detail in Chapter 2 – 2.7, 2.14.

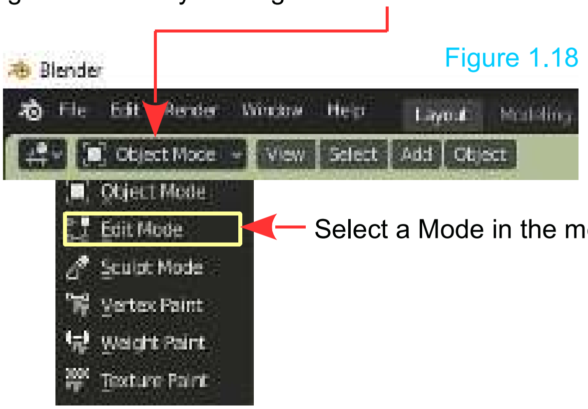
With the Cube hidden, using the Transform Widget, move Suzanne to one side of the center of the Scene, then in the Outliner Editor, click the eye icon adjacent to Cube to reinstate the display of the Cube in the 3D Viewport Editor.

1.10 3D Viewport Editor Modes

The 3D Viewport Editor can be displayed in different Modes depending on what operation is to be performed.

Note: Section 1.9 has been titled **Working in the 3D Viewport Editor (Object Mode)**. You change the Mode by clicking the **Mode Selection button** in the 3D Viewport Editor Header.

Figure 1.18



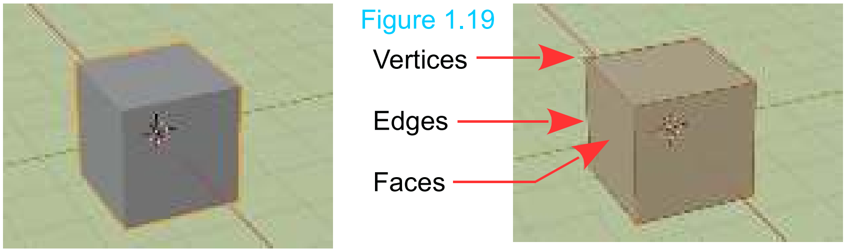
Select a Mode in the menu that displays.

1.11 Working in the 3D Viewport Editor (Edit Mode)

Note: You will find there are many times when you want to switch between Object Mode and Edit Mode. Instead of using the Mode Selection Menu simply press the **Tab Key** on the Keyboard to **Toggle** between the two Modes (have the Object selected).

In **Edit Mode** the default Cube displays with its **Faces** a different shade of gray, with orange dots at each corner called **Vertices**, connected by thin orange lines which are the **Edges**.

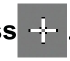
Figure 1.19



Object Mode **Edit Mode**

When changing from Object Mode to Edit Mode all **Vertices**, **Edges** and **Faces** are selected.

Click LMB in the 3D Viewport Editor to deselect the Vertices, Edges and Faces.

Note: In Edit Mode, the Mouse Cursor displays as a **white cross** . Figure 1.20

Position the Mouse Cursor (white cross) over one of the Vertices and click LMB to select a single Vertex on the Cube (vertex turns white).

Note: Selection in 3D Viewport Editor, in Edit Mode, is by default, set to **Vertex Select.**

You change the **Selection Mode** in the 3D Viewport Editor Header.

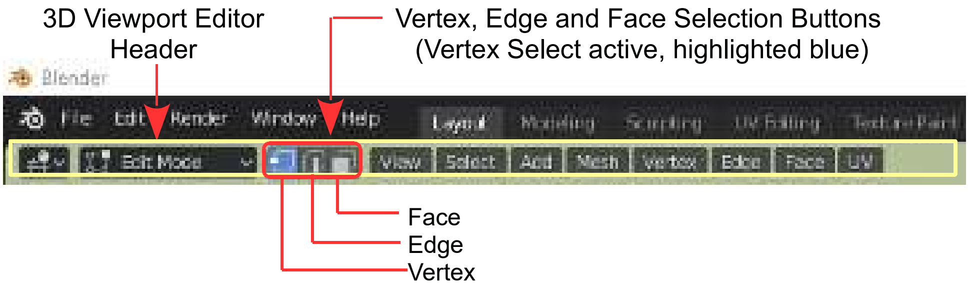


Figure 1.21

Note: When changing to Edit Mode the array of buttons in the 3D Viewport Editor Header is different to Object Mode and the options in the Tool Panel change. You are able to select a Vertex since the Vertex Select button in the Header is active (highlighted blue). You have the options to select Edges or Faces.

With the Vertex selected, press the G Key and drag the Mouse to reposition the Vertex. Click LMB to set in place.

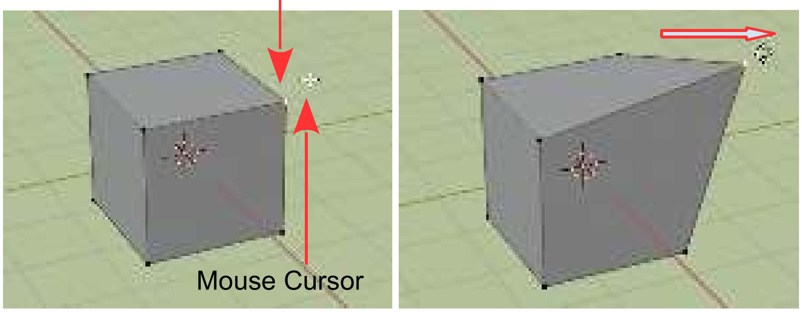


Figure 1.22

This simple rudimentary procedure is the basis of **Modeling**.

With the Vertex repositioned, Tab back to Object Mode.

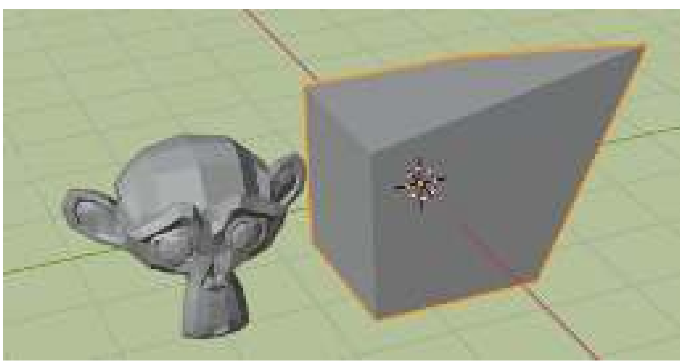


Figure 1.23

1.12 Coloring Using the Properties Editor

Bear in mind, the objective in this chapter is to familiarise you with the Graphical User Interface, not to explain all the functions available in Blender. You have been introduced to Editors and Headers and given a small insight into operating in 3D Space and working with Objects.

The **Properties Editor** contains controls which affect what happens in the 3D Viewport Editor. Some controls apply to the Scene as a whole and some specifically affect the properties of the Selected Object. There are usually multiple Objects in a Scene. The controls in the Properties Editor change when an Object is selected and affect only the Selected Object.

To demonstrate, it will be assumed, you have a Scene containing a Cube Object and a Monkey Object. In this case the Cube has been modified per the previous example (Figure 1.22) and Suzanne has been moved to the side (Figure 1.23).

Figure 1.24

The Properties Editor will be used to add a color to Susanne.

With Suzanne selected, click on the **Material button** at the left hand side of the **Properties Editor** (Figure 1.24).

Remember, Monkey is called **Suzanne**. With Suzanne selected the Material button controls only affect Suzanne.

The Material button controls for Suzanne at this stage consist of the single **New Button**. This is telling you that Suzanne has no Material applied. At this point consider Material to mean **Color**.

The vertical array of buttons at the left hand side of the Properties Editor will be explained in due course but for the moment only be concerned with making Suzanne appear blue.

Why Blue?

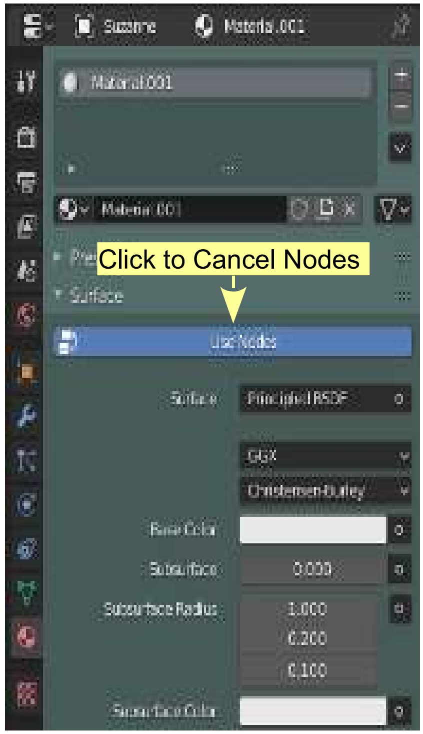
Having a Plan

When constructing a Scene you should consider having a plan in mind. In this demonstration the plan will be to have Suzanne appear to be blue with cold and sitting somewhere in the background. Suzanne will move forward in the Scene and collide with an Object. Being cold and brittle Suzanne will shatter into pieces.

This plan will be a very simple unsophisticated example of animation which will give a preview of a physical simulation (Explode).

To add **Material** (color) to Suzanne (the selected Object) click the **New Button** in the Properties Editor. The display expands (Figure 1.25).

Figure 1.25



By default, Material Color is being controlled by a hidden **Node System**. The blue bar with the notation **<u>Use Nodes</u>** indicates that the Node System is in control.

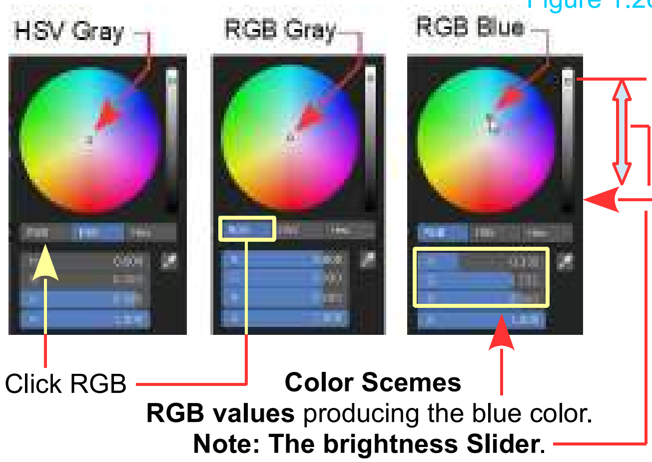
Nodes are explained in Chapter 16, but for the moment click on the blue **Use Nodes** button to **cancel the Node System**.

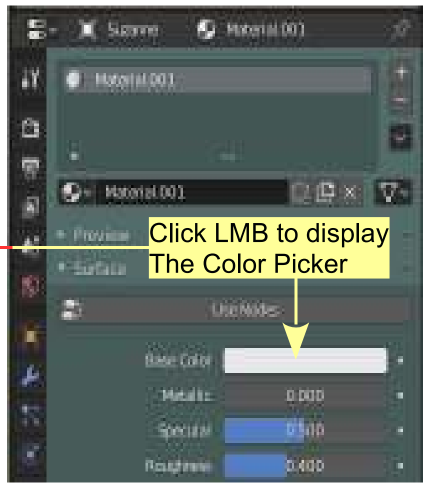
With the Node System cancelled the Properties Editor, Material buttons display with a reduced number of functions (Figure 1.26 **Note:** diagrams are curtailed to save page space).

Remember the Material button controls only apply to the selected Object in the 3D View Editor, in this case Suzanne.

To turn Suzanne blue, click on the white **Base Color** bar to display a **Color Picker**. The Color Picker gives the options to select one of three color schemes; **RGB**, **HSV** or **Hex**. By default the HSV color scheme is selected. Click on the RGB button to change the color scheme to RGB (**R**ed, **G**reen, **B**lue).

Figure 1.26





When you add a Color to an Object the RGB values are by default, R: 0.800, G: 0.800, B: 0.800 and A: 1.000. The RGB values generate the Blender default gray color, while the A (Alpha) value sets the transparency of the color (A: 1.000 = Opaque, A: 0.000 = Fully Transparent).

To make Suzanne blue in the face, click LMB in the RGB Color Picker Circle where it displays blue. To select the exact blue shown in the diagrams you may double click on a numeric value (displays a typing cursor) hit delete or backspace and retype a new value (Figure 1.27 opposite).

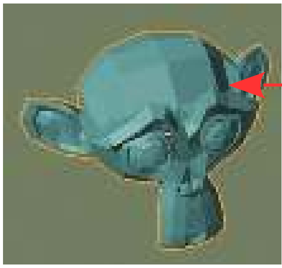


Figure 1.27

When you select a color in the circle or alter the numeric values, the color of the selected Object changes. **Note:** This is a basic procedure demonstrating the application of Material color prior to understanding **Viewport Shading Modes** and **Material Nodes** (see Chapter 14 and 16).

Suzanne is now a nice blue.

1.13 Simple Animation

Animation is the allusion of making something appear to move. Remember, the plan in this demonstration is to have Susanne move from the back of the Scene, contact the modified Cube and explode. At this point both Susanne and the Cube are located at the center of the Scene. The Cube has been hidden from view as explained in section 1.8 Using the Outliner Editor.

Have Susanne selected in the 3D Viewport Editor and using the Move Tool (Manipulation Widget) in the Tool Panel (Figure 1.17) click, hold and drag the red arrow moving Susanne towards the back of the scene along the red X Axis(Figure 1.28).

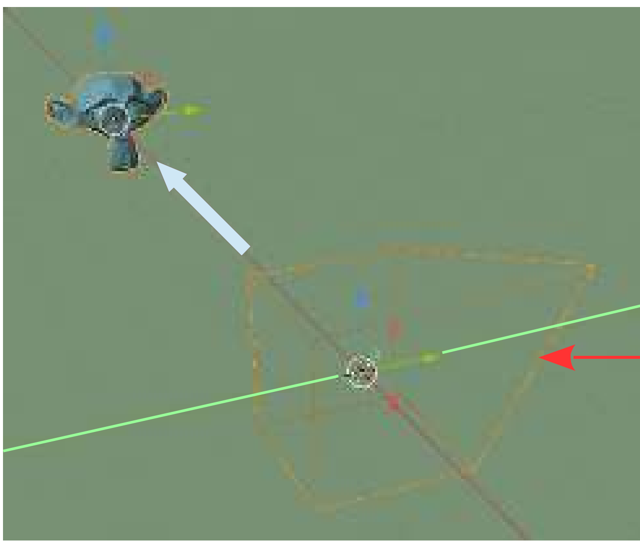


Figure 1.28

Animations are controlled in the Timeline Editor at the bottom of the Screen. An animation in its simplest form is a series of images played in quick succession to create the illusion of motion. When an animation is made in Blender an image is created for each Frame in the animation. The **Frames** are represented by the graduations in the **Timeline Editor** (Figure 1.29).

Figure 1.29

By default an animation is show with a **Timeline Cursor** (blue line) positioned at Frame 1.

With Susanne selected in the 3D Viewport Editor she is said to be at Frame 1 in the animation. With Susanne selected and with the **Mouse Cursor** in the 3D Viewport Editor, press the **I Key** on the Keyboard and select **Location** in the **Insert Keyframe menu** that displays.

Move the Timeline Cursor to Frame 40 (click hold and drag the blue rectangle or click on Frame 40). Reposition Susanne at the center of the Scene. Press the **I Key** again and select **Location**.

Click on Frame 1 in the Timeline Editor and Susanne will move back in the Scene. You have set up an animation which will show Susanne move from the back of the Scene to the center in 40 Frames. Press the **Play button** in the Timeline to see the animation play (Press **Esc** to quit).

Animation is explained in detail in Chapter 18 but for the time being accept the animation as it plays with Susanne moving in the 3D Viewport Editor from the back of the Scene to the center as the animation plays between frame 1 and frame 40. At Frame 40 Susanne stops but the animation Timeline Cursor continues on to Frame 250 then restarts at Frame 1. Press Esc to quit.

This simple animation is all very well but not that exciting. Let's make Susanne explode when she reaches the center of the Scene and impacts with the Cube. Remember, the Cube has been hidden from view.

1.14 Explode – Quick Method Example

Blender is designed to create effects from first principles. This applies to modeling and creating physical simulation effects. There are however several Quick effects one of which is a method for generating an explode effect. Make note, this is a **Quick Method** which has a limited application. You will be instructed in how to generate this effect from first principles later on and when you understand the procedures the results are limitless.

In the animation you want Susanne to explode when she reaches frame 40.

Click Frame 40 in the Timeline Editor. Susanne locates at the center of the Scene. Have Susanne selected (orange outline). In the 3D Viewport Editor Header click on Object then Quick Effect then Quick Explode (Figure 1.30). Susanne breaks into pieces.

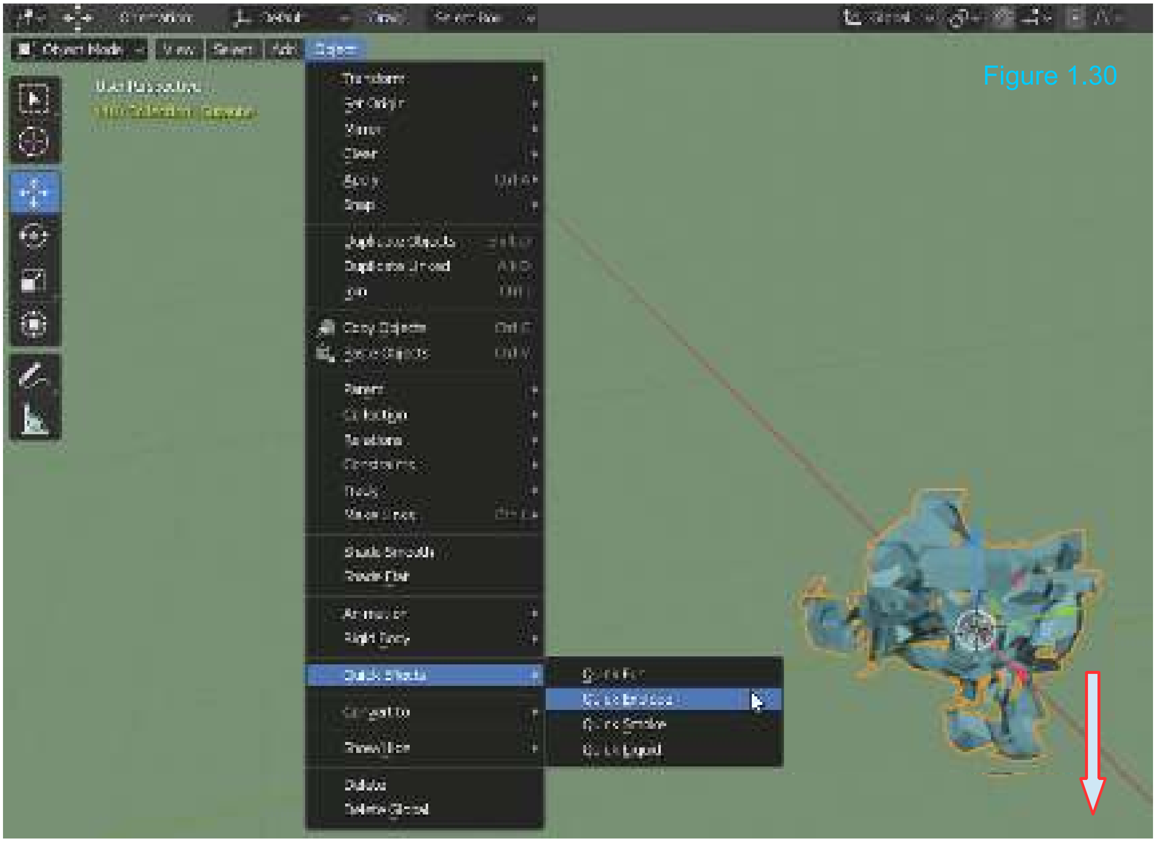


Figure 1.30

Return the Timeline Cursor to Frame 1. Susanne prepositions at the back of the Scene. Press the Play button in the Timeline Editor to see Susanne move forward and at Frame 40 break apart into pieces which fall away and disappear out of sight.

Quick Explode has set up an Explode Simulation all be it a fairly tame one. Susanne breaks apart and falls due to a Gravitation Force. The control for Gravity is found in the Properties Editor, Scene Properties buttons (Figure 1.31). Click on the blue Gravity tick to cancel the Gravity effect.

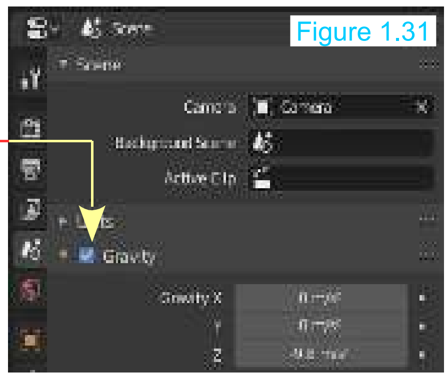


Figure 1.31

Unhide the Cube and replay the animation.

Figure 1.32

Susanne explodes when she runs into the Cube (Figure 1.32).

The explosion created is a slow motion effect. To make the effect more dramatic you have to understand what takes place behind the scenes when you apply Quick Explode. The following explanation is to make you aware and prepare you for detailed instruction to follow later in the book.

In Blender there are items called **Modifiers** (see Chapter 7), pre written code which when activated cause effects. When you apply Quick Explode, with an Object selected, two Modifiers are automatically activated. One is the **Explode Modifier** and the other is the **Particle Systems Modifier. The Modifiers can be** seen in the Properties Editor, Modifier Properties buttons (Figure 1.33).

The Explode Modifier causes the Object to break apart. The number of pieces depends on the number of vertices forming the Mesh Surface (see the Object in Edit Mode). The Particle Modifier or ParticleSettings causes Particles to be emitted from the Object either falling under Gravity or floating off into space with gravity disabled. The broken pieces of the Mesh follow the Particles.

Properties Editor

Modifier Properties

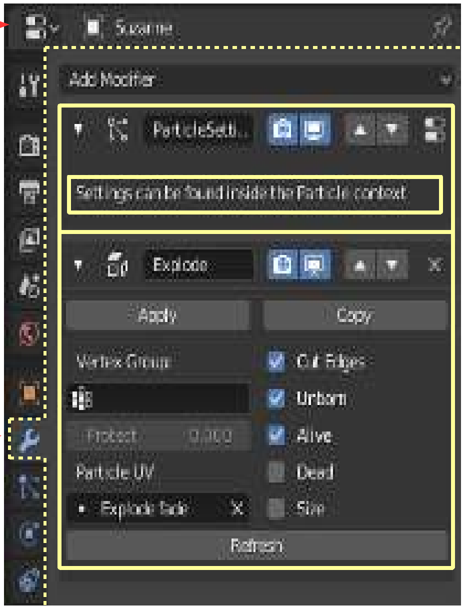


Figure 1.33

Note: The content of the Properties Editor depends on which button is selected.

The Explode Modifier contains a note directing you to the **Properties Editor, Particle Properties** (Figure 1.34). Here you may adjust values to influence what happens in the 3D Viewport Editor.

As an example increase the **Velocity Normal** value to 10 m/s and replay the animation.

You now have a much more dramatic Explosion.

Particle Properties

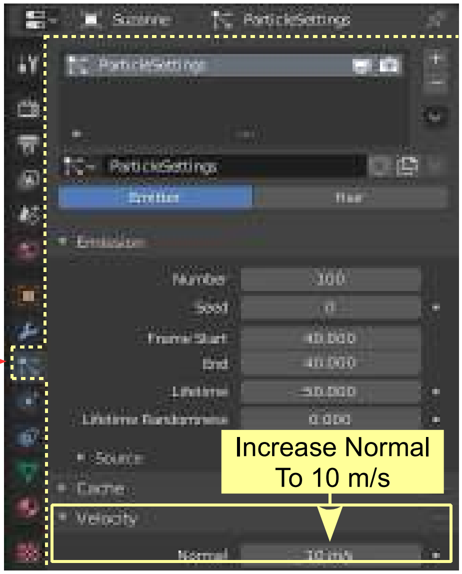


Figure 1.34

1.15 Summary

The forgoing is intended to familiarise you with the Graphical User Interface and demonstrate a few of the operational features of Blender. Understanding the Interface and how the Editors relate to one and other is a start to understanding how Blender works.

This has been a brief introduction. There are many features to be discovered, therefore the following chapters will expand on what has been covered and show where Blender Tools are located and give examples on how to use the Tools.

Before moving on to the other Chapters there are two more items you should be aware of.

Undoing: When you perform successive operations in creating a Scene you can backtrack through the sequence of operations, undoing each operation. By default undo operations are limited to 32 steps. To undo an operation press **Ctrl + Z Key**. This applies to any Editor.

Deleting: Deleting means, removing an Object and all its Properties from a Scene. To delete an Object, select the Object and press the **X Key**, Delete. This applies only to the 3D Viewport Editor.

Figure 1.33

2

Editors – Workspaces - Themes

2.1 Editor Types
2.2 Resizing Editors
2.3 Splitting Editors
2.4 Cancel an Editor
2.5 3D Viewport Editor Features
2.6 Scene Manipulation
2.7 Scene Manipulation Widget
2.8 Multiple Scenes
2.9 Headers Menus and Panels
2.10 Headers and Panels
2.11 The Blender Interface Header
2.12 The Blender Screen Header
2.13 The 3D Viewport Editor Header
2.14 The Widget Panel
2.15 Tool Panel and Object Properties Panel
2.16 Properties Editor Tabs
2.17 The Preferences Editor
2.18 3D Viewport Editor - Background Color
2.19 Workspaces
2.20 Creating New Workspaces
2.21 Themes
2.22 Saving a Theme

Editors – Workspaces - Themes

Editors are the individual windows or panels which make up the Blender Interface. They contain the controls for editing data. Everything initially displayed in the 3D Viewport Editor (Window) is generated by a set of default data which you modify using the controls in the various Editors.

Workspaces are the arrangement of Editors in the Graphical User Interface (GUI). The Blender **GUI** opens with four separate Editors displayed. This arrangement constitutes a **Workspace** (working space) where you arrange models and characters and create Scenes. The default Workspace is called the **General** Workspace. There are alternative pre-constructed Workspaces available and you may configure your own.

Themes are how the Graphical User Interface displays as a whole and are purely cosmetic. Blender has two Themes for selection. You can create your own or download alternatives from the internet.

You may resize the Editor Panels, divide the Panels, creating additional Panels and change each Panel to a different type. In doing this you create a specialised Workspace which can be saved in a Blender file and reuse. You can generate your personal Theme in a Blender file.

This chapter will introduce the controls for each of the above which will allow you to configure Blender for your personal requirements.

2.1 Editor Types

The **Default** Screen arrangement comprises four individual panels or windows, as shown in Figure 1.1 in Chapter 1. The panels are called **Editors**.

The default Editors displayed are: The **3D Viewport Editor**, the **Outliner Editor,** the **Properties Editor** and the **Timeline Editor.** Each has an icon representing the **Editor Type** in the upper left hand corner of the panel. Clicking LMB on this icon displays a menu for changing the Editor to a different Editor Type.

3D View Editor Icon – Editor Type Selection Menu

Figure 2.1

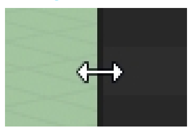
In the Editor Type menu, select (click) one of the Editors and the current Editor changes to that selected.

Here's an example; In the upper LH (Left hand) corner of the **3D Viewport Editor**, position the mouse cursor over the **Editor Icon** and click the left mouse button to display the Editor Type selection menu. Select (click on), **Graph Editor**, in the menu and the 3D Viewport Editor changes to the **Graph Editor**. In the upper left corner of this Editor click on the **Graph Editor** icon and select **3D Viewport** in the menu. The Graph Editor reverts to the 3D Viewport Editor. Any Editor may be changed to a different Editor type in this way.

Note: Make a note of the **Preferences Editor** in the selection menu.

2.2 Resizing Editors

Figure 2.2

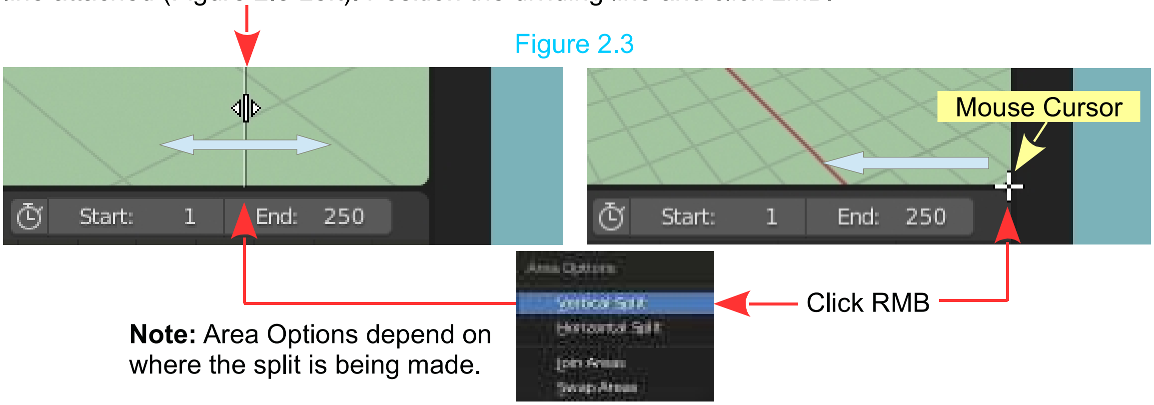


Most Editors and panels may be resized. Place the mouse cursor on an Editor or panel border and it changes to a double headed arrow (Figure 2.2). Click and hold with the LH mouse button and drag the arrow to resize the Editor panel. This works on both horizontal and vertical borders.

2.3 Splitting Editors

Editors may be divided, to initially form a duplicate, then changed to a different Editor type. When the mouse cursor is placed in the corner of an Editor panel it changes to a **white cross** Figure 2.3 Right). Click **RMB** and select **Split Area** in the menu that displays. Drag the Mouse **horizontaly or verticaly** into the Editor to be divided. The Mouse Cursor changes with a dividing line attached (Figure 2.3 Left). Position the dividing line and click LMB.

Figure 2.3



Alternativly, to split an Editor, mouse over in the corner of an Editor panel (mouse icon becomes a cross), LMB click, hold and drag the Cursor into the Editor to be divided.

If you make a mistake with the Split direction (Vertical – Horizontal) press **Esc**.

Alternativly, where **View** displays in a **Header**, click **View** then select **Area** (at the bottom of the menu that displays) then choose Horizontal or Vertical Split. Position the line that displays where you want the split to be then click LMB.

With an Editor split in two one copy may be changed to another Editor Type (Figure 2.4).

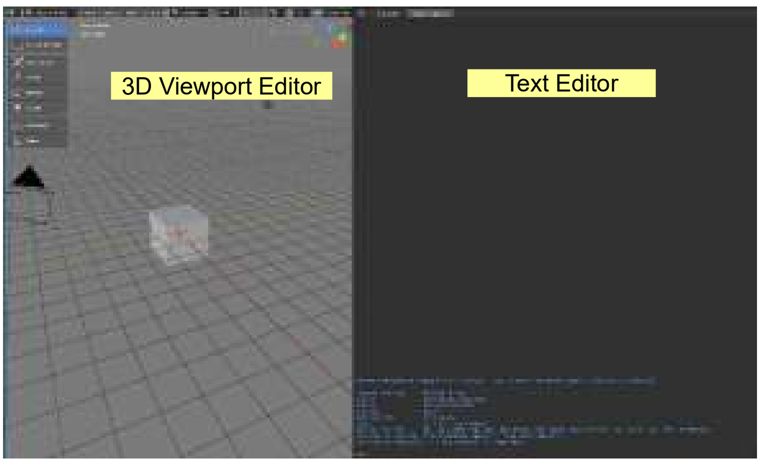


Figure 2.4

Note: Henceforth the **3D Viewport Editor** may be abbreviated to the **3D Viewport**

2.4 Cancel an Editor

To cancel or join an Editor panel, position the Mouse cursor in the Editor corner (cursor becomes a cross). Click RMB and select **Join Area** in the menu that displays (Figure 2.5). A large arrow displays pointing into the unwanted Editor (Figure 2.6). Release LMB to cancel the Editor.

Figure 2.5

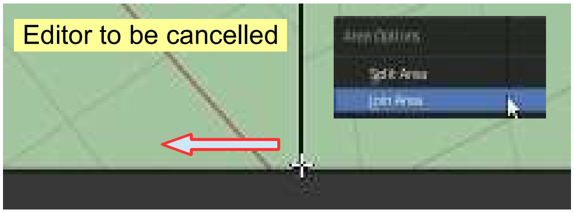
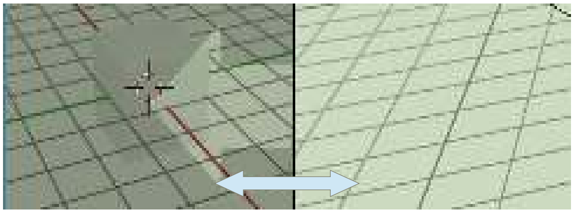


Figure 2.6

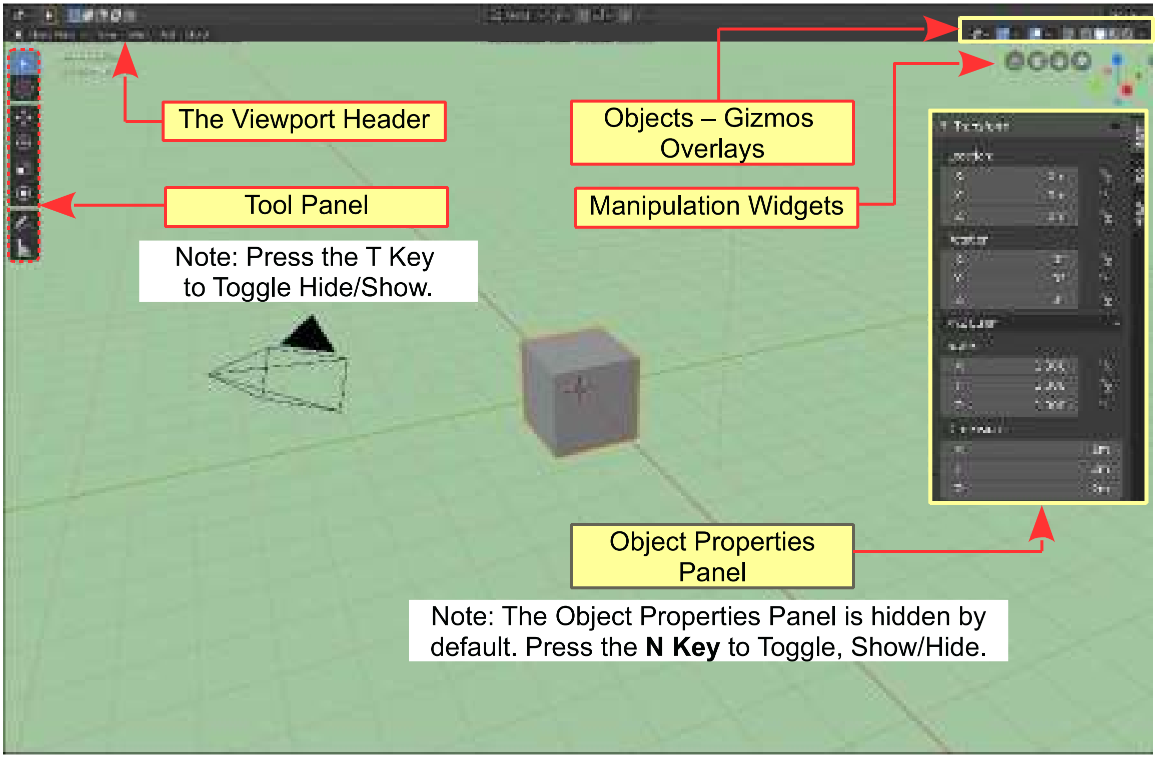


Note: While holding LMB with the large arrow displayed you may reverse the direction of the arrow from one Editor to the other.

2.5 3D Viewport Features

Figure 2.7 shows the main features included in the 3D Viewport display.

Figure 2.7



Uncluttering the Scene

When a Scene becomes complicated it can be advantageous to turn off displays such as the User Perspective and Object notification in the upper left hand corner of the 3D Viewport or the Scene manipulation Widget at the right hand side or perhaps the background grid in the 3D Viewport panel.

Figure 2.8

As described in Chapter 1 – 1.8 some of the display in the 3D Viewport may be controlled in the **Outliner Editor** by clicking the eye icons adjacent to the entries.

Hiding and showing displays here applies to Objects in the 3D Viewport.

Other displays are controlled by **Object Type**, **Gizmos** and **Overlays** from the 3D Viewport Header (Figure 2.9).

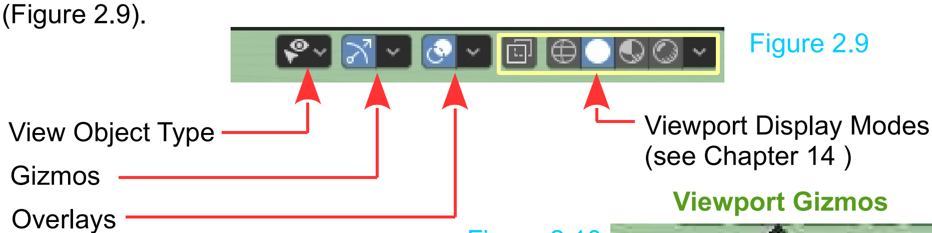
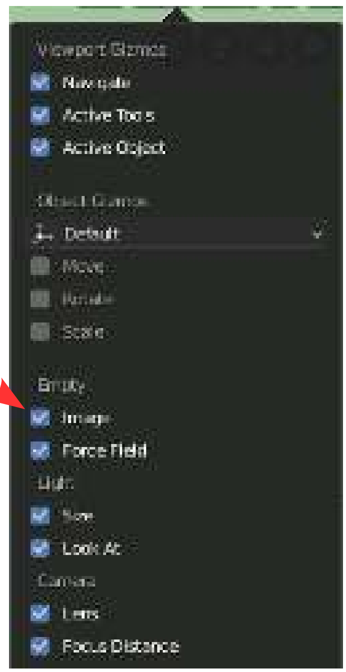


Figure 2.9

Viewport Gizmos

Figure 2.10



View Object Type

Click an Eye Icon to Hide/Show an Object Type.

Click a Cursor Icon to toggle Cursor Selection in the 3D Viewport Editor.

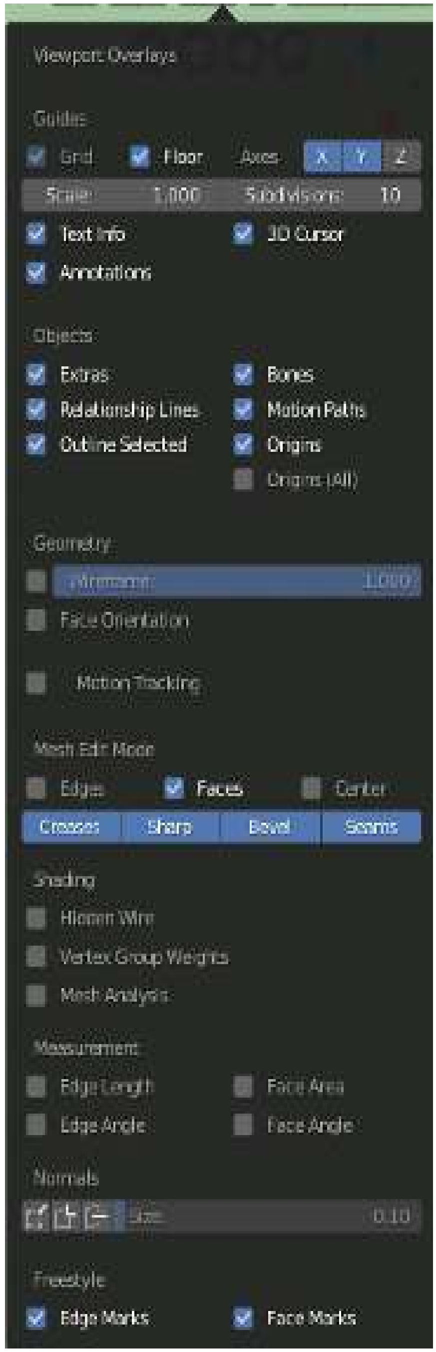
Check/Uncheck Gizmos to Activate/Deactivate functions.

Figure 2.11

Overlays: control what displays in the 3D Viewport.

Note: The Overlay selection is different in Object Mode and Edit Mode (Figure 2.12 over).

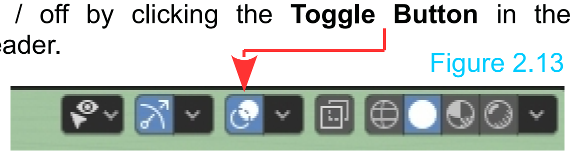
Object Mode Overlays Figure 2.12 **Edit Mode Overlays**



Note: The 3D Viewport has several different Modes. Overlays are only relevant to Object Mode and Edit Mode. You switch between the Modes by clicking on the Object Mode button in the 3D Viewport Header and selecting Edit Mode or vice versa. You may also toggle between Object and Edit Modes by pressing the **Tab Key**.

You set Overlay preferences in the relevant Overlay panels. The preferences are then toggled on / off by clicking the **Toggle Button** in the Header.

Figure 2.13



e.g. With **Floor** checked in Object Mode, clicking the Toggle button Hides and Shows the Grid Floor.

2.6 Scene Manipulation

Before adding new Objects and creating a Scene you should be conversant with how the 3D Viewport may be viewed and how to move in the three dimensional world.

Moving in 3D Space

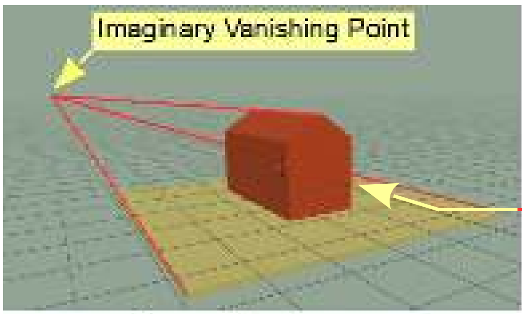
In a 3D (Three Dimensional) program, not only do you have to consider where you are in two dimensions (height and width), but you also need to consider depth (how close or far away).

Moving around in the 3D Viewport is controlled by the Mouse and the Keyboard Number Pad.

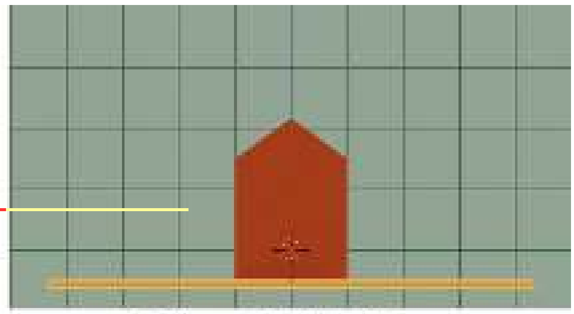
User Perspective and Orthographic View

The Blender default Scene in the 3D Viewport, opens in the **User Perspective** view as indicated in the upper LH corner of the Editor. The Scene contains a Cube Object located at the center. There is also a Camera and a Light in the Scene. All three Objects are positioned relative to the center of the Scene which is the center of the 3D World, or if you like, a central point in 3D Space.

The Blender Scene may be viewed in either **Perspective** or **Orthographic** view.



Perspective View Figure 2.14



Orthographic View View Figure 2.15

A **Perspective View** projects parallel lines to a single vanishing point somewhere in the distance.

An **Orthographic View** is seen looking square on to a Face.

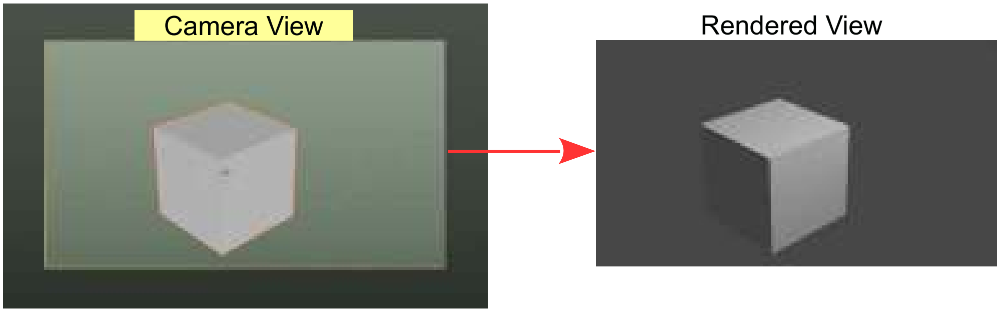
The position of Objects relative to each other is important when considering 3D Space especially with Lights (lighting) and the Camera (seeing). When taking a photograph with a camera the position of the camera relative to what you want to photograph and where the lighting is located determine what you get in your snapshot. This is the same in a Blender Scene.

By default the Camera in the default Scene is positioned such that it points towards the Cube and with the default settings for the Camera captures an image of the Cube in its viewport. This is the image that will render (convert what the Camera sees to an image). To understand this, perform the following demonstration.

Render Demonstration

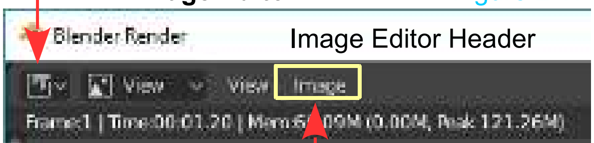
With the default Scene, have the Mouse Cursor in the 3D Viewport and press the Keyboard **Num Pad 0.** This places the 3D Viewport in **Camera View** (what the Camera sees). Press **F12** on the Keyboard to **Render (Esc to Quit)**.

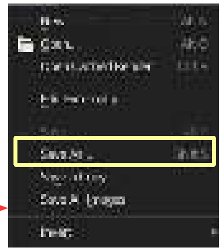
Figure 2.16



Pressing **F12** Renders (converts) the Camera view to a format that may be saved as an image file. Note that the rendered view has been opened in a new Editor – the **Image Editor**.

Image Editor Figure 2.17

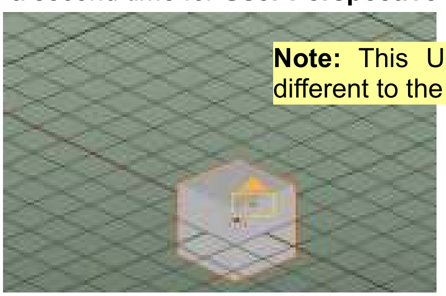




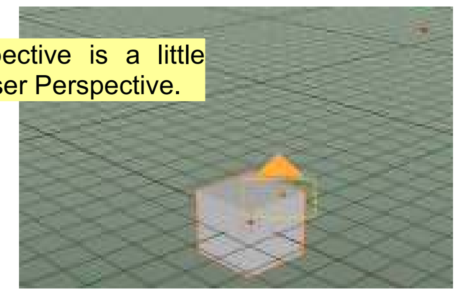
Click **Image** in the Header to see the menu.

At this point you could save the display as an image. To save an image you have to understand how to save a file into a folder (see Chapter 3).

Press the **Esc Key** to cancel the Image Editor window and return to Camera View in the 3D Viewport . Press the **Num Pad 5 Key** to enter **User Orthographic** view, then press the **Num Pad 5 Key** a second time for **User Perspective** view.



Note: This User Perspective is a little different to the default User Perspective.



User Orthographic View Figure 2.18 User Perspective View

Pressing Num Pad 5 a second time displays a User Perspective view but it isn't the same as the original view in the 3D Viewport. To return to the origional view press **Num Pad 6** or place the Mouse Cursor in the 3D Viewport, click the Midle Mouse Button (MMB), hold the button depressed and drag the Mouse to rotate the view.

Clicking, holding and dragging MMB is one of several methods for manipulating the Scene in the 3D Viewport. Clicking **View – Navigation** in the Header gives a menu with all the **options**.

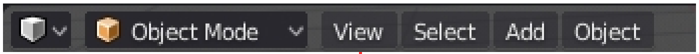
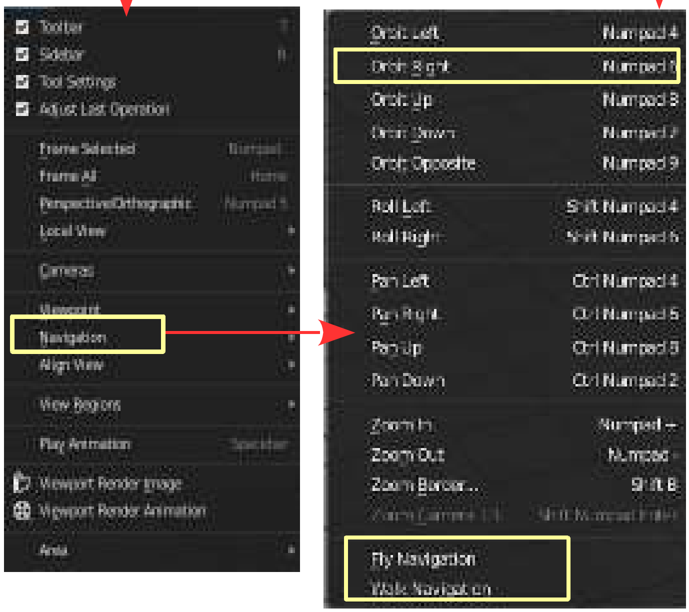


Figure 2.19

Experiment with the options to find out what each one does. Remember you can always click on File – New – General in the Blender Screen Header to start over.



Two interesting navigation modes are **Fly Navigation** and **Walk Navigation.** After clicking Fly Navigation, moving the Mouse Cursor causes the view to FLY. **Move the Mouse gently**. Walk navigation is similar. In either case there are cross hairs in the center of the Viewport.

2.7 Scene Manipulation Widget (another way to Navigate)

Place the Mouse Cursor in proximity to the Widget to display the circle. The Mouse Cursor changes to a white **+**, click, hold and move the Mouse to rotate the view.

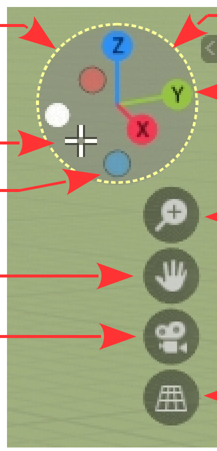
Circle displays on Mouse-over

Click, hold and move the mouse to Rotate the view

Colored Circles Confine Manipulation to a Plane

Click, hold and move the mouse to pan the view

Click on the Camera to toggle Camera View On/Off



The Circle represents a Sphere

Click to display Properties Panel

XYZ Axis Manipulation

Figure 2.20

Click and hold and move the Mouse up/down to zoom the view

Click the Grid to toggle User Perspective/User Orthographic views

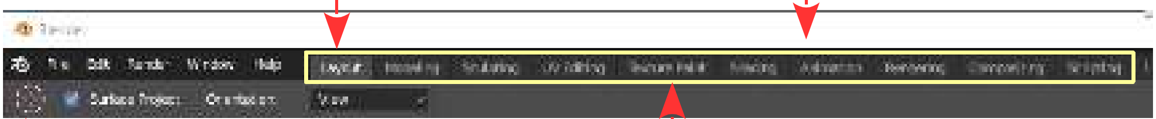
Note: The Red, Green and Blue circles on the rotation sphere align with the Red, Green and Blue Axis of the 3D Scene.

2.8 Multiple Scenes

At this point it is worth reinforcing the distinction between a **Scene** and a **Workspace**. The definitions have been presented at the beginning of the chapter but in introducing the concept of multiple Scenes clarification may be required.

The **Scene** is what you see in the 3D Viewport and consists of your models, characters, lighting effects and background. The **Workspace** is the arrangement of Editor Panels in the Graphical User Interface (what you see on the computer screen).

Workspaces are Screen Arrangements of Editors for working at specific tasks. The default Screen arrangement is the **Layout Workspace** as seen in the **Screen Header**.



Cursor Tool Selected **Workspaces** Figure 2.21

The main portion of the Layout Workspace is the 3D Viewport which shows a 3D View of the default Blender Scene. The Scene has a Cube Object at the center of the 3D World.

Figure 2.22

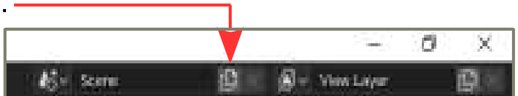
The Outliner Editor (Figure 2.22) displays **Scene Collection** which lists the Objects in the Scene in the 3D Viewport. At this point there is one single Scene in this Blender file.

At some stage you may wish to have more Scenes which is like having different sets on a stage or different sets for filming different parts of a movie.

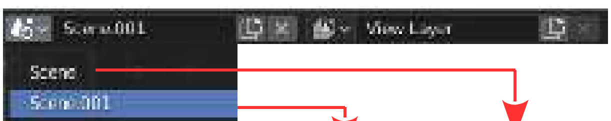
In the Screen Header (upper RH side) you will see **Scene** displayed. Clicking on the Scene button shows a single entry **Scene** (highlighted blue).

Figure 2.23

To add additional Scenes click the **Add Scene button**.



Click **New** in the options menu. The 3D View Editor shows a new empty Scene. **Scene.001** is entered in the Header.



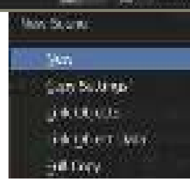


Figure 2.24

Scene.001 **Scene** (the Original Scene)

If you add a Monkey to the Scene you have the option to select the default Scene with the Cube or the New Scene with the Monkey. The New Scene is only available in the Blender File being worked on. Save the file for future use.

The demonstration shows the default Blender Scene containing the default Cube Object and a new Scene containing a Monkey Object. The default Scene is named: **Scene**, the new Scene is named: **Scene.001**.

With the two Scenes created make note of the content of the Outliner Editor when each Scene is selected in turn (Figure 2.25).

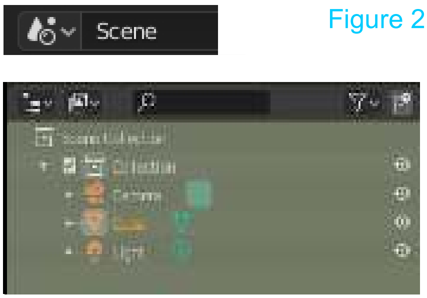


Figure 2.25

With Scene (the default Scene) selected, pressing Num Pad 0 will display Camera View (what the Camera sees). Pressing Num Pad 0 with Scene001 selected has no effect since there is no Camera in Scene.001. There is also no Light in Scene.001, therefore, there will be no lighting effects until a Light is added to Scene.001.

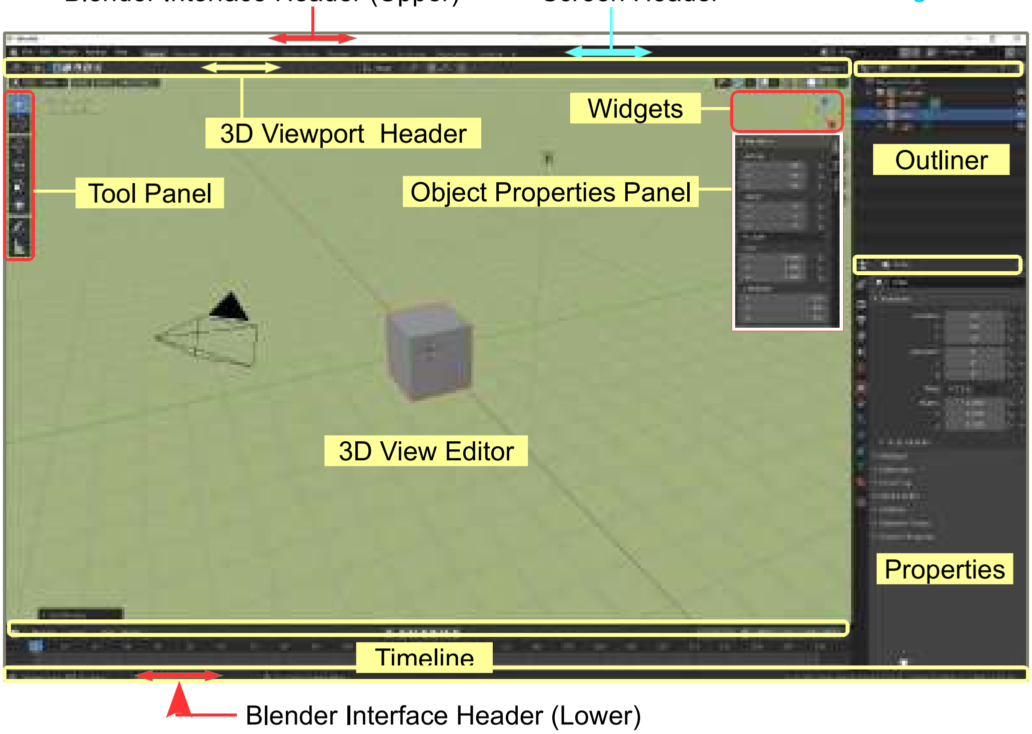
If you wish to add items included in Scene to Scene.001 you simply copy and paste.

Fore example: To add the Camera, Cube and Light in Scene to Scene.001, in the Outliner Editor, with **Scene** selected, hold Shift and LMB click on the items to be copied to select the entries then RMB click and select Copy in the menu that displays. Select Scene.001 and in the Outliner Editor for Scene.001 click on **Collection** (you are adding the items to the Collection). With Collection selected, click RMB and and select Paste.

2.9 Headers Menus and Panels

The default Blender Screen is made up with four Editor Panels and three Headers as seen in Figure 2.26. Each Editor Panel has a Header across the top of the Panel.

Figure 2.26



The following diagrams will make you aware of the selection menus available in the Headers.

2.10 Headers and Panels

The Headers contain icons and text notations which are buttons that display Selection Menus containing options for activating functions affecting what takes place in the Editor. The options are numerous, therefore, it is not recommended that you attempt to memorise every option. Being aware of the different menus will help when reference is made in instructions. Specif references to selections will be made as required.

2.11 The Blender Interface Header

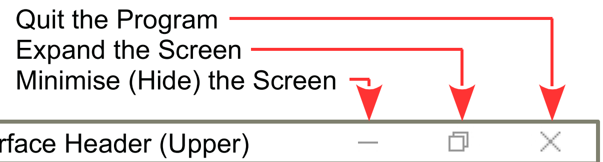


Figure 2.27

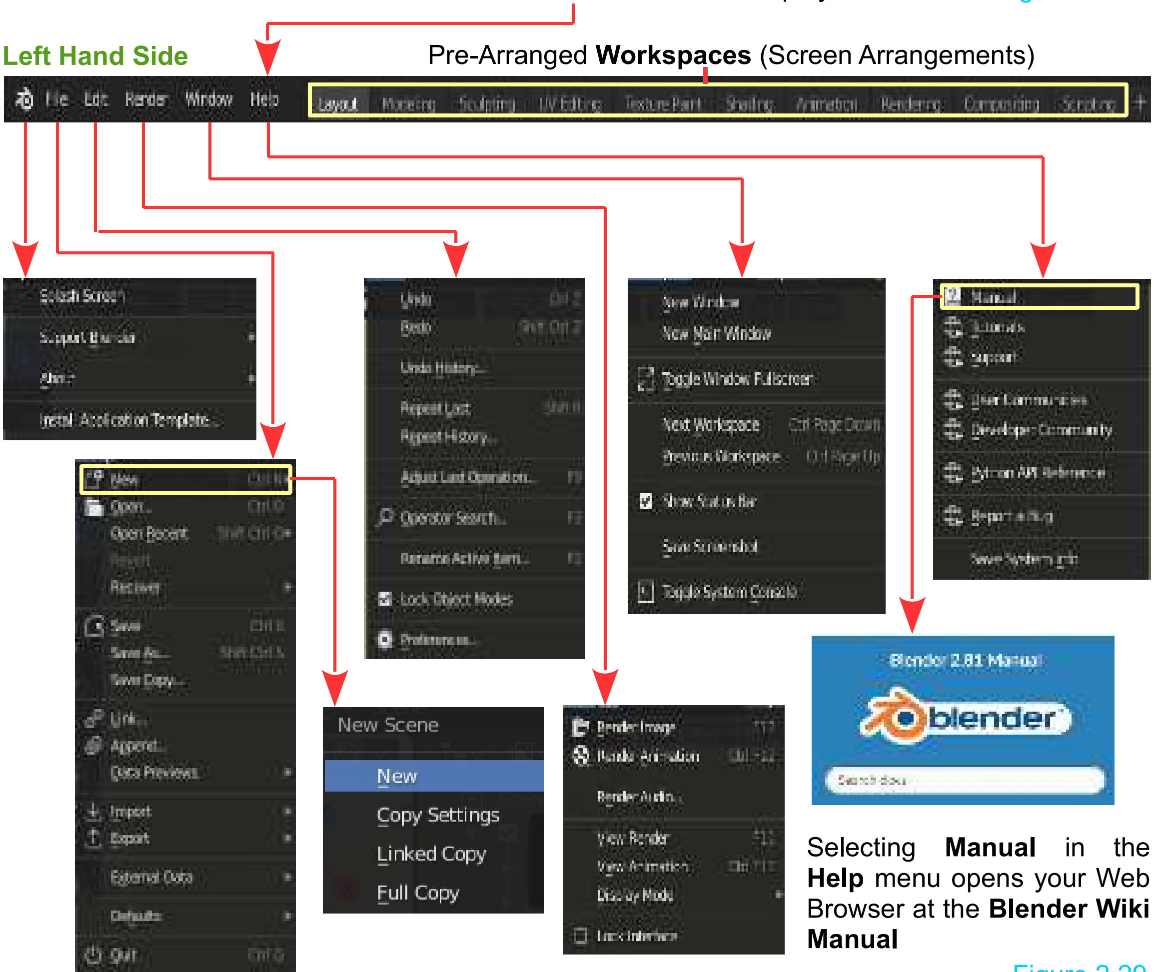
2.12 The Blender Screen Header

Click a Button to Display a Menu

Figure 2.28

Left Hand Side

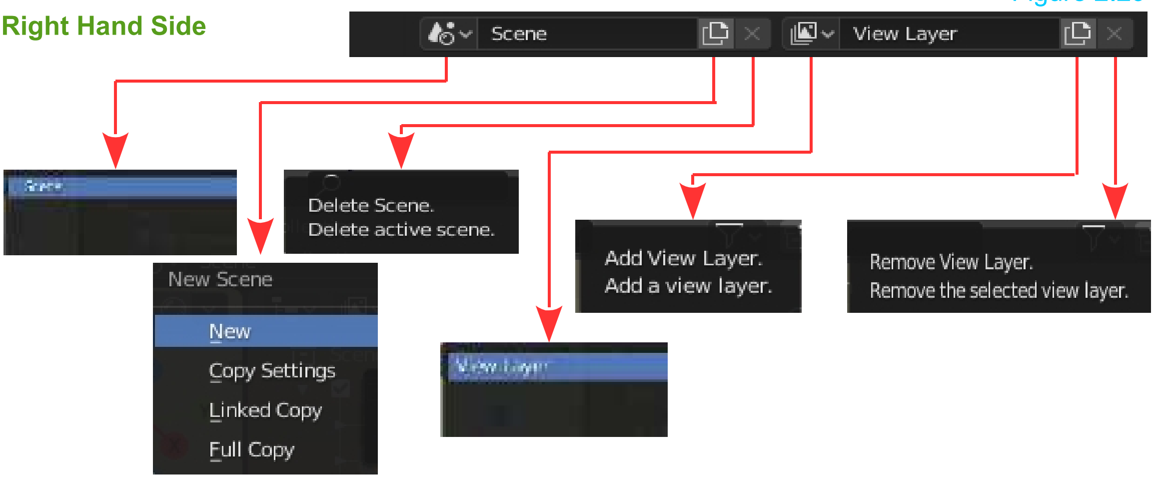
Pre-Arranged **Workspaces** (Screen Arrangements)



Selecting **Manual** in the **Help** menu opens your Web Browser at the **Blender Wiki Manual**

Figure 2.29

Right Hand Side



2.13 The 3D Viewport Header

The 3D Viewport Header is divided into three sections.

Note: The Header controls in Figure 2.30 are for the 3D Viewport when in **Object Mode**. The selection menus shown are a sample only.

The controls change when selecting an alternative Mode for the 3D Viewport Editor.

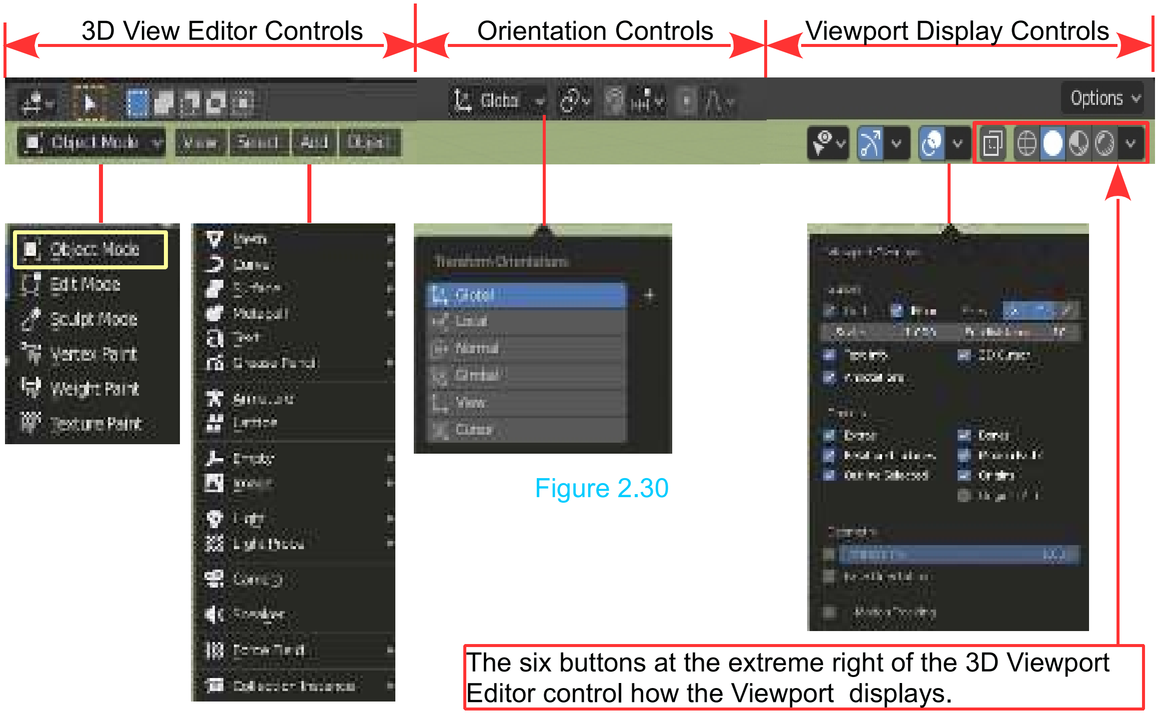


Figure 2.30

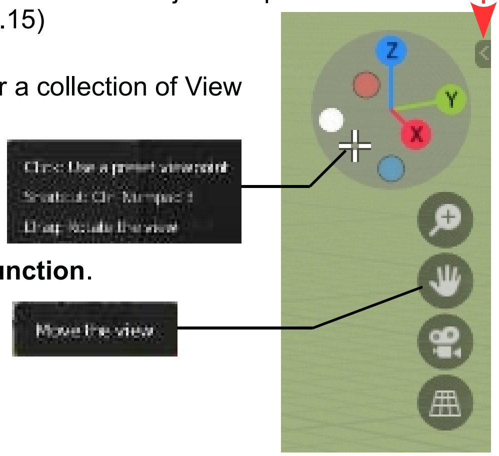
2.14 The Widget Panel (See 2.7)

Click to Show the Object Properties Panel (see 2.15)

The Widget Panel is not a panel as such, but rather a collection of View Manipulation Tools (Widgets).

Figure 2.31

For a full description see section 2.7.



Mouse over on a Widget for a **description of its function**.

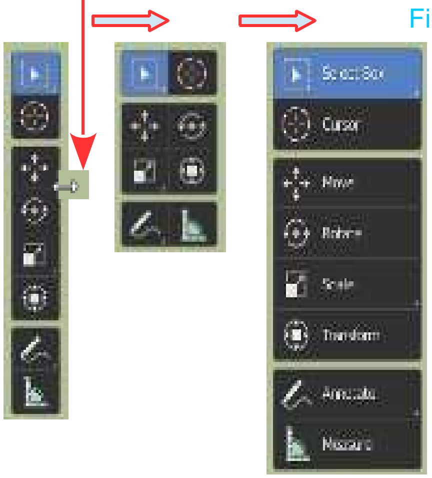
2.15 The Tool Panel and Object Properties Panel

The Tool Panel at the left hand side of the 3D Viewport Editor houses Tools for performing operations on the Object which is selected. The Panel has three display arrangements.

Note: The content of the panel varies depending on which Mode is selected for the 3D Viewport Editor

Mouse over on the edge of the panel, click, hold and drag to increment the displays.

Figure 2.32



Object Properties have three display Modes.

Click a Tab to change Modes

The Object Properties Panel is hidden from view by default to conserve space in the 3D Viewport Editor.

Press the **N Key** to show the panel.

Note: The **Object Properties Panel** allows you to adjust values affecting the Properties of the selected Object. For example increasing the X Location value in the positive direction moves the Object on the X Axis in the 3D Viewport Editor.

Note: To hide the Object Properties Panel press the **N Key.** You may show and hide the **Tool Panel** by pressing the **T Key**. Alternatively click on or Chevrons in upper corners of the Editor when panels are hidden.

2.16 Properties Editor Tabs

The Properties Editor is the panel below the Outliner Editor which extends to the bottom of the Screen. This Editor is the engine room for Blender containing controls for actions in the 3D Viewport Editor. The controls will be explained as you progress through the book and encounter the different features of the program. What you see in the Properties Editor depends on which selection button is activated (Figure 2.33 over).

There are fourteen buttons from which to choose, each will present a different display of controls. The buttons are arranged in two categories (Scene Controls and Object Controls).

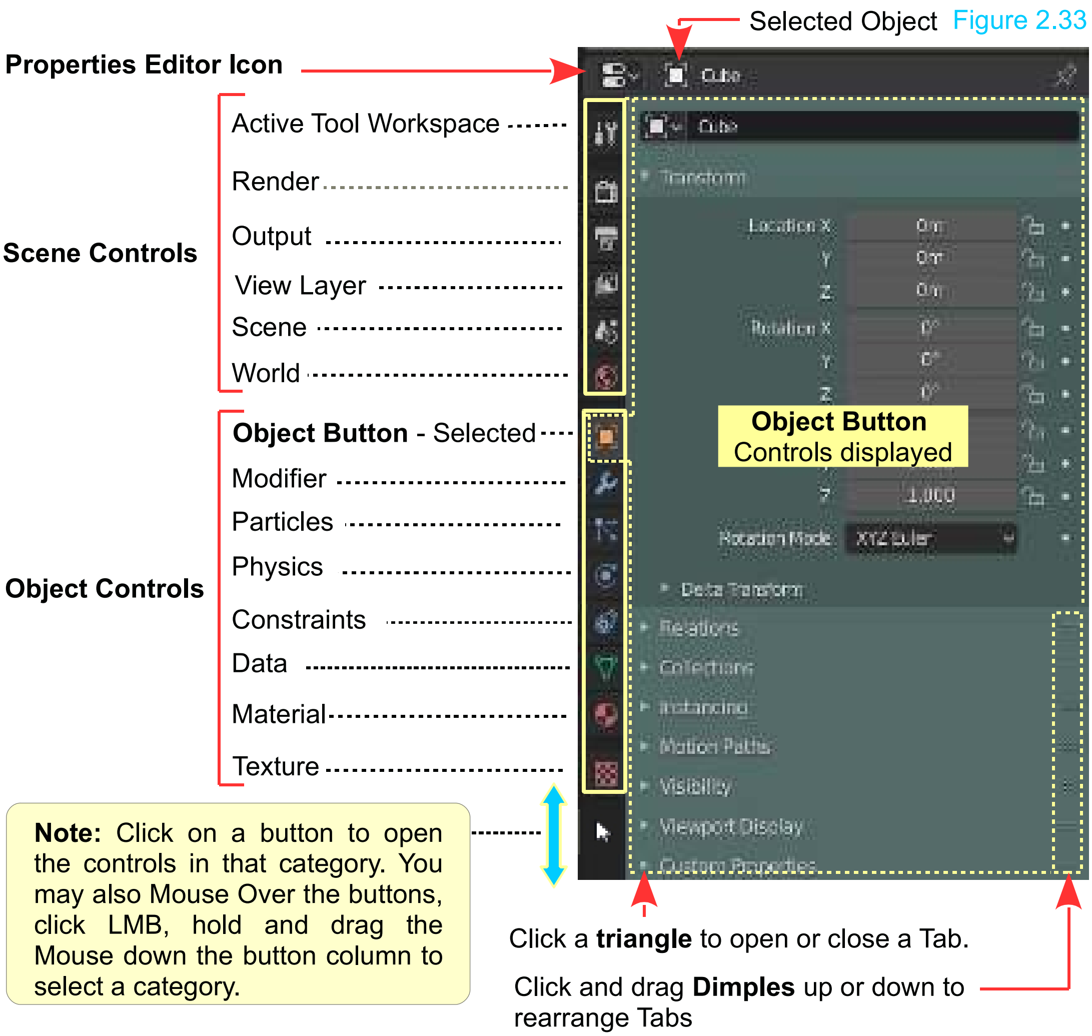


Figure 2.33

Figures 2.32 shows the Properties Edit with the **Object button** selected. The Object buttons control the properties of **the Object that is selected** in the 3D Viewport Editor Scene. The default Object is the Cube. The Object button displays controls and information about any Object which you have selected in the 3D Viewport Editor.

2.17 The Preferences Editor

The **Preferences Editor** is a behind scenes control panel for configuring and adding functionality to Blender. The controls are extensive, therefore, will be referenced as the various features are required while progressing through the book. At this point you should be aware of the Editors existence and have a general understanding of what it entails.

The **Preferences Editor** may be opened by clicking an Editor Icon and and selecting **Preferences** in the Editor selection menu (Figure 2.1). This method will fill the entire Editor Panel. For example selecting the 3D Viewport Editor icon and selecting Preferences fills the 3D Viewport Editor Panel with the Preferences Editor.

For many operations opening the Preferences Editor in this way is fine but when configuring the 3D Viewpot Editor from the Preferences Editor it is advantageous to see changes as they are made.

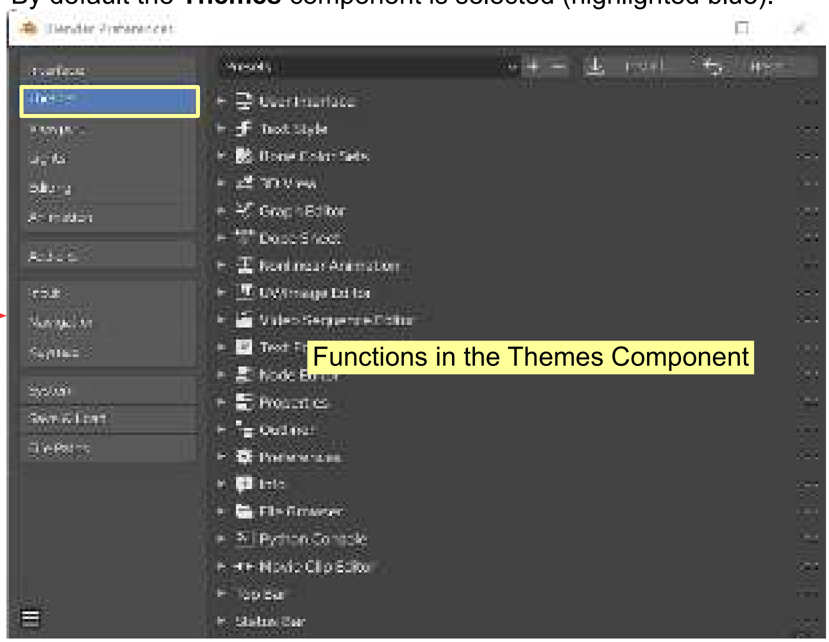
Access the Preferences Editor from the Blender Screen Header.

Click **Edit** and select **Preferences**

Figure 2.34

Opening the **Preferences Editor** using this method opens the Editor in a panel overlaid in the upper left hand corner of the Screen. The Editor has a component selection menu at the left hand side and a list of the functions included in the selected component at the right.

By default the **Themes** component is selected (highlighted blue).

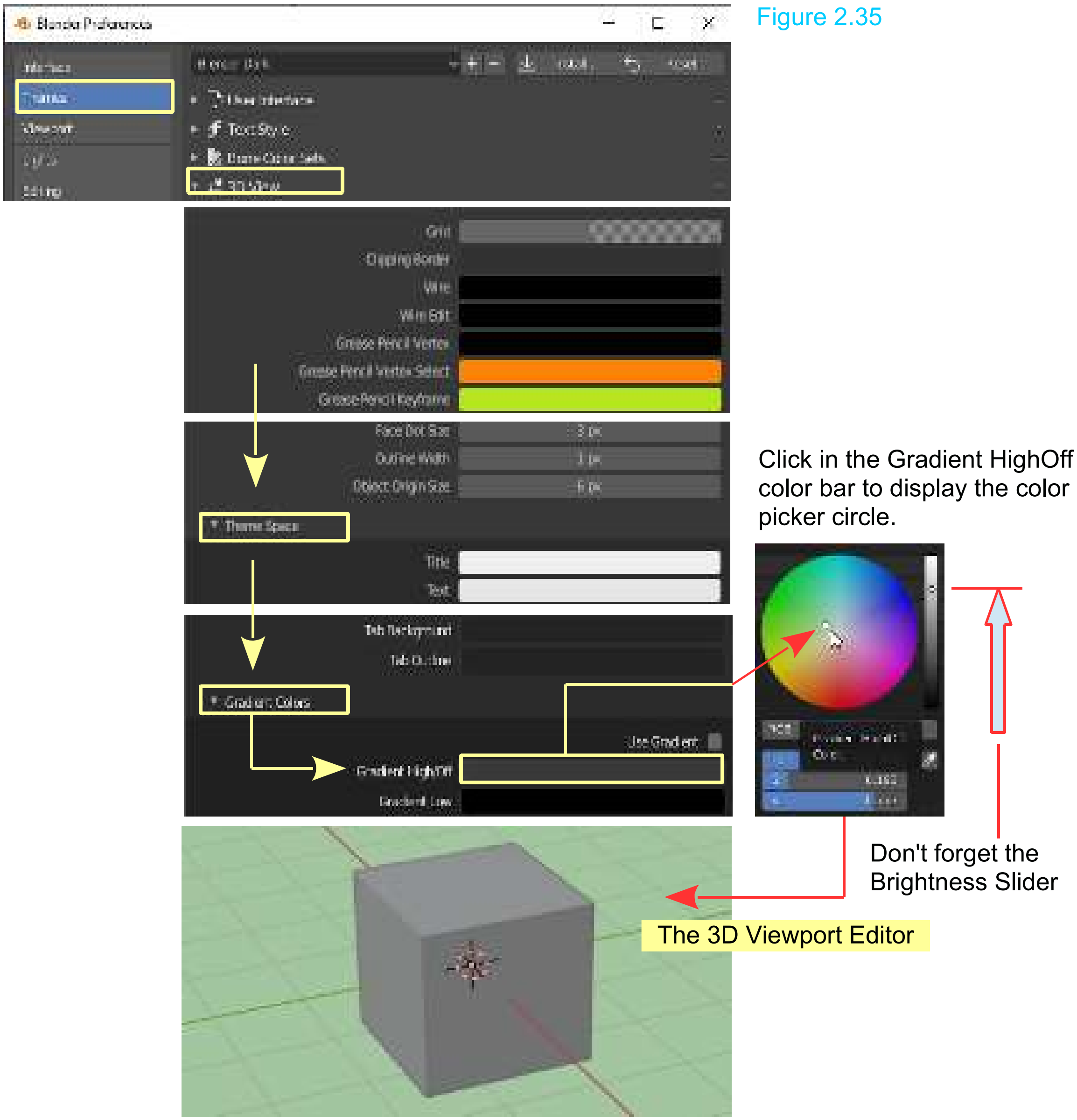


Note: Although the Themes option is the default display, if you have used a different option and closed the Preferences Editor, whatever option you selected will display next time you open.

2.18 3D View Editor - Background Color

In the **Preferences Editor, Themes**, click the triangle adjacent to **3D View**. With the **Mouse Cursor** in the right hand panel of the **Preferences Editor**, scroll down, **way way down**, until you see **Theme Space**. Expand this entry (click the triangle) and scroll way way down again to **Gradient Colors**. Expand this entry. You will find the **Gradient High/Off** color bar. This is where you change the color of the 3D Viewport Editor background.

Figure 2.35



2.19 Workspaces

Workspaces are the arrangement of Editor panels configured for specific working procedures.

The default arrangement of Editors is configured to provide a space for compiling a Scene, that is primarily to enter and position Objects. The Objects may be for creating models or they could be pre-constructed models of characters. The default arrangement is named the **Layout Workspace**.

In the default Screen arrangement Header you will see **Layout** highlighted white which indicates that this Workspace is the **Active Workspace**.

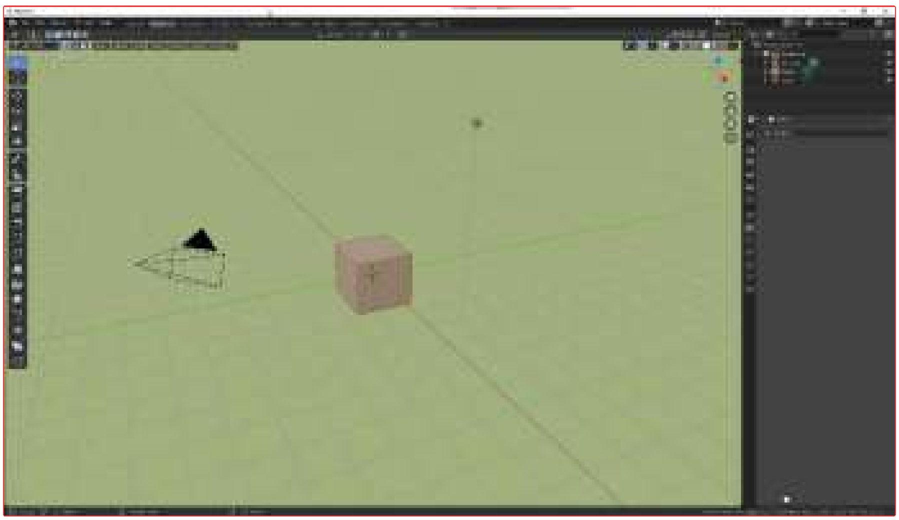
Also in the Screen Header is a selection of **alternative Workspaces** designed for a variety of operations (Figure 2.36).

The Active Workspace

Figure 2.36

Selecting the **Modeling** Workspace places the default 3D Viewport Editor in Edit Mode.

Figure 2.37



2.20 Creating New Workspaces

As explained in Section 2.19, **Workspaces** are the arrangements of Editor Panels configured for specific working procedures. You may select one of the **Pre-Assembled Workspace** in the Blender Screen Header (Figure 2.38 over) or you can create a new unique Workspace.

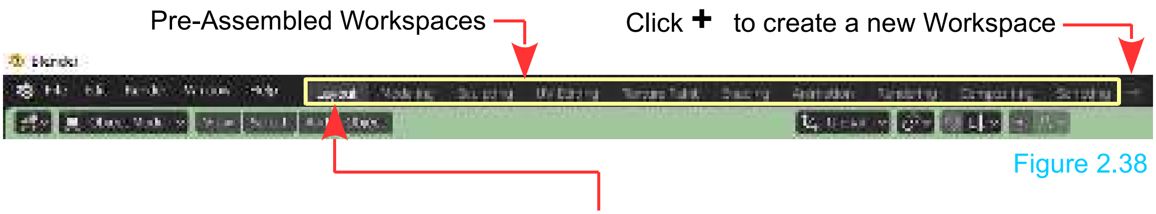


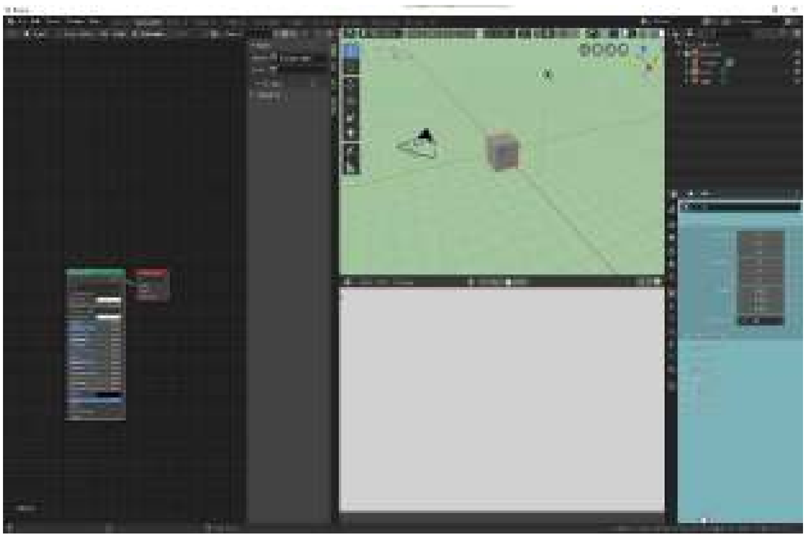
Figure 2.38

To create a new Workspace select the default **Layout** Workspace in the Header, that is, have the default Blender Screen arrangement opened.

Click the cross in the Blender Screen Header at the RHS of the Workspace options. Click **Duplicate Current** in the menu that displays. Duplicating Current generates a copy of the current Screen arrangement and automatically names it **Layout.001**. The new name is displayed in the Header.

Click on **Layout.001** in the Blender Screen Header to ensure you have Layout.001 displayed in the Screen. You may now reconfigure the Screen arrangement to suit your working requirements. Rearrange the Blender Screen by splitting Editors and moving borders and changing the Editor Types. This creates a new Workspace (Figure 2.39).

Figure 2.39



Note: The new Workspace is only available in the current Blender File. If the current file is the default Blender file, save the current file with a new name to make the new Workspace available for future work.

With **Layout.001** configured, selecting **Layout** in the Screen header changes the Screen back to the default Screen arrangement.

Renaming Workspaces

You may create as many Workspaces as you like by repeating the procedure outlined above. New Workspaces will be named: Layout.001, Layout.002, Layout.003, Layout.004 etc.

You rename a Workspace by double clicking on the name in the Screen Header, backspace and retype a new name.

Saving a Workspace

> **Note**: Creating a Workspace (Working Environment) in the default Blender Screen arrangement is, in fact, modifying the default Blender File. This procedure occures whenever you change anything in the default Screen. This means, whenever you model something, change a color or create an animation, the changes are, therefore, only available in the Blender file that is open when the changes are made.
>
> To use changes in future work you have to save the Blender File, as a new file, then reopen it when you want to use something contained in the file. This applies to Workspaces.

How to save a Blender file is discussed in Chapter 3.

2.21 Themes

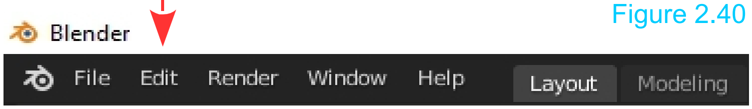
A **Theme** is the cosmetic appearance of the interface. This is purely a matter of taste and personal preference. Working in a pleasing environment has a beneficial effect on work output and changing the environment occasionally can give a new lease of life.

For your convenience Blender has a choice of two Themes. You may download and install new Themes into Blender from the Internet.

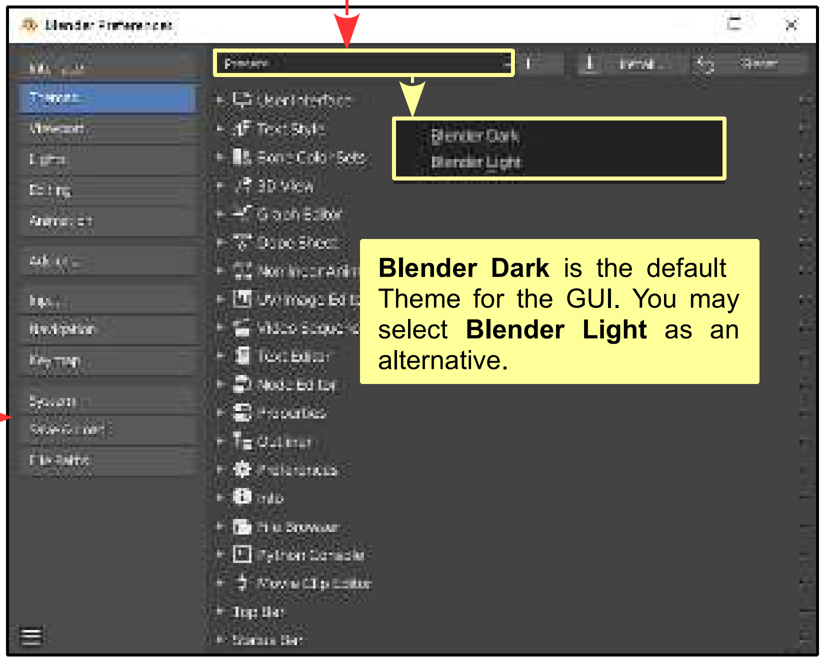
Inbuilt Themes: are found in the **Preferences Editor**. You can change an Editor Panel to the Preferences Editor as demonstrated in Section 2.1 but for convenience, when changing the appearance of the Blender interface, it is better to open the Preferences Editor from the Blender Screen Header. This method opens the Editor as a small separate Panel over the top of the GUI allowing you to see changes as the occur .

In the Blender Screen Header click on **Edit**. Select **Preferences** at the bottom of the menu.

Figure 2.40



In the **Preferences Editor** click **Presets** Figure 2.41



Close the Preferences Editor.

When Blender is closed and reopened the selected Theme will be displayed.

Installing New Themes

You may download and install themes from the internet. Themes are downloaded as Blender 2.81 XML Files. One example is found at:

Https://blenderartists.org/t/theme-awsome-theme-for-blender-2-8/1120656

Download [Theme] **Awsome** – Theme for Blender 2.8 XML File from:

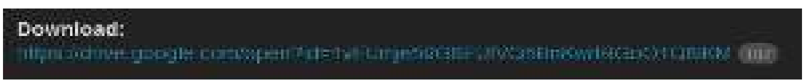


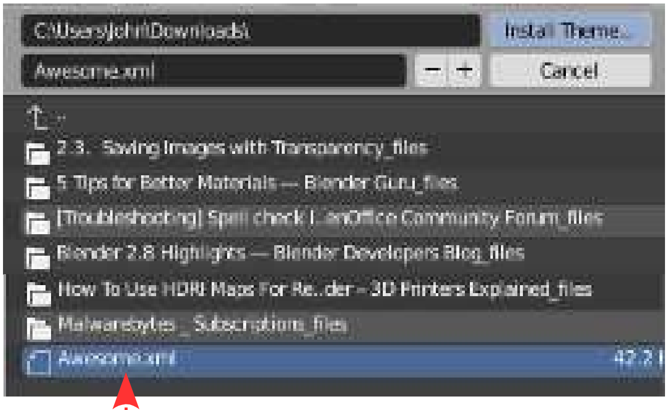
Figure 2.42

With the XML file saved to your computer, open the **Preferences Editor** and click on **Install...** in the Header.

Figure 2.43

Navigate to the **XML file** in the **File Browser** (see Chapter 3), select the file and click **Install Theme** .

The **Awesome** Theme will be available in the **Theme Preset** menu.



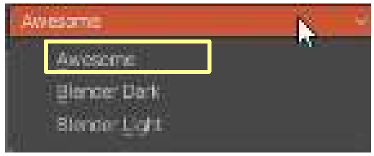


Figure 2.44

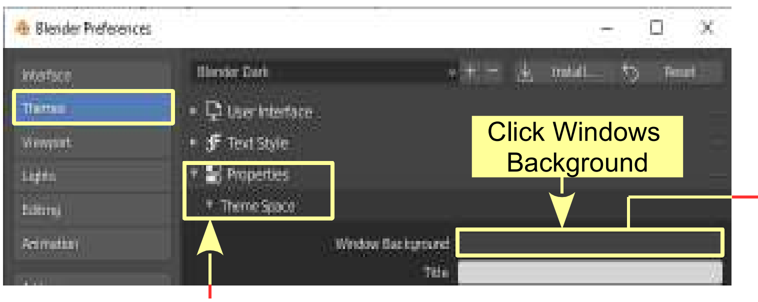
The **Theme: Awesome.xml** saved in the Downloads folder on the PC.

Note: Saving Files and Navigating the **Blender File Browser** is explained in Chapter 3.

Creating New Themes

A new Theme may be created from within Blender. In Figure 1.1 in Chapter 1 the background colors of the Editor Panels were modified to make it easier to identify the individual Panels. These modification can be saved as a Theme for future use.

To change Editor background colors, open the **Preferences Editor** and have **Themes** selected in the left hand column. Click on a triangle adjacent to the Editor you wish to modify, for example the **Properties Editor**, then click the triangle adjacent to **Theme Space**. You will see Window Background and a gray color bar. Click the color bar and select a new color in the color picker.



Click Triangles to Expand

Figure 2.45

Drag the Brightness Slider Up

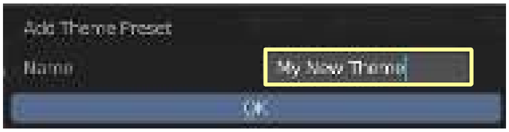
Selecting a color changes the color in the Color Bar and the background of the Editor Panel.

You may repeat this procedure for any Editor Type but be aware, the 3D Viewport Editor is different, as explained in section 2.18.

2.22 Saving a Theme

In the **Preferences Editor** Header click on **Add Theme Preset**. Figure 2.46

In the panel that displays click in the area next to **Name** to show a typing cursor and type a name for the Theme. Click **OK**.



My New Theme is entered as one of the available Themes.

Note: A Theme, including a new Theme, may be applied to any Workspace. As with Themes, you can create your own unique Workspaces.

3

Navigate and Save

3.1 Files and Folders
3.2 Saving a File
3.3 Window File Explorer
3.4 Windows File Explorer Diagram
3.5 Blender File Browser
3.6 Opening Files
3.7 File Browser Editor Features
3.8 Make a New Folder
3.9 Display Options
3.10 Saving Your Work
3.11 The Concept of Files
3.12 The Append or Link Command
3.13 Importing Objects
3.14 Activating Import File Types
3.15 Packing Data

Saving Work

When you work in Blender you edit (modify) the default file which opens when you start Blender or a file that has been previously saved. Blender file names end with a **.blend** suffix and are peculiar to the Blender program. Saving work means you save the modifications or editing, that has been performed in a Blender file. You save the file, in a folder of your choice on your computer's hard drive. You should understand how and where to create a folder and how to retrieve a file when it has been saved. In other words you need to know how to navigate your file system. Files are saved on your computer using the **File Browser Editor**.

Navigation

Navigation is the science of finding the way from one place to another. If you can see where you are going it's an easy process to head over to that place but sometimes where you want to go is hidden from view. In Blender you create files and store them away for future use. You can reuse the files and build on to them and then save the new material. Saved files are your library of information from which you extract elements and insert into future work. The saying is, **“There is no point reinventing the wheel”**. If you have created something that works use it again. But where did you put the wheel? That's where navigation comes in. You need to find the place where you safely stored that wheel or, in the case of Blender, where you saved a file containing the wheel. Navigation in Blender is performed in the **File Browser Editor**.

3.1 Files and Folders

Definition (from the internet)

A file is a common storage unit in a computer, and all programs and data are "written" into a file and "read" from a file. A folder holds one or more files, and a folder can be empty until it is filled. A folder can contain other folders (sub folders). Folders provide a method for organising files much like a manilla file folder contains paper documents in a file cabinet. In fact, files that contain text are often called documents.

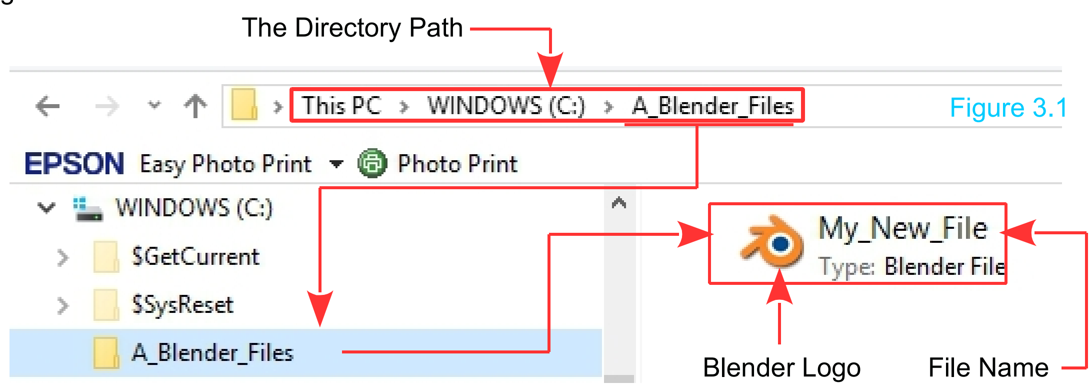
Folders are also called "directories," and they are created on the hard drive (HD) or solid state drive (SSD) when the operating system and applications are installed. Files are always stored in folders. In fact, even the computer desktop is a folder; a special kind of folder that displays its contents across the entire screen.

File Extensions

A file extension or suffix, is the bit at the end of a file name preceded by a dot or period. For example, My_Photo**.**JPEG, would be a JPEG image (photograph). The **.**JPEG extension tells the computer which application (App) or program to use when opening the file. With a **.**JPEG extension the computer would look for an image editor or viewer to open the file. With a **.**TXT extension, signifying a text file, the computer would use a text editor.

When writing file extensions to a file name they are usually written in lower case letters such as **.jpeg** or **.txt**.

Blender files have a **.blend** extension which tells the computer to open the file in the Blender program.



Windows 10 File Explorer

Figure 3.1 show a Blender file saved in the **C: Directory** (Hard Drive) in a Folder named **A_Blender_Files**. The Blender file is named **My_New_File**. Blender file names usually display with the Blender logo preceding the file name but the **.blend** file extension does not always display.

3.2 Saving a File

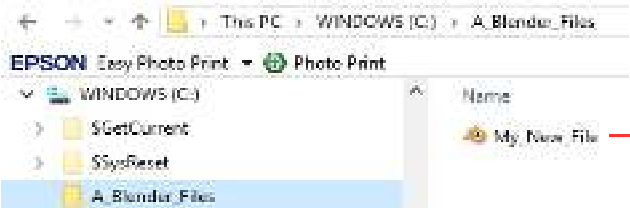
Outliner Editor

Blender File Mode

On a computer, when you save a Blender file (.blend) you are saving the data which is producing the display on the computer screen. This set of data includes not only what you see but all the settings which control all the effects that will be displayed in the various Editors. The Blender file may be considered as a complete package. Saving a file for the default arrangement saves everything.

Figure 3.2 shows the data listed in the Outliner Editor which would be saved for the default Blender Scene. Even before any editing has taken place the list is extensive. All this data is saved to a single file.

Figure 3.2



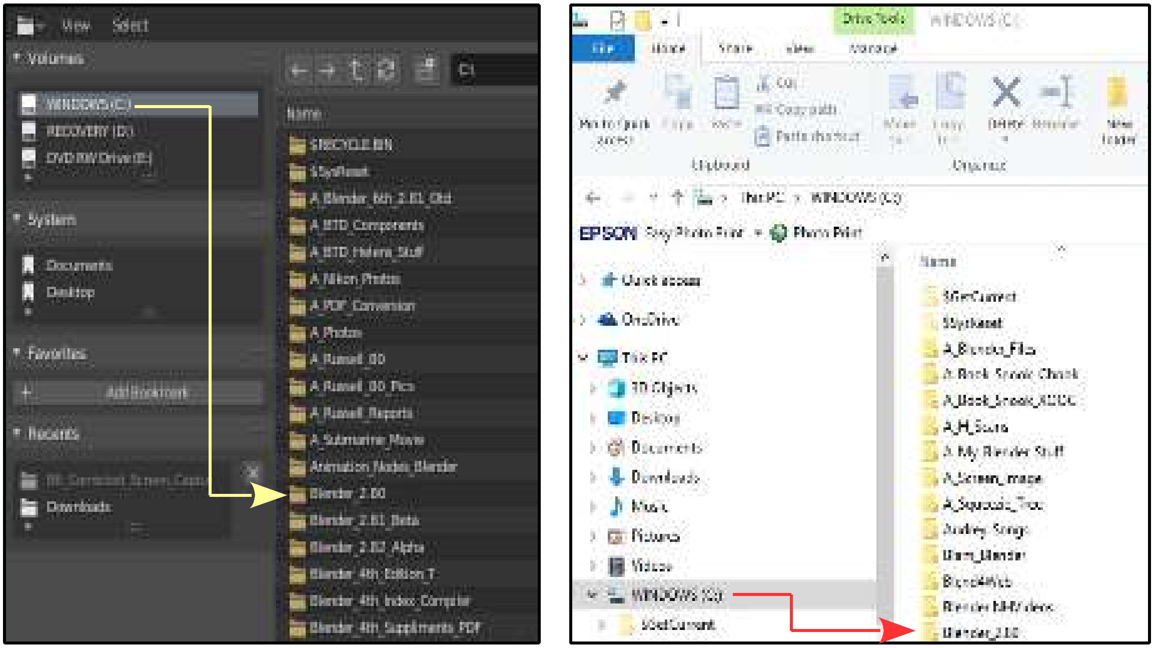
Click the ▶ Icons to expand the entries

The diagram shows the file saved on the **C:** Drive (Hard Drive) of the computer in the Directory Folder named **A_Blender_Files**. The file has been named **My_New_File**. Although not shown, in this Windows file system the file does have a **.blend** suffix.

Note: Figure 3.2 shows the **Outliner Editor in Blender File Mode.**

Note: Placing an **A** in front of the Directory Folder name ensures that it is located at the top of the alphabetical directory list.

In Blender the **File Browser Editor** is used to navigate through the file system on your computer. On a Windows operating system, **Windows Explorer** or **Windows File Explorer** are used. Blender's File Browser is a little different to the Windows system in appearance but uses the same work flow.

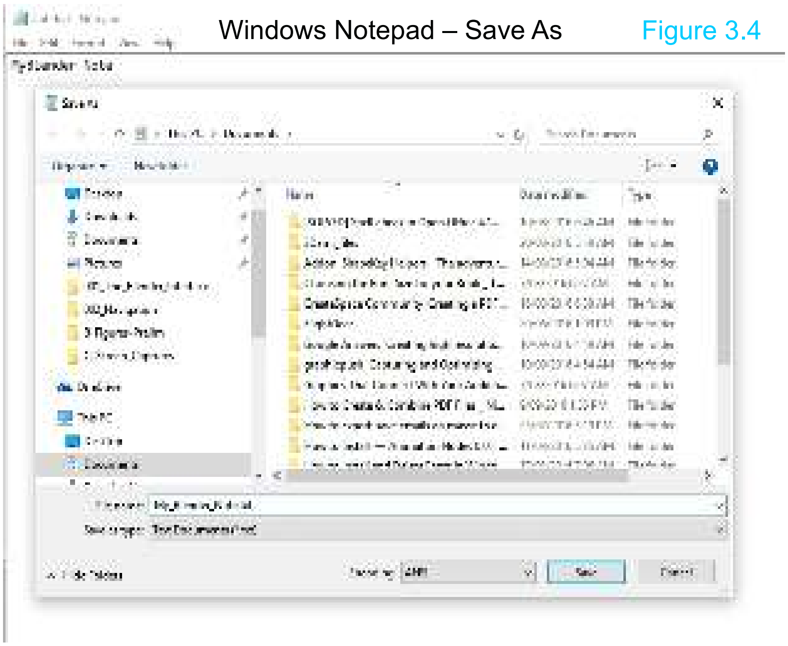


Blender – File Browser Figure 3.3 Windows – File Explorer

3.3 Windows File Explorer

Take a short refresher to analyse what you do when you save something when using a Windows operating system.

Windows Notepad – Save As Figure 3.4

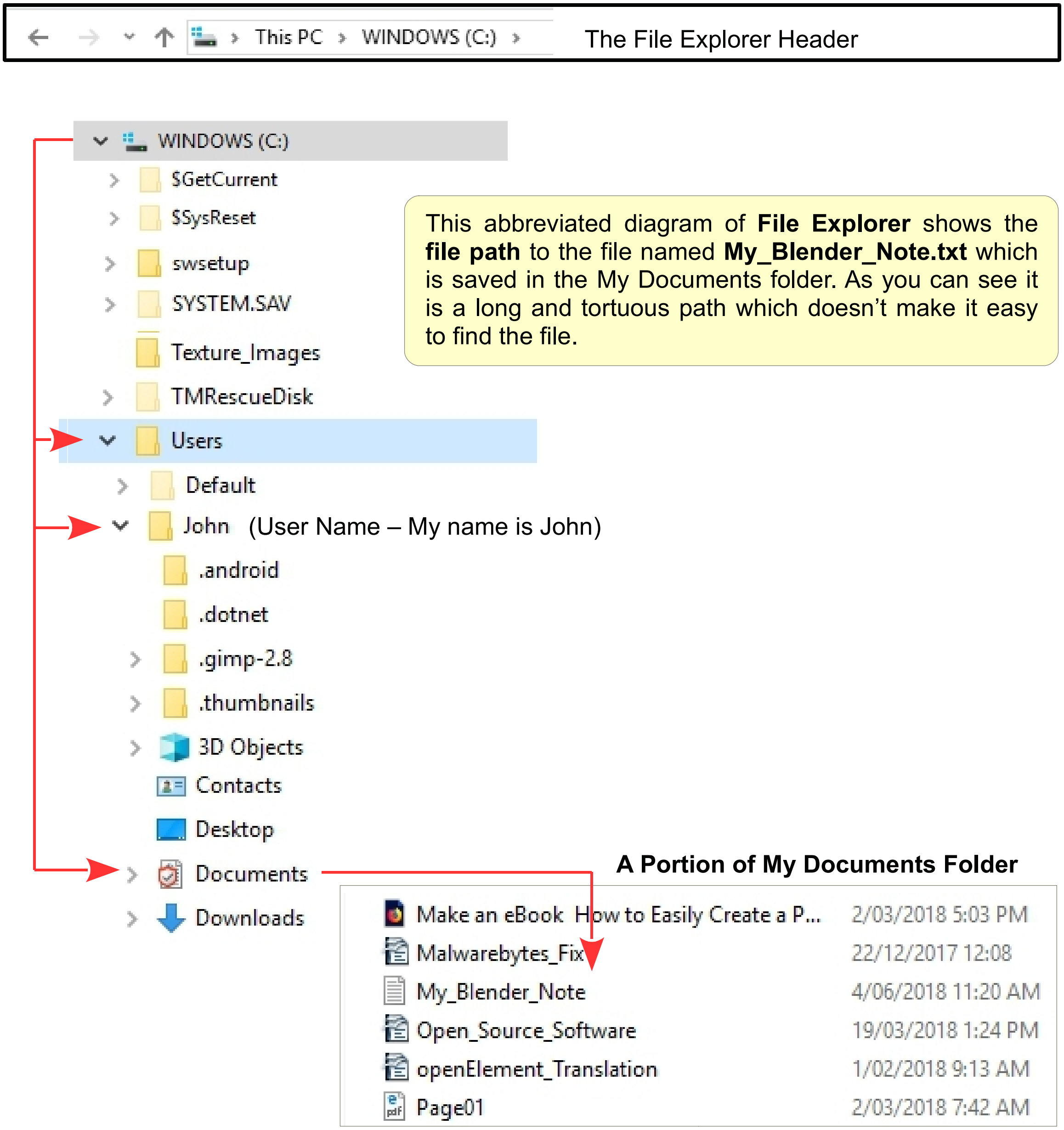


As an example, it is assumed you have written a note using Windows Notepad and you are about to save the file. You simply go to the top of the Notepad window, click on File, click on Save and the Save As window displays. In the panel at the top of this window you will probably see a panel showing This PC > Documents which is telling you that your file will be saved to the Documents folder on your computer (Figure 3.4). You enter a name for your file (My_Blender_Note.txt) and click Save. Simple!

The problem with this is; the file gets saved amongst your letters to your mother, the tax man, pictures of your pet dog and holiday snaps all saved in the Documents folder. You should make a special folder for your **Blender Stuff**. You can create new folders in File Explorer by Right clicking on a folder or sub folder, selecting **New** then clicking **New Folder** and entering a name. You probably know how to do this but it is more important for you to understand how to do this is in Blender.

3.4 Windows File Explorer Diagram

Figure 3.5

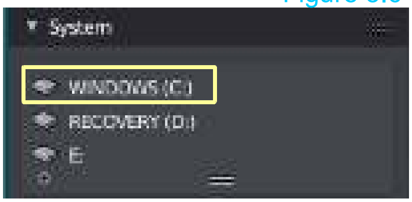


3.5 Blender File Browser

Blender's File Browser is the **File Browser Editor**. Click on the 3D Viewport Editor icon (upper left) and select **Editor type: File Browser** in the menu. The 3D Viewport Editor is replaced by the **File Browser Editor** (Figure 3.7). This is where you navigate to find things and save things. You save your Blender files and rendered images and animation files and you search for pre-saved files from which you obtain data to use in new work. You can also create a new folder for your **Blender Stuff**.

To navigate the File Browser is very simple. As an example, go find the file named **My_Blender_Note.txt**. The **.txt** bit (suffix) on the end of the name tells you that the file is a Text file.

Figure 3.6



In the File Browser Editor click on **(C:)** or **Windows (C:)** in the **System Tab** panel in the upper LH part of the Editor panel. This is the C: drive on your PC. The PC used in this demonstration is a HP computer running Windows 10. The name on your computer is probably different but you will have something that tells you it is your C: Drive.

When you click on the C: Drive the main RH panel (in the File Browser Editor) displays the list of folders that you have in the C: Drive. The list is displayed in columns and by default is in alphabetical order. To follow the file path that was shown in Windows File Explorer:

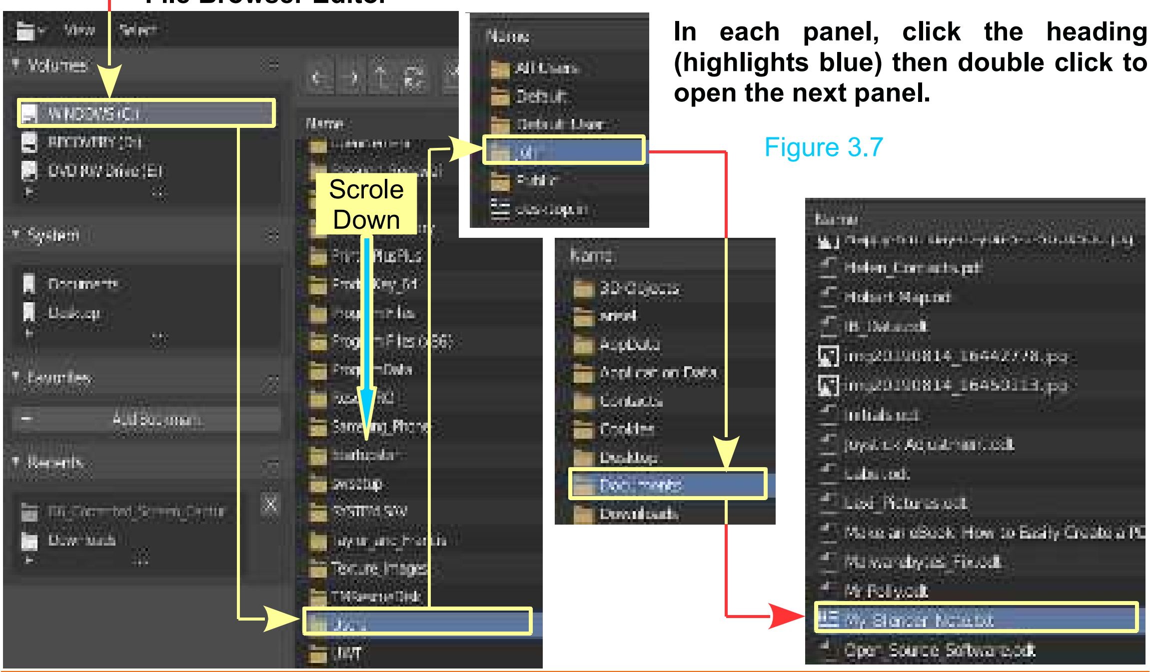
C:\ Users\ John\ Documents\ My_Blender_Note.txt

My name is John. This will be your **User Name**.

File Browser Editor

In each panel, click the heading (highlights blue) then double click to open the next panel.

Figure 3.7



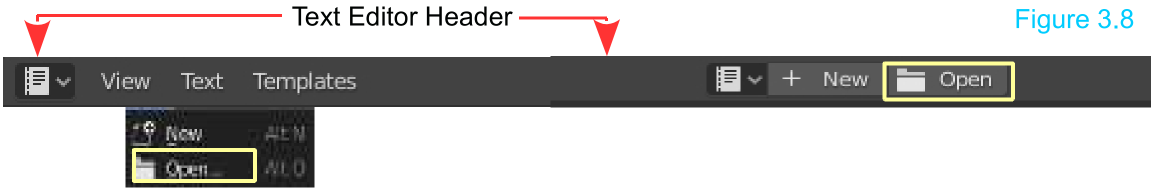
3.6 Opening Files

When the File Browser Editor has been opened, replacing the 3D Viewport Editor, it is merely allows you to search your file system to locate folders and files or create a new folder. You can not open files.

Blender opens different types of files in different Editors (see Chapter 04 Objects in the 3D Viewport Editor). **My_Blender_Note.txt** is a text file therefore you would open it in the **Text Editor**. Blender files with the **.blend** extension open in **Blender** in the 3D Viewport Editor. Image files would open in the UV Image Editor.

To demonstrate, consider the file named My_Blender_Note.txt. The **.txt** suffix indicates that it is a text file, therefore, it is opened in the Text Editor. Replace the 3D Viewport Editor with the Text Editor. To open My_Blender_Note.txt click **Text** in the Header and select **Open** or click **Open** (Figure 3.8).

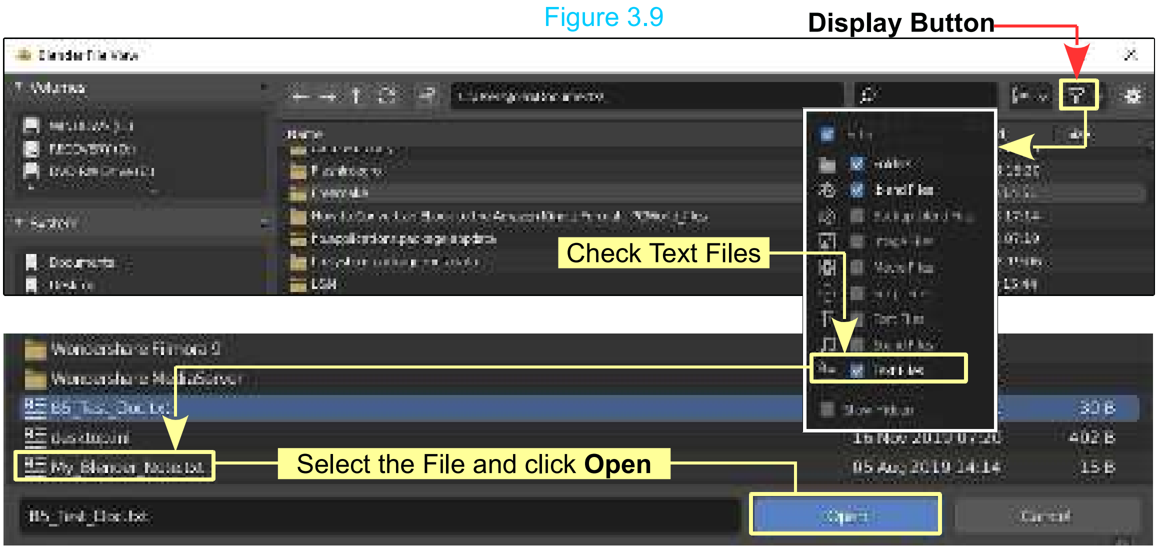
Figure 3.8



Clicking on either **Open** options displays the **Blender File View** panel which is essentially the Blender File Browser for the Text Editor. If you were in the Image Editor or the 3D Viewport Editor the Blender File View panel would be applicable to the Editor that was opened allowing you to select and open files applicable to the particular Editor.

Having navigated to the Documents Folder in the File View panel and scrolling you will be disappointed to find **My_Blender_Note.text** is nowhere to be found. By default text files are hidden? Click on the **Display button** in the upper RH corner of the panel and check **Text Files** in the display menu. Text Files will be shown, Select (click to highlight) and click Open Text.

Figure 3.9



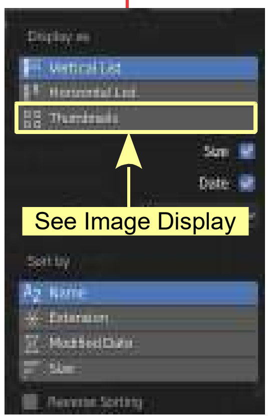
3.7 File Browser Header Features

Figure 3.10

Previous Folder
Next Folder
Parent File (Go Back)
Refresh the File display
Create a New Directory

File Display Options

Editor Display Options



3.8 Make a New Folder

Clicking the **Create New Directory** button creates a New Folder in the Directory that is open, in this case the My Documents directory. The New Directory is named **New Folder** but is displayed with a **Typing Cursor active** allowing you to enter your own name.

Figure 3.11

3.9 Display Options

The way in which Folders and Files are displayed can be changed in the **Editor Display Options.**

Which Type of Files display is controlled in the **File Display Options.**

Image Display: By default Image File names are displayed as text. By activating **Thumb Nails** in the **Editor Display Options** you can see Image Files as an Image.

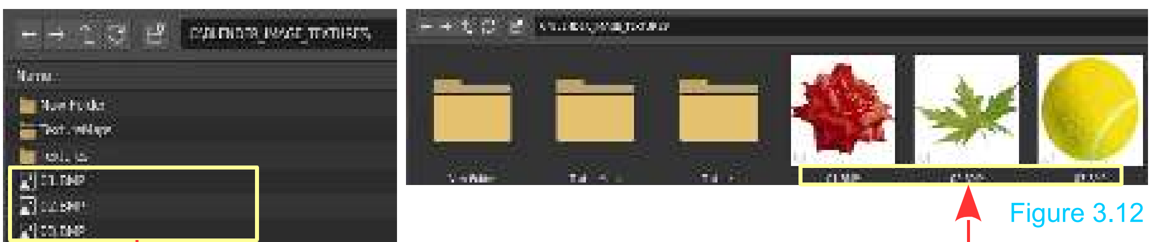


Figure 3.12

Thumbnails

3.10 Saving Your Work

Besides being able to navigate the File Browser to find things that have been saved you will inevitably want to save your work. It's a good idea to be organised and create folders for different things.

Make a new folder in the C:\ Directory and name it **A_My_Blender_Stuff**.

Open the File Browser Editor.

Click on **Windows (C:)** under **Volumes** (upper LH). In the File browser Header click the Create New directory Button. New Folder is created. With the Typing Cursor active, backspace and retype **A_My_Blender_Stuff**. Press Enter.

Note: Putting **A** at the beginning of the name places the New Folder at the top of the list in the C:\ Drive (makes it easy to find).

Figure 3.13

For the exercise a modified copy of the default Blender Scene will be saved to the new folder named My_Blender_Stuff.

With the new folder created, open the 3D Viewport Editor to display the default Blender Scene with the Cube Object. Replace the Cube with a Monkey Object. Adding the Monkey will distinguish the file to be saved from the original default Scene.

In the 3D Viewport Editor Header, click on **File** then click on **Save As** in the menu. The Blender File Viewer opens. Navigate to the Folder named My_Blender_Stuff. At the bottom of the File Viewer, where you see **untitled.blend**, click to display the Typing Cursor, backspace and retype a name for your new file, **My_New_File.blend** (If you forget the .blend suffix, Blender will obligingly add it for you). Click on **Save As** (highlighted blue).

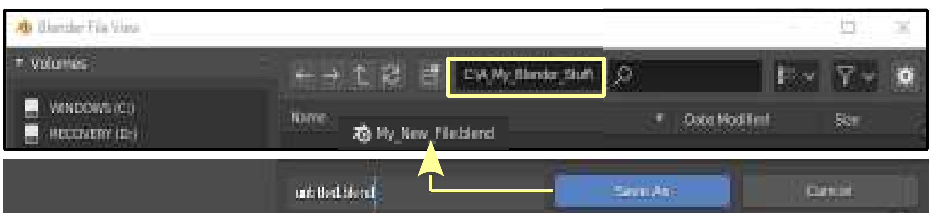


Figure 3.14

Retype: My_New_File.blend

My_New_File.blend is saved in the My_Blender_Stuff folder.

3.11 The Concept of Files

To save a file? What does this mean? It's easy to say, **save a file,** but what are you actually doing when you save? The chapter started by discussing saving a file created in Windows Notepad. This was a simple text file. A text file contains data which displays letters and words on your screen i.e. Text. An image file contains data which displays a picture. A music file plays music. Each file type uses a different application (App) or program to generate the display or, in the case of a music file, play the music. Sure! You know all this but the point is; a Blender file contains a combination of data organised into separate parts or elements.

When you save a Blender file you save all the elements.

To show you what this means in practical terms, open Blender with the default Scene. Click on **File** in the **Blender Screen Header** then click on **Append**. The **File Viewer** opens. Navigate to the file you previously saved named **My_New_File.blend** (Figure 3.15).

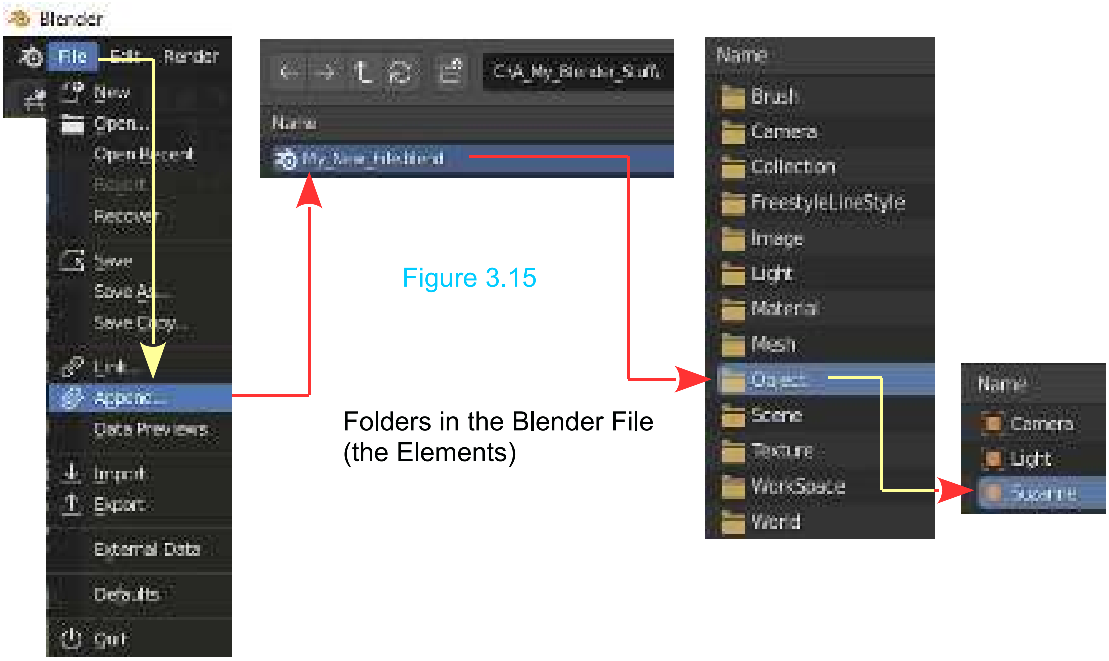


Figure 3.15

3.12 The Append or Link Command

You can insert elements from one Blender (.blend) file into another Blender file. To do this you select the **Append** or **Link** commands from the File pull-down menu in the Blender Screen Header (Figure 3.15). An element could be a model you have created.

Append takes data from an existing file and adds it to the current file. **Link** allows you to use data from an existing file in the current file but the data remains in the existing file. In the latter case the data cannot be edited in the current file—if the data is changed in the existing file, the changes show in the current file the next time it is opened.

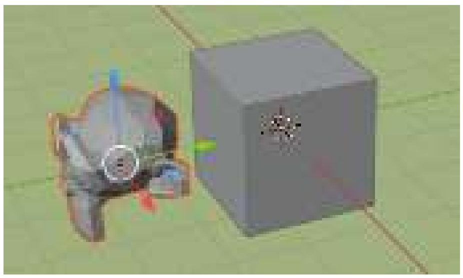
At this stage the foregoing is probably somewhat difficult to understand, therefore working through an example will help to clarify the meaning. You will have to jump the gun a little and follow some procedures without explanation. The detail of the procedures will be covered later but at the moment only be concerned with the file system navigation involved.

Selecting **Append** or **Link** opens the File Viewer allowing you to navigate to the Blender file you wish to select elements from. You can **Append** anything, including cameras, lights, meshes, materials, textures, scenes, and objects. By appending Objects, any materials, textures and animations that are linked to that object will automatically be imported with the Object. Clicking the LMB on an Object will select it. Pressing the A key will deselect.

To clarify this procedure start a new Blender file (open Blender) with the default Scene containing the Cube Object. Select the **Append** command as previously described and navigate to the file **My_New_File.blend**. Open the **Object directory** (the Objects folder, Figure3.15). Click on the Object named **Suzanne** to highlight it, then click on the **Append** button in the lower RH corner of the Viewer (Figure 3.16).

Figure 3.16

Suzanne Appended in the 3D Viewport Editor



You can Append any Object from any Blender file.

3.13 Importing Objects

One of Blender’s strong points is its ability to accept several generic types of 3D files from other programs. Two examples are:The **.dae Collada** file format used by the **Make Human** program, which creates models of the human figure.

The **Make Human** program is freely available. Other programs save files in one format but also give the option to export in another format. You will have to find the **Export** command in the program and match up the file type with one of the file types in Blender’s import menu .

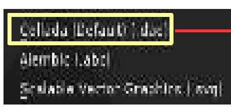
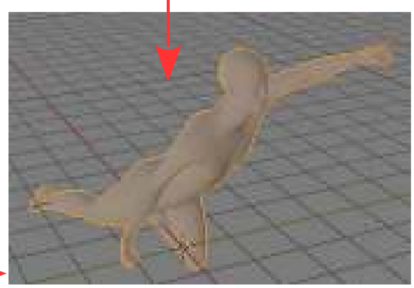


Figure 3.17



Collada File Imported

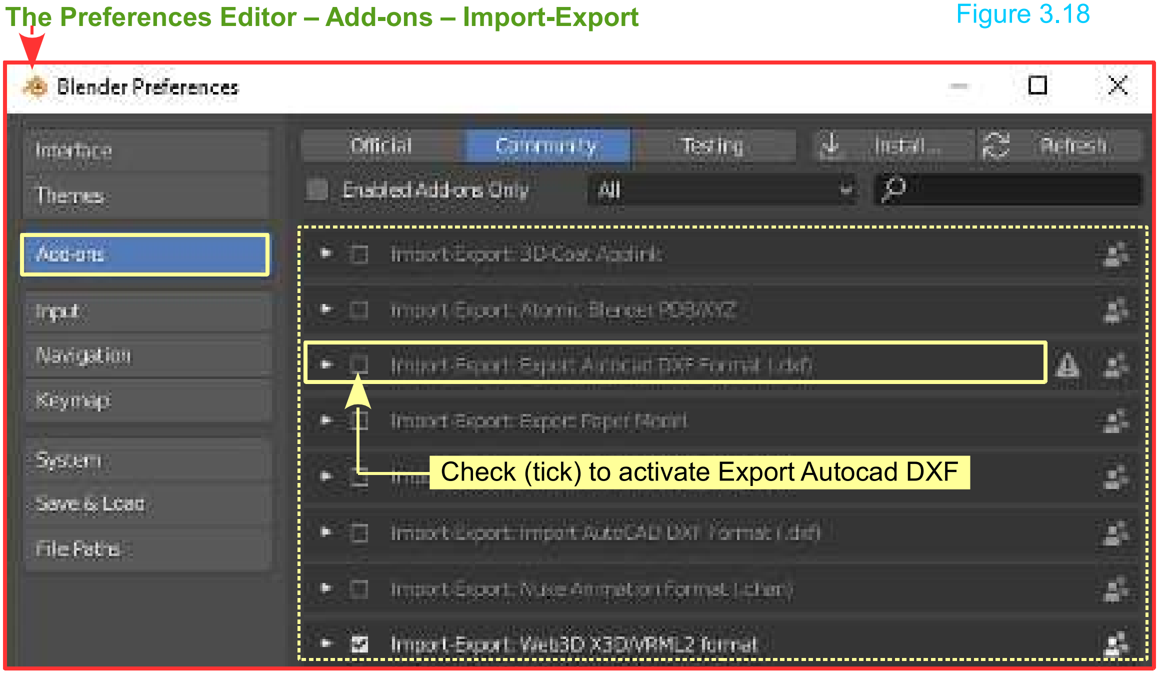
> **Note:** There are only a few file type options shown in the default selection menu (Figure 3.16). Collada (.dae) is shown while Pointcache (.pc2) is not. To conserve space in the GUI, Blender has limited the file type display. Other file types are available as **Add-ons** in the **Preferences Editor** in the **Import-Export** category.

3.14 Activating Import File Types

To import a DXF file into a Blender scene, open the **Preferences Editor** and click on **Add-ons** at the LHS of the Editor. In the list to the right select an **Import-Export** Add-on. Find the file you require and check (tick) the box adjacent to the file name. The checked file type will display in white text and be available in the **Import** or **Export** selection menu.

> **Note:** When importing Blender files into other Blender files, remember to use the **Append** command instead of Import. In the **Append** command, select the file, then select what you would like to bring into the current file. You will usually use the Objects option.

The Preferences Editor – Add-ons – Import-Export Figure 3.18



To import a particular file type click on the type in the list.

Clicking the file type opens the File Browser Editor where you navigate to the file containing the Object you wish to import. As an example, a model of a human figure has been created using the **Make Human Program**. The model has been exported as a **Wavefront.obj** file. You will see that this type of file is included in the default Import file list, **Wavefront OBJ.** Click on this file type to display the **File Browser Editor**.

Important: When you export a model from another program, know where it is saved on your computer and what the file name is.

The model exported from the **Make Human** program is named **Running_Man.obj.** The model was exported to:

C:\A_My_Blender_Stuff

Figure 3.19

Figure 3.20

In the File Browser Editor navigate and find your file. Click on the file name to select it (highlight) then click on **Import OBJ** in the lower RH corner

The Object Running_Man (Figure 3.20) is entered into the Blender 3D View Editor. Note: You will probably have to scale the model to suit.

3.15 Packing Data

If you plan to open a Blender file on other computers, you will need to select the **Pack All into .blend file** option in the **File** menu under **External Data**. Textures and sounds are not automatically included in your Blender file in order to keep the file size down. Every time your file opens, the textures and sounds are placed into your file. If the files can't be found, you won't have any textures and sounds. If you **Pack the Data**, those files are included with the .blend file so they can be opened anywhere. Remember, your file size may become very large. You can also unpack data to bring the file size back down.

You may alternatively check **Automatically Pack Into .blend**.

4

Objects in the 3D Viewport Editor

4.1	Modeling Workflow Philosophy	4.12	Object Mode Manipulation
4.2	Starting a New File	4.13	The Last Operator Panel
4.3	Modifying the Scene	4.14	Tool Panel - Widgets
4.4	Object Mode and Edit Mode	4.15	Manipulation Units
4.5	3D View Editor Cursor	4.16	Measuring – Ruler/Protractor
4.6	Selecting/Deselecting Objects	4.17	Precision Manipulation
4.7	Adding Objects	4.18	Coloring Objects
4.8	Object Primitives	4.19	Other Types of Objects
4.9	Locating the Editor Cursor	4.20	Naming Objects
4.10	Deleting Objects	4.21	the Header Buttons Menu
4.11	Duplicating Objects	4.22	Meta Shapes

The overview of Blender introduced the Editors in the default Screen arrangement and demonstrated how they interrelate. The fundamental concept in using Blender is to create a model, place the model in a Scene and perhaps animate the model to move creating an animation sequence. In the creation process the models and components of the Scene may be colored and textured and the Scene illuminated for effect.

To model an object or character, or a component of a Scene such as a landscape, a simple shape is placed in the 3D Viewport Editor and modified (modeled). The simple shape is called a **Primitive**. Blender has ten primitives from which to choose, which one you select will depend on what you want to create.

Instruction will be given with the default Screen Arrangement (GUI) with the **Eevee Render Engine** active.

Bear in mind that you have the options to use the **Cycles** or **Workbench** Render Engines. Workbench provides a simplified working environments for modeling when a Scenes become complicated. Cycles allows you to work in a viewport that continually renders a **photo-realistic** view.

4.1 Modeling Workflow Philosophy

Blender has been introduced by studying the Graphical User Interface (GUI) with its arrangement of Editors and panels and having Keyboard and Mouse input commands explained. Knowing how to work the interface allows you to create something by Modeling.

Before you begin to Model you should understand the philosophy of the Blender process.

When you open Blender you are presented with the default 3D Viewport Editor showing a Scene containing a Cube Object. The Scene also has a Light and a Camera in place. To create something new, you start by saving this arrangement with a **new file name**. The new file is a starting point for developing a new Scene with new Models. You modify the default Scene in the new file to whatever you require. Modifying a Scene will involve such things as moving and repositioning objects, reshaping objects, adding new objects, applying color, arranging lighting effects, positioning the camera etc.

4.2 Starting a New File

When beginning a new project it is advisable to start a new file with a new name. Start Blender and before changing anything in the default Scene, save the file in your **Blender_Stuff** folder with a meaningful name. Write down the name. You can save your work wherever you like as long as you remember what you named the file and where you saved it. Be familiar with saving and creating files and folders. Go back and review Chapter 3 if necessary.

> **Note:** Depending on the version of Blender you have, the program may not prompt you to save your file when closing . Remember to always save your work often and don't forget the .blend suffix!

After saving the default Scene as a new file, the new file is open in the Screen ready to be modified. The new Blender file will display the default arrangement of Editors and the 3D Viewport Editor will display the default Scene. If you have closed Blender after saving you will have to reopen the new file.

When you restart Blender the default Screen arrangement is displayed. To reopen the file that you saved, click on **File** in the **Blender Screen Header** and click on **Open** in the **File** menu. The **File Viewer** opens (Figure 4.1) where you navigate to your saved file. Click on your file name then click **Open** in the lower RH corner of the Editor.

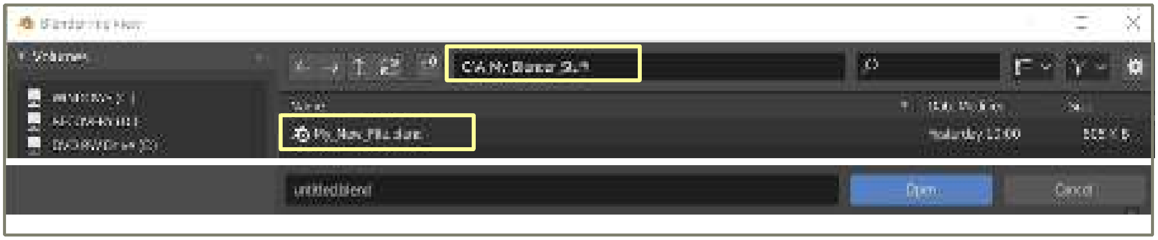


Figure 4.1

4.3 Modifying the Scene

Any changes you make to the Scene will be construed as modifying the Scene. For example, changing the shape of an Object is a modification. Changing the shape of an Object is called modeling. Another basic modification would be to move an Object in the Scene. Another Scene modification is to add an Object. There are many modifications that can be made.

4.4 Object Mode and Edit Mode

In the **3D Viewport Editor** there are two basic display modes; **Object Mode** and **Edit Mode**. With an Object selected in the 3D Viewport in Object Mode you Translate (move), Rotate and Scale the Object. In Edit Mode you change the shape of the Object. Note: This is a simplistic description of the operations, there is more to it than that. Look at the Cube Object in the default Scene.

Switching Modes: Click to display the menu and select **Edit Mode** in the 3D Viewport Header.

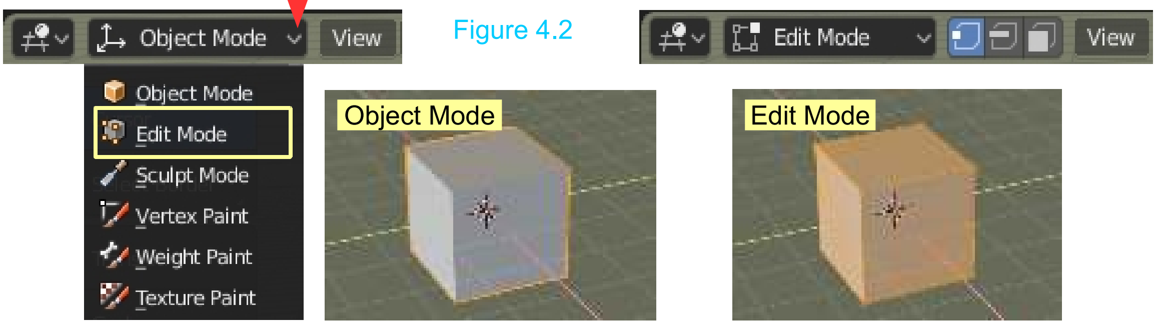


Figure 4.2

Alternative: Press the **Tab Key** on the Keyboard to toggle between modes.

In **Object Mode** the Cube displays as a solid gray Object with an orange outline. The orange outline indicates that the Cube is **selected**. Being selected means that the Cube may be manipulated in the Scene (Translated (Moved), Rotated or Scaled).

In **Edit Mode**, when the Cube is selected, it is shown with an orange tint with orange edges and with little orange dots at each corner. The orange dots are called **Vertices**, the orange edges are **Edges** while the orange tinted surfaces are **Faces**. In Edit Mode you select either of these elements individually and manipulate them to change (model) the shape (see Chapter 5).

4.5 3D Viewport Cursor

3D Viewport Editor Cursor

Mouse Cursor Figure 4.3

When working in the 3D Viewport Editor there are two Cursors; the **Mouse Cursor** and the **Editor Cursor**. By default the **Editor Cursor** is located at the center of the Scene. The center of the default Cube Object is also at the center of the Scene. Objects may be positioned by using the Editor Cursor. To understand positioning using the Editor Cursor you must first understand selecting, deselecting and adding Objects.

4.6 Selecting – Deselecting Objects

In the default Scene the **Cube Object is selected as shown by the orange outline.** To deselect the Cube press **Alt + A Key** on the keyboard (the orange outline cancels) or **LMB click** (left mouse button) an empty space in the Editor. To **select** the Cube again, click **LMB** on the Cube.

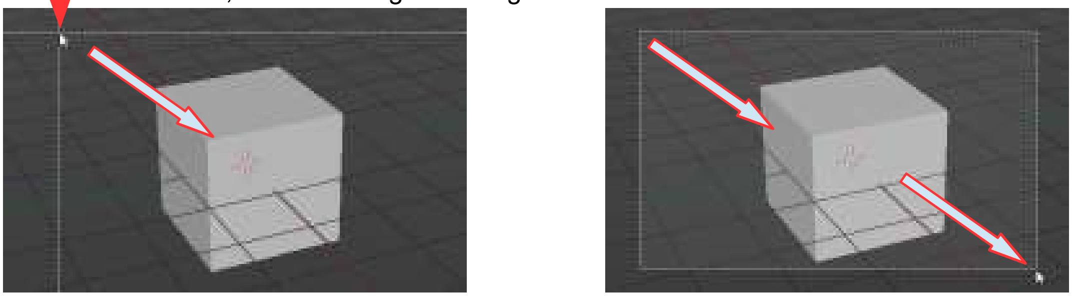
> **Note:** If you deselect then press the **A Key,** all Objects in the Scene will be selected. If you inadvertently select all Objects press Alt + A Key or LMB click an empty space to deselect all Objects. Click LMB on a single Object to select.

B Key Selection

An alternative selection method is to press the **B Key** on the Keyboard with the Mouse Cursor in the 3D Viewport Editor panel. In this case, pressing the B Key displays cross hair lines in the Editor panel which you drag, forming a rectangle, around an Object **or multiple Objects**. Release the mouse button to select.

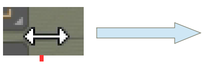
Press the B Key to display the cross hairs - Position the Mouse Cursor
Click LMB, hold and drag a rectangle – release the Mouse button

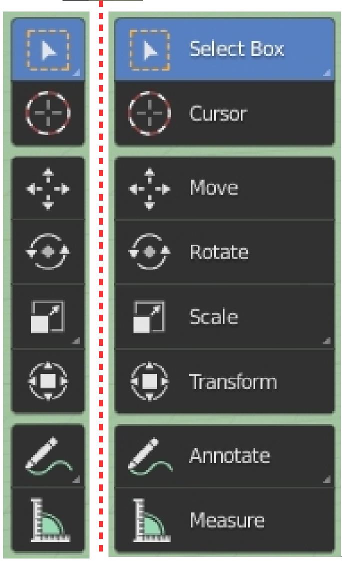
Figure 4.4



Border Select Tool

Note: The default **Tool Panel** is minimised. Mouse over, click, hold and drag the double headed arrow to expand and display the names.



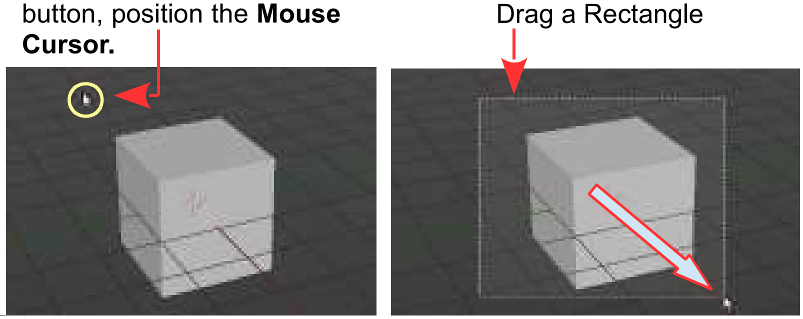


Another method of selection is to use the **Border Select Tool** in the **Tool Panel** at the LH side of the 3D Viewport Editor. In this case, click the **Select Box** button, position the Mouse Cursor, click LMB, hold drag the mouse, drawing a rectangle around the Object or Objects to be selected. Release the Mouse button to select (as previously described).

Click the **Select Box** button, position the **Mouse Cursor.**

Figure 4.5

Click, Hold and Drag a Rectangle



C Key Selection

Yet another method of selection is to position the Mouse Cursor in the 3D Viewport Editor and press the **C Key**. In this case the Mouse Cursor becomes a **Selection Circle** which you position over the Object or Objects to be selected. When first displayed the circle is relatively small.

Unless the circle encapsulates a whole Object the Object will not be selected. To increase or decrease the size of the circle **Scroll MMB**. With the circle surrounding the Object click LMB to select.

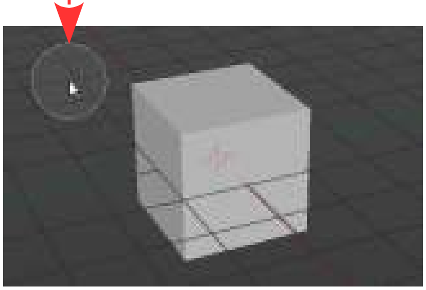
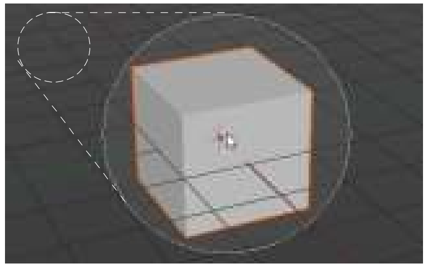


Figure 4.6

Scroll MMB to increase the size of the Circle.

Position over the Cube and click LMB to select. Click **Esc** to cancel the Circle.



4.7 Adding Objects

The default Blender Scene contains three Objects, a Cube, a Camera and a Light. The Camera and Light are special Objects which perform functions but do not render as part of an image or animation. The Cube, on the other hand, does render. The Cube is one of ten Objects called **Primitives**, which are the starting point for modeling. You modify the shape of a primitive into a model of a character or as part of the Scene background.

4.8 Object Primitives

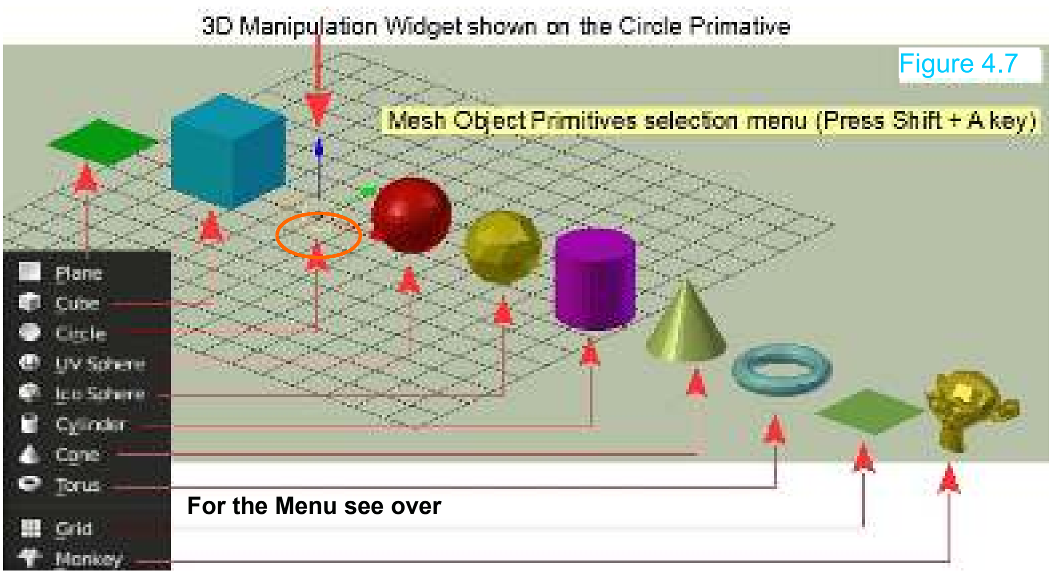


Figure 4.7

Figure 4.7 shows the ten default **Primitives** available for selection. They have been colored to distinguish them. When added to a Scene they are entered with the default gray color. A **Primitive** shape entered into the scene is referred to as an **Object**. Blender automatically names Objects according to the shape i.e. **Cube**, **Sphere**, **Cone** etc. When you reshape (modify) the primitive Object to make a model you will rename it. Primitives are entered in the 3D Viewport Editor with the Editor in **Object Mode.**

To add a new Object into a Scene you click on **Add** in the **3D Viewport Editor Header** then click **Mesh** to add a new Object. This displays the **Add Mesh menu**.

An alternative way to display the **Add** menu is to press **Shift + A Key**.

In either case, with the Add menu displayed you click **Mesh** to display the selection menu where you click to select one of the **Primitives**. Selecting a Primitive enters it in the Scene at the location of the **3D Viewport Editor Cursor**.

4.9 Locating the 3D Viewport Editor Cursor

By default the **3D Viewport Editor Cursor** is located at the center of the Scene which is the center of the 3D World. Also by default, the Cube Object is located at the same point.

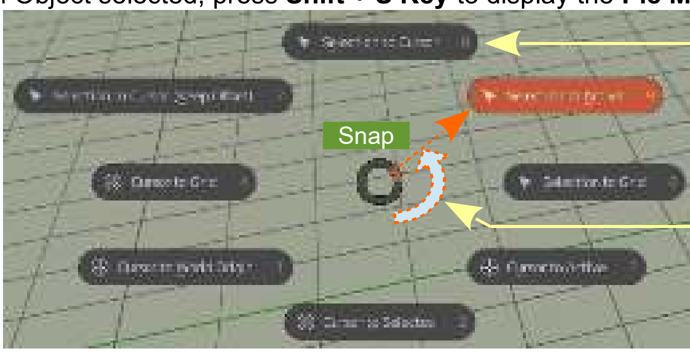
Remember; Objects added (entered) in the Scene are located at the position of the **3D Viewport Editor Cursor**, therefore, you will wish to relocate the Cursor to position Objects.

Hold Shift and **click RMB** to position the Cursor. Alternatively activate the **Cursor Tool** in the Tool Panel. With the Tool activated you can click **LMB** anywhere in the 3D Viewport Editor to position the Cursor. With the Tool activated you can click LMB to relocate the Cursor or, hold and drag the Cursor to a new location.

Don't forget to deactivate the Cursor Tool so you can LMB click to select and deselect Objects. To deactivate the Cursor Tool click on the **Select Box** Tool (uppermost in the panel).

The Cursor Pie Menu (Snap Tool)

Yet another control for locating the Cursor and positing Objects is the **Snap Tool Pie Menu**. With an Object selected, press **Shift + S Key** to display the **Pie Menu** (Figure 4.8).



Clicking **Selection to Cursor** relocates the selected Object to the position of the 3D Viewport Editor Cursor.

You may also drag the Mouse to rotate the **Snap Ring** at the center of the Pie Menu to make a selection. With the orange segment located as shown, **Selection to Active** is selected.

4.10 Deleting Objects

To Delete (remove) an Object from the Scene, select the Object then press the **X Key**. The **OK Delete** panel displays. Click **Delete** to delete or press **Esc** to cancel.

Note: You may select multiple Objects for deletion.

Figure 4.9

4.11 Duplicating Objects

When you want to **duplicate an Object** (make an identical copy), select the Object and press **Shift + D Key**. A new Object is created occupying the same space as the original. The new Object is in Move Mode (able to be moved by dragging the Mouse) as indicated by a white outline. To reposition in the Scene, drag the Mouse and click LMB when in place.

4.12 Object Mode Manipulation

The three basic manipulation controls are: **Translate, Rotate and Scale**.

Translate: To move an Object freely in the plane of the view, press the **G Key** (Grab Mode) with the object selected and drag the Mouse. In Grab mode the outline turns white. To lock the movement to a particular axis, press the G Key + X, Y, or Z. G key + Y restricts the movement to the Y (green) Axis (Figure 4.10).

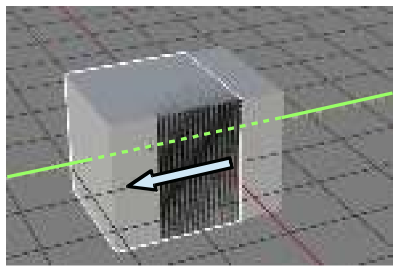


Figure 4.10

Scaling: To scale an Object (make larger or smaller), press the **S Key** and drag the mouse. To lock the scale to a particular axis, press S Key + X, Y, or Z. To scale by a specificg value press S Key + Number Key (S + 2 + Y = Scale twice on the Y Axis (Figure 4.11)

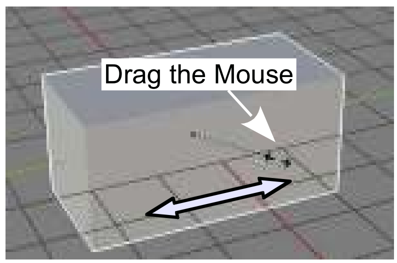


Figure 4.11

Rotating: To rotate an Object, press the **R Key** and move the mouse about the **Object's center**. To lock the rotation to an axis, press the R Key + X, Y, or Z. To rotate a set number of degrees, press R + the number of degrees of rotation and press Enter. R+30 rotates the Object 30 degrees. R + Y + 30 rotates the Object 30 degrees about the Y-Axis (Figure 4.12).

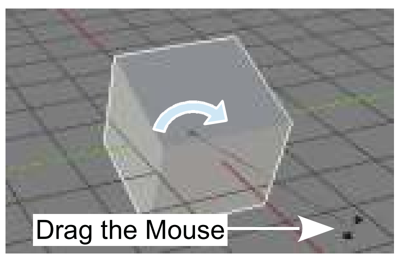
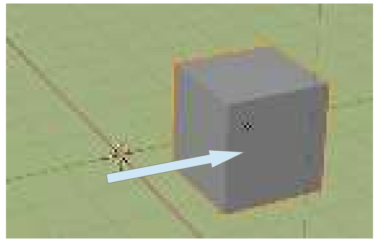


Figure 4.12

4.13 The Last Operator Panel



When an Object is manipulated a panel displays at the lower left hand side of the 3D Viewport Editor. This panel shows information relating to the last operation performed in the Editor. The panel also allows values to be adjusted, providing a means of fine tuning or correcting the operation.

Consider Translation of the default Cube Object along the Y Axis. When the Cube is moved a panel displays in the lower left of the 3D Viewport. The name of the action is shown in the panel, in this case **Move**.

Click to expand

When expanded the panel contains values which may be adjusted to fine tune the operation. You can see the same values in the **Properties Editor, Object Properties.**

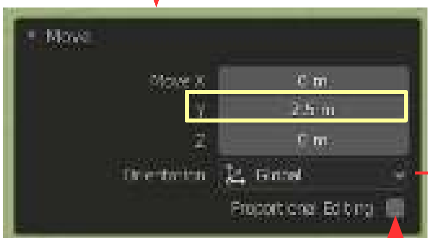
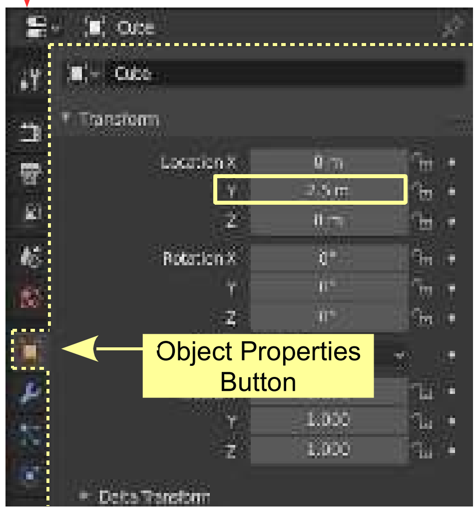
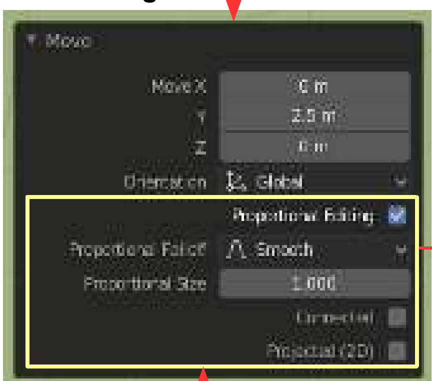


Figure 4.13



Object Properties Button

Check (tick) **Proportional Editing**



Note: Proportional Editing with the Falloff options is applicable to Moving Vertices in Edit Mode (see Chapter 5 - 5.10).

When values are altered in the Last Operator panel the corresponding value in the Properties Editor is also adjusted.

Note: The **Move Y** value in the Last Operator panel shows the distance moved from the original location. The Location Y value in the Properties Editor shows the actual location on the Y Axis of the Scene. Moving the Cube 1m on the Y Axis will show 1m in the Last Operator panel (distance moved) and 3.5m in the Properties Editor (the Location).

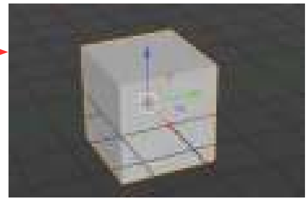
4.14 Tool Panel – Widgets

Expand the Tool Panel to display the Tool Names (see 4.6).

Tool Panel

In the **3D Viewport Editor, Tool Panel** at the left hand side you will see **Transform, Move, Rotate** and **Scale** buttons. Clicking on a button (highlights red) displays a **Manipulation Widget** at the center of the selected Object. To use a Widget click LMB on a red, green or blue handle, hold the mouse button and drag the mouse.

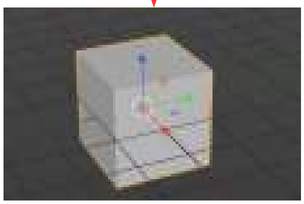
Move Click LMB on an Arrow Hold and Drag

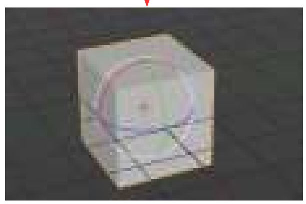


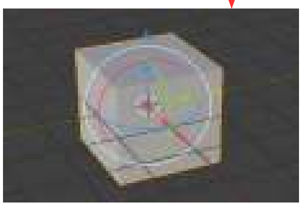
Rotate Click LMB on a Circle Hold and Drag

Scale

Figure 4.14







Scale Click LMB on a Paddle, Hold and Drag

Note: Click, Hold and Drag a Square to confine the Scale to an Axis.

Transform combines Move, Rotate and Scale

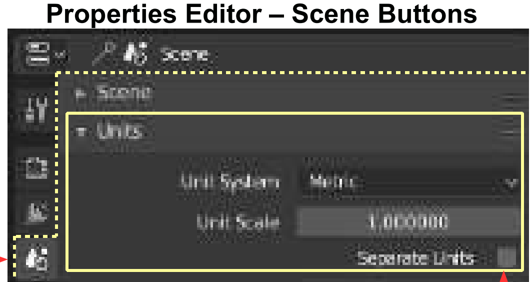
4.15 Manipulation Units

By default Translation and Scaling units are expressed in **Metric** values and Rotation is in **Degrees**. You can change the values in the **Properties Editor, Scene buttons, Units tab.**

Figure 4.15

When using Metric values the Background Grid in the 3D View Editor is considered to represent One Meter by One Meter divisions.

Properties Editor – Scene Buttons



Scene button

Check **Separate Units** to display values in M, cm, mm etc.

Scale Units: By default the size of an object is expressed in **Metric Units**. You may elect to change this. In the **Properties Editor, Scene buttons, Units tab** you will see **Unit System** and **Rotation**. Clicking either unit bar will display option menus (Figure 4.16 over).

Unit System – Metric is the default setting, in which case the mid plane grid in the 3D View Editor is considered as representing 1M x 1M units.

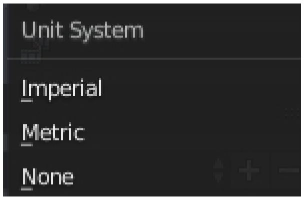
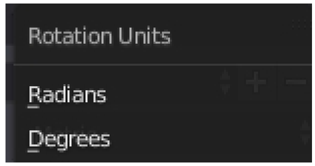


Figure 4.16



To demonstrate: With the Mouse cursor in the default 3D Viewport Editor press the G Key (Grab) and move the mouse translating the Cube (the Cube must be selected). In Figure 4.18 the Cube has been translated + 45.89**cm** on the X axis, +1.8844 **M** on the Y axis and +64.109 **cm** on the Zaxis.

You can see the exact values in the **Editor Header** while you have the Cube in Grab mode. You will also see the values in the **Object Properties Panel** (Press the **N Key** to display, Figure 4.17).

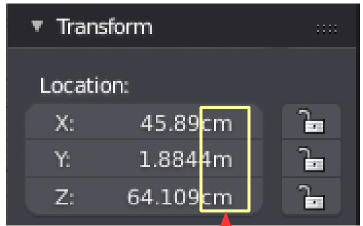
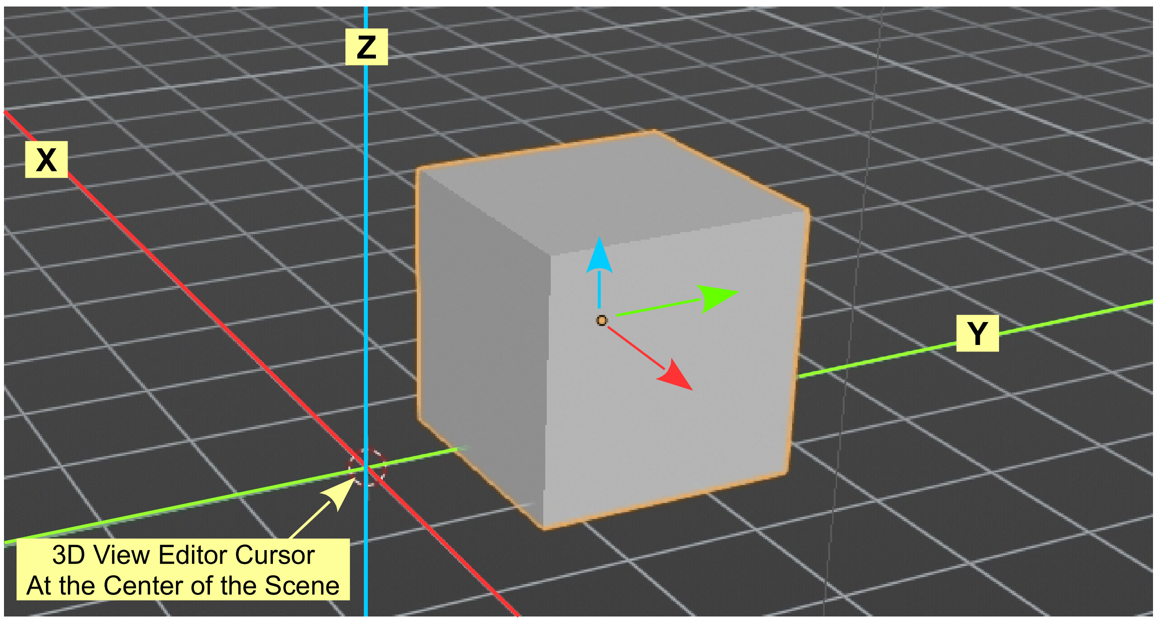


Figure 4.17

Note: Values change from Meters to Centimetres to Millimetres depending on the scale **when <u>Separate Units is checked</u>** (see Figure 4.15).

Values in the 3D View Editor display during Manipulation (upper LH corner of the Screen.

Figure 4.18



None: Changing the **Unit System – Unit Preset** to **None** means you chose to work in Blender units as represented by the division of the mid plane grid (each grid segment = 1 Unit by 1 Unit)

Rotation or Angle: Changing the Unit Preset **Degrees** to **Radians** means you are choosing the measurement where there are **2π Radians** in a circle (Figure 4.19). Angular values are, therefore given in Radians instead of Degrees.

2π = 2 x 3.142 = 6.284

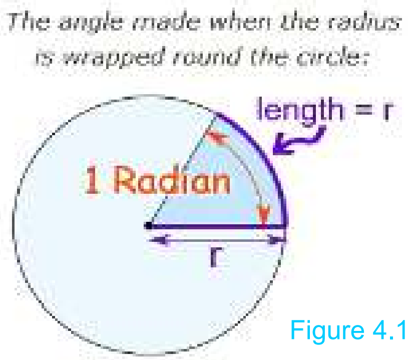


Figure 4.19

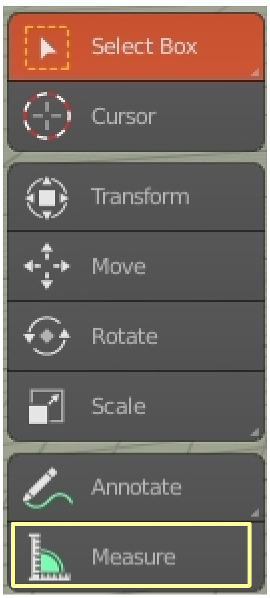
Note: Pi (**π**) is not an absolute value. Pi = 3.141592653589793238462643383279502884197169399375105820974944592307816406286 .

4.16 Measuring Ruler / Protractor

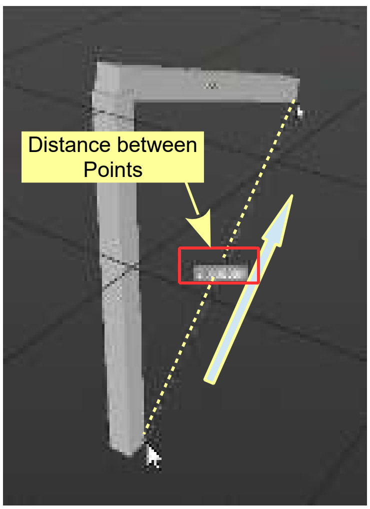
At the bottom of the Tool Panel you will see the **Measure button** (Figure 4.20). This button allows you to take liner and angular measurements in the 3D View Editor.

Figure 4.20

Tool Panel

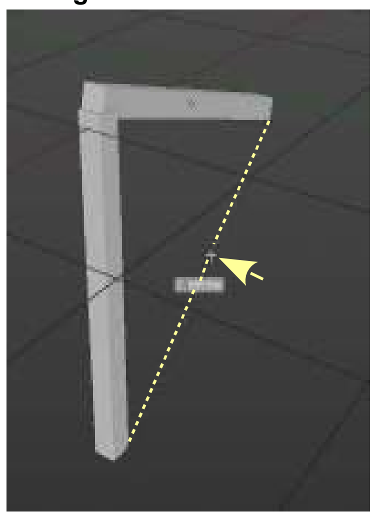


Linear Measurement

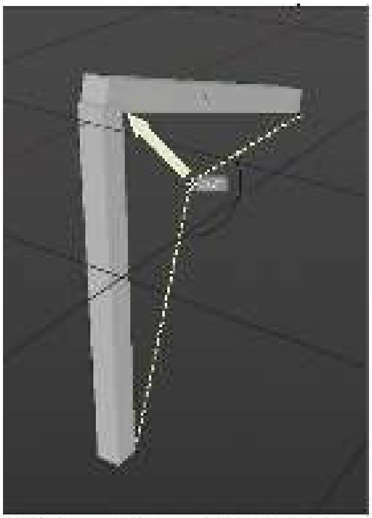


Position the Mouse Cursor, click, hold and drag from Start point to Finish.

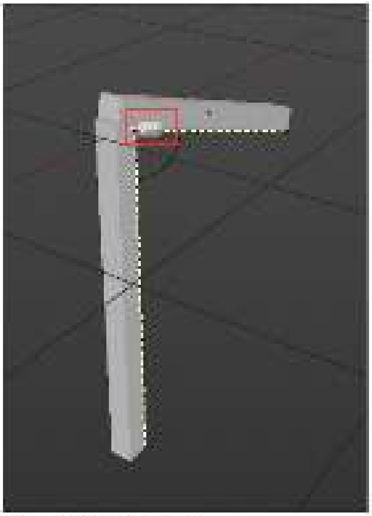
Angular Measurement



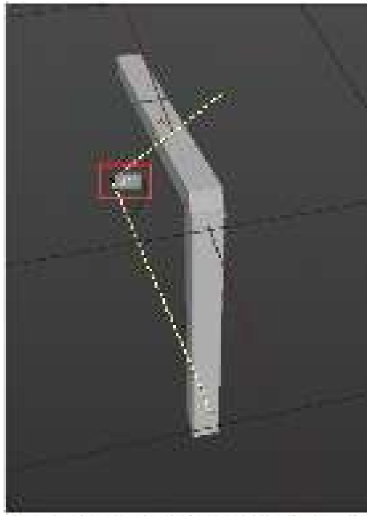
Position the Mouse Cursor, (Cross) mid way between points.



Click, hold and drag the mid point to the Apex.



Read the angle.



Plane of the screen rotated showing where measurement were taken (See Note).

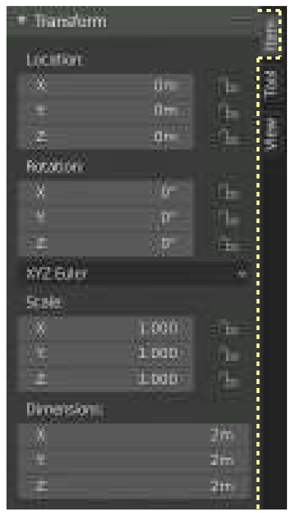
Figure 4.21

Note: When using the Measure Tool measurement are taken on the plane of the computer screen. True measurements can only be made in Top, Front and Side Orthographic Views.

4.17 Precision Manipulation

Figure 4.22

Precise Manipulation, precise Translation (location), Rotation and Scaling can be performed in the **3D Viewport Editor, Object Properties Panel, Item Tab** (press the N Key to display). Remember, the values shown in this panel are for the Object that is selected in the 3D Viewport Editor.



In Figure 4.22 the values are for the default Cube Object in its default position at the center of the Scene. The location is, therefore, X, Y and Z = 0m.

To move the Cube a precise distance away from the center, position the Mouse Cursor over a value. The cursor changes to a double headed arrow.

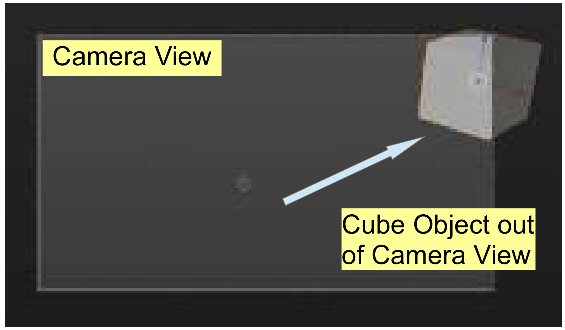
Click LMB and drag left or right to change the value. The value bar displays the value as you drag the cursor. Release the Mouse button to set the value. The Cube is moved in the 3D View Editor as the value alters. Clicking the **little arrows** incrementally alters the value.

You may also click LMB on the value bar to display a typing cursor

Backspace to delete the existing value and retype a new value.

Figure 4.23

Note: When Translating an Object in the 3D Viewport Editor you may be moving the Object out of Camera View. When you render an image your model may not be included. Press **Num Pad 0** to see what is included in the shot.



To return to the original User Perspective View press Num Pad 5 twice, click and hold RMB to rotate the Viewport or press Num Pad 6.

4.18 Coloring Objects

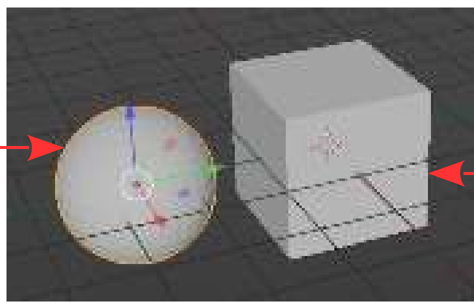
Figure 4.7 shows the Object Primitives displayed in different colors. Adding color to an Object in Blender is referred to as; **Applying a Material**. Materials are discussed in Chapter 16 in detail but for the moment consider Material as simply meaning Color.

Color is how you see something in a certain lighting condition. A white ball in the sunlight will look completely different under a colored street lamp at night. This phenomena is true in Blender. How something appears on the computer screen is determined by the simulated lighting effects that are generated, the Material color that is applied and the **Viewport Shading Mode** that is being employed. For the present, how to color an Object in the default Screen arrangement will be demonstrated. The default **Viewport Shading Mode** is; **Solid** with **Studio Lighting** (see Chapter 14)

For the demonstration, add a **UV Sphere** Object (Primitive) to the Scene (Figure 4.24).

When the UV Sphere is entered into the Scene it is selected as shown by the **orange outline**.

Press **Alt + A Key** to deselect or LMB click an empty part of the Editor.



LMB Click to select the Cube.

Figure 4.24

Have the Cube selected in the 3D Viewport Editor then go to the Properties Editor and click on the **Material button** (Figure 4.25). In the Properties Editor panel, **Note: Use Nodes** highlighted blue.

Note: With the Cube Object selected the controls in the Properties Editor apply only to the Cube.

Properties Editor, Material Button

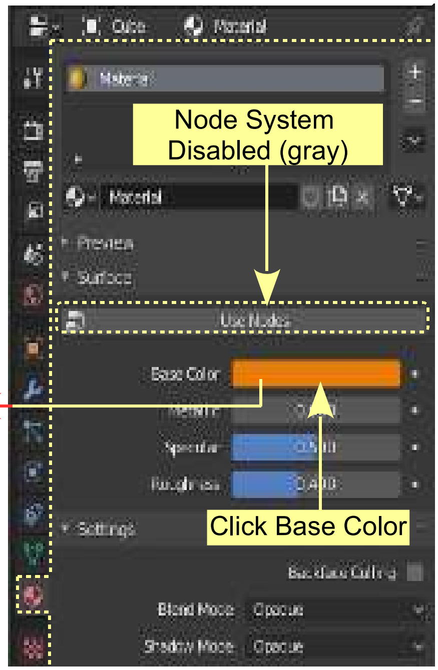
Figure 4.25

The blue highlight indicates that the **Blender Node System** for applying the Material is active. The Base Color shows a color bar with the default gray color of the Cube. Clicking on the color bar displays a color picker circle where you select a different Material (color). **BUT:** If you are reading this book for the first time and are progressing chronologically you have not encountered **Nodes** (Chapter 16) or **Viewport Shading** (Chapter 14) both of which determine whether a new Material will display in the 3D Viewport Editor.

To enable you to add Material color at this point, click on the **Use Nodes** bar (the blue bar). This disables the Node System and allows a basic Material to be added to an Object and to display in the default 3D Viewport Editor.

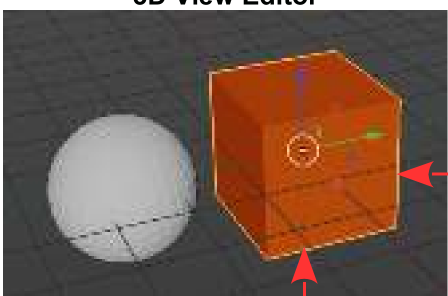
Material Button

In the **Surface Tab** click on the **Base Color bar** to display the **Color Picker**, click in the circle to select a color. The color is applied to the Cube in the 3D View Editor. Note that the brightness slider at the side of the color picker is towards the top making the applied color comparatively bright.



Brightness Slider

3D View Editor



Selected color applied to Cube

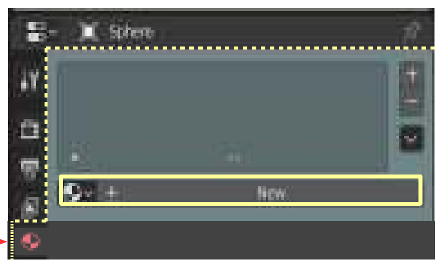
Click to select a Color

Figure 4.26

With color applied to the Cube, deselect the Cube and select the UV Sphere.

When you select the **UV Sphere** the **Properties Editor, Material buttons** change showing a minimal display containing only the **New** button (Figure 4.27).

Figure 4.27



Material Button

Click the **New** button to open Material (color) controls for the **UV Sphere**.

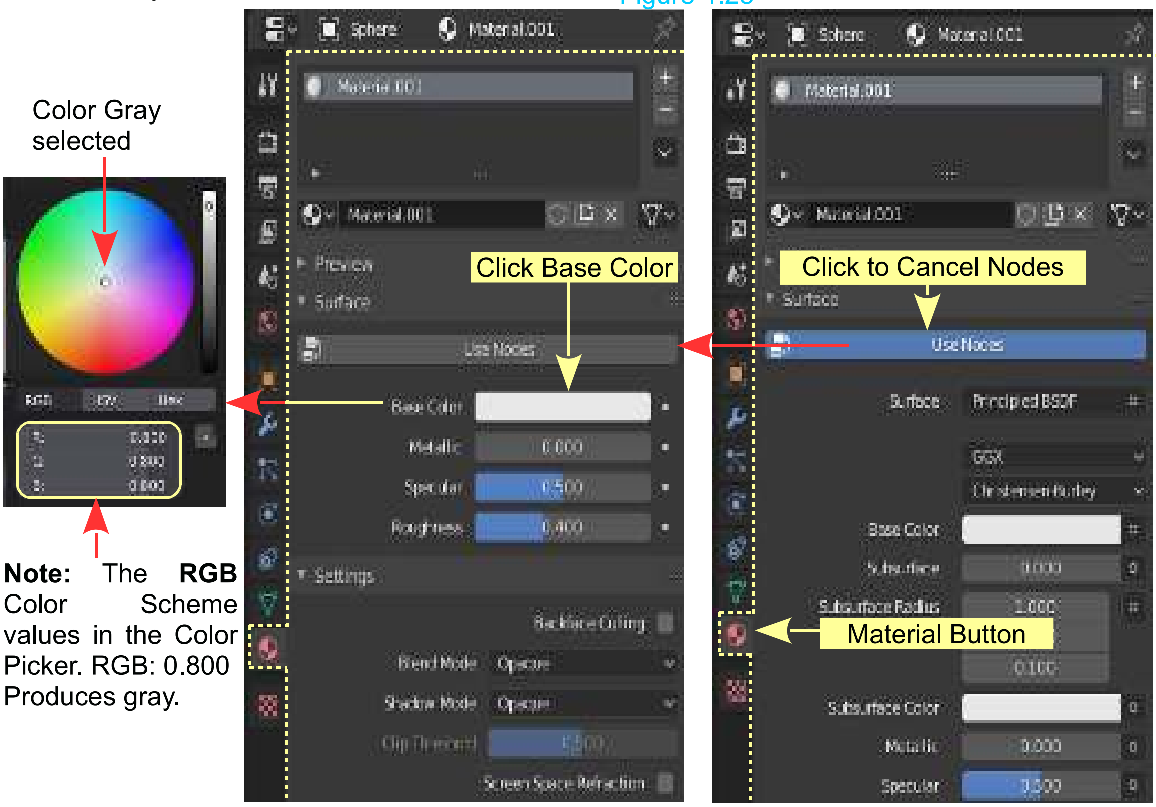
In the default Scene, the default Cube Object was displayed with a gray Material color. This color is a **default Material** which shows on all new Objects entered into a Scene. In the case of the default Cube the Material is considered to be pre-applied. In the foregoing exercise, coloring the Cube has modified the pre-applied gray Material.

When a new Object is entered into a Scene it displays with the default gray color but the Material **HAS NOT** been applied. Blender needs something to show, therefore, the default gray is used.

You click the **New** button in the **Properties Editor, Material buttons** to apply the default gray Material. You then modify the Material. With the UV Sphere selected, clicking New, again, activates the Node System, reverting to the **Base Color** used previously.

In the new **Properties Editor, Material buttons** click in the bar where you see **Use Nodes** to **cancel the Node System.** The Editor will display the arrangement similar to that employed for the Cube Object.

Figure 4.28



Material Buttons – Nodes Canceled **Material Buttons – Nodes Active**

Clicking **Base Color** and selecting a color applies it to the UV Sphere (the selected Object).
Note: The Material buttons apply to the selected Object only. With a different Object selected a different button panel is displayed.

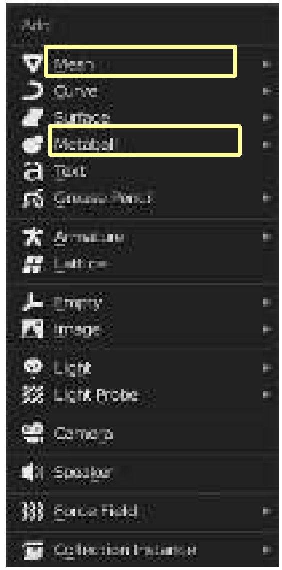
4.19 Other Types of Objects

Besides **Object Primitives** there are other types of Objects which can be introduced into a Scene. These have a variety of uses and are accessed by clicking the **Add** button in the **3D Viewport Editor Header** or by pressing **Shift + A Key** on the Keyboard (Figure 4.29).

How the different types are used will be explained as you progress through the book but you see the **Mesh** option at the top of the Add menu which opens the list of Primitives previously discussed.

From the menu you will see that you may add additional Cameras and Lights into a Scene. These influence how you see Objects. For one type of special Object see 4.21 **Metashapes** (Metaball).

Figure 4.29



4.20 Naming Objects

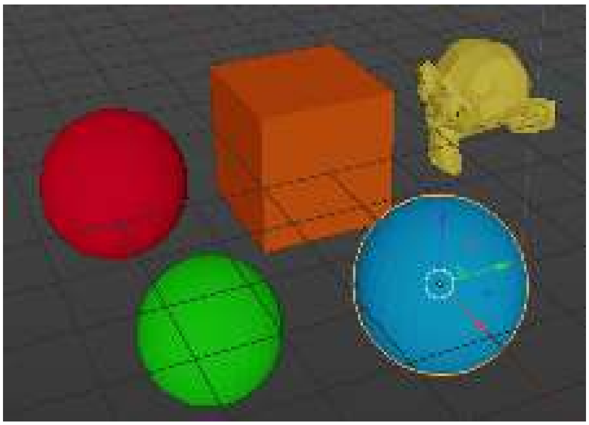


Figure 4.30

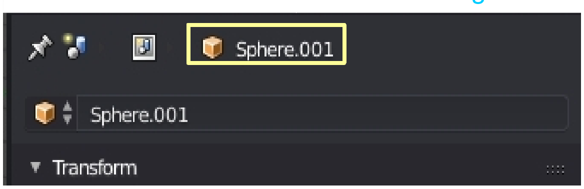
As you enter Objects to a Scene Blender automatically assigns a name. In Figure 4.31 the Cube Object has been named **Cube**, the Monkey Object has been named **Suzanne** and the UV Spheres have been named **Sphere, Sphere.001** and **Sphere.002**.

The names are displayed in the **Outliner Editor** under **Scene Collection** (Figure 4.31).

You will also see an Object's name in the **Properties Editor** with the **Object button** selected (Figure 4.32).

Figure 4.31

Figure 4.32



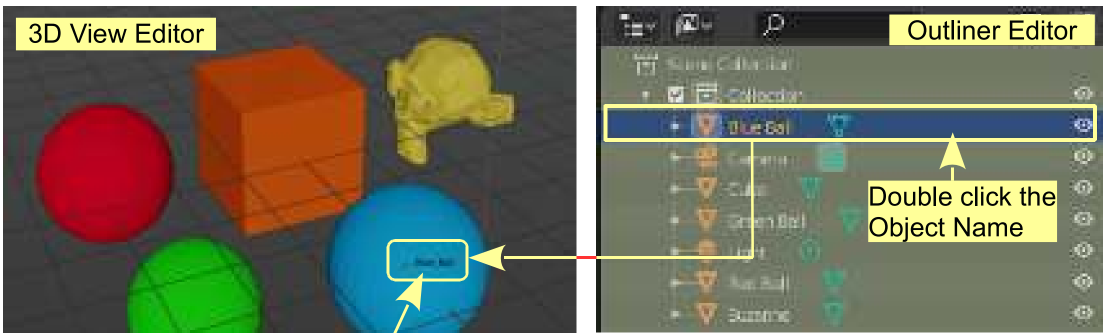
The automatic names are all very well, but as you build a Scene and add many Objects, it is obvious that automatic names could become meaningless and confusing. For example; **UV Spheres** are named **Sphere, Sphere.001** and **Sphere.002**.

Blender has a monkey head that's affectionately referred to as **Suzanne**, a reference to the ape in two of Kevin Smith's films: *Jay and Silent Bob Strike Back* and *Mallrats* (close to the end). Many 3D modeling and animation suites have a generic semi-complex primitive that is used for test renders, benchmarks, and examples that necessitate something a little more complex than a cube or sphere.

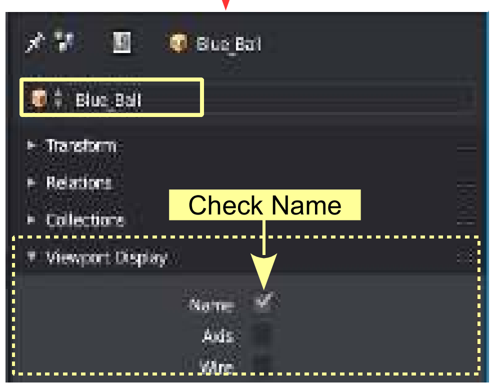
The name **Suzanne** will definitely distinguish Monkey unless you add more Monkeys, in which case they will be named Suzanne, Susanne.001, Suzanne.002 etc. Even though the UV Spheres have been colored the question arises, *which one is which?*

Obviously it is preferable to name Objects with meaningful names especially when they have been reshaped into Characters or components of a complex Scene.

You rename Objects in the **Properties Editor, Object buttons** or in the **Outliner Editor** by double clicking on the Object name, backspacing or deleting the name and retyping a new name.



Properties Editor – Object Buttons



Object Name Displayed Figure 4.33

A handy way of identifying Objects in the 3D Viewport Editor is to check (tick) **Name** in the **Properties Editor, Object buttons, Viewport Display Tab**. The name of the Object is displayed in the Editor (Figure 4.33).

Note: When Objects are renamed they are alphabetically listed in the Outliner Editor.

Note: Objects in the 3D Viewport Editor are listed in the Outliner Editor in groups called **Collections**.The arrangement and management of Collections are detailed in Chapter 12.

4.21 The Header Button Menus

The 3D Viewport Editor **Header** Buttons provide menus for selecting a variety of functions. The individual functions will be called upon as required in specific instructions. Some functions have already been covered such as switching between Object Mode and Edit Mode, Object selection (Select button) and adding Objects (Add button). The menus allow you to activate a function by clicking the function name and in many cases provide a Keyboard shortcut. For example; in the Select button menu you will see Box Select and Circle Select with the Keyboard shortcuts B Key and C Key. You either click the select type name in the menu or press the Keyboard shortcut with the Mouse cursor in the 3D Viewport Editor panel. The Add button displays the Object Add Menu which is the same as pressing Shift + A Key. The Object button displays a comprehensive menu with sub menus. As you progress in Blender you will become familiar with the functions in the menus but for now, the following are worth mentioning:

Join (Ctrl + J Key) Selecting two or more Objects at the same time (Hold Shift + LMB Click) then clicking Join in the menu or pressing Ctrl + J Key joins the selected Objects into a single Object.

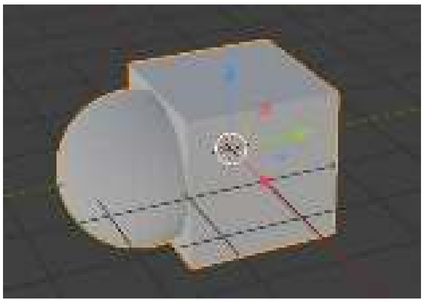


Figure 4.34

Copy and Paste - Objects may be copied from one Blender file and pasted into another file.

Smooth and Flat Shading

In the previous diagrams describing naming and coloring Objects you will observe that the surface of the UV Sphere is made up from a series of rectangular flat surfaces (Flat Shading). In the **3D Viewport Editor Header** selecting **Object** – **Shade Smooth** in the menu produces a smooth spherical surface which is much nicer for coloring the sphere. Alternatively RMB click to display the **Object Context Menu** with the shading options.

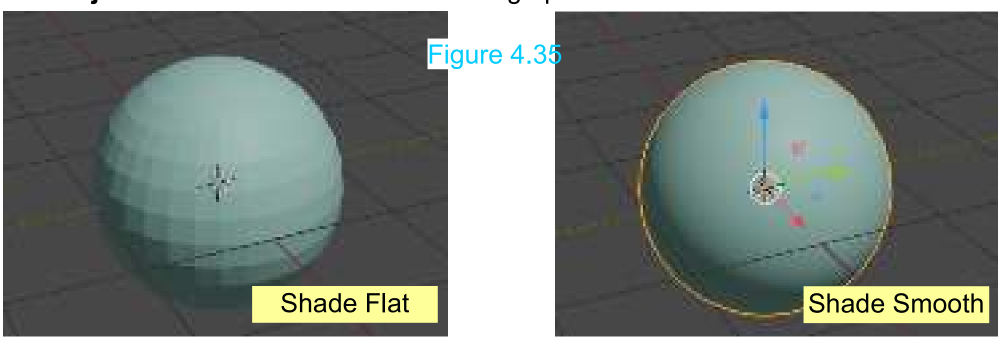


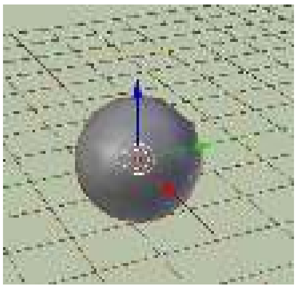
Figure 4.35

4.22 Meta Shapes

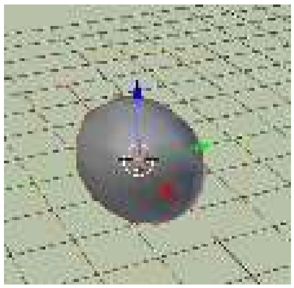
Meta Shapes are described as *mercurial, or clay-like forms that have a rounded shape.*

When two Meta Objects get close, they begin to interact with one another. They merge, as water droplets do. When they are moved apart, they restore their original shape.

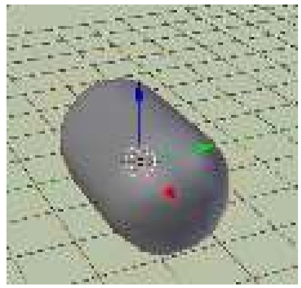
There are several Meta Shapes you can use in Blender (Figure 4.36). Meta Shapes are added to a Scene in Object mode like any other shape: press **Shift + the A key – Add – Metaball** and select either Ball, Capsule, Plane, Ellipsoid, or Cube. Be sure to deselect one shape before adding another, or they will be automatically joined. When **Meta Shapes** get close to one another, they begin to pull and flow together like droplets of liquid (Figure 4.37). The shapes can be animated and textured, and reflection and transparency can be applied to create some stunning effects.



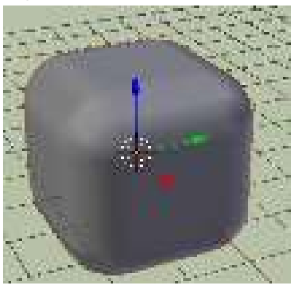
Meta Ball



Meta Elipsoid

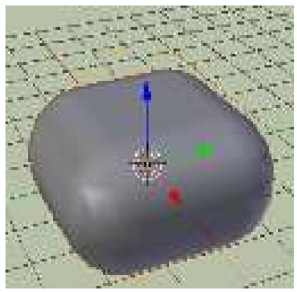


Meta Capsule

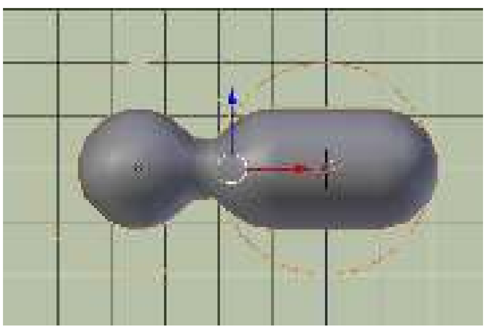


Meta Cube

Figure 4.36



Meta Plane



Meta Ball and Meta Capsule flowing together when in close proximity.

Figure 4.37

5

Editing Objects

5.1 The Mesh Object
5.2 Edit Mode Selection
5.3 Selecting Verts Edge Face
5.4 Manipulating
5.5 Creating Vertices
5.6 Adding and Deleting
5.7 Center Points
5.8 Joining and Separating
5.9 Creating Vertex Groups
5.10 Proportional Vertex Edit
5.11 Inset Faces
5.12 Parenting

Editing Objects

Editing or modifying one of the basic shapes (Primitives) in Blender is the process of Modeling.

Creating a model begins by introducing a Primitive to the Scene. Blender's Primitives are Mesh Objects, that is to say, they are constructed with surfaces formed by a mesh. The mesh can be imagined as a fishing net or a piece of chicken coop wire with strands of twine or wire criss-crossing and joined where they intersect. The spaces between the strands are filled in forming a surface.

The shape of a primitive is altered by manipulating the mesh. This is achieved by selecting (grabbing) the intersection points (**Vertices**) or the strands (**Edges**) or the filled in pieces (**Faces**) and moving them in 3D Space.

Vertices, Edges and Faces can be extruded to build onto a Primitive. Edges and Faces may be scaled and rotated to twist the shape of the Primitive.

Several Primitives can be joined together to shape a single Object.

5.1 The Mesh Object

The default Blender Scene contains a **Cube Mesh Object** which, by default, is selected in **Object Mode**. With the Cube selected (orange outline) press the **Tab key** to enter **Edit Mode** to see the basic components of the Cube Mesh (Figure 5.1).

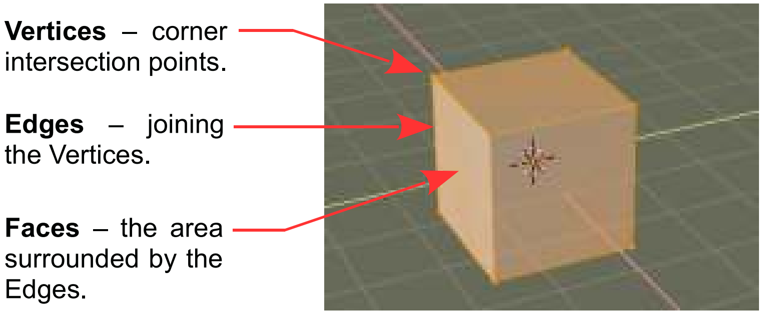


Figure 5.1

Default Cube

5.2 Edit Mode Selecting

With the 3D Viewport Editor In **Edit Mode**, you work with the individual **Vertices** (mesh intersections) to Model the shape. You know you're in Edit Mode when you see orange lines and dots on the selected Object (Figure 5.1). When you tab into Edit Mode, the whole of your selected Object is in Edit Mode with all the Vertices selected. By default, Edit mode is in **Vertex Select Mode**.

Selection Options

In **Edit Mode**, the default selection Mode is **Vertex** which means you may select Vertices. You can elect to enter **Edge** or **Face** select Mode (Figure 5.2). These options are available in the 3D Viewport Editor Header.

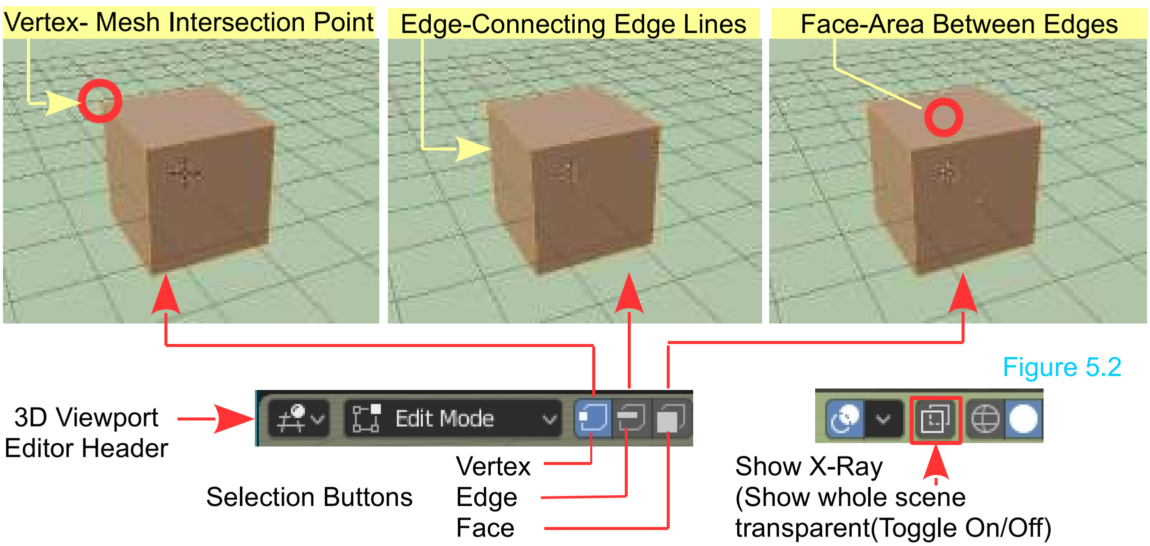
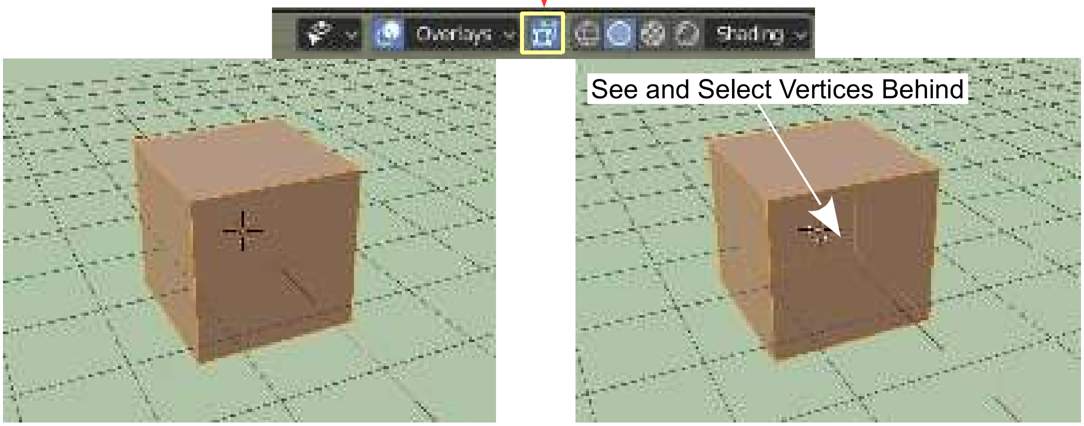


Figure 5.2

Also, by default, only visible Vertices, Edges or Faces are available for selection. This means that you can only select the Vertices, Edges or Faces that you actually see in the Editor. Blender has a **Show X -Ray** function, which allows you to only select Vertices, Edges or Faces on the front (what you see) (Figure 5.3). This function is toggled on and off in the 3D View Editor Header by clicking the **X-Ray** button.



Limit Selection to Visible - On Figure 5.3 Limit Selection to Visible - Off

Introducing the **Limit Selection to Visible** option, allows you to see Vertices in Edit Mode which are hidden behind front Faces. You should be aware that a similar feature exists for Object Mode. You can not select Vertices in Object Mode but there are occasions when you may wish to see hidden geometry.

The 3D Viewport Editor displays Objects in several different Display methods referred to as **Viewport Shading Modes** (see Chapter 14 – Viewport Shading). The default display is Solid Viewport Shading. The options are accessed in the 3D Viewport Editor Header.

Show Whole Scene Transparent
(**Limit Selection to Visible**)

Wireframe

Solid Viewport Shading

3D Viewport Editor Header (RHS)

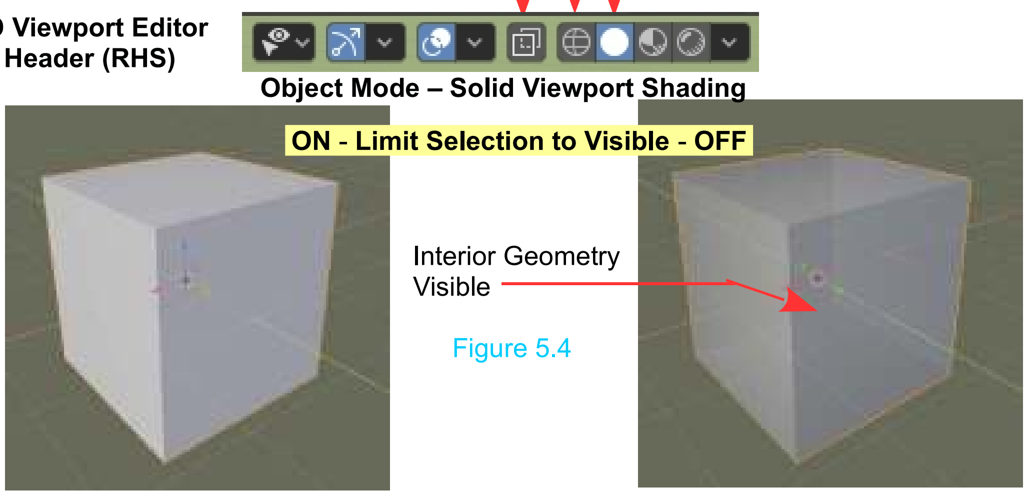


Figure 5.4

Object Mode – Wireframe Display

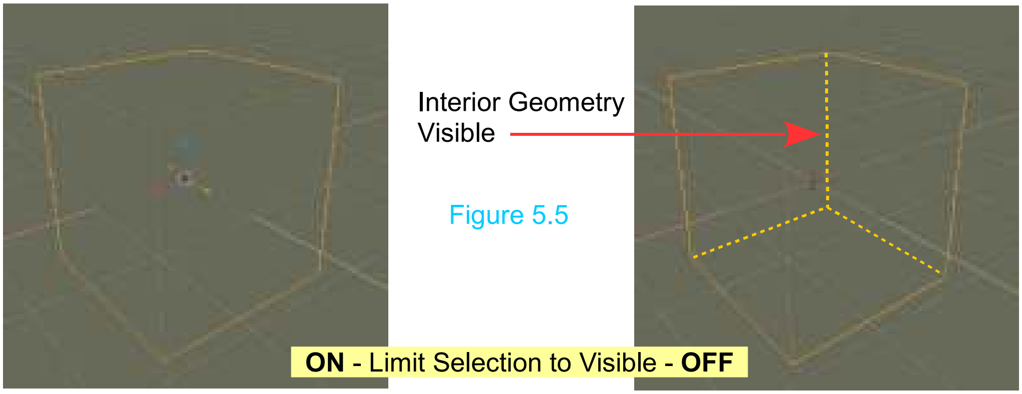


Figure 5.5

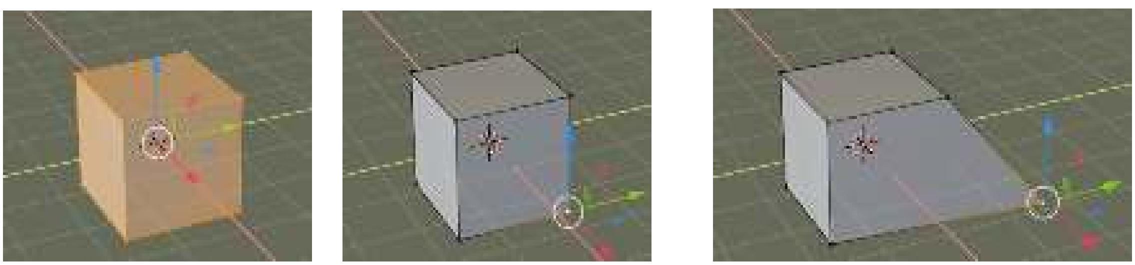
5.3 Selecting Vertices, Edges and Faces

While in **Edit Mode**, to select a single Vertex, first press **Click LMB** to deselect all the Vertices. In **Edit Mode** this does not deselect the Object, only the Vertices. Click with the left mouse button (LMB) on a single Vertex to select it. To select multiple Vertices, hold down **Shift** while using the LMB to click. You can also drag a rectangle around the Vertices. Press the **B Key**, hold and drag a rectangle to select a group of Vertices. Pressing the **C Key** will bring up a circle selection tool. Holding the LMB and dragging the circle, selects Vertices on the move. The circle can be sized by scrolling the center Mouse Wheel (MMB). Pressing **Esc** will get you out of the circular selection tool. In order to deselect all Vertices or deselect those currently selected, press the **Alt + A Key** or **LMB** click on an empty space in the **3D Viewport Editor**. The selection and deselection procedures are the same for Vertices, Edges and Faces.

5.4 Manipulating Selected Vertices, Edges and Faces

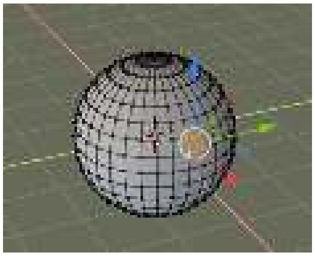
After selecting Vertices, Edges or Faces, you can use the basic controls used for manipulating Objects (**G Key** to grab or move (Translate), **S Key** to scale, and **R Key** to rotate) (Figure 5.6). Obviously you cannot scale a single vertex but you can scale two or more selected Vertices which constitute a **Vertex Group**. **Note:** The **Edit Mode Tool Panel** at the LHS of the 3D Viewport Editor provides **Manipulation Widgets** for Translating, Scaling and Rotating (see Chapter 6 - Editing Tools).

Examples of Translation (Move), Scale and Rotation Figure 5.6

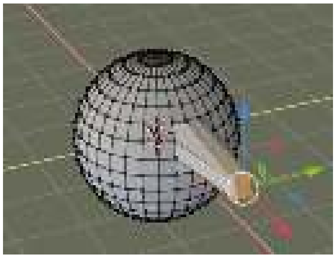


Default Cube – All Vertices Selected | Single Vertex Selected | Single Vertex Moved (Translated)

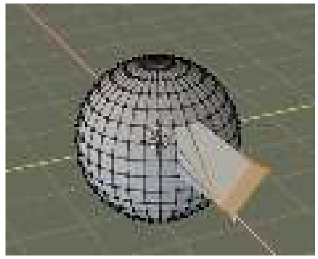
EDIT MODE



Four Vertices Selected
Hold Shift – Click RMB

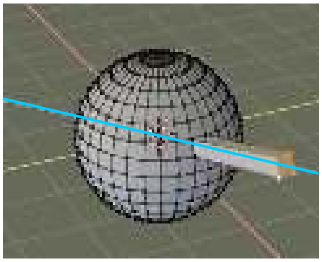


Vertex Group **Translated**
Using the Widget

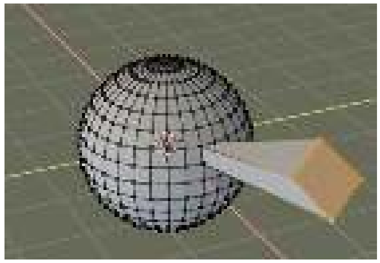


Vertex Group Scaled and Rotated
S Key Scale – R Key Rotate

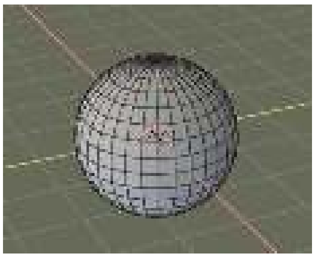
Figure 5.7



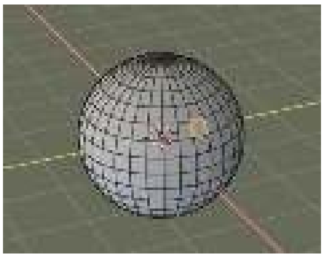
Vertex Group **Extruded** Along
the Axis Normal to the Face



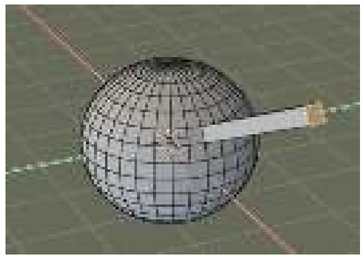
Vertex Group Scaled and Rotated



Face Select Mode



Single Face Selected

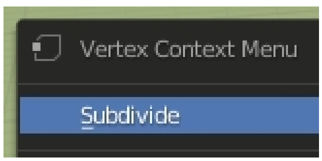


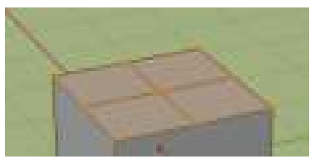
Face Extruded Along Axis

Note the difference between **Translating (Moving)** a **Vertex Group** and **Extruding** a **Vertex Group**. Extrusion creates new Vertices (see Chapter 6- 6.5 Editing Tool – Extrude Region).

5.5 Creating Vertices by Subdivision

There are occasions when you need to add more Vertices to part or **all of the mesh** in order to create detail. To do this, you must be in **Edit Mode** with Vertices selected. To add Vertices to a specific area select Vertices surrounding the area where you wish to add detail. Click **RMB** in the Screen to display the **Vertex Context Menu** and select **Subdivide.** Figure 5.8



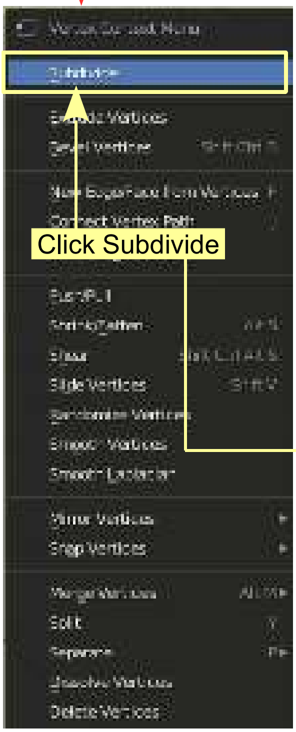


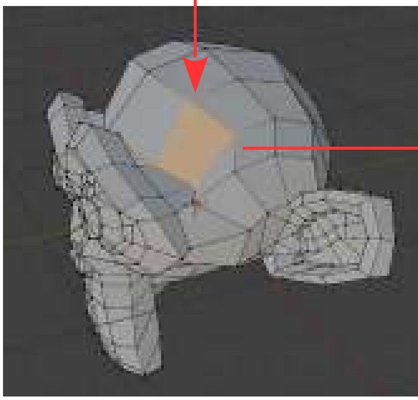
Selecting **Subdivide** inserts a new Vertex at the mid point of each Edge defined by the selected Vertices. Opening the Last Operator **Subdivide Panel** shows **Number of Cuts = 1**. Each Edge has been divided once. You may increase the Number of Cuts, further dividing.

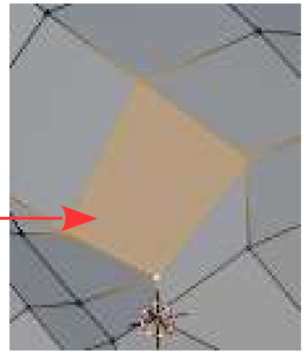
RMB click to display the **Vertex Context Menu**

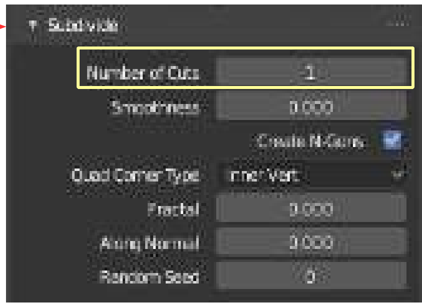
Vertices Selected

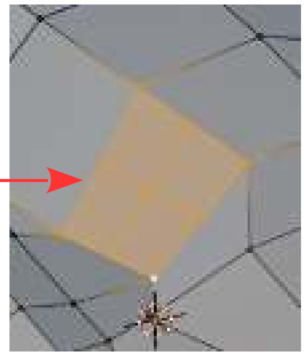
Figure 5.9





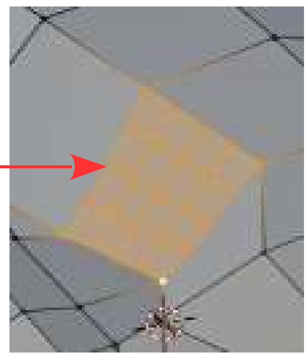






Last Operator Panel

Mouse over on the **Number of Cuts** (slider) and adjust the value.



Note: With the initial selection of Vertices the maximum Number of Cuts is 10. To increase beyond 10, have the subdivided area selected, click RMB again and repeat the subdivision process.

Alternative Subdivision Method

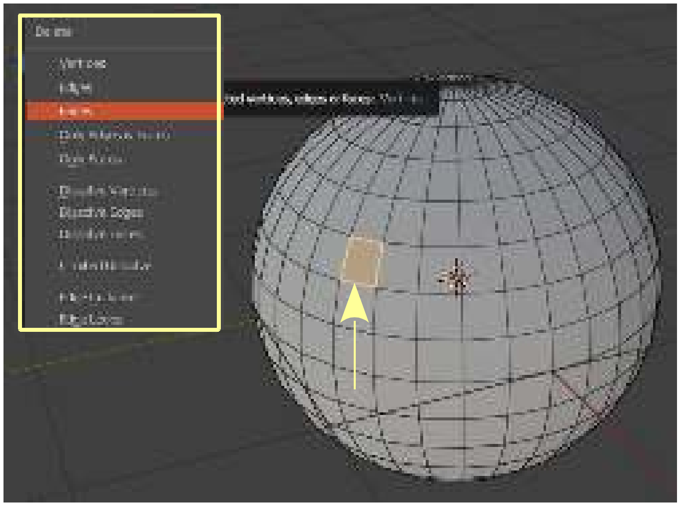
Note: With the initial Vertices selected you may also click **Edge** in the 3D Viewport Editor Header and click Subdivide for the same result.

5.6 Adding and Deleting Vertices, Edges, or Faces

Deleting: If you want to make a hole in a mesh, enter **Edit mode** and select the Vertices, Edges or Faces you wish to remove, then hit the **X Key or Delete Key.** Select (click) the item from the menu that displays (Figure 5.10).

Figure 5.10

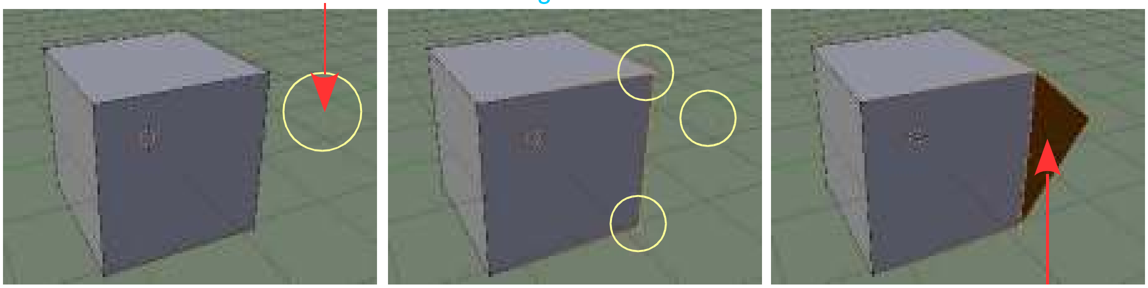
Adding Vertices and Faces: Place the Object in **Edit Mode**. Deselect all Vertices. **Press Ctrl** and click **RMB** where you wish to place a new Vertex. Shift select three or more Vertices. Press the **F key** to **Face** (fill in between the selected Vertices Figure 5.11).



UV Sphere in Edit Face Select Mode

New Vertex Ctrl + RMB click

Figure 5.11



Cube Object in Edit Mode

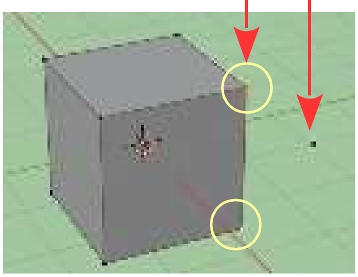
Select Three Vertices

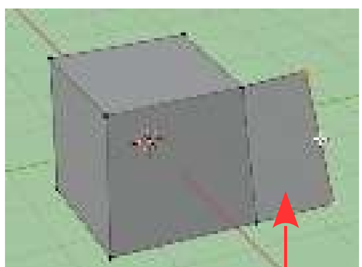
Press **F key** to Face

Note: If you get the sequence of operations wrong you will get unexpected results.

Two Vertices Selected

Mouse positioned to add a Vertex





Ctrl + RMB Clicked

Adding Faces – User Perspective View

Be aware that when you add a new Vertex in **User Perspective View** the Vertex is placed on the mid plane of the view. This means it is placed on an imaginary plane located at the center of the 3D World. The plane is normal to your computer screen.

Top Orthographic View

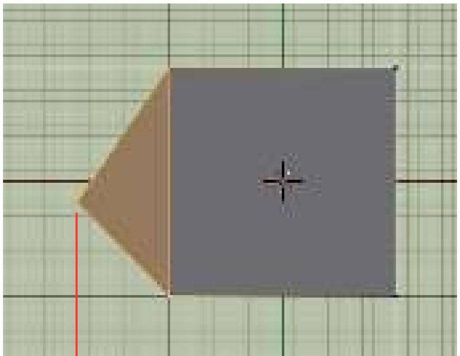


Figure 5.12

New Vertex added. Three Vertices are selected then Faced (Figure 5.12).

All Vertices are located on the same plane in elevation.

Front Orthographic View (Figure 5.13)

Side Orthographic View (Figure 5.14)

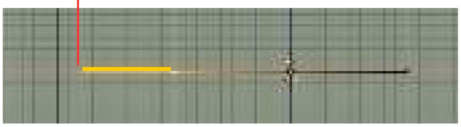


Figure 5.13

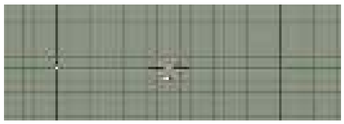


Figure 5.14

User Perspective View

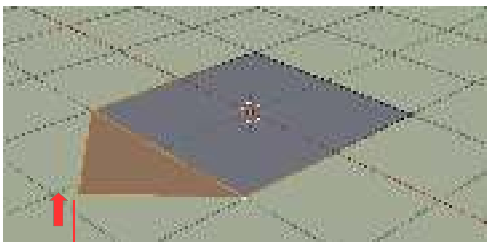


Figure 5.13

New Vertex added. Three Vertices are selected then faced (Figure 5.13).

The new Vertex is displaced in elevation.

Front Orthographic View (Figure 5.14).

Side Orthographic View (Figure 5.15).

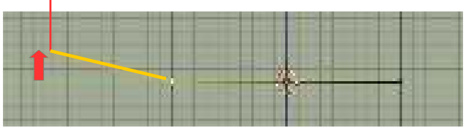


Figure 5.14

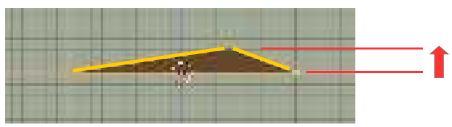
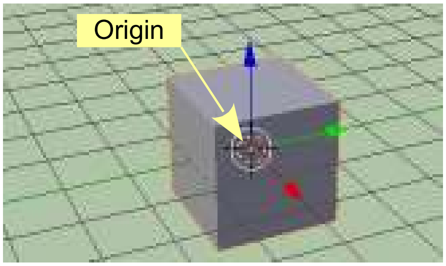
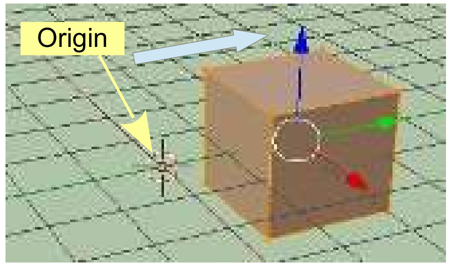


Figure 5.15

5.7 Center Points

Every Object you create in Blender has a small dot somewhere in the center (by default, usually at the center of geometry of the Object).This is the Object's **Origin**, or pivot point (Figure 5.16). With the Object selected in **Object Mode**, moving the Object moves the origin at the same time. In **Edit mode** the origin does not move when Vertices are moved.

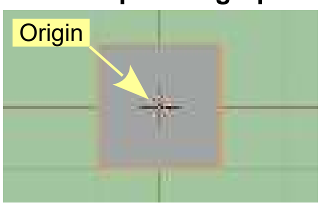


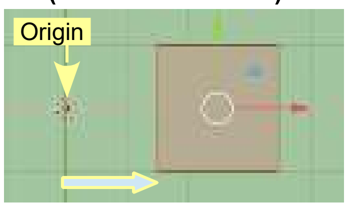


Origint at Center of Geometry   Figure 5.16   Vertices Moved in Edit Mode

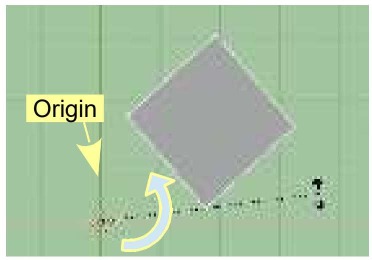
Having the Origin located somewhere else is advantageous when you want to set a Rotation point.

Top Orthographic View (Press Num Pad 7)





In Top Orthographic View – Object Mode – Vertices moved, Rotation is about the original Origin position.



R Key (Rotate)- Drag the Mouse

Rotation occurs about the Origin. To rotate about a different position, relocate the Origin to the location of the **3D Viewport Editor Cursor,** when it has been relocates. Press **Shift and RMB click** in the Editor to locate the Cursor. With the Mouse Cursor in the 3D Viewport, **RMB click** to display the **Object Context Menu**. Mouse over on **Set Origin** then click, **Origin to 3D Cursor**. Rotating the Cube will be about the Origin located at the position of the 3D Viewport Cursor.

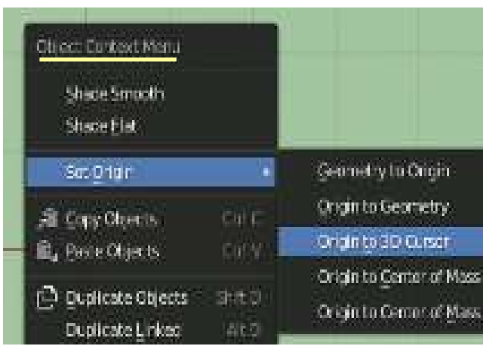
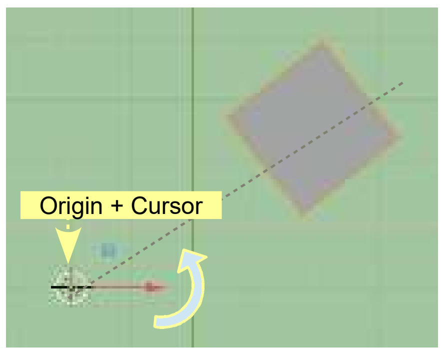


Figure 5.17



In the Object Context Menu you can move the Cube to the new Origin (Geometry to Origin) or move the Origin back to the Cube (Origin to Geometry).

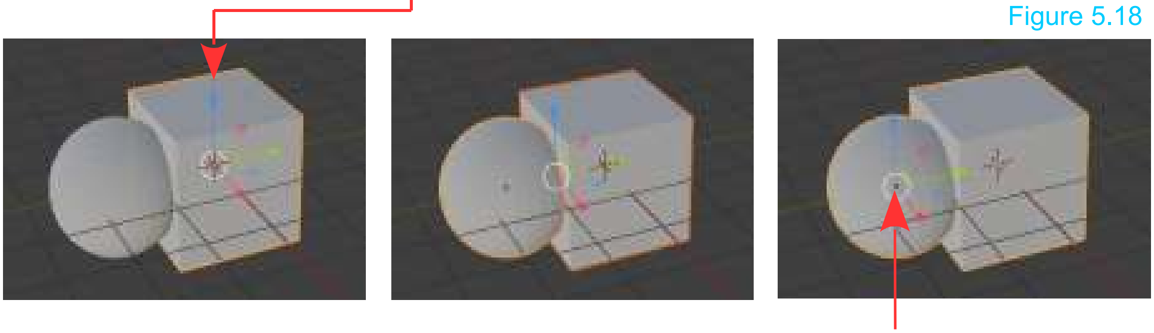
5.8 Joining and Separating

Individual Objects can be joined together to make a single Object. The Objects may be separated under certain conditions or parts of a mesh can be separated from the main Object.

Joining in Object Mode

In Figure 5.18, a UV Sphere Object has been added to the default Scene and positioned such that it intersects with the default Cube. After positioning, the Sphere is deselected and the Cube selected. **Note:** The Move Tool has been selected in the Tool Panel displaying the Translate Manipulation Widget. The Manipulation Widget is located at the center of the Cube.

Figure 5.18



Cube Selected After Positioning   Widget Locates Mid Way   New Center of Rotation

To join the two Objects, have the Cube selected and shift select the UV Sphere. Note: The Sphere was the last Object to be selected and now the Manipulation Widget is located mid way between the center of the Sphere and the Cube. Press **Ctrl + J Key** to join the two Objects. Note: There is an orange outline encapsulating both the Sphere and the Cube which indicates they are a single Object. Note Also: The Widget has located at the center of the Sphere, the last Object selected. The center of geometry for the combined Object is at the center of the Sphere. Rotation of the combined Object will be about this center.

Joining in Edit Mode

Consider the following with the default Blender Scene; The Cube Object is selected in Object Mode. Press **Tab** to enter Edit Mode. Press the **Alt +A Key** deselecting the Vertices. The Cube remains selected since it is the active Object selected in Object Mode. While remaining in Edit mode, add a UV Sphere Object to the Scene.

> Objects added to a Scene in **Edit Mode** are automatically joined to the last object selected while in **Object Mode**.

When the UV Sphere is added all its Vertices are selected and may be manipulated (translated and scaled). Press **Alt + A** Key or click LMB to deselect the Sphere's Vertices. Press the A Key to select the UV Sphere plus the Cube. They have been joined and form a single Object (Figure 5.19 over)

When the UV Sphere is added it is positioned at the location of the 3D Viewport Editor Cursor which, by default, coincides with the center of the Scene and the center of the default Cube Object. The UV Sphere is, therefore, fully encapsulated inside the Cube and not visible. Selecting the Move Tool in the Tool Panel displays the Translate Widget for the UV Sphere and allows you to move the Sphere's Vertices.

Tip: To see the UV Sphere inside the Cube click the **Show X Ray** button in the 3D Viewport Editor Header.

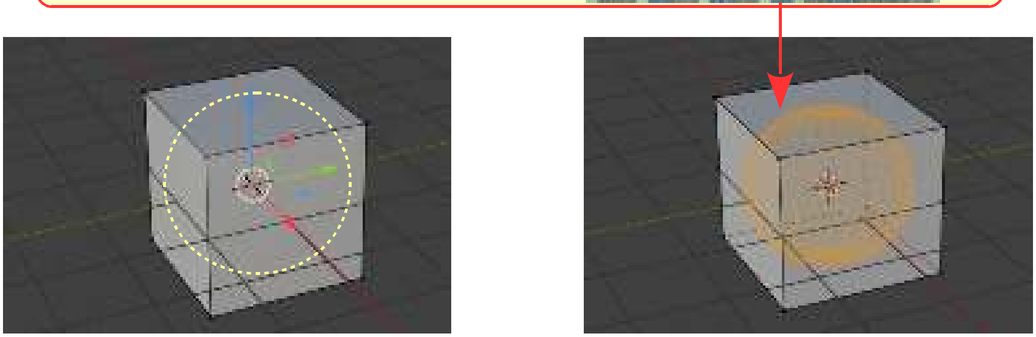
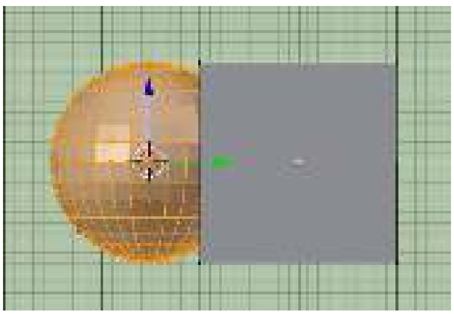
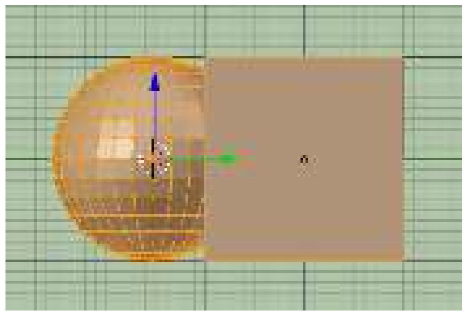


Figure 5.19



UV Sphere added in Edit Mode
The Sphere May Be Repositioned

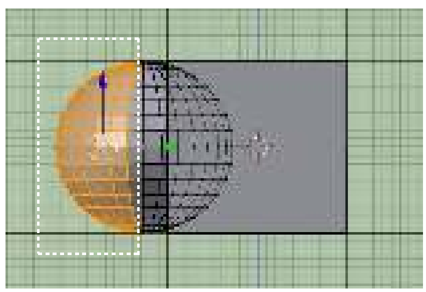


Click **LMB** in the Editor (deselect) then press **A Key** (Joins the Mesh)

Separating in Edit Mode

To demonstrate separation in Edit Mode, use the same Cube – Sphere arrangement as shown in Figure 5.19. Have the Cube and the Sphere joined into a single Object.

Figure 5.20

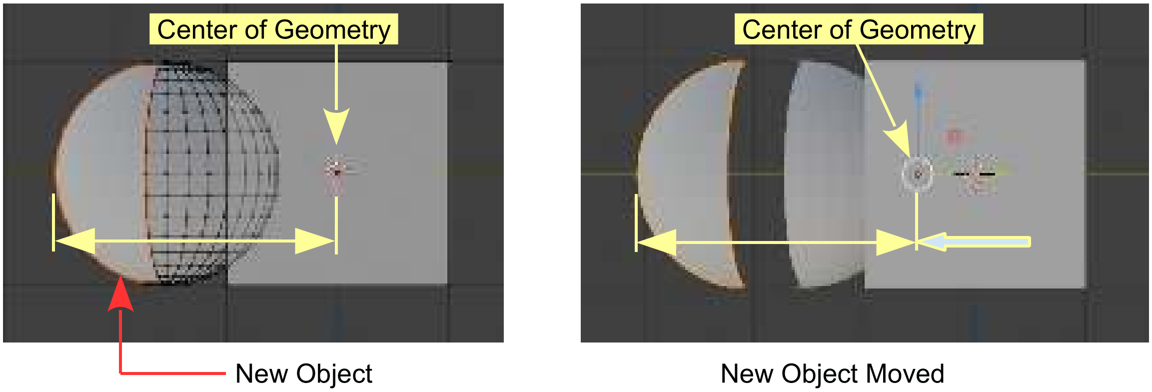


Place the **3D View Editor** in **Right Orthographic view** and with the combined Object selected, **Tab** to Edit Mode. Press **Alt + A key** to deselect all Vertices. Press the **B key** (Box Select) and drag a rectangle around the LH side of the spherical part. **Don't forget to have Show X Ray turned Off.**

The selected Vertices will be displayed orange. (Figure 5.20)

With the selection made, press the **P Key** to display the **Separate Menu** and in this case, click on the **Selection** option. The selection option separates the selected Vertices creating a new Object as shown by the orange outline. (Figure 5.21).

Figure 5.21



Tab back to Object mode. With the Manipulation Widget turned on, move the new Object along the Y Axis. You can move the object anywhere you like, rotate it, scale it etc.

Note: In joining the Sphere to the Cube in Object Mode by pressing **Ctrl + J**, in this case the Cube was the last Object selected, therefore, the center of geometry of the combined Objects was at the center of the Cube. After separating part of the Sphere mesh, its' center of geometry is also located, coinciding with the center of the Cube. When moving the separated part of the Sphere you see the center of geometry, i.e. center of rotation, displaced from the mesh.

The Separate Menu Options

In the previous example you used the **Selection option** in the **Separate** menu. There are two alternatives (Figure 5.22):

Figure 5.22

Separate by Material: When joined objects have different Materials (Color) applied they will be separated into single Objects according to their color.

Material (Color) is discussed in Chapter 16

Separate by Loose Parts: Consider the Objects automatically joined in Edit Mode (Figure 5.22).

With the UV Sphere and Cube joined in Edit Mode, and displayed in Edit Mode, press the **P Key** to display the **Separate** menu and select **By Loose Parts**. Immediately one of the Objects will display a red outline. **Tab to Object Mode**. You may now select either part as a separate Object. Note the center of Geometry (Origin).

5.9 Creating Vertex Groups

On occasion you will want to manipulate a group of vertices. You can select multiple vertices on an Object and manipulate them, but once deselected you could have trouble selecting the exact same group the next time. To assist with this you can assign multiple Vertices to a designated group for re-selection. Working through the following example will show you how.

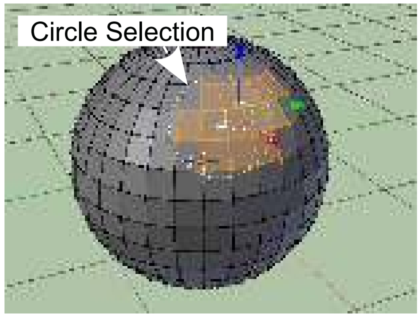


Figure 5.23

Start the default Scene and replace the Cube with a **UV Sphere**. Zoom in on the Scene to give a better view (press the Number Pad **+** sign). Tab to **Edit mode** and then press **Alt + A key** to **deselect** all the Vertices. Press the **C key** for circle select (scroll the mouse wheel to adjust the circle size) and click, hold and drag the circle over the Sphere to select a group of Vertices (Figure 5.23). Press **Esc** to cancel the circle selection. The Vertices remain selected.

In the **Properties Editor, Object Data button, Vertex Groups tab**, click on the **+** sign to create a **Vertex Group Data Slot**. By default, this will be named simply **Group** (Figure 5.24). If you wish you can change the name to something meaningful by clicking on **Group** in the **Name** slot, deleting it, and retyping a new name.

Properties Editor

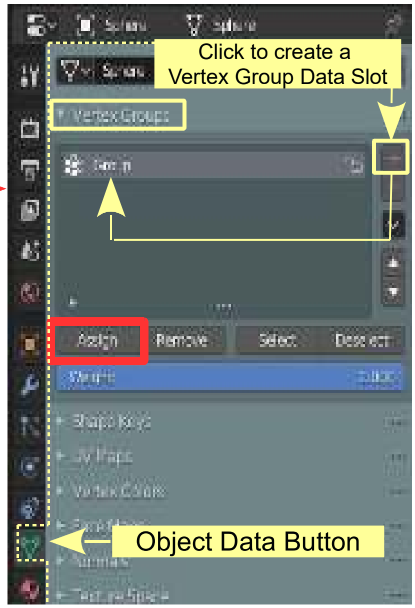


Figure 5.24

With the group of vertices still selected on the Sphere, click on the **Assign button** in the **Vertex Groups Tab -** this assigns the selected vertices to **Group**.

By clicking on the **Select** and **Deselect** buttons, you will see the vertices on the Sphere being selected or deselected, respectively.

Deselect the Vertices and repeat the circle select with a different group. Click on the **+** sign again in the **Vertex Groups Tab** and you should see a new data block created named **Group.001**. Click the **Assign button** to assign the new group of vertices to **Group.001**. Deselect the Vertices on the Sphere in the 3D View Editor, and you can now select **Group** or **Group.001** (Figure 5.25).

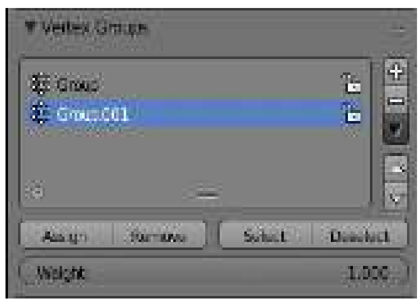


Figure 5.25

Weigh Paint Method

An alternative method for selecting Vertices for assignment to a Vertex Group is to use Blenders, **Weigh Paint Tool.**

With a **UV Sphere** selected in the **3D Viewport,** go to the **Properties Editor, Object Data buttons**. In the **Vertex Group Tab** click the **Plus** sign to create a new **Vertex Group**. The Vertex Group will be named simply **Group** (Figure 5.27).

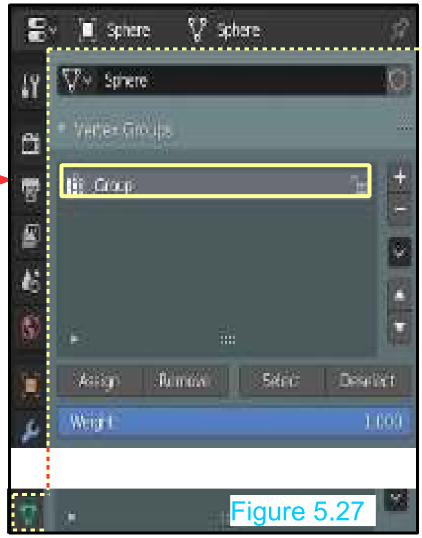


Figure 5.27

Place the 3D Viewport Editor in **Weigh Paint Mode** (Figure 5.26).

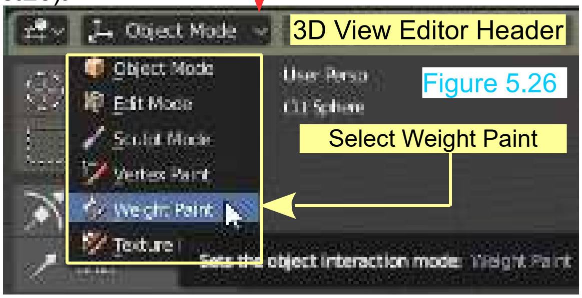


Figure 5.26

In the **Weigh Paint Mode, Tool Panel** click on **Draw.**
The 3D Editor cursor becomes a red circle which is the paint **Brush** (Figure 5.28).

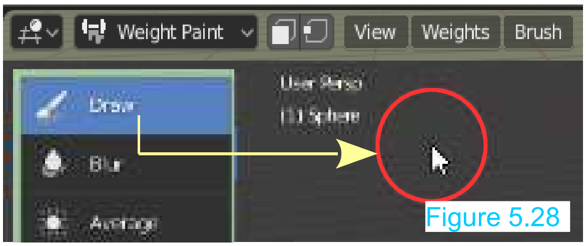


Figure 5.28

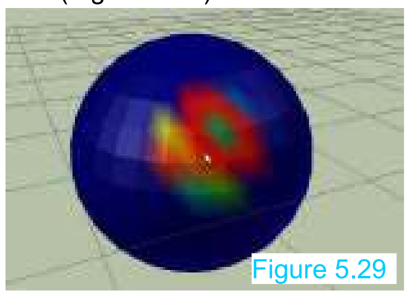


Figure 5.29

The UV Sphere displays blue. Click, hold and drag the brush over the surface of the UV Sphere painting an area until it is red (Figures 5.29, 5.30). Painting selects Vertices.

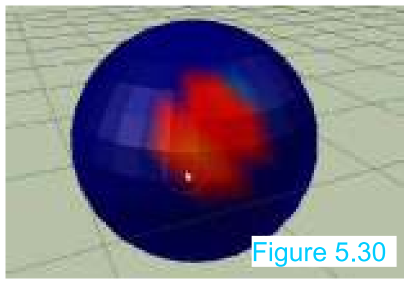


Figure 5.30

Press the **Tab Key** to place the 3D Viewport in **Edit Mode** and **deselect all Vertices** (press Alt + A Key).

In the **Properties Editor, Object Data buttons, Vertex Groups Tab,** with the new Vertex Group named Group highlighted, click the **Assign button** (Figure 5.31).

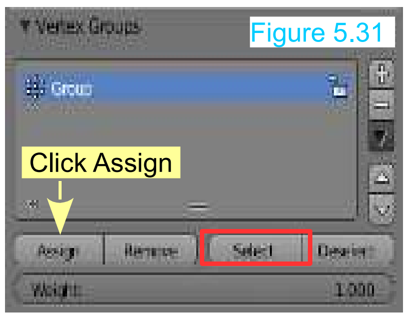


Figure 5.31

Click the **Select button** to see the painted vertices assigned to the **Vertex Group** (Figure 5.32).

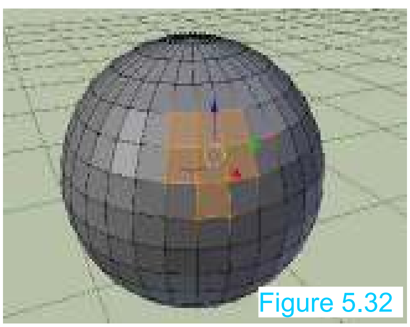


Figure 5.32

5.10 Proportional Vertex Editing

Proportional Vertex Editing is used to create a flow in the shape when editing Vertices. To turn **Proportional Vertex Editing** on, in **Edit mode**, click the **Proportional Editing** button in the **3D View Editor Header** (Figure 5.33) .

Click to Enable Proportional Editing

Click to Select Falloff Type

3D View Editor Header
(Center)

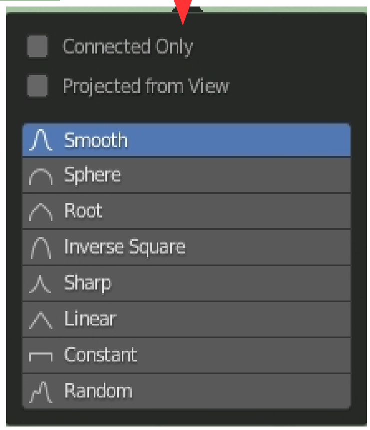


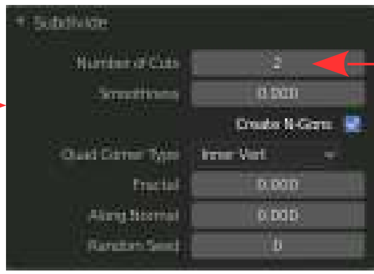
Figure 5.33

Note: You can only select Proportional Editing while in Edit Mode.

With Proportional Vertex Editing enabled there are several types of Falloff available. To see what this means perform the following:

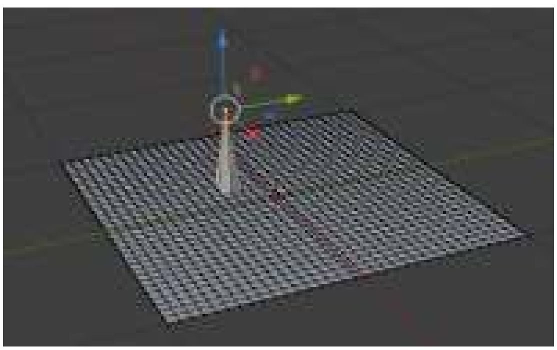
Zoom in on a Plane Object in **Edit Mode** in the 3D Viewport. In Edit Mode subdivide the Plane (**RMB click – Subdivide**) with Number of Cuts = 10. Deselect the Vertices then **re-select** (press **A Key**)and repeat the subdivision with Number of Cuts = 2.

Last Operator Panel



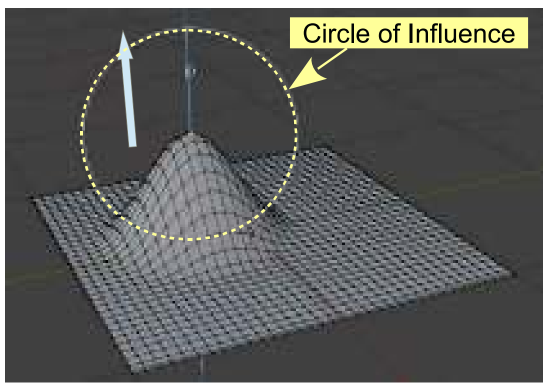
Note: To adjust the **Circle of Influence** select a Vertex or Vertices. Press the **G Key** (grab) and scroll the Mouse Wheel. (See over page)

Select a single Vertex and Translate up on the Z Axis (Figure 5.34).



Plane Subdivided – Single Vertex Translated

Note: Proportional Vertex Editing has **NOT** been activated.



Single Vertex Translated on the Z Axis
Proportional Vertex Editing Activated

Figure 5.34

Circle of Influence

When a single Vertex is selected and Translated with Proportional Vertex Editing activated a **Circle of Influence** determines how many surrounding Vertices are influenced in the Translation.

The diameter of the circle is adjustable. Select the Vertex to be Translated. Press the G Key (places the Vertex in Grab Mode) to display the circle. Without moving the Mouse, scroll the mouse wheel. Click LMB. The circle display is cancelled but the influence is retained. Pressing the G Key and moving the Mouse moves the selected Vertex. Pressing the Grab button in the Tool Panel displays the Manipulation Widget and allows Translation of the Vertex. Although not displayed the Circle of Influence previously set is in effect. Experiment with the different types of Falloff.

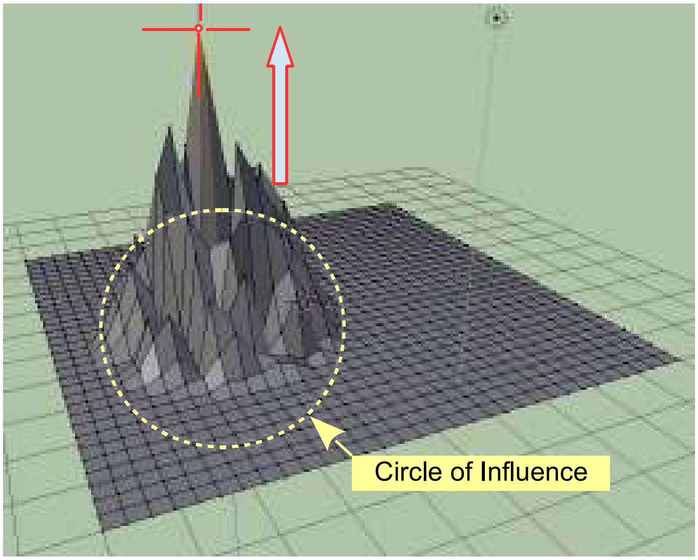


Figure 5.35

Single Vertex Translated with Random Falloff Selected

It doesn't take much imagination to see that Proportional Vertex Editing as seen in Figure 5.35 can be employed to create a landscape (see Chapter 11 – 11.1 Editing Techniques and Examples).

5.11 Inset Faces

The **Inset Faces** command causes new Faces to be created inside or outside a selected geometry.

To demonstrate, delete the default Cube in the 3D Viewport and add a **Plane** Object. Zoom in (Scroll MMB), Tab into **Edit** mode and Subdivide the Plane (Number of Cuts = 3). Deselect the Vertices (LMB Click in Editor). Change from **Vertex Select** mode to **Face Select** mode.

Select a single Face and with the Mouse Cursor in the 3D Viewport Editor, **moved to one side**, press the **I Key** and move the Mouse Cursor towards the center of the Face.(Figure 5.36). Alternatively click **Face** in the 3D Viewport Editor Header and select **Inset Faces** or press **Inset Faces** in the **Tool Panel.** With either method, move the **Mouse cursor** towards the center of the selected Face and you see new Faces created. Click LMB to set the new Faces in position.

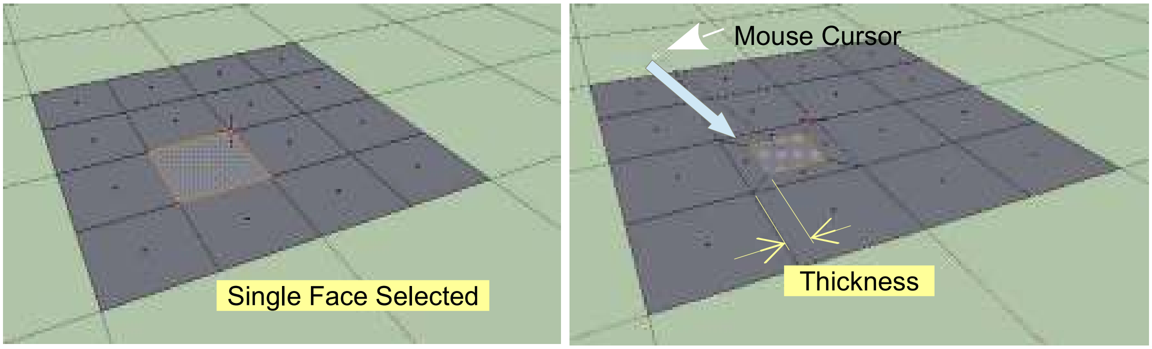
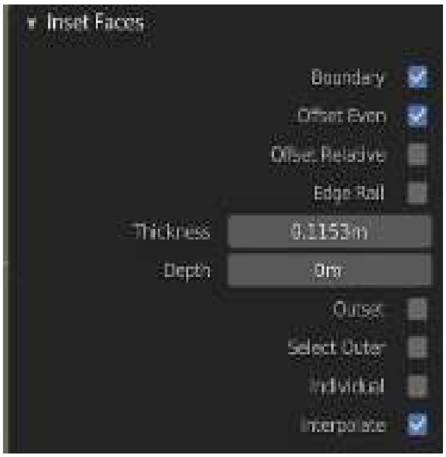


Figure 5.36



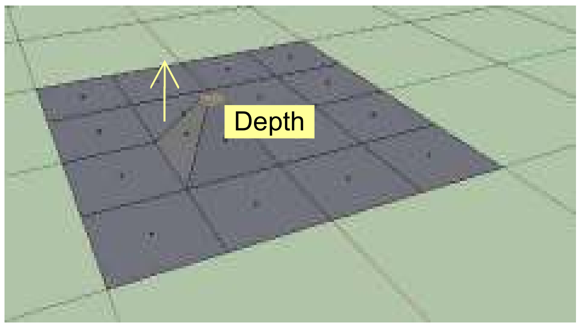


Figure 5.37

Last Operator Panel

Note: Inset Faces displays in the **Last Operator Panel** (Figure 5.37). While this panel is displayed you can make adjustments. The **Thickness Slider** controls the size of the new Face. The **Depth Slider** displaces the face normal to the Plane. Positive values above the Plane, negative values below the Plane.

Note: The procedure can be processed in both **Vertex Select Mode** and **Edge Select Mode** by selecting the perimeter of an area on the surface of the plane. The principle can be applied to the surface of any mesh Object.

5.12 Parenting

In **5.8 Joining and Separating**, it was demonstrated how two Mesh Objects may be joined together to form a single combined Object. There are, however, occasions when you will want two or more Objects to act as a single unit but not actually have the mesh joined. For example, you may want one Object to follow another when the first Object is moved. This can be achieved by **Parenting** or creating a **Child Parent Relationship** between Objects.

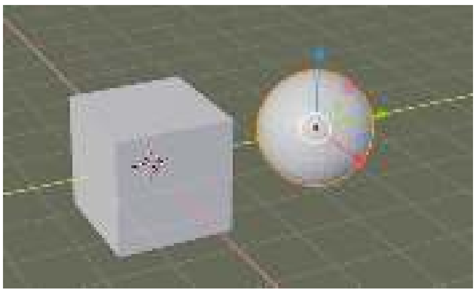
To demonstrate, add a UV Sphere Object to the default Scene (Figure 5.38).

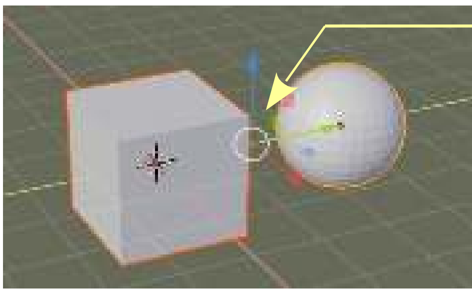
Note: In the diagram the Move Tool in the Tool Panel has been activated and the Manipulation Widget employed to position the UV Sphere.

With the UV Sphere selected press Shift and select the Cube. For the demonstration make the selection in this order (Sphere selected – Shift select the Cube).

Press **Ctrl + P Key** and click on **Set Parent To Object.**

Figure 5.38





With the Move Tool activated displaying the Manipulation Widget, you will observe that the **Widget relocates mid way** between the two Objects. This indicates that Parenting is in place. Using the Widget to move along the Y Axis will demonstrate that the Objects are Parented. They both move together.

Note: The selection order in the Parenting operation is important.

Having the UV Sphere selected then selecting the Cube has made the UV Sphere the child of the Cube. Selecting the Cube individually and moving, will see the UV Sphere follow. If the UV Sphere is selected individually it can be moved independently.

6

Editing Tools

6.1 The Tool Panel
6.2 The Add Cube Tool
6.3 The Last Operator Panel
6.4 Extrusion
6.5 The Extrude Region Tool
6.6 Inset Faces
6.7 The Inset Faces Tool
6.8 The Bevel Tool
6.9 Edge and Loop Selection
6.10 The Loop Cut Tool
6.11 The Knife Tool
6.12 The Poly Build Tool
6.13 The Spin Tool
6.14 Creating a Spin Profile
6.15 Spin Duplication
6.16 The Screw Tool
6.17 The Smooth Tool
6.18 The Edge Slide Tool
6.19 The Shrink Fatten Tool
6.20 The Shear Tool
6.21 The Rip Region Tool

Editing Tools

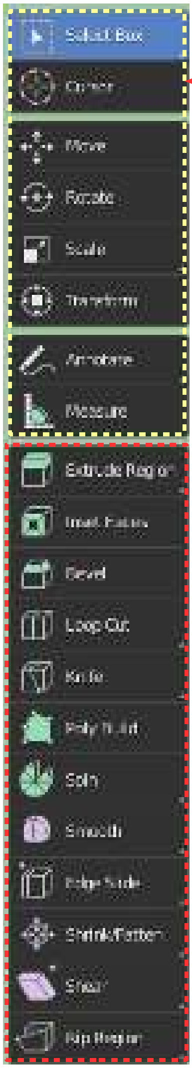
In the previous chapter some of Blender's basic mesh editing techniques were introduced which allowed you to manipulate and reshape Primitives. These techniques are the beginning of the process and are essential for mastering more sophisticated practices. Blender incorporates many techniques for performing a variety of functions some of which are automated. The automated techniques may be considered as **Tools**.

Like any trades person, mechanic or engineer, knowing what tools are available, how each functions and most importantly what tool to use for a particular application is the key to success. And, yes! where to find the tool.

As you have seen many editing techniques are simple Key and Mouse commands applied to an Object or to an Object's mesh surface. Other tools automate some fantastic and complex operations. In this chapter some of the Tools will be introduced with examples showing how they are employed.

Other Tools will be introduced in context with specific operations as you progress through the book.

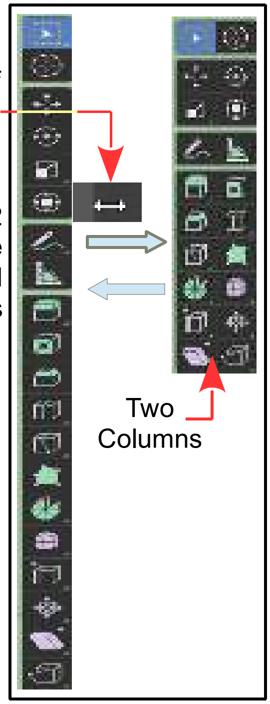
6.1 The Edit Mode Tool Panel



The **Tool Panel** at the left hand side of the **3D Viewport Editor** in **Edit Mode** contains a variety of tools for automating editing processes (Figure 6.1).

The top eight Tools are identical to those found in the Object Mode Tool panel and function in the same way when applied to a selection of Vertices, Edges or Faces. The Tools are activated by clicking (LMB) on a Tool (highlights blue – see **Select Box Tool** at the top of the Tool Stack).

Figure 6.1 Figure 6.2



To gain Screen space you may mouse over at the side of the Tool Panel to reveal a **double headed arrow**, click, hold and drag, to expand or reduce the size of the panel (Figure 6.2).

By default the Tool Panel displays as shown in Figure 6.2 (LHS). Mouse over on the panel edge and drag the double headed arrow to expand. First expansion created a two column display. Second expansion displays names as shown in Figure 6.1.

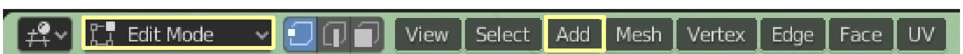
Note: You cannot apply the Rotate, Scale or Ruler Tools to a single Vertex.

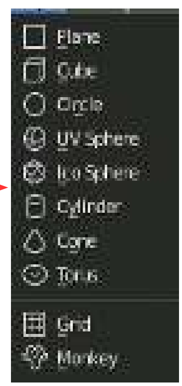
Pressing the **T Key** on the Keyboard toggles hide and show the Tool Panel.

Note: When in Object Mode you can not enter Edit Mode unless you have a Mesh Object in the 3D View Editor. With two or more Objects in the 3D View Editor, the selected Object or the last Object that was selected will be the active Object when entering Edit Mode.

6.2 The Add Menu

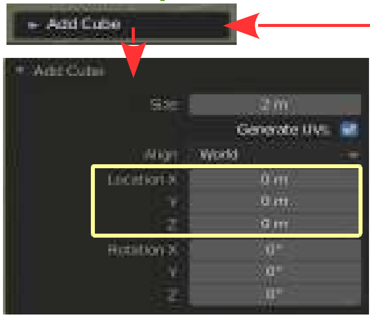
Figure 6.3





Objects may be added to the Scene with the 3D Viewport Editor in Edit Mode by clicking **Add** in the 3D Viewport Editor Header (Edit Mode).

6.3 Last Operator Panels



Click to Expand the Panel

When an action has been performed in the 3D Viewport Editor, the **Last Operator Panel** is displayed in the bottom LH corner of the Editor. **Click to Expand**, allowing values in the panel to be adjusted affecting the action (see Chapter 4 – 4.13).

The Last Operator Panel (Figure 6.4) shows that a Cube Object was added at the center of the Scene (Location X, Y, Z = 0 m)

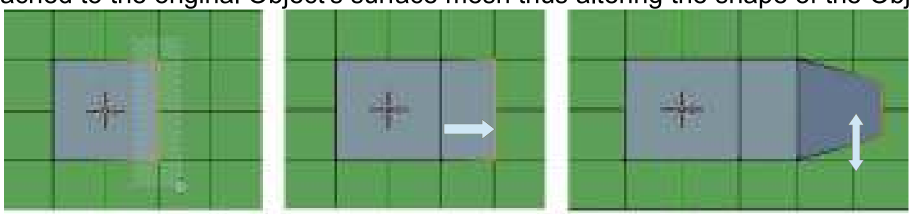
Figure 6.4

6.4 Extrusion

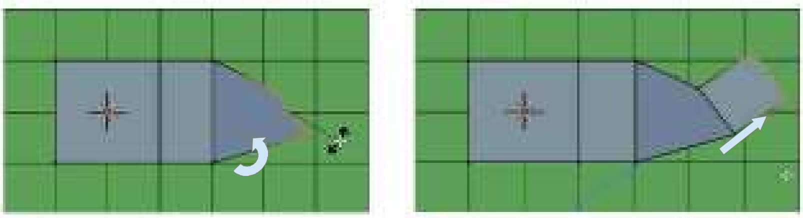
Before examining the **Extrude Region Tool** consider Extrusion in general.

Extrusion means, stretching such that the shape is altered. Shapes can be altered by selecting a single Vertex or a group of Vertices, then Translating, Rotating or Scaling. You may also select Edges or Faces and apply the same processes (Figure 6.5).

Vertices are selected with the Object in Edit Mode. When the selected **Vertices** are **Extruded duplicate Vertices are created**, which may be Moved, Scaled or Rotated. The new Vertices remain attached to the original Object's surface mesh thus altering the shape of the Object.



Vertices Selected — Vertices Extruded — Extruded and Scaled



Vertices Rotated — Vertices Extruded

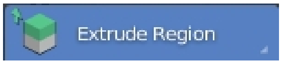
Figure 6.5

Rendered Image

For Extrusion instruction see the following page.

In Figure 6.5 the RH Vertices of a Cube (Top Orthographic View) are selected in **Edit Mode** by pressing the **B Key** (Box Select) and dragging a rectangle (don't forget to have **Show X-Ray** turned off - Chapter 5 – 5.2 – Figure 5.3). With the Vertices selected press the **E key** (Extrude) + **X Key** (confines Extrusion to the X Axis) and drag the Mouse. The Vertices are duplicated and repositioned. With the Vertices remaining selected the Extrusion process is repeated, and the selection Scaled down by pressing the **S Key** and moving the Mouse in. The selection is Rotated by pressing the **R Key** and moving the mouse. Finally, the selection is Extruded again.

6.5 The Extrude Region Tool



Activating the **Extrude Region Tool** displays a manipulation Widget located at the center of the selection. In Figure 6.6 the selection is the top Face of the default Cube. Click, hold and drag the Widget to Extrude the selection.

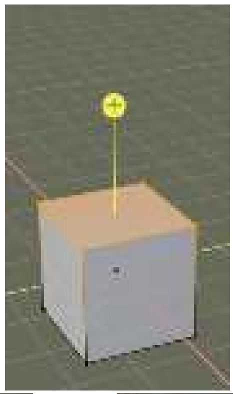
The Tool has four options. Mouse over on the Tool and click to expand the panel.

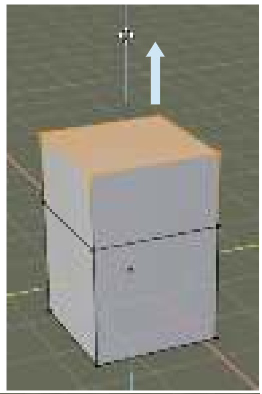
Figure 6.6

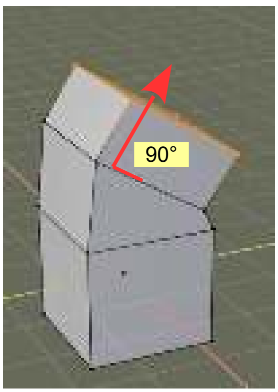
Extrude Region

Extrude Along Normal means Extrude at right angles to the selected Face.

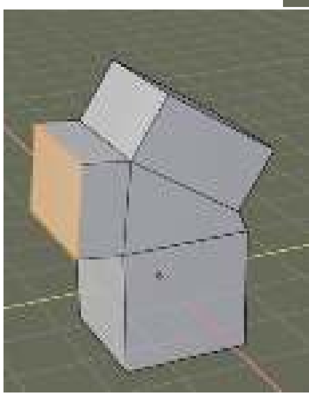
Extrude Individual allows Extrusion of an individual Face.



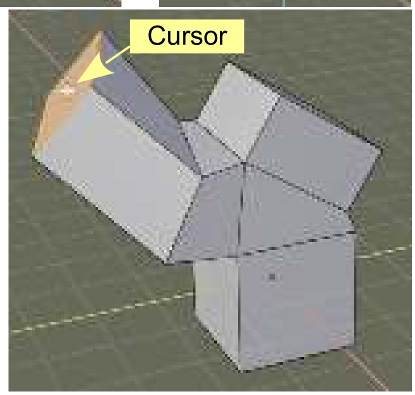




Extrude Along Normal



Extrude Individual



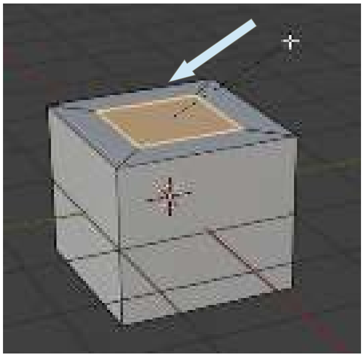
Extrude to Cursor

With **Extrude to Cursor** selected. Click LMB in the 3D View Editor and the selected Face will be Extruded to wherever the Cursor has been placed.

Note: The Extrusion methods can be applied to Faces, Edges and Vertices.

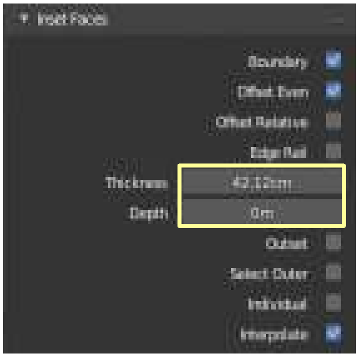
6.6 Inset Faces

Figure 6.7



Inset Faces creates new Faces inside a selected geometry.

To demonstrate, select the top **Face** of the default Cube while in Edit Mode. Press the **I Key** (**I**nsert - Figure 6.7) and move the **Mouse Cursor** towards the center of the selected Face. You see new Faces created. Click LMB to set the new Faces in position.



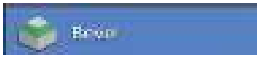
Note: The **Inset Faces Last Operator Panel** displays (Figure 6.8). While this panel is displayed you can make adjustments. The **Thickness slider** controls the size of the new Face. The **Depth slider** displaces the Face normal to the surface (positive values above the surface, negative values below). Note: The procedure can be processed in both **Vertex Select Mode** and **Edge Select Mode** by selecting the perimeter of an area on the surface. The procedure can be applied to the surface of any mesh Object.

Figure 6.8

6.7 The Inset Faces Tool

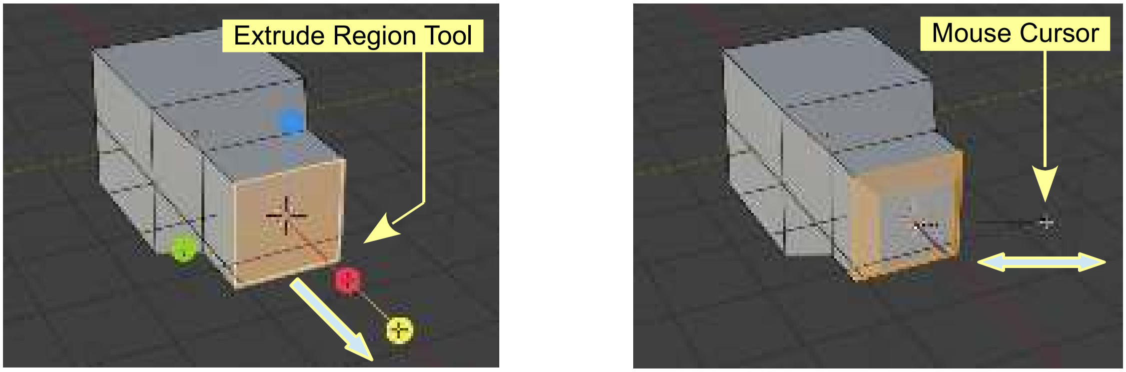
Activating the **Inset Faces Tool** replicates the above procedure. Click the Tool to activate, place the Mouse Cursor in the 3D View Editor, click and drag. While the Tool is activated you can select any Face in the 3D Viewport and apply the procedure.

6.8 The Bevel Tool



The **Bevel Tool** bevels the Edges of a selected Face.

Figure 6.9



The default Cube with the front face Extruded and Scaled down then Extruded a second time.

With the face selected activate the Bevel Tool. Place the Mouse Cursor, click hold and drag to bevel the edges of the Face.

6.9 Edge and Loop Selection

When working with Vertices, it is sometimes useful to select a group of Vertices which form an Edge or a Loop.

Cylinder Object in Edit Mode

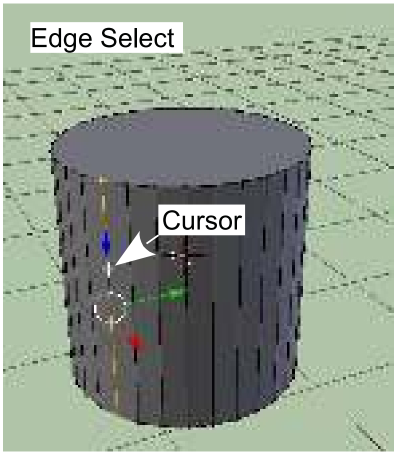
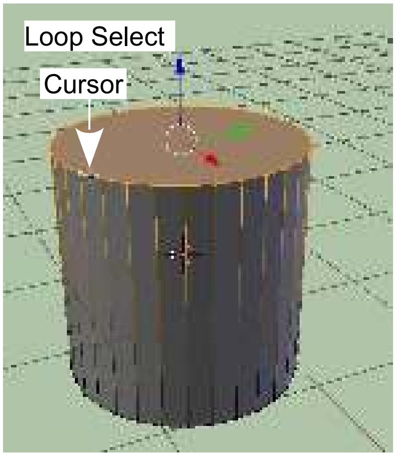


Figure 6.10



Place the Mouse Cursor (White Cross) over an Edge – Press and Hold **Alt – Click LMB**

Place the Mouse Cursor (White Cross) over a Loop – Press and Hold **Alt – Click LMB**

6.10 The Loop Cut Tool

The **Loop Cut Tool** allows you to create new Edges and Loops. In Edit Mode (Vertices deselected).

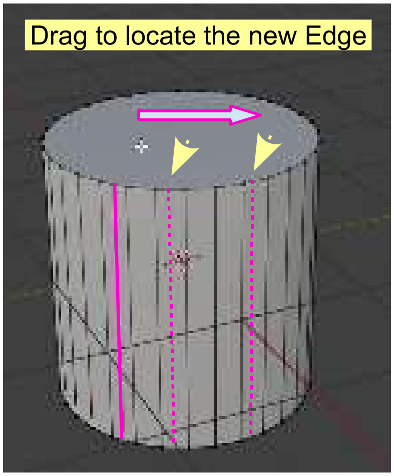
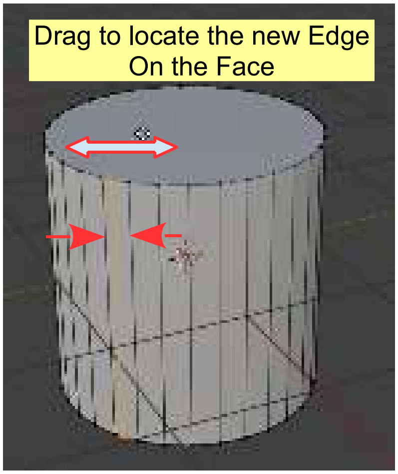


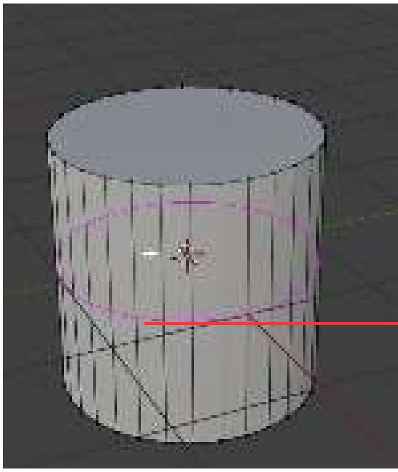
Figure 6.11

Create an Edge



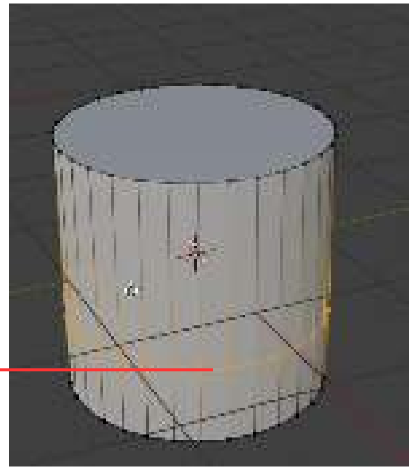
Position the Mouse Cursor and click LMB. to create, hold and drag to locate the new Edge. Click LMB.

Clicking LMB sets the Edge on a Face. Drag the Mouse to locate the new Edge on the Face then click LMB again.



Create a Loop

Figure 6.12



Position the Mouse Cursor and click LMB. Hold LMB and drag the Mouse to locate the new Loop. Click LMB.

Clicking LMB sets the Loop in place. Hold and drag the Mouse to locate the new Loop then click LMB again.

Adjust the number of Loop Cuts in the **Last Operator Panel.**

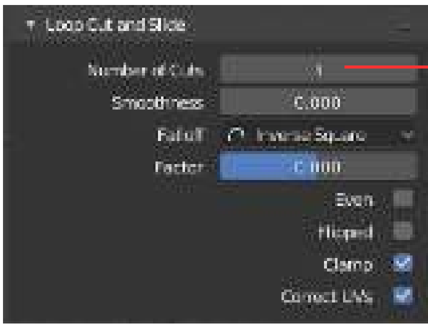
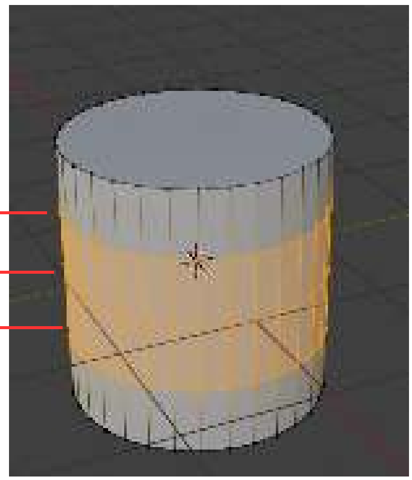
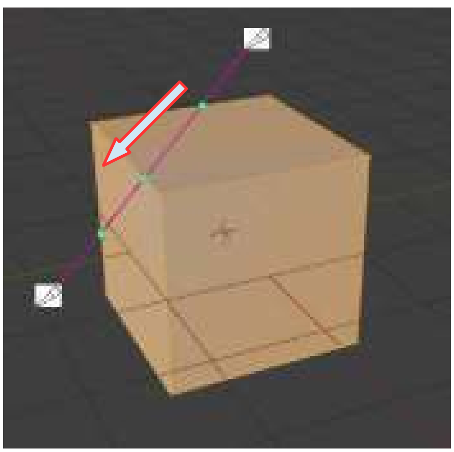
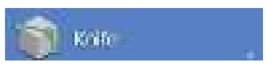


Figure 6.13



6.11 The Knife Tool

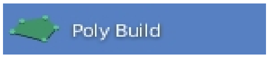




With the **Knife Tool** activated clicking LMB in the Editor displays the Mouse Cursor as a knife. Hold and drag across Edges creating Vertices and Edges. Release the Mouse button and press Enter.

Figure 6.14

6.12 The Poly Build Tool



Poly Build allows you to create Polygon Surfaces generating shapes by simply clicking LMB in the 3D View Editor.

With the **Poly Build Tool** activated, in **Vertex Select Mode**, Mouse Over on an **Edge** (highlights). Click **LMB, hold and drag** to generate a new Face. Click LMB to place.

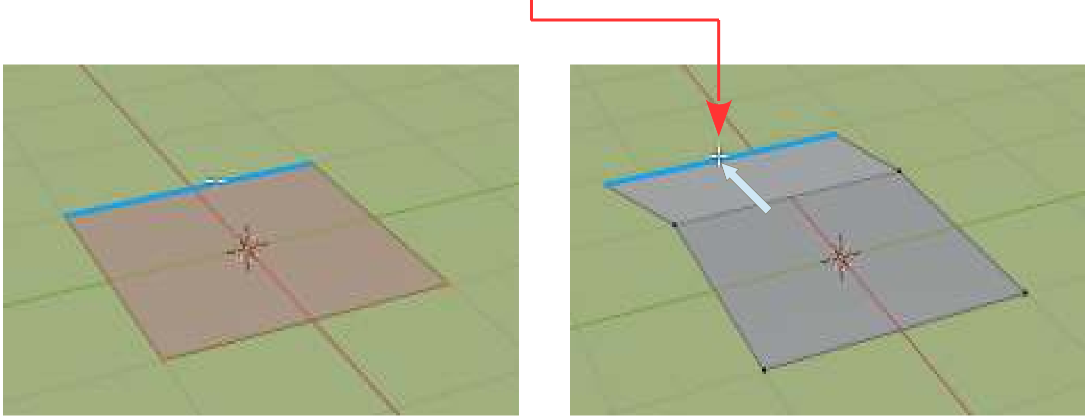
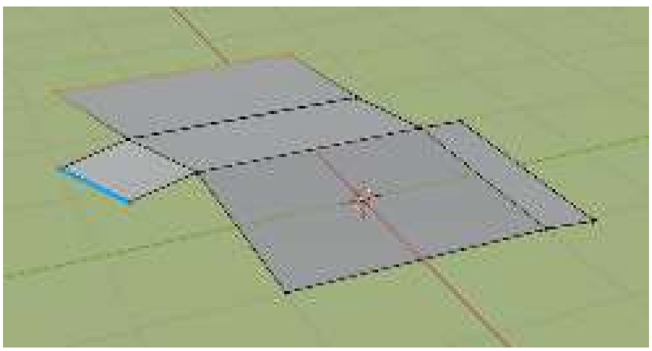
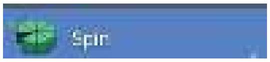


Figure 6.15

Repeating the procedure produces Polygon Shapes.



6.13 The Spin Tool



To see what the Spin Tool accomplishes, have the default Cube Object in Edit Mode displaced from the center of the Scene (Figure 16.16).The Viewport Editor Cursor is located at the center of the Scene. The Cursor is the center of rotation for the Spin Action. Click on the Spin Tool in the Tool Panel. The **Spin Arc** displays.

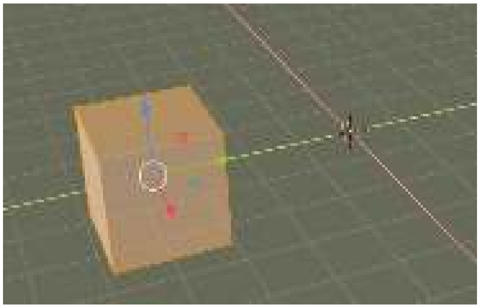


Figure 6.16

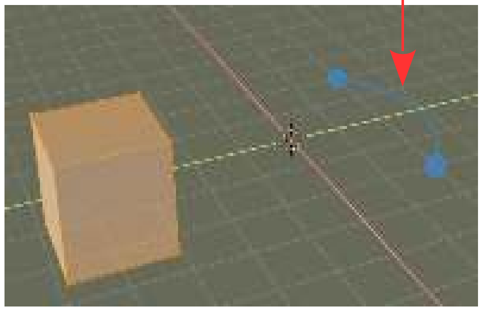


Figure 6.17

At this point there are two options. Click and release LMB on a cross to Spin the Cube 360° about the center of rotation (the **3D View Editor Cursor**) (Figure 16.18) or click and hold LMB and drag the Mouse to create a partial Spin (Figure 16.19).

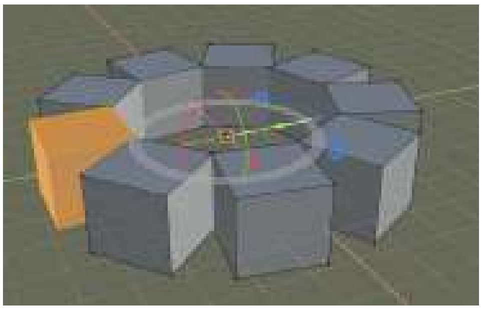


Figure 6.18

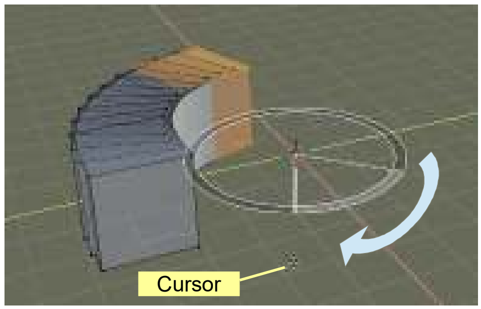


Figure 6.19

Continue dragging the Mouse to increase the Spin. Release the Mouse button then click on the manipulation Widget that displays and skew the Spin profile (Figure 16.20).

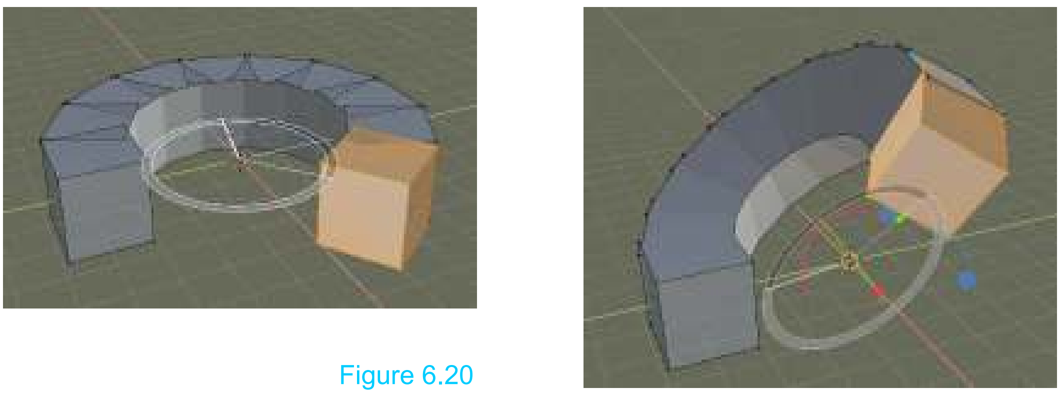
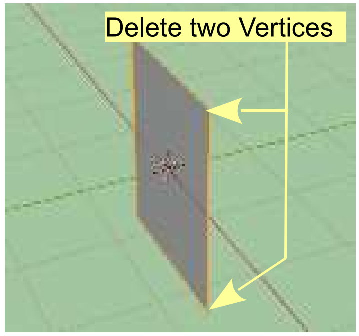


Figure 6.20

6.14 Creating a Spin Profile

A Spin Profile is a line drawing of a shape representing the cross section through an object you wish to generate. As an example a wine glass or goblet will be created.

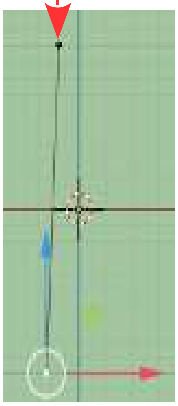


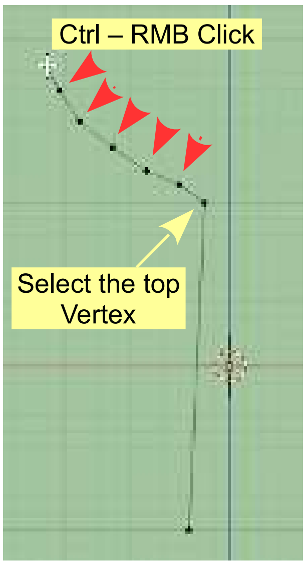
To create a Spin Profile you start with two vertices in Edit Mode in the 3D Viewport Editor. One way to do this is to have a **Plane Object** in a new Scene and delete two Vertices in Edit mode

A Plane Object is always added to a Scene laying flat in Top Orthographic View, therefore, flick it on edge by pressing **R Key** (Rotate) + **X Key** + **90** (rotate about the X Axis 90 degrees) press **Enter.**

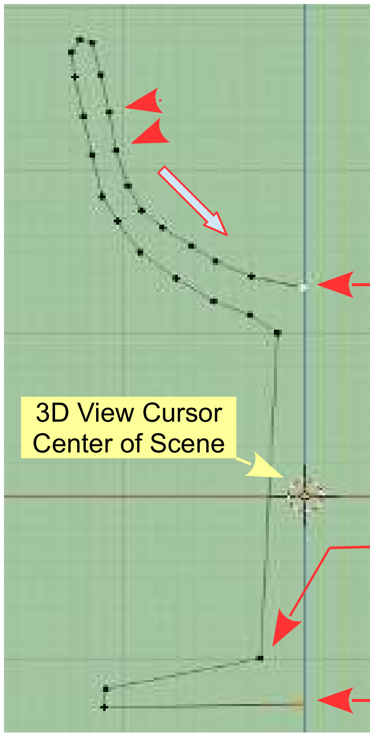
Have the Plane in **Front Orthographic View**, in **Edit Mode** and delete two Vertices. This leaves the remaining two Vertices from which you build your profile.

Position Vertices as shown.





Front Orthographic View



Select the top Vertex then hold **Ctrl** and click **RMB** to place additional Vertices creating the profile of your (Wine glass).

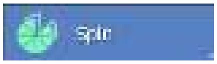
Last Vertex placed for the top portion.

Select the lower Vertex and repeat adding Vertices for the base of the glass. **Finish on Center**

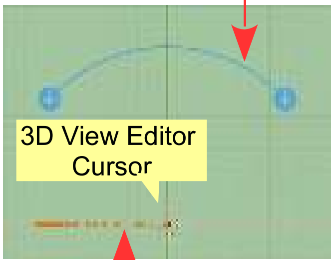
Spinning: To generate the glass the completed profile will be spun around the position of the **3D View Editor Cursor** with the **3D View Editor** in **Top Orthographic View** in **Edit Mode**.

In creating the profile the 3D View Editor has been in **Front Orthographic View** and **Note: The 3D View Editor Cursor is at the center of the Scene.**

Important: If the 3D View Editor Cursor is located other than at the center of the Scene, spin rotation will take place about that point with unexpected results.

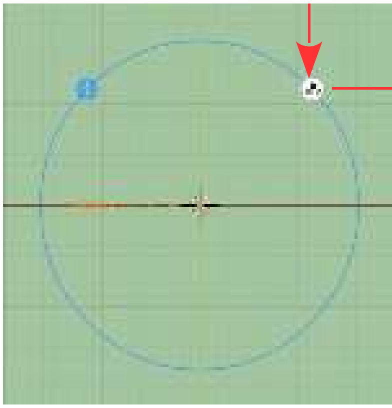


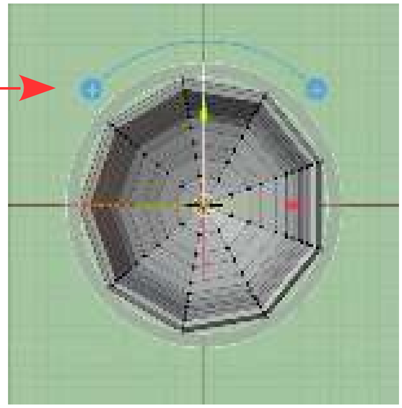
In Top Orthographic View activate the Spin Tool.



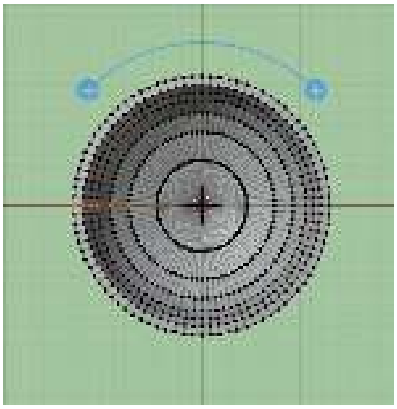
Profile
Top Orthographic View

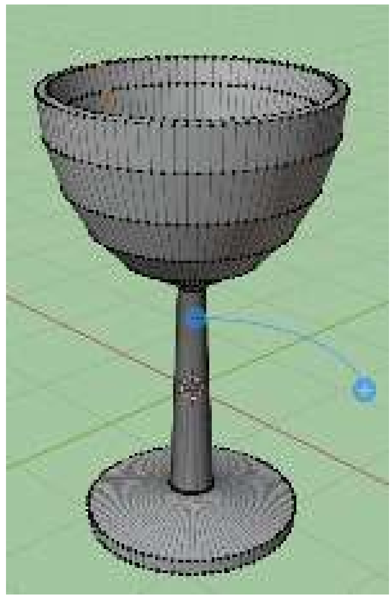
Mouse Over – Click LMB





In the **Last Operator Spin Panel** increase the number of **Steps** to create a rounding effect.





User Perspective View

In Object Mode, LMB click and select **Shade Smooth** in the **Object Context Menu.**

Add a Glass Material (more on this later – Chapter 16).

6.15 Spin Duplication

The Spin Tool may be used to duplicate an Object around a circular path. The Spin is always about the Z Axis on the XY Plane, therefore, place the 3D Viewport Editor in **Top Orthographic View**. The Spin uses the location of the **3D Viewport Editor Cursor** as the center of rotation.

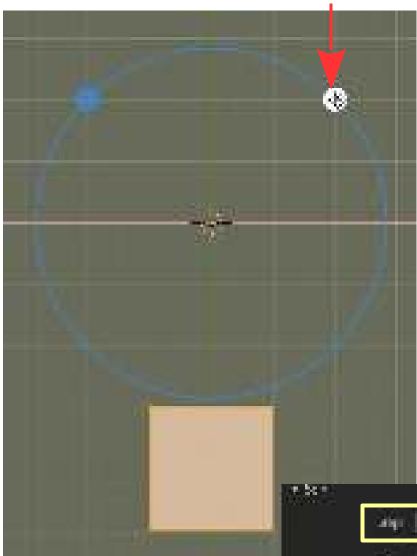
In a new Scene in **Top Orthographic View** with the default **Cube Object** selected and located at the centre of the Scene, Tab to **Edit Mode**. Place the 3D Viewport Editor Cursor off to one side (Shift + RMB click to place). Alternatively, with all Vertices selected move the Cube away from the Cursor which is at the center of the Scene. Activate the **Spin Tools** and click **LMB** on either of the crosses in the blue circles that are displayed. (Figure 6.24).

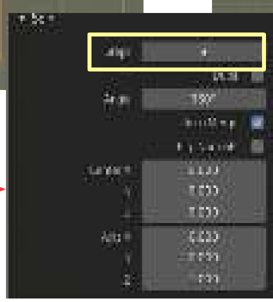
By default the Spin creates eight duplications of the Cube spaced in a circle around the 3D Viewport Editor Cursor. The Vertices of the original Cube are selected (in Edit Mode). You may press the G Key and move the Vertices but if you Tab to Object Mode you will discover that although you appear have separate Cubes, they are in fact joined as one Object. Tab back to Edit Mode. Press the **P Key** and select **Separate by Loose Parts**. In Object Mode you may select individual Cubes and move them but note where the center of each Cube is located. With one Cube selected Tab to Edit Mode and reposition the individual Vertices of the Cube over the center point.

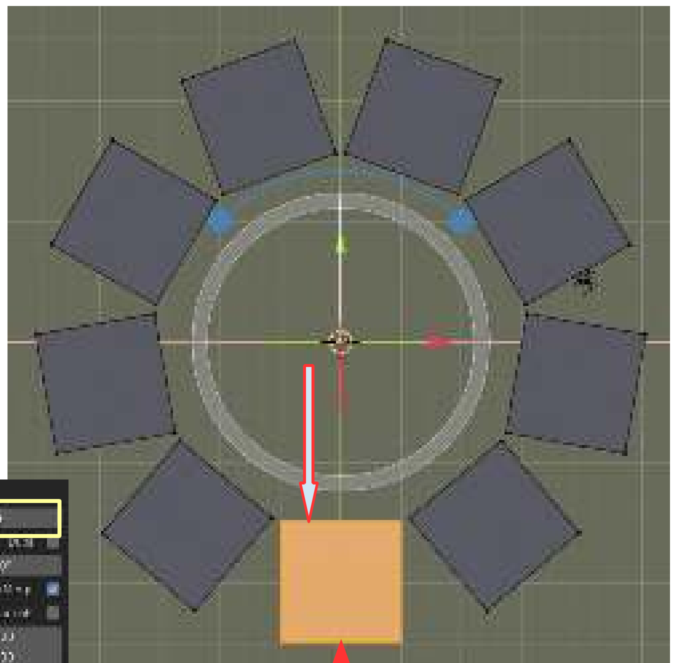
Top Orthographic View
Click LMB on a Blue Cross

Figure 6.24

Eight Duplication
Nine Steps in the Last Operator Panel





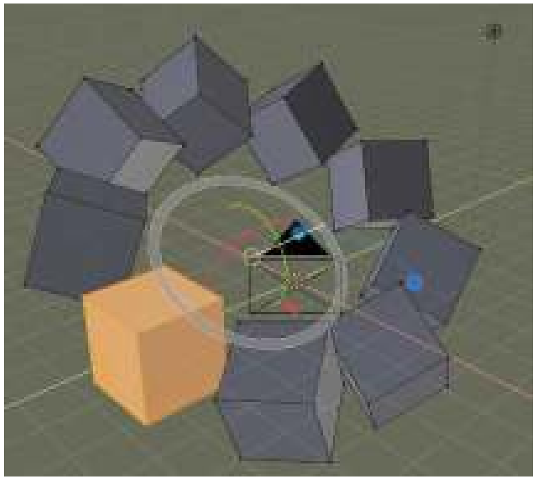


Last Operator Panel

Original Cube
Moved from the Center

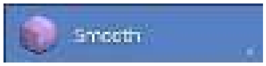
6.16 The Screw Tool

Figure 6.25



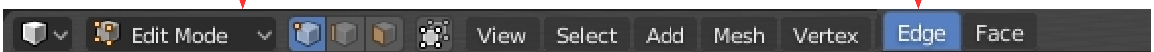
Previous versions of Blender included a Screw Tool which spun vertices and at the same time generated duplications at right angles to the spin producing a Screw effect. This procedure is now accomplished by the **Screw Modifier** (see Modifiers Chapter 7). You may, however, use the Manipulation Widget of the Spin Tool to skew the Spin Duplication.

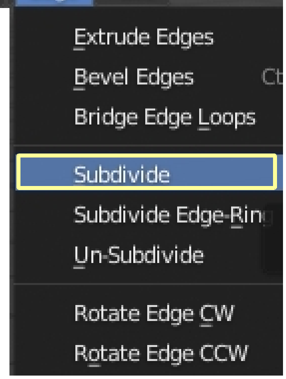
6.17 The Smooth Tool



The effect of the **Smooth Tool** is to smooth or round transitions at the corners of a mesh. It is best demonstrated with an Object that has been Extruded and Subdivided (see Section 6.4).

In the **3D View Editor Header** select **Edge** and click **Subdivide**.





Extruded Object – Edit Mode

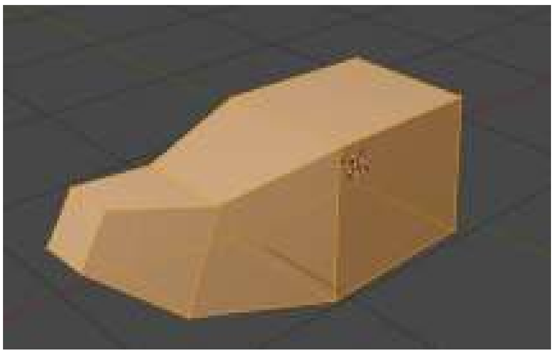
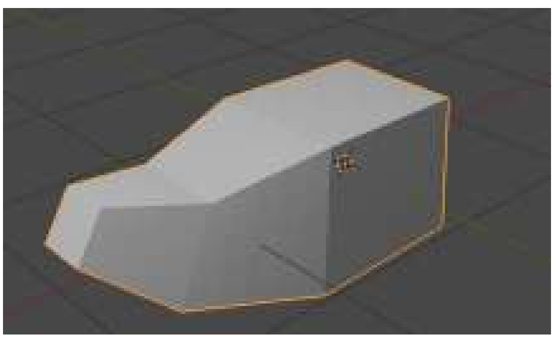


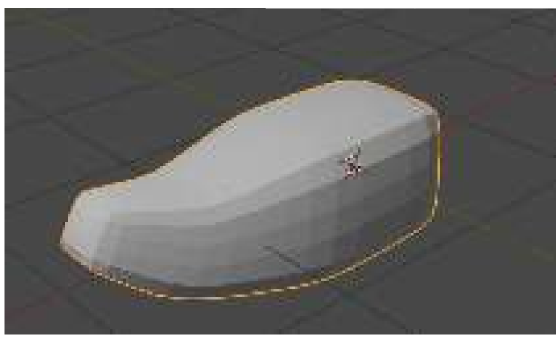
Figure 6.25

In the **Last Operator Panel** increase the number of **Cuts** further subdividing the Mesh.

Activate the **Smooth Tool.** In the **Smooth Vertex** panel (Click LMB- Drag) increase **Smoothing** to 1.000.



` Before Subdividing and Smoothing

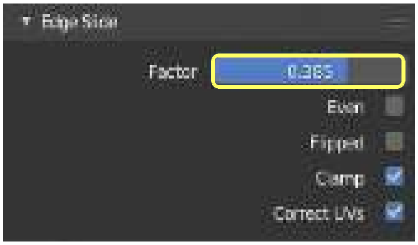


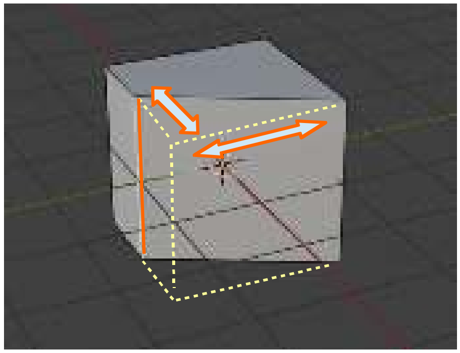
After Subdividing and Smoothing

6.18 The Edge Slide Tool

Figure 6.26

Select an Edge on an Object. Activate the Edge Slide Tool. Click in the Editor and drag the Mouse. The Edge will be translated within the space occupied by the Object.



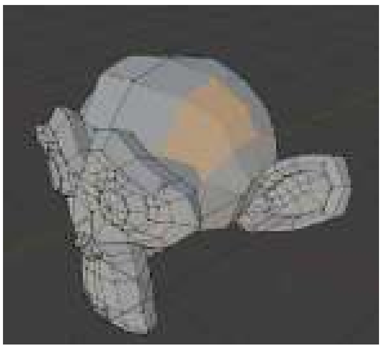


Adjust the position of the Edge in the Last Operator Panel, Factor Value

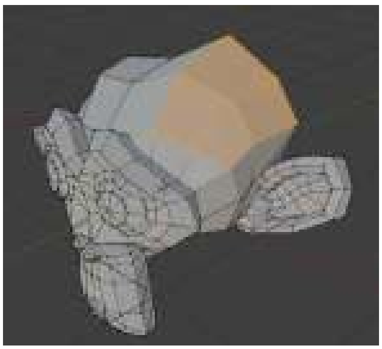
6.19 The Shrink Fatten Tool

The **Shrink Fatten** Tool allows you to expand (fatten) or shrink a selection.

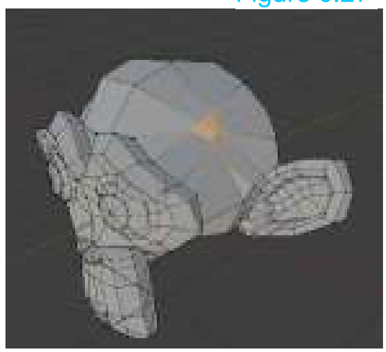
Figure 6.27



Normal Selection

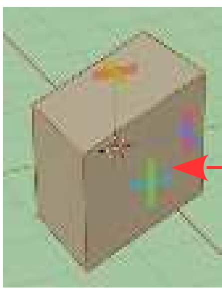


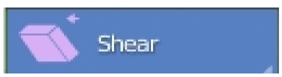
Fatten



Shrink

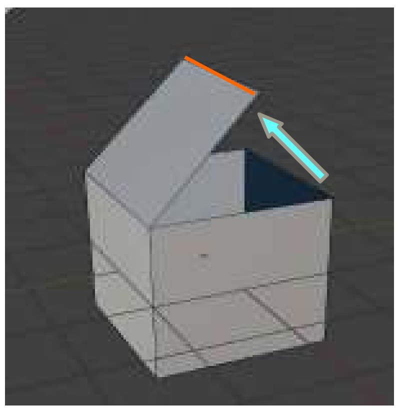
6.20 The ShearTool



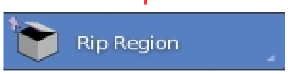


Click LMB on a handle to Shear the Object.

Figure 6.28



6.21 The Rip Region Tool



Select an Edge (Edit Mode – Edge Selection Mode). Activate the **Rip Region Tool**. With the Mouse Cursor in the Editor, click, hold and drag to translate the selected Edge.

7

Modifiers

7.1 Modifiers in General

7.2 The Modifier Stack

7.3 The Modifier Group

7.4 The Simulate Group

7.5 Generate and Deform Modifiers

Modifiers, in Blender, are pre-assembled code that apply a process or algorithm to an Object, changing the Object's properties and affecting the way the Object behaves or how it is displayed. Modifiers may, therefore, be considered as Editing Tools.

The Modifiers are designed to automate some of the otherwise tedious processes involved in shaping Objects and controlling their behaviour. Some Modifiers can only be used in conjunction with other processes.

The following chapters are offered as a guide. You will be shown how a Modifier is added to an Object and provided with examples showing the Modifier's basic features.

Modifiers are found in the **Properties Editor, Modifiers buttons**.

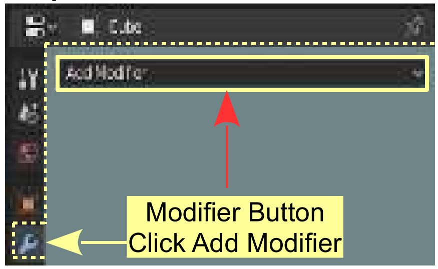
The Object Modifiers button is only displayed when an object to which a Modifier can be applied is selected in the 3D Viewport Editor. Some objects can not have Modifiers applied.

Note: If there are Objects in the 3D Viewport Editor to which Modifiers may be applied (not necessarily selected), clicking the **Add Modifier** button and selecting a Modifier will apply the Modifier to the last Object that was selected. This occurs even though that Object is not selected at the time.

7.1 Modifiers in General

Modifiers are found in the **Properties Editor, Modifiers button** (Figure 7.1).

Figure 7.1 **Properties Editor, Modifier button**



Note: The Modifiers button is only displayed when an Object to which a Modifier can be applied is selected in the 3D Viewport Editor. Some Objects cannot have Modifiers applied.

In this chapter **Modifiers in general** will be briefly described. Some Modifiers are complex and beyond a basic introduction and will be better understood having undergone further studies. New Modifiers are continually being added to the program and the selection menu changes accordingly. Click on the **Add Modifier** button to view the menu (Figure 7.2).

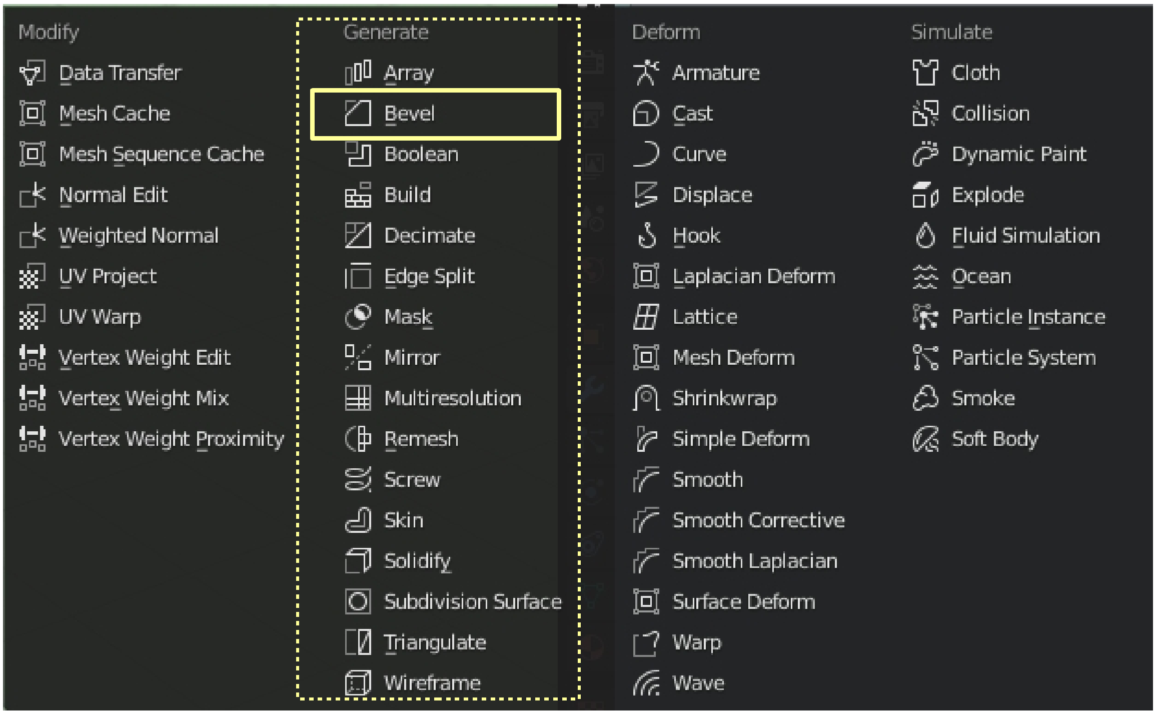


Figure 7.2

The menu is divided into four categories to aid selection.

To demonstrate the basic procedure for adding a **Modifier** the **Generate – Bevel Modifier** will be used. Begin by having the default Cube Object selected in the **3D Viewport Editor**. In the **Properties Editor, Modifier buttons**, click the **Add Modifier** button to display the selection menu (Figure 7.2).

This instruction has been purposely repeated

Under the **Generate** heading select **Bevel**.

Figure 7.3

The **Bevel Modifier panel** opens in the **Properties Editor** and the Cube object in the 3D View Editor displays with its edges bevelled (Figure 7.4).

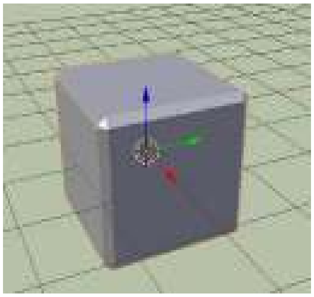
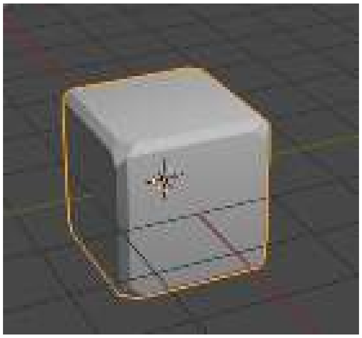


Figure 7.4

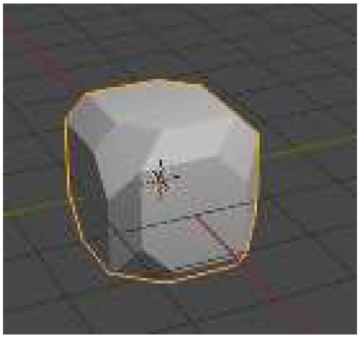
Values in the Modifier panel may be adjusted to affect the bevel.

Before adjusting values make note of the **Apply button** in the Modifier panel. At this point the Modifier has been added to the Cube (the selected Object) but it has **NOT been applied**. If you Tab to Edit Mode you will see the Cube displayed without bevels, as it was before adding the Modifier (Figure 7.8).

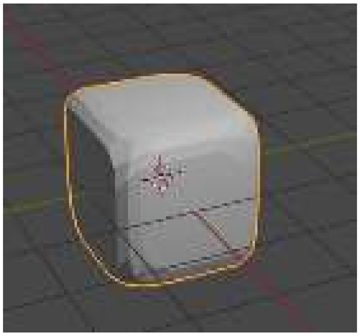
Change the Width value (Width: 30cm – 0.3m) and Segments value (Segments: 3) to increase the width of the bevel (Figure 7.6) and divide the bevel, rounding the edges (Figure 7.7)



Bevel Added Figure 7.5



Width: 0.3710 Figure 7.6



Segments: 3 Figure 7.7

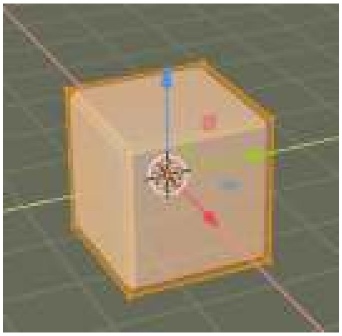


Figure 7.8

Having adjusted values in the Modifier panel, be in Object mode and click the **Apply** button.

Tab back to Edit mode to see that additional Vertices, Edges and Faces have been created (Figure 7.9).

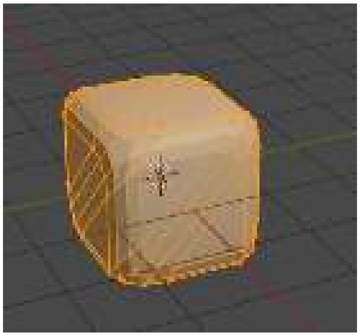
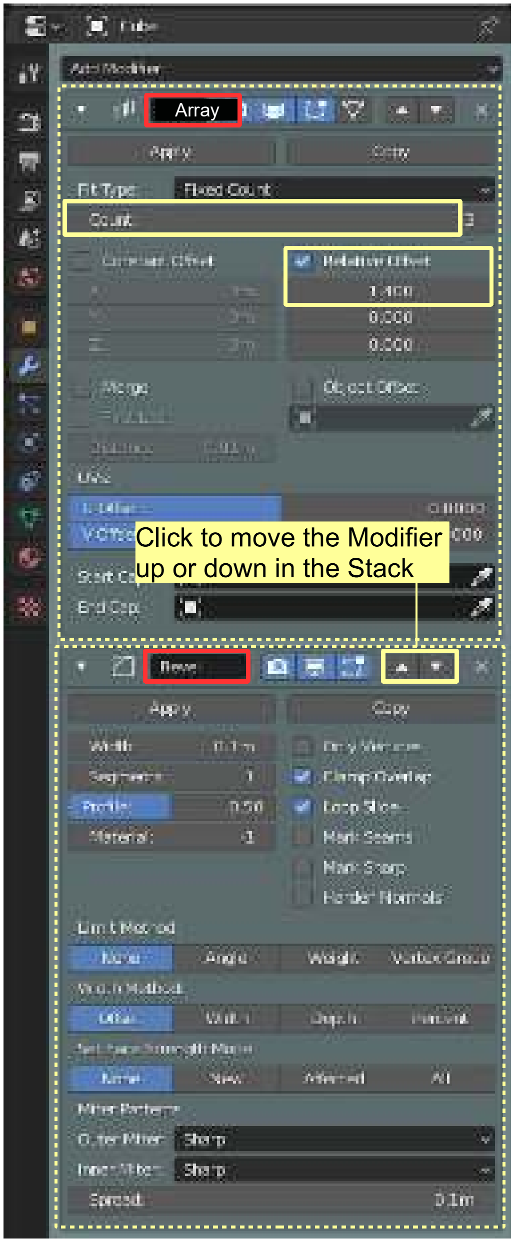


Figure 7.9

7.2 The Modifier Stack

Figure 7.10



In some cases it is appropriate to apply more than one Modifier to an Object. The modifiers are placed in a stack in order of priority. A Modifier at the top of the stack takes precedence over Modifiers lower down. The priority can be changed by moving a Modifier up or down in the stack. Although Modifiers are generally applied in Object mode, some may be used in Edit mode. Figure 7.10 shows an **Array Modifier** and a **Bevel Modifier**.

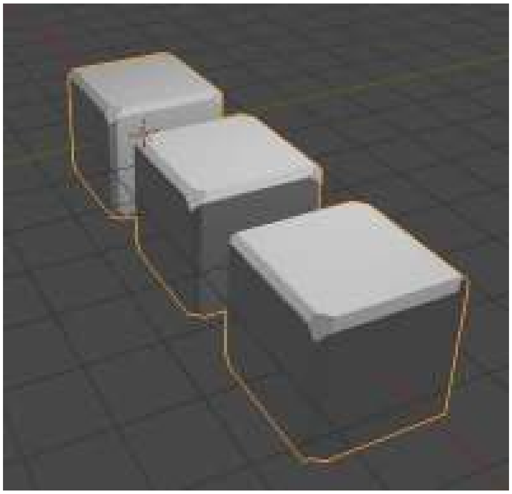


Figure 7.11

The Bevel Modifier has been added first followed by the Array.

The Array modifier has been moved to the top of the stack.

The Bevel Modifier bevels the edges of the Cube and the Array modifier duplicates the Cube in the 3D Viewport Editor.

In the following pages you will be shown how some of the Modifiers are used. The full listing of Modifiers available are shown in the Modifier selection menu (Figure 7.2).

Where Modifiers are used in conjunction with other processes they will be described in the chapter which relates to that process. For example: Armatures (Chapter 20), Particle Systems (Chapter 22), Fluid Simulation and Smoke Simulation (Chapter 23).

7.3 The Modify Group

The Modifiers under the heading **Modify** do not directly affect the shape of an object but rather other data such as Vertex Groups and appearance. The demonstration of this group will be left in abeyance at this point since you will have to study some of Blender's more advanced features before being a position to understand what they do.

7.4 The Simulate Group

The **Simulate** group of modifiers, activate simulations. In most cases, these modifiers are automatically added to the Modifiers stack whenever a **Particle System** or **Physics Simulation** is enabled. Their role is to define the place in the modifier stack used as base data by the tool they represent. Generally, the attributes of these modifiers are accessible in separate panels.

This group of Modifiers is discussed in Chapter 23 Physics and Simulation.

7.5 Generate and Deform Modifiers

The Generate and Deform Modifier Groups are discussed in Chapters 8 and 9.

8

Editing with Generate Modifiers

8.1 Modifiers – Generate
8.2 Array Modifier
8.3 Boolean Modifier
8.4 Build Modifier
8.5 Decimate Modifier
8.6 Edge Split Modifier
8.7 Mask Modifier
8.8 Mirror Modifier
8.9 Multiresolution Modifier
8.10 Remesh Modifier
8.11 Screw Modifier
8.12 Skin Modifier
8.13 Solidify Modifier
8.14 Subdivision Surface Modifier
8.15 Triangulation Modifier
8.16 Wireframe Modifier

Modifiers

Modifiers are described as automatic operations that affect an object in a non-destructive way allowing effects to be generated which would otherwise be tedious to do manually.

Modifiers work by changing how an Object is displayed and rendered in the Viewport. The underlying geometry of the mesh is maintained until the Modifier is Applied. This means that the underlying geometry of the mesh may be edited to suit, before permanently applying the Modifier.

You can add several modifiers to a single Object combining effects. This forms a Modifier Stack.

Modifiers are accessed in the **Properties Editor**, **Modifiers Button**.

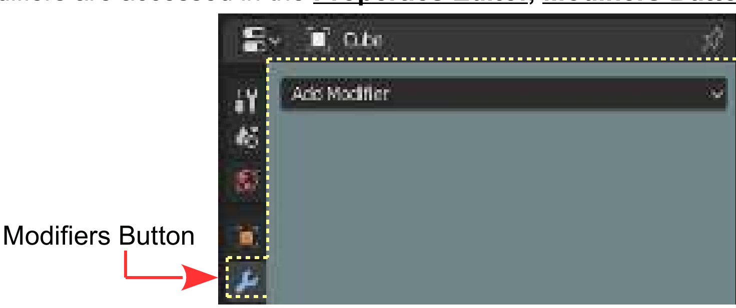


Figure 7.0

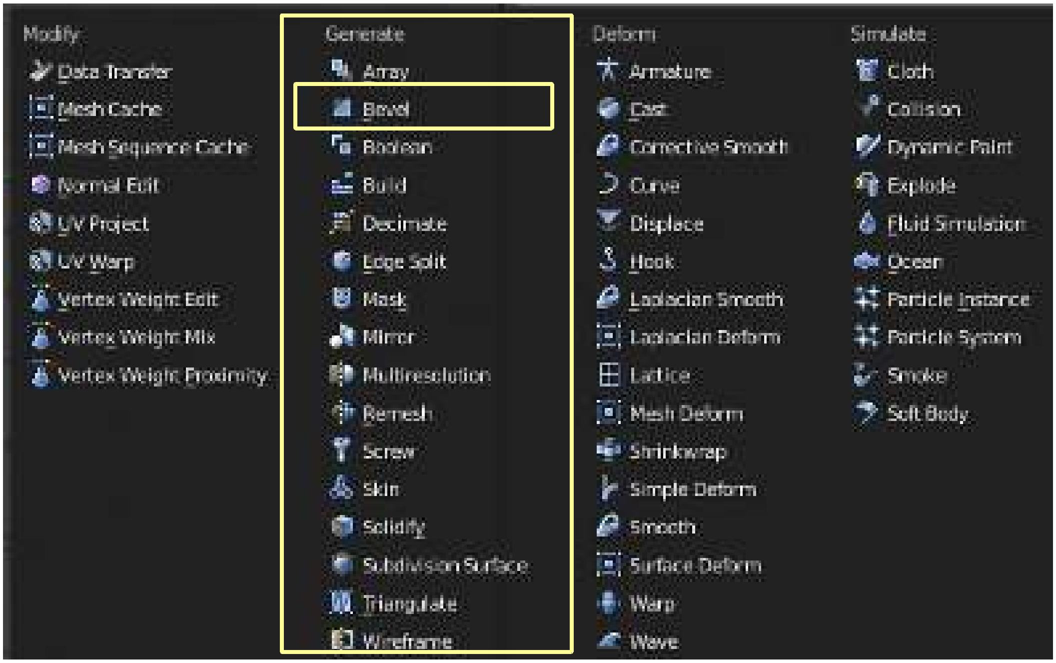
The **Generate** group of Modifiers are construction tools that change the general appearance of a shape or add new geometry to an Object.

8.1 Modifiers - Generate

Note: When an Editing Modifier is activated it immediately affects the Object that is selected in the 3D Viewport Editor but initially it is not a permanent effect. **The Modifier has to be Applied**.

Clicking the **Modifiers button** in the **Properties Editor Header** displays the **Add Modifier** button. With an Object selected, clicking **Add Modifier** displays a selection menu listing the available Modifiers.

Figure 8.1



The Modifiers for Editing an Object, by and large, are listed in the **Generate** category. This group of Modifiers are building tools that change the general appearance of, or automatically add new geometry to an Object.

Some Modifiers duplicate processes which are encountered in Editing Tools. For example; the Bevel Modifier performs the same action as the Bevel Tool.

To demonstrate the procedure for selecting and applying a Modifier to an Object the Bevel Modifier will be used.

In the 3D Viewport Editor have the default Cube Object selected in **Object Mode**.

Note: Modifiers can only be used with the selected Object in **Object Mode**

In the **Properties Editor** click the **Modifiers button , click Add Modifier,** then in the selection menu under **Generate** click on **Bevel**.

Clicking on **Bevel** displays the **Bevel Modifier Tab** in the **Properties Editor** and at the same time you will see that a bevel has been created on the Edges of the Cube in the 3D Viewport Editor.

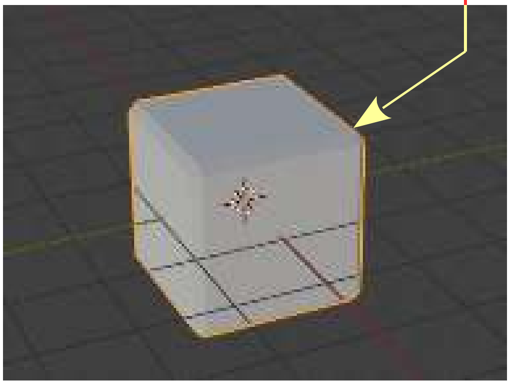
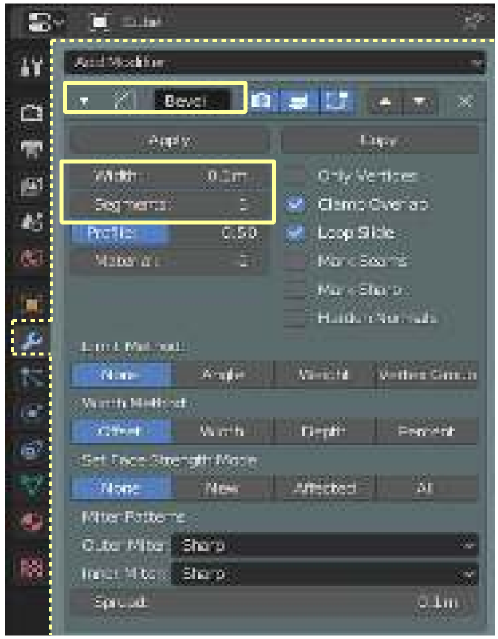
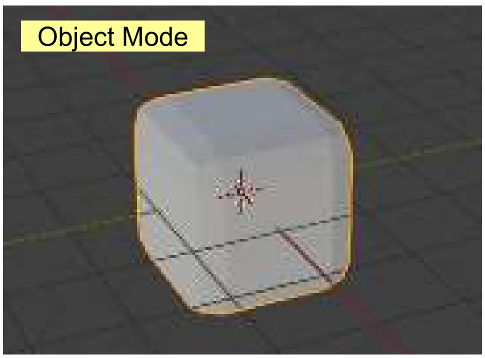


Figure 8.2



If you increase the Width value to 38cm and the Segments value to 2 the bevel in the 3D View Editor will be increased in size and rounded.

If you press the **Tab Key** and enter **Edit Mode** you will find that the Cube Object retains its original geometry with the default eight Vertices. You may alter the shape of the Object in Edit Mode and the bevel will still be displayed in Object Mode.



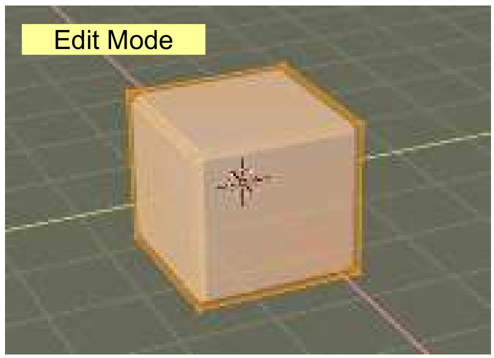
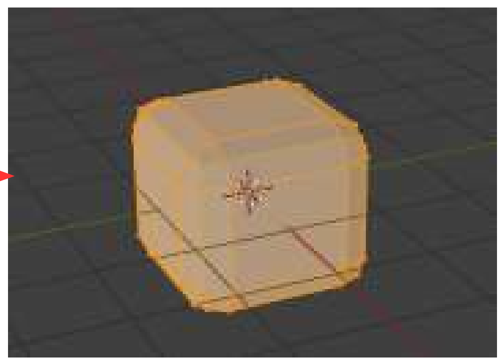


Figure 8.3

To permanently apply the bevel click the **Apply** button in the Modifier tab. In **Edit Mode** you will see that additional Vertices, Edges and Faces are created.

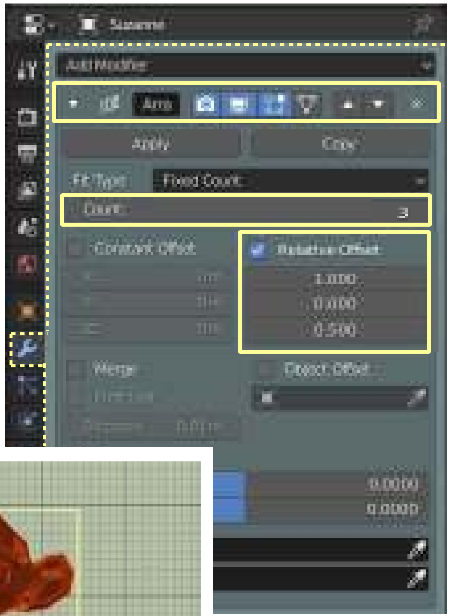


Note: If you use the Bevel Tool in Edit Mode then add a bevel Modifier in Object Mode you will be bevelling the bevel.

8.2 Array Modifier

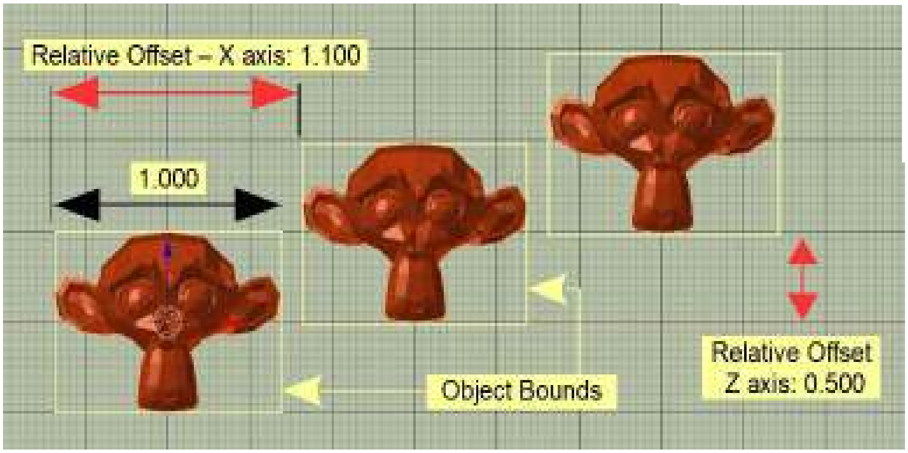
The **Array Modifier** creates copies of an Object, placing the copies in an array with each copy offset from the original. Figure 8.5 shows a **Monkey** Object in **Front Orthographic** view duplicated using an Array Modifier. To add the modifier select the Monkey in the 3DViewport Editor then in the **Properties Editor, Modifier buttons** click on **Add Modifier** and select **Array** from the menu.

Figure 8.4



To produce the arrangement shown in Figure 8.5 enter the **Relative Offset** values shown in Figure 8.4. The **Count: 3** value tells Blender to produce three Monkeys in the array (the original plus two).

Figure 8.5



The Offset is calculated using the **Object's bounds**. Every Object has a **Bounding Volume** which encapsulates its shape. You may view the Bound Volume by checking (tick) **Bound** in the **Properties Editor, Object buttons, Viewport Display Tab**.

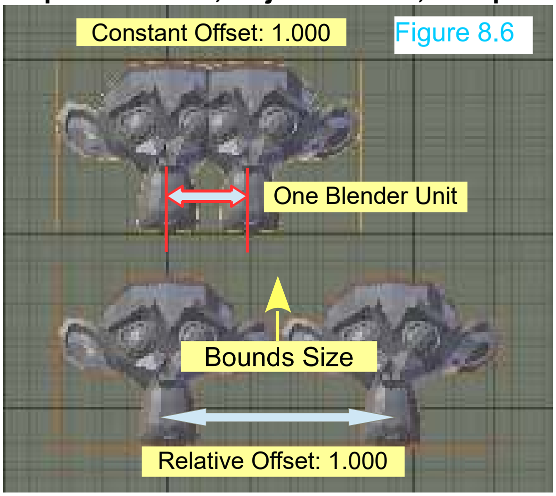


Figure 8.6

The Bound Volume may be viewed in a variety of ways. In the image above the **Bound Volume** is **Type: Box**.

The difference between relative and constant offset is shown in Figure 8.6. Constant offset one (1) means offset one Blender unit irrespective of the Object's size. The Monkey's center is offset one Blender unit which overlaps the display. Relative offset uses the **Bound** size (overall size) of the Object.

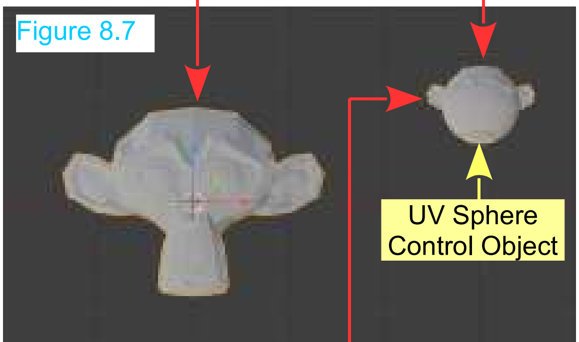
Object Offset: Uses the relative displacement of one Object to influence the displacement of another.

To use **Object Offset** position the **Control Object** in the 3D Viewport Editor (you can Translate, Rotate and Scale after adding the modifier if you wish). By default **Relative Offset is** checked (ticked) in the **Properties Editor, Modifier panel**. Uncheck and check Object Offset. Click in the bar below Object Offset and select your **Offset Object** (the Sphere) from the menu that displays (Figures 8.7, 8.8).

UV Sphere positioned and scaled to affect the Array Offset

Monkey Object in the 3D View Editor

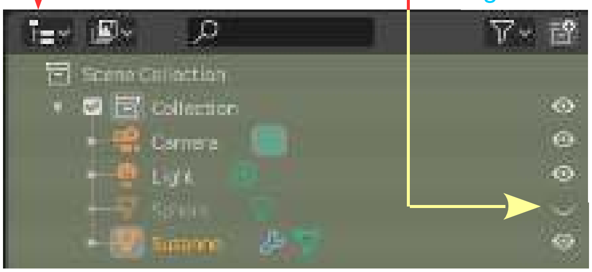
Properties Editor



Second Object in the Array scaled and positioned at the location of the UV Sphere.

To hide the UV Sphere from view, in the Outliner Editor, click the Eye Icon

Figure 8.9



Increasing the Count Value in the Array Modifier panel duplicate Objects. As demonstrated, when using Object Offset, the duplicated Object is positioned and Scaled accordingly. Increasing the Count Value in the Modifier will replicate the original Object, repositioning and Scaling exponentially. Any modification made to the Control Object will be reflected in the duplications. (see Figure 8.10 over).

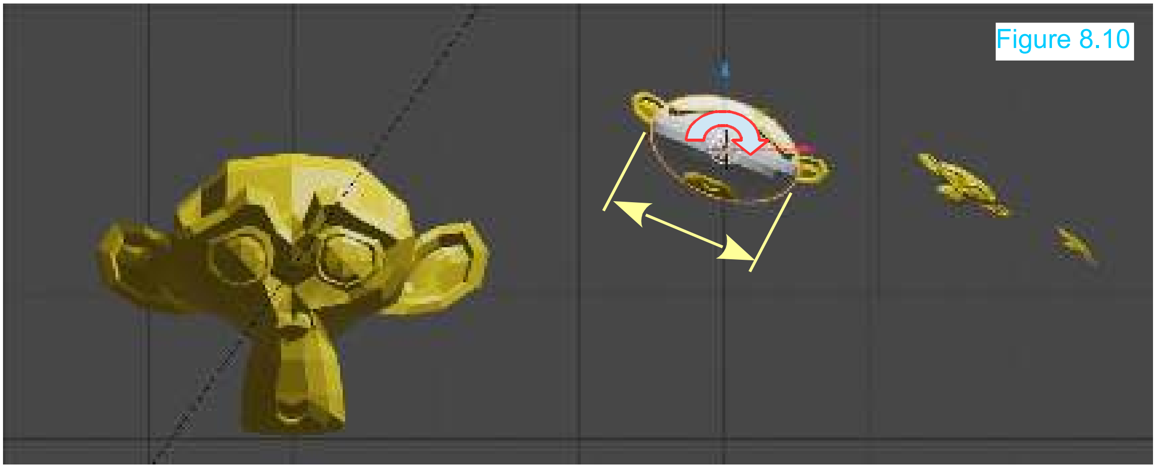


Figure 8.10

Figure 8.10 shows the Array with the Count Value in the Modifier increased to 4 and with the UV Sphere Control Object Scaled on its X Axis and Rotated.

8.3 Boolean Modifier

Boolean Modifiers are used to create shapes by adding or subtracting one Object from another. In the Modifier panel there are three options: **Difference**, **Intersection**, and **Union.**

To demonstrate the different operations position a UV Sphere Object with the default Cube as shown in Figure 8.11. Scale the sphere down to fit inside the top face of the cube.

The arrangement of cube and sphere will be used for all three Boolean operations.

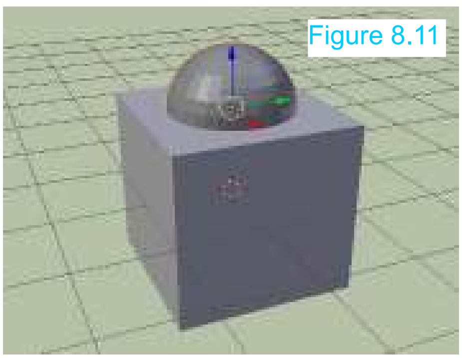


Figure 8.11

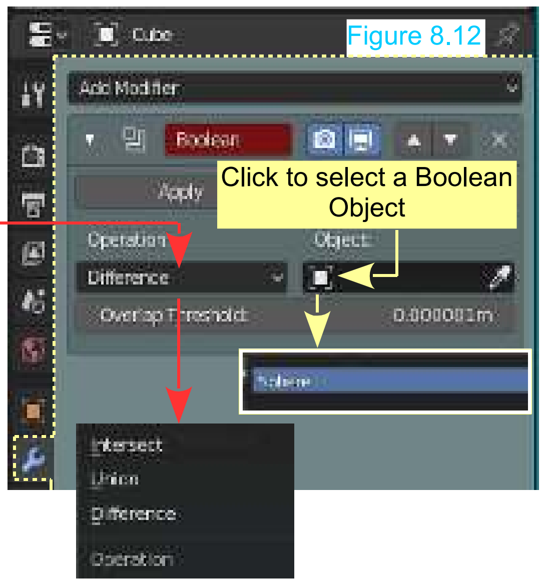
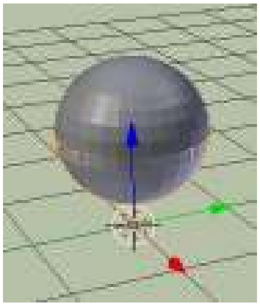


Figure 8.12

Click to select an Operation Type.

The procedure for a Boolean Operation is as follows; select the Cube. Add the Modifier. Select the Operation Type. Select the Boolean Object. Click Apply (Figure 8.12)

Boolean Intersect



The part of the Cube intersected by the Boolean Object (the Sphere) is separated as a New Object

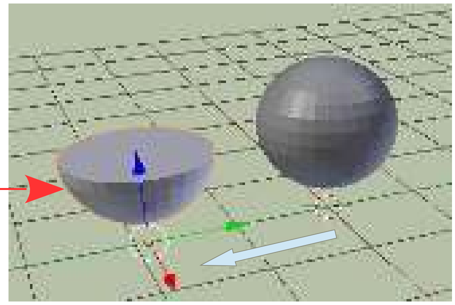
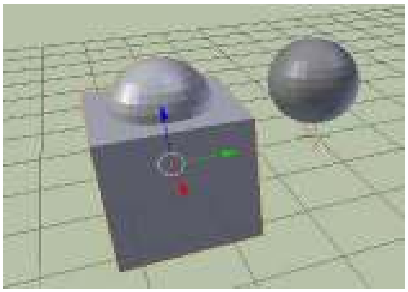


Figure 8.13

Boolean Union



Union: The surfaces of the two Objects are joined.

Note: The lower part of the Sphere inside the Cube does not exist after Union.

Boolean Difference

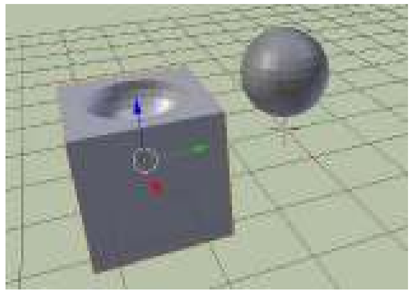


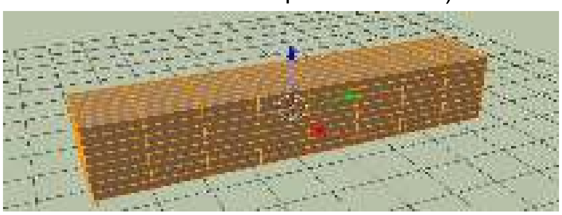
Figure 8.14

Difference: The part of the Boolean Object (the Sphere) overlapping the Cube forms a dish in the surface of the Cube.

8.4 Build Modifier

The **Build Modifier** creates the effect of something building linearly over a period of time. Any Object can have a build modifier, but to see a nice effect, a high vertex count is required.

In the 3D Editor, Scale the default Cube on the Y axis, Tab to **Edit mode** and Subdivide the surface (select Edge in the 3D View Editor Header and click Subdivide – Increase the Number of Cuts value in the Last Operator Panel).



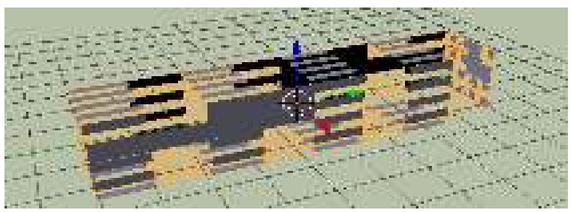


Figure 8.15

Tab back to **Object mode** and add a Build Modifier. **The Object disappears from view.** LMB click and hold on the blue Cursor in the **Timeline Editor** and Drag (Scrub) to see the elongated Cube being reconstructed (Figure 8.15). When you have the build where you want it apply the Modifier. Checking (ticking) **Reversed** in the Modifier panel reverses the build process.

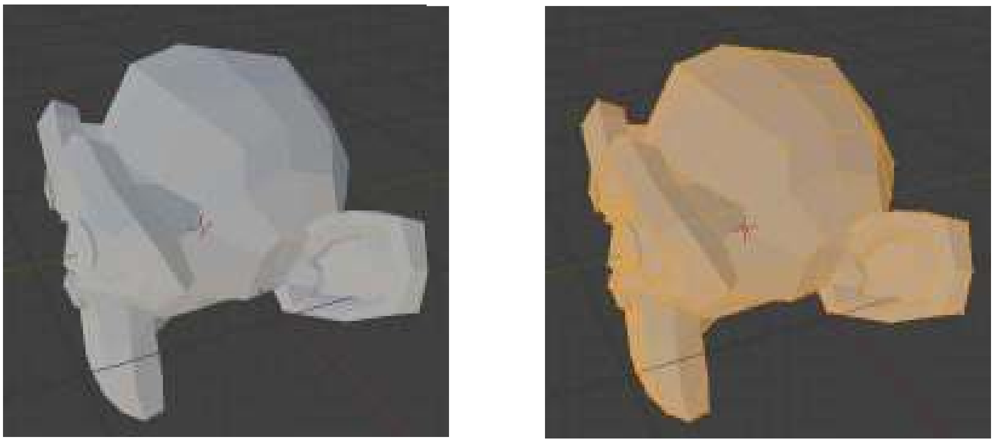
8.5 Decimate Modifier

When a mesh Object has been created using complex modeling, you may well have an Object with many vertices and , therefore, a high Vertex Face count. Blender uses the Vertex/Face count to calculate such things as shading effects. This should not be confused with the Vertices and mesh Faces in the actual construction of a model. The Vertex/Face count is, in effect, triangulation within mesh Faces.

Using the Decimate Modifier is a quick and easy way of reducing the Vertex/Face count.

To demonstrate Decimation start with the default blender Scene, delete the Cube Object and add a **Monkey**. The Monkey is a reasonably complex shape consisting of numerous Faces and Vertices.

Figure 8.16



Object Mode Edit Mode

In Object Mode the shape of the Monkey is representative of the Vertices you see in Edit Mode.

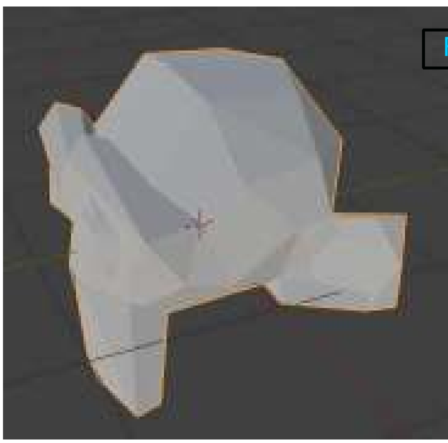
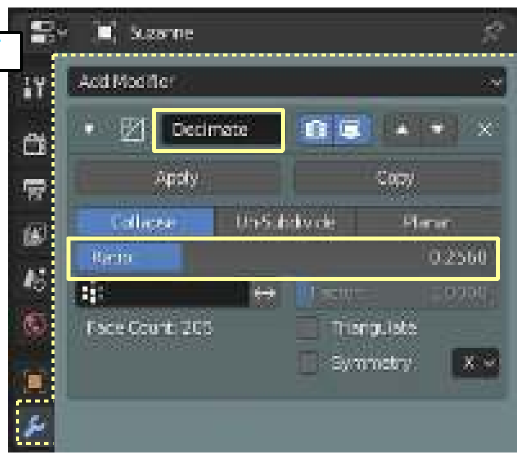


Figure 8.17



Applying a Decimate Modifier and reducing the Ratio value to approximately 0.25 significantly alters the shape in the 3D View Editor (Figure 8.17).

Subdividing the Mesh in Edit Mode with Number of Cuts 10 creates many Vertices.

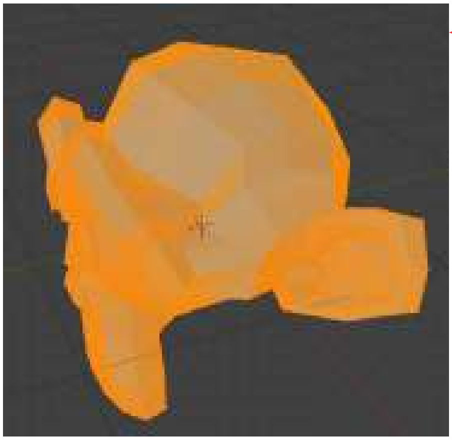
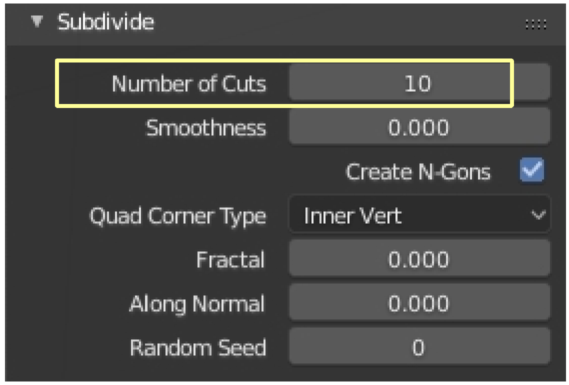


Figure 8.18

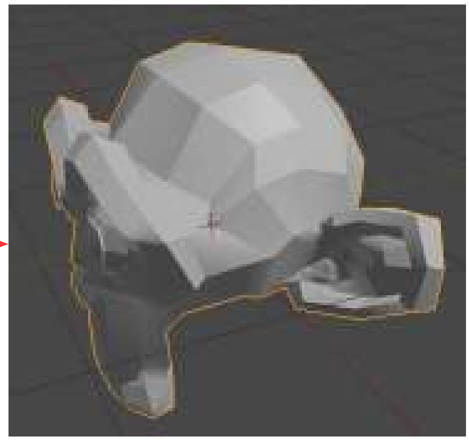
Last Operator Panel



Reducing the Ratio Value to 0.255 in the Decimate Modifier when there are many Vertices reduces the Face Count for generating Shading Effects.

Reducing the Face Count in this case has no appreciable effect on the display in the **3D View Editor** or in a rendered image.

Figure 8.19



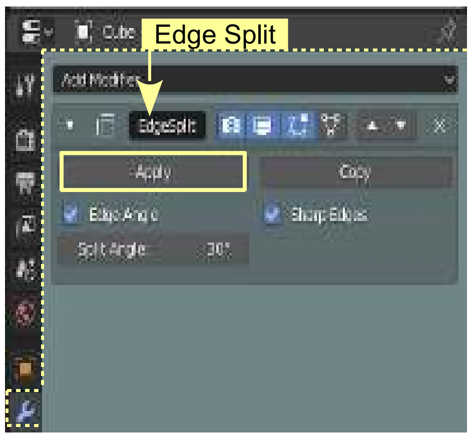
8.6 Edge Split Modifier

The **Edge Split Modifier** allows you to split an Object apart by selecting Vertices, Edges, or Faces.

In **Object Mode** with the Cube selected, add an **Edge Split Modifier** and click **Apply**

Make sure you click Apply

Figure 8.20



Tab to **Edit mode.** Select a **Face**. Use the **Move Tool Widget** to pull the Face away from the Cube.

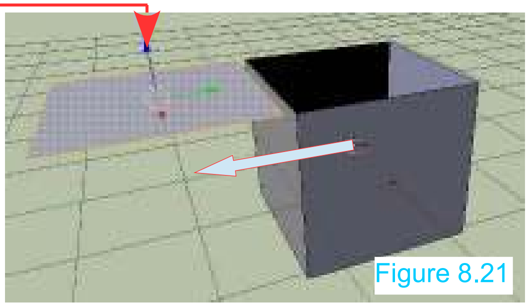


Figure 8.21

The Face remains part of the Object even though it is separated.

Selecting an Edge will open a face like the lid on a box (see **Rip Region Tool** Chapter 6 - 6.21)

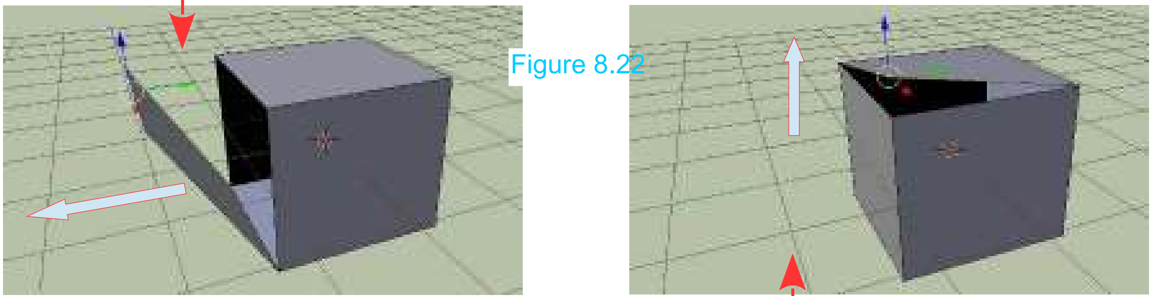


Figure 8.22

Selecting a **Vertex** will allow a corner to be moved.

8.7 Mask Modifier

The **Mask Modifier** allows you to limit what part of a mesh displays in the 3D View Editor or renders. The part of the mesh is defined by a **Vertex Group** (see Chapter 5 – 5.9). Add a **UV Sphere** to the Scene. In **Edit Mode** select Vertices (Figure 8.23x). Leave the Vertices selected.

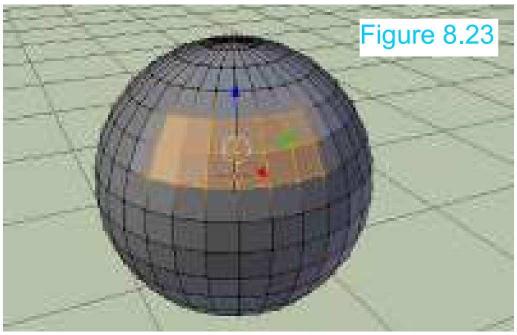


Figure 8.23

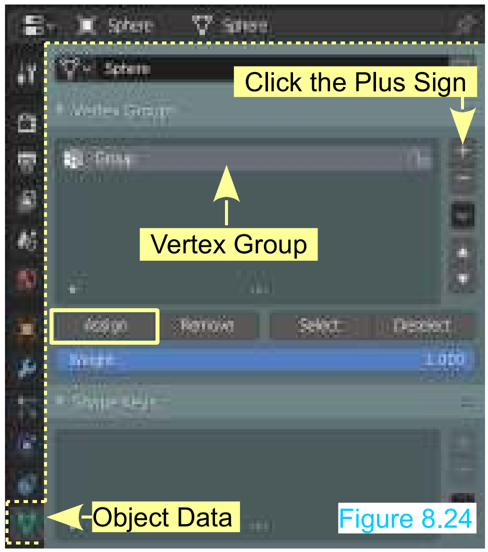


Figure 8.24

In the **Properties Editor, Object Data buttons, Vertex Groups Tab** (Figure 8.24) click the **Plus sign** to create a Vertex Group

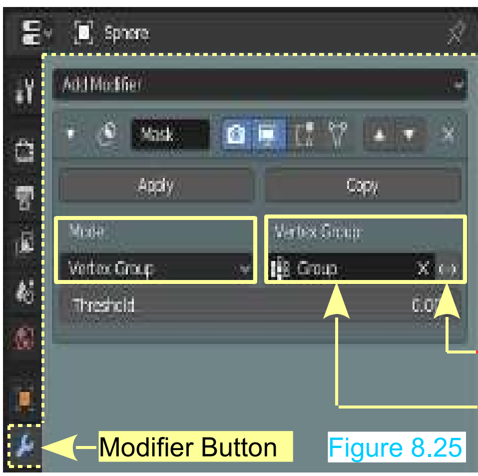


Figure 8.25

Click the **Assign button** to assign the vertices to the Group. **Note:** The vertex group is named **Group**.

Switch to the **Modifiers buttons** (Figure 8.25) click **Add Modifier** and select the **Mask Modifier**. The **Mode** should be **Vertex Group**.

Click the **Double Headed Arrow** to **Invert** the display.

Click in the **Vertex Group bar** and select the Vertex Group named **Group** from the menu.

In the **3D Viewport Editor** in **Object Mode** only the part of the Cube defined by the Vertex Group is displayed (Figure 8.26).

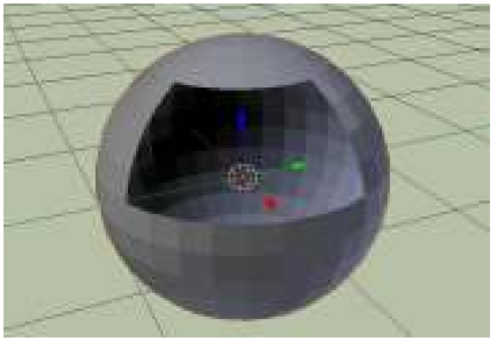
In the bottom right hand corner of the Mask Modifier panel click the **Double Headed Arrow** button and the complete Object less the area defined by the Vertex Group is displayed (Figure 8.27).

By using the modifier, visibility can be controlled without removing any Vertices from the UV Sphere.

Figure 8.26

3D Viewport – Object Mode

Figure 8.27



8.8 Mirror Modifier

The **Mirror Modifier** allows the construction or deformation of a mesh on one side of a centre point to be duplicated (mirrored) on the opposite side.

Add a **UV Sphere** to the Scene in **Top Orthographic View**. Tab to Edit Mode, deselect the Vertices. **Have Toggle X Ray on,** then B key (Box Select) and drag a rectangle to select one half of the Sphere's Vertices (Figure 8.28, 8.29). Press **X Key** to delete the selected Vertices (Figure 8.30).

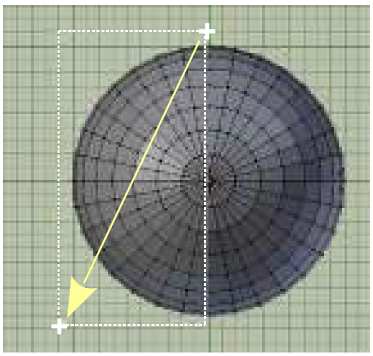


Figure 8.28

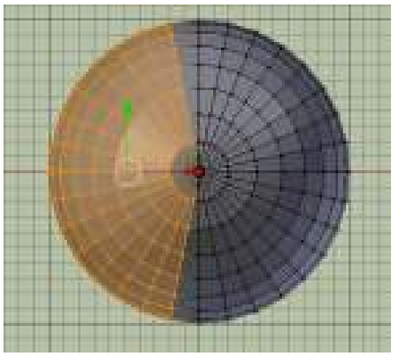


Figure 8.29

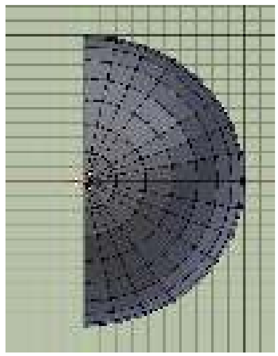


Figure 8.30

Tip: Don't forget to turn **Toggle X-Ray** on in the 3D Viewport Editor Header before dragging the rectangle.

In **Object Mode** (with the half sphere selected), in the **Properties Editor, Modifier buttons** add a **Mirror Modifier**. The deleted half of the UV Sphere will be reinstated in the 3D View Editor (Figure 8.31).

In **Edit Mode** you will see that vertices exist only on one side of the sphere (Figure 8.32).

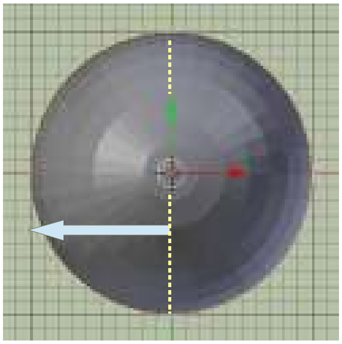


Figure 8.31

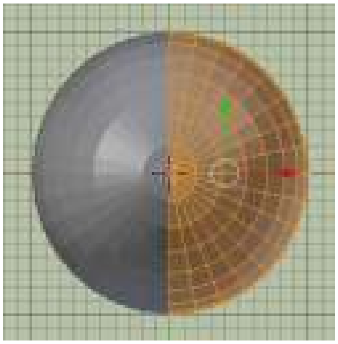


Figure 8.32

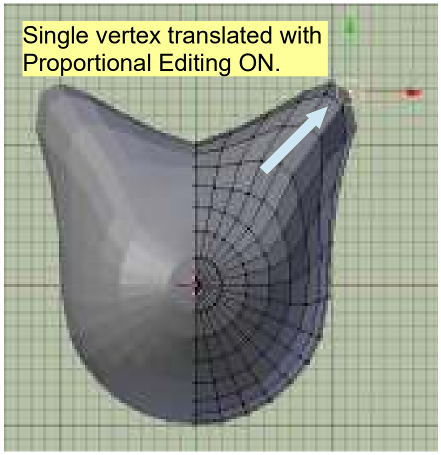


Figure 8.33

Select and Translate a single Vertex and you see that the mesh on the opposite side is duplicated (mirrored) (Figure 8.33).

When the Modifier is applied (click **Apply** in the Modifier Panel) Vertices are created on the mirrored side (Figure 8.34).

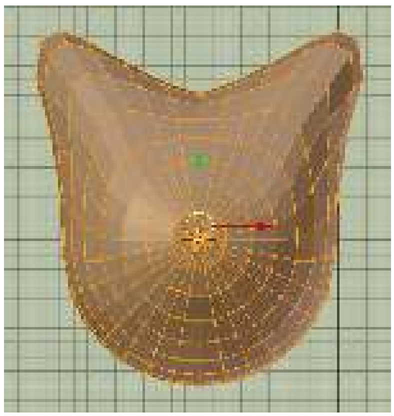


Figure 8.34

Note: By default the mirror takes place either side of the X Axis. You may elect to mirror on the Y or Z Axis.

Figure 8.35

In the center of the Mirror Modifier panel you will see **Mirror Object**. Placing an Object in the Scene and entering the name of this Object in the Mirror Object Bar causes the mirror to be about the centerline of the new Object instead of the centerline of the original Object (Figure 8.35, 8.36, 8.37).

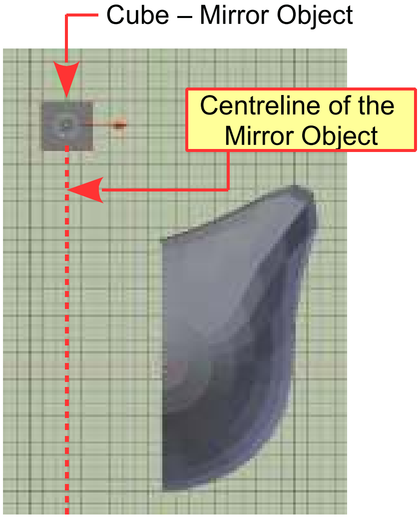


Figure 8.36

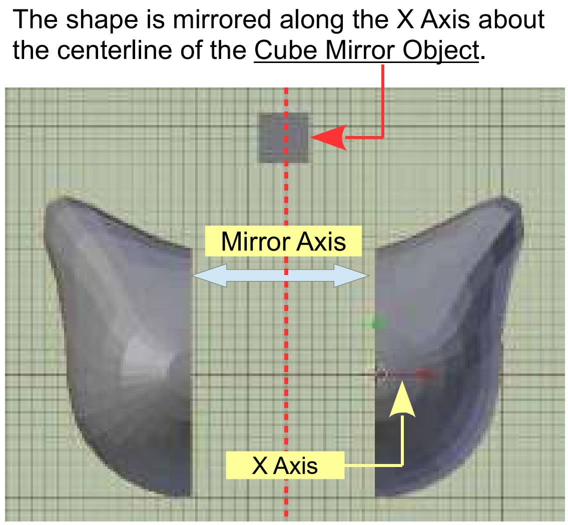


Figure 8.37

8.9 Multiresolution Modifier

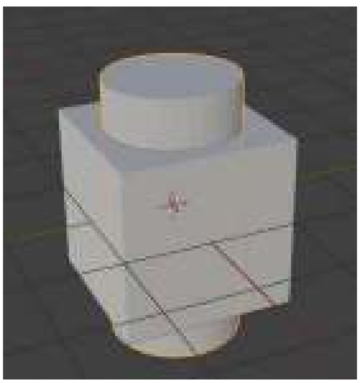
The **Multiresolution Modifier** is designed to be used with the **Sculpt Tool** (Chapter 11 –11.4, 11.5).

8.10 Remesh Modifier

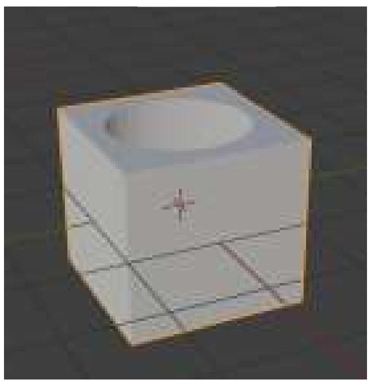
The **Remesh Modifier** allows you to recalculate how a Mesh Surface is constructed. Some basic mesh shapes do not provide sufficient Vertices, Edges and Faces to allow detailed modeling.

To demonstrate, use a Cylinder Object to cut a hole through the default Cube Object by applying a **Boolean Difference Modifier**.

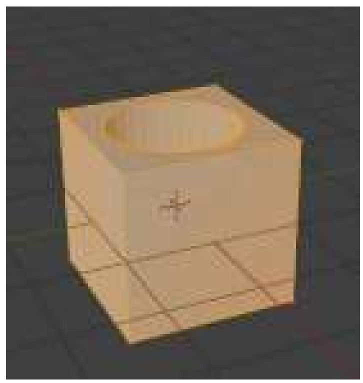
Figure 8.38



Cylinder scale down and extended on the Z Axis.



The Boolean Difference Modifier Applied.



Edit Mode showing the Mesh construction

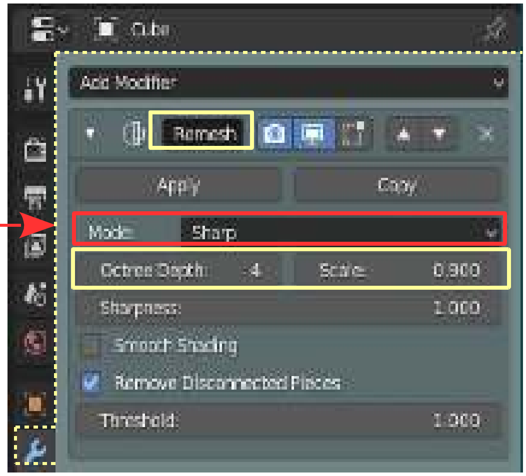
When the Boolean Modifier is applied you see a minimal mesh construction which limits any detailed modeling. To increase the Vertex count apply a **Remesh Modifier.**

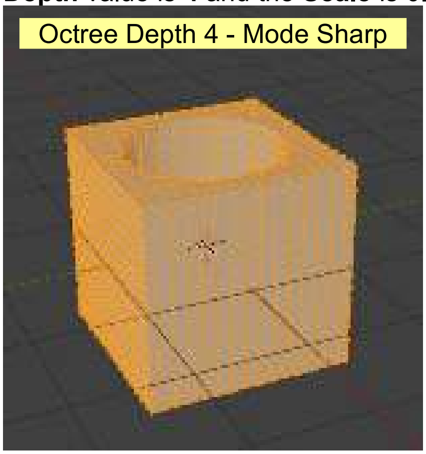
Remember: To apply a **Modifier** to an **Object** it must be in **Object Mode.**

With the Cube selected in Object Mode add a Remesh Modifier. In Object Mode there is no change.

Note: In the Modifier Panel the default **Octree Depth** value is **4** and the **Scale** is **0.900**.

Figure 8.39





Note: Three Modes

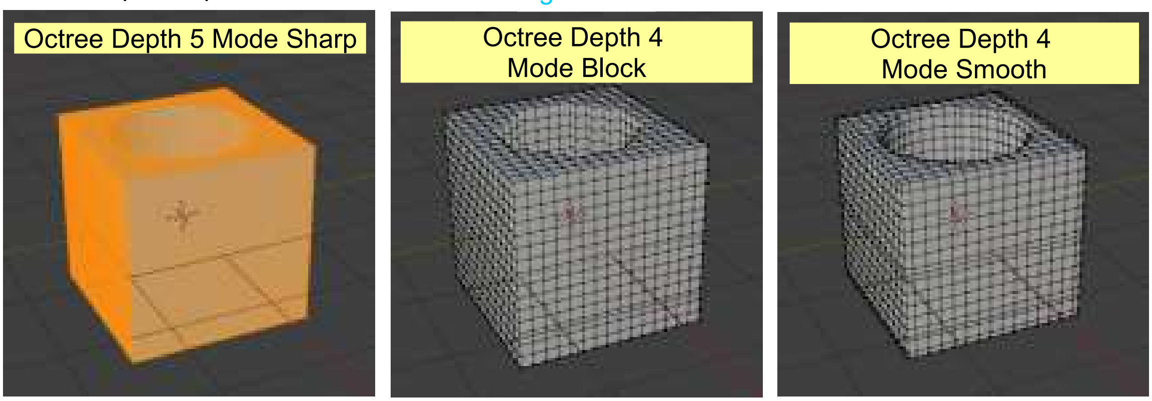
Figure 8.40

With the default values, when the Modifier has been Applied (click the Apply button) the Mesh surface of the Cube **in Edit Mode** shows a significant increase in the number of Vertices, Edges and Faces (Figure 8.40).

When the Modifier is Applied the Modifier Panel is cancelled. To adjust the Octree and Scale values press **Ctrl + Z Key** to undo and step back through the operations until the panel is reinstated. Increasing the Octree Depth significantly increases the number of Vertices on the Mesh. Even increasing from 4 to 5 has a dramatic effect.

Be Warned: Increasing to 6 - 7 - 8 will exponentially increase the Vertex Count and seriously affect computer speed.

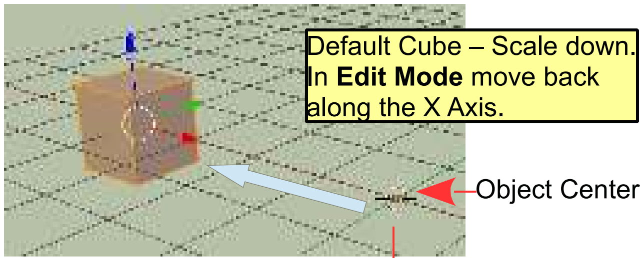
Figure 8.41



8.11 Screw Modifier

The **Screw Modifier** generates a spiral shape by revolving a profile around an Axis. To demonstrate, construct a coil spring from the default Cube object.

All operations are conducted in the default **3D Viewport Editor, User Perspective view**. Follow the steps below.



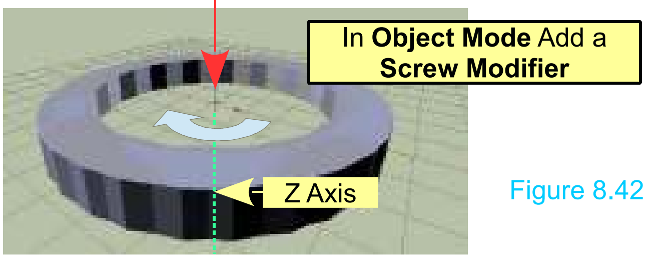
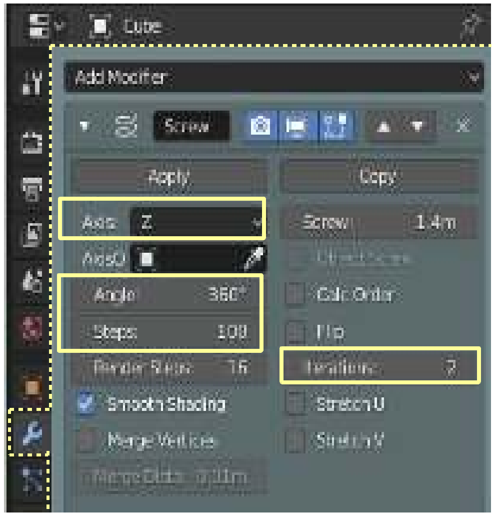
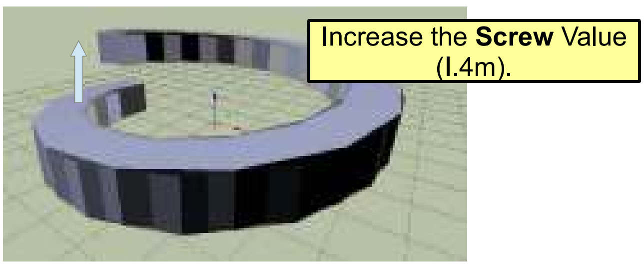


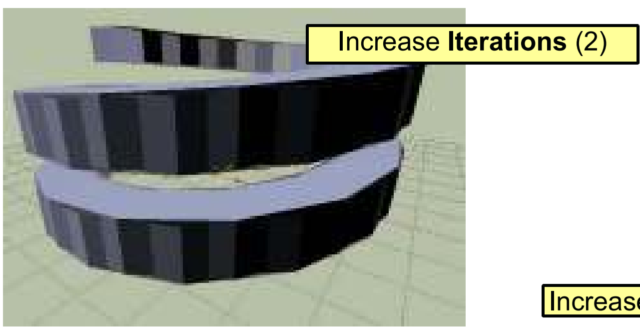
Figure 8.42

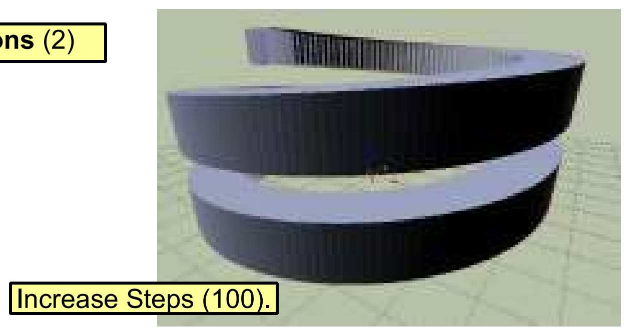


Screw Modifier Panel



By default the Screw Modifier is set to revolve about the **Z Axis**. You may change this to either the X or Y Axis.





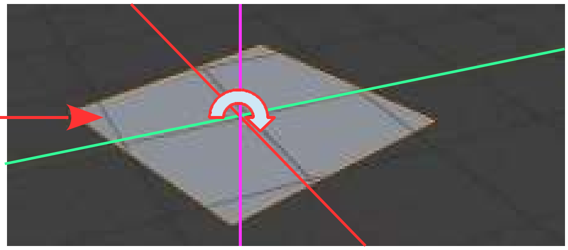
8.12 Skin Modifier

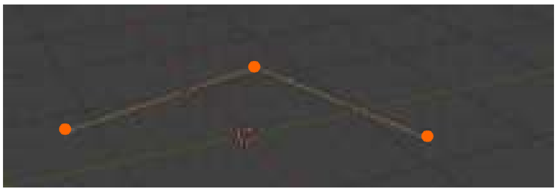
The **Skin Modifier** allows you to create a three dimensional shape from a basic stick arrangement consisting of a minimal number of Vertices. To demonstrate how this is achieved have a Plane Object in the 3D Viewport Editor. The Plane is a simple Object with four Vertices, four Edges and one Face.

Rotate the Plane about the Z Axis. This simply moves the Edges of the Plane away from the background grid lines to improve visibility when in Edit Mode.

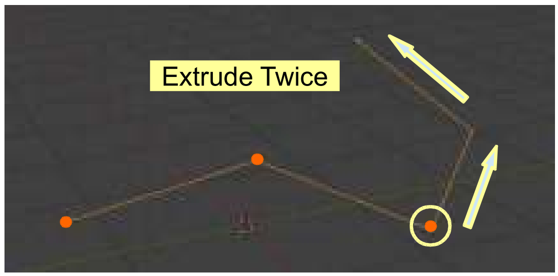
Figure 8.43

Background Grid Line



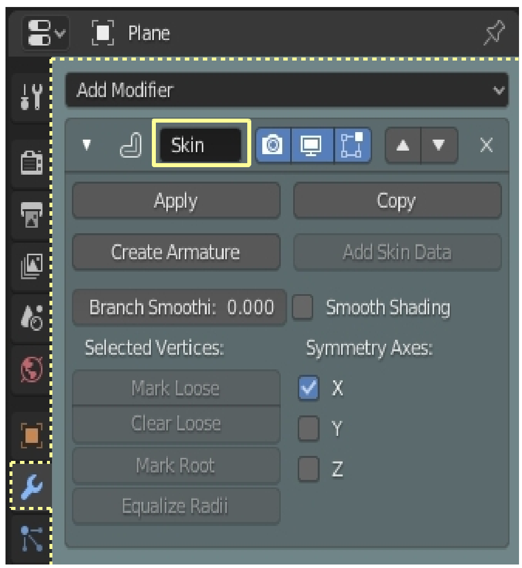


In **Edit Mode** delete one Vertex leaving two Edges (the basic stick arrangement).



Select one Vertex and extrude twice. Remember; the original Edges are located on the X – Y Axis of the Scene. The two new Edges will be drawn in a plane passing through the center of the Scene normal to the computer Screen.

Figure 8.44



In Object Mode, with the stick figure selected, add a **Skin Modifier** and **click Apply** to produce the solid shown in Figure 8.45.

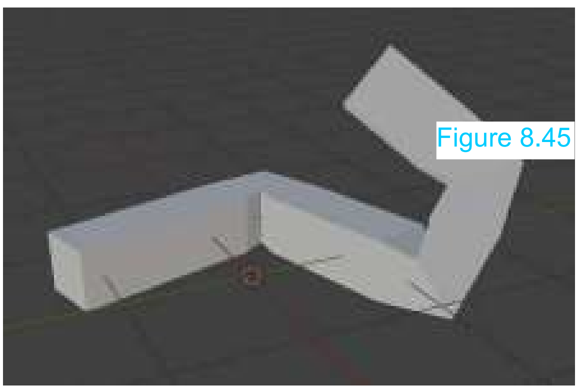


Figure 8.45

In essence the procedure entails Extruding Vertices from a simple Object to form a rudimentary stick shape in Edit Mode. The Skin Modifier is then added to the shape in Object Mode. The Modifier creates a cage around the stick which converts to a Mesh Object when the Modifier is applied.

At this point, note the distinction between **Adding the Modifier** and **Applying the Modifier**. You add the Modifier in the Properties Editor, Modifier buttons by clicking the Add Modifier button and selecting from the menu. The Modifier panel displays where you adjust values to affect the selected Object in the 3D Viewport Editor. When adjustments are complete you Apply the Modifier by clicking the Apply button in the Modifier panel.

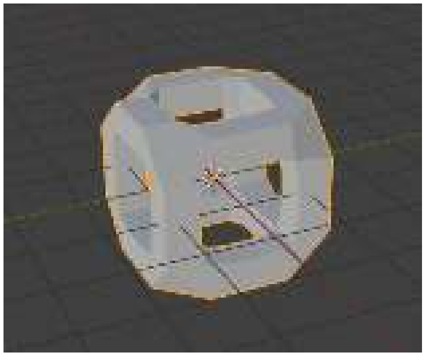
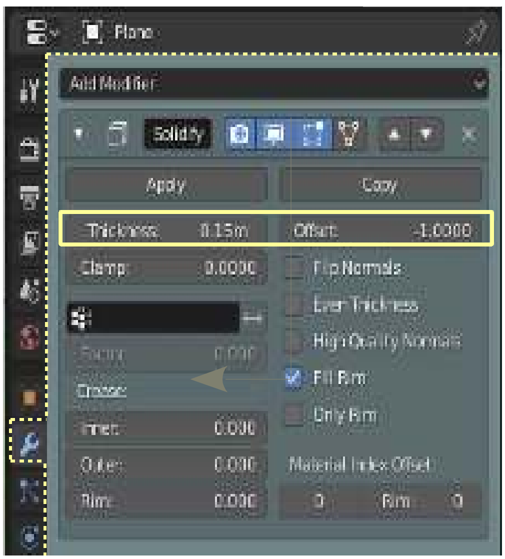


Figure 8.46

Skin Modifier Applied to the default Cube

8.13 Solidify Modifier

Figure 8.47



The **Solidify Modifier** provides a tool for creating solid Objects from thin-walled Objects. To demonstrate this, begin with a simple Plane Object selected in the 3D Viewport Editor. Add a **Solidify Modifier** in the **Properties Editor.**

Look closely at the plane and you will observe that it now has a thickness (Figure 8.48).

In the Modifier panel you will see **Thickness** 0.15m and **Offset** -1.0000.

Thickness is the thickness of the surface. Increasing this to 10 cm will give a better view (Figure 8.49).

The Offset value range is -1.0000 to +1.000 which places the Thickness below or above the mid-plane. Offset 0.0000 has the Thickness straddling the mid-plane.

Tab to **Edit mode** and see that the original vertices of the plane object remain on the mid-plane of the Scene.

Figure 8.48

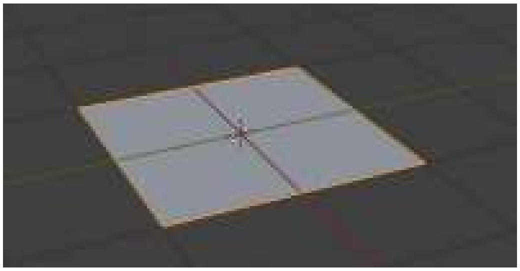
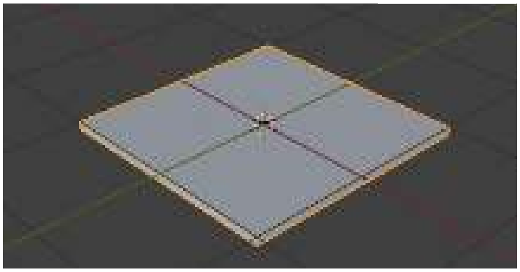


Figure 8.49



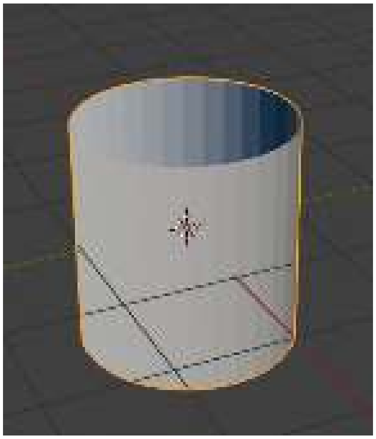
For a practical demonstration of how to use the **Solidify Modifier**, create a new Scene with a **Cylinder** object instead of the default Cube. Delete the upper face of the Cylinder. You now have a thin-walled container (Figure 8.50). In Object mode add a **Solidify Modifier** and increase the thickness value from 0.01m (1.0 cm) to 0.1m (10 cm) . The container will have wall thickness (Figure 8.51).

Note: Dimensions in Blender are proportional. A wall thickness of 0.01m (1.0cm) gives a thin wall thickness considering that the default overall dimensions of the Cylinder are 2m in diameter by 2m high (press the N Key to see Dimensions).

With Offset -1.0000 the wall thickness is created inside the original surface of the Cylinder. Offset +1.0000 creates the thickness outside the original surface.

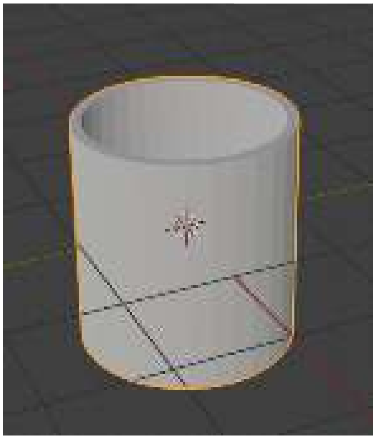
In Edit Mode you see the original Vertices, Edges and Faces are unchanged until you click Apply in the Modifier Panel with the Cylinder in the 3D View Editor in Object Mode

Figure8.50



Original Cylinder – Top Face Deleted

Figure 8.51



Cylinder – Solidify Modifier Added
Thickness 0.1m (10cm)

8.14 Subdivision Surface Modifier

The Subdivision Surface Modifier subdivides the surface of an Object adding Vertices, Edges and Faces giving the surface of the Object a smoother and rounded appearance. The additions also allow more detail to be modeled.

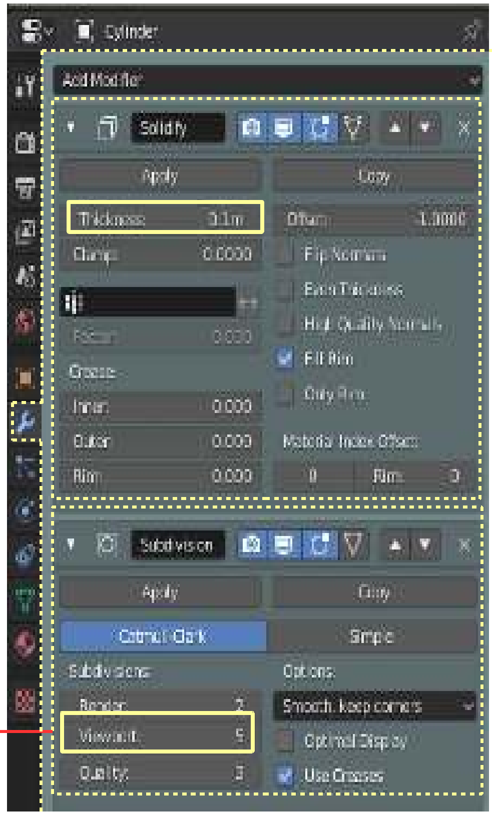


Figure 8.52

To demonstrate, use the container created in the previous exercise (Figure 8.51) and with the Solidify Modifier in place (**NOT Applied**) add a Subdivision Surface (Subserf) Modifier.

In the Subserf Modifier panel increase the Subdivisions – **Viewport** value to: 5 (Figure 8.53).

Figure 8.53

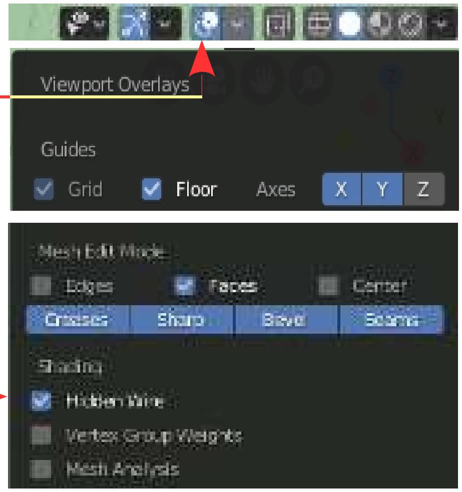
Note: At this point neither the Solidify Modifier or the Subserf Modifier have been applied. The Apply button, in both cases, has **NOT** been activated. The Modifiers display their effects in the 3D Viewport Editor but placing the Cylinder Object in Edit Mode shows that the original Vertices, Edges and Faces remain.

Figure 8.54

To demonstrate the previous statement a little cheating has taken place. A new Cylinder has been added to the Scene superimposed over the original.

The new Cylinder has been placed in **Edit Face Select Mode** then, **Overlays** in the 3D Viewport Editor Header have been activated and **Hidden Wire** checked.

Figure 8.55

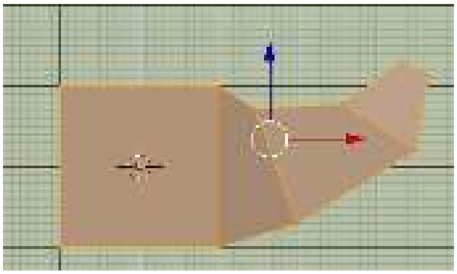


Edit Mode Overlay Preferences

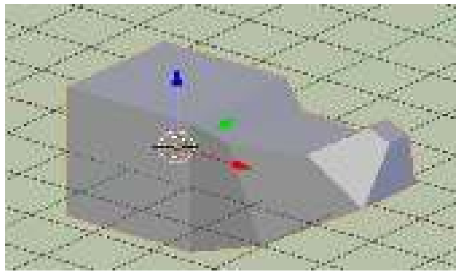
Lower part of the Overlay Preferences

Hidden Wire checked allows you to see Objects behind the selected Object

Another simple example using the Subsurf Modifier forms something like a whale's tooth (Figure 8.56).

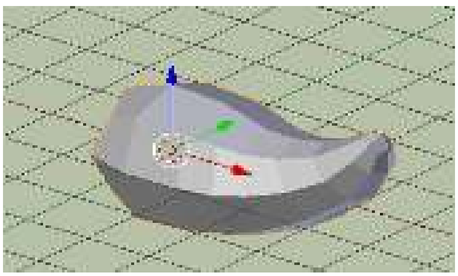


Cube Extruded – Edit Mode

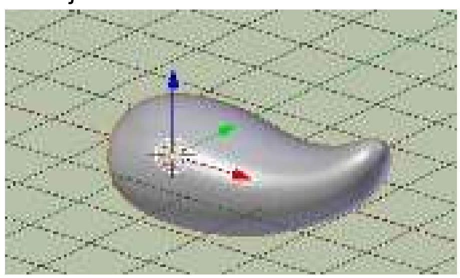


Object Mode – 3D View Rotated

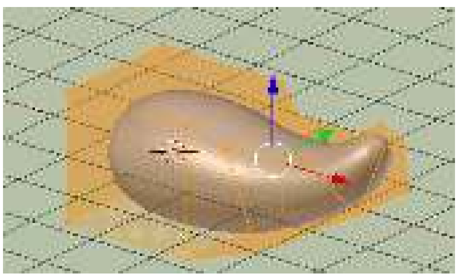
Figure 8.56



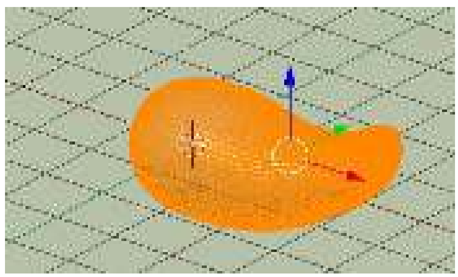
Object Mode – Subserf Added



Subdivision View Value : 4



Edit Mode – Show Original Mesh



Modifier Applied – New Mesh Created

8.15 Triangulation Modifier

A **Triangulation Modifier** is added when a mesh model has been subdivided and Vertices added producing fine detail in a model. The Modifier ensures that triangulation will remain consistent when exporting or rendering.

If the model is animated using armatures the modifier should be placed in the modifier stack before (above) the armature modifier.

The Triangulation Modifier is also used when baking prior to exporting and importing.

8.16 Wireframe Modifier

The **Wireframe Modifier** converts a solid display as seen in **Solid Viewport Shading** to **Stick** or **Wireframe** display.

With the modifier added to a **Cube** object, instead of a solid Cube, you see a frame where the edges of the Cube have thickness (Figure 8.57).

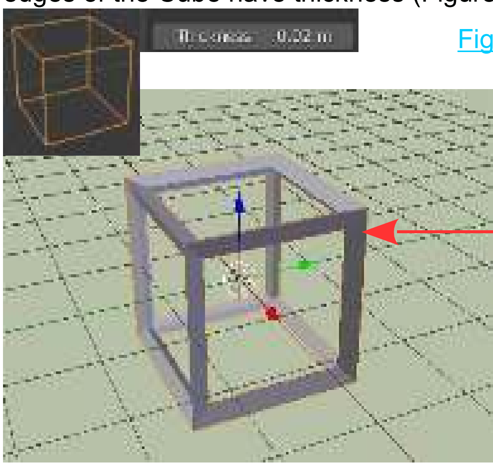
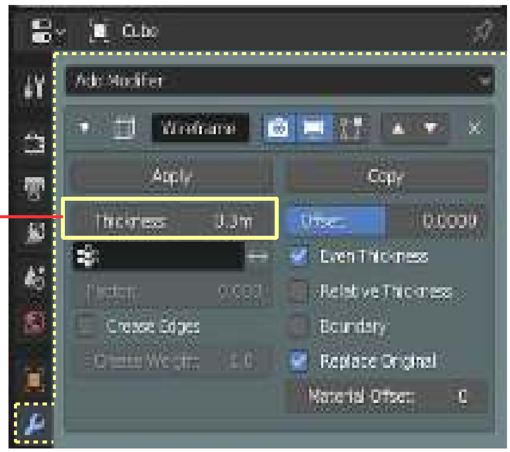


Figure 8.57



The Whale's Tooth from the previous example with a Wireframe Modifier added (Figure 8.58).

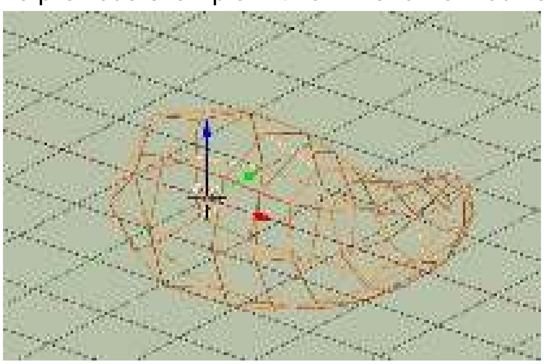


Figure 8.58

9

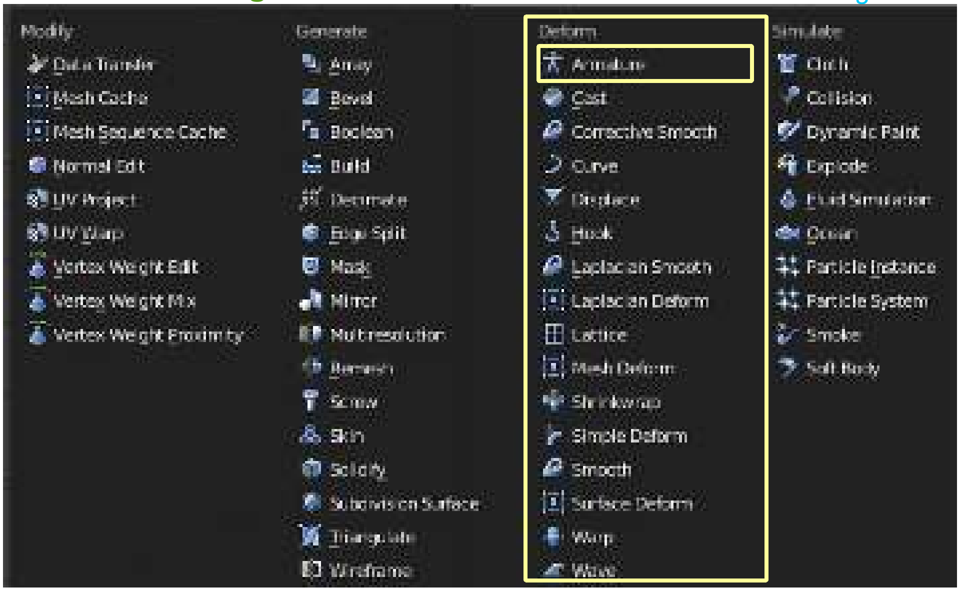
Editing with Deform Modifiers

9.1 Modifiers - Deform
9.2 Armature Modifier
9.3 Cast Modifier
9.4 Corrective Smooth Modifier
9.5 Curve Modifier
9.6 Displace Modifier
9.7 Hook Modifier
9.8 Laplacian Deform Modifier
9.9 Lattice Modifier
9.10 Mesh Deform Modifier
9.11 Shrinkwrap Modifier
9.12 Simple Deform Modifier
9.13 Smooth Modifier
9.14 Smooth Corrective Modifier
9.15 Smooth Laplacian Modifier
9.16 Surface Deform Modifier
9.17 Warp Modifier
9.18 Wave Modifier

The Deform group of Modifiers change the shape of an Object without adding new geometry, and are available for meshes, texts, curves, surfaces and/or lattices.

9.1 Modifiers for Editing - Deform

Figure 9.1



The Deform group of Modifiers generally provides tools for modifying or deforming a mesh Object as a whole. Some of these modifiers require a knowledge of other Blender features and will, therefore, be described in conjunction with the feature as it is encountered.

9.2 Armature Modifier

Armatures in Blender are Objects used for manipulating and posing other Objects such as models of characters. Posing is the technique used when animating figures. The **Armature Modifier** is discussed in conjunction with Armatures and Character Rigging in Chapter 20.

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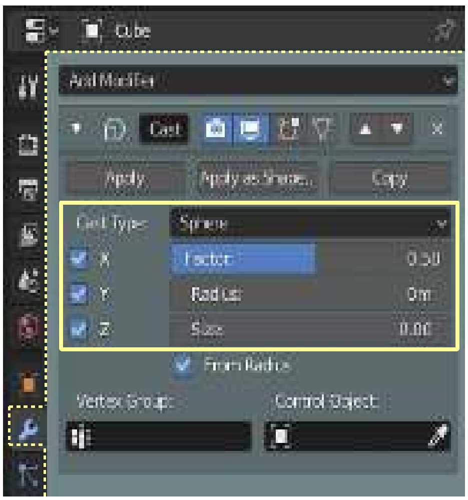
9.3 Cast Modifier

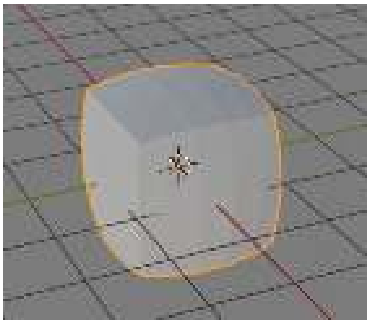
Figure 9.2



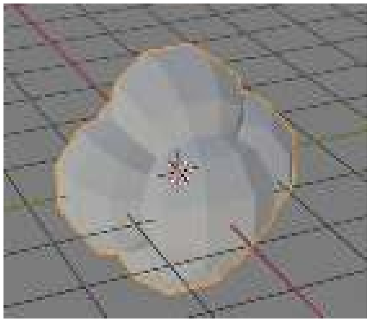
The **Cast Modifier** is used to deform a primitive Object such as the Cube Object in the default Scene.

Select the Cube Object. In **Edit Mode,** Subdivide (number of cuts 4) (Chapter 5 – 5.4) then **Tab** back to **Object mode**.

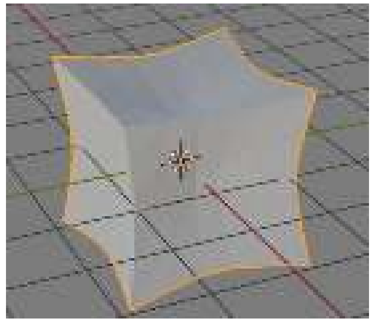
In the **Properties Editor, Modifier button** add a **Cast Modifier** (Figure 9.2). By changing the **Cast Type**, altering the **Factor**, **Radius** and **Size** values and or limiting the effects to the X,Y and Z axis the deformation of the cube is controlled.



Default Cube
Subdivided Four Times
Cast Modifier Added
Type Sphere Factor: 0.50



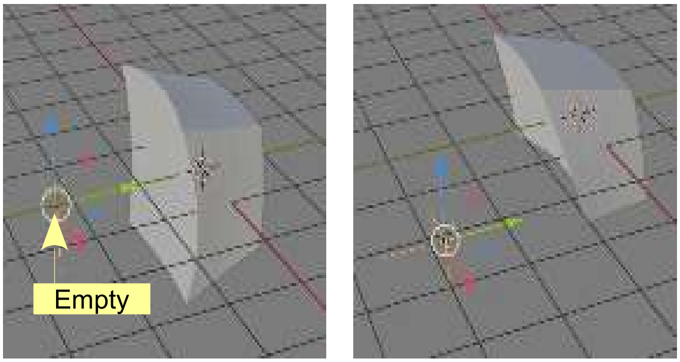
Cast Type: Sphere
Factor: 2.000



Cast Type: Sphere
Factor: -2.000

Figure 9.3

The deformation may also be controlled by introducing a **Control object** (Figure 9.4).



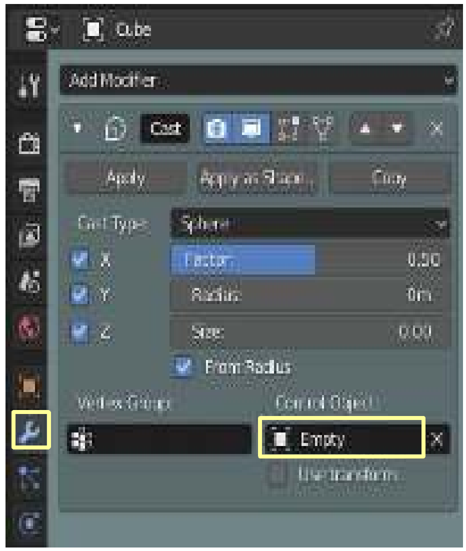


Figure 9.4

With the default Cube subdivided, deselect the Cube and place an **Empty Object** in the Scene. Add a **Cast Modifier** to the **Cube** and then click on the **Control Object** (cube icon) and select **Empty** from the menu to enter the **Empty** as the **Control Object**.

Move the Empty in the Scene to see the Cube being deformed.

Experiment with the Cast Type, the X,Y and Z axis settings and Factor, Radius and Size values. Keep in mind that the Empty Object may be animated to move in the Scene thus animating the deformation of the Cube.

9.4 Corrective Smooth Modifier

The **Corrective Smooth Modifier** is primarily designed to smooth incorrect mesh deformation which can occur when Armatures are used to deform a mesh. See Chapter 20.

9.5 Curve Modifier

The **Curve Modifier** uses the shape of a Curve to deform a mesh. Figure 9.5 shows the default Blender Scene with the Cube Scaled down, then Scaled along the Y Axis (S Key + Y Key) and Subdivided in Edit Mode with Number of Cuts = 10.

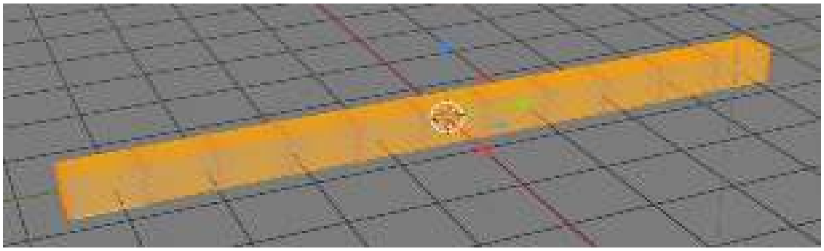


Figure 9.5

In **Object Mode** the elongated Cube is deselected and a **Bezier Curve** added (Chapter 10 – 10.2). The **Curve** is rotated and scaled up to match the length of the Cube (Figure 9.6).

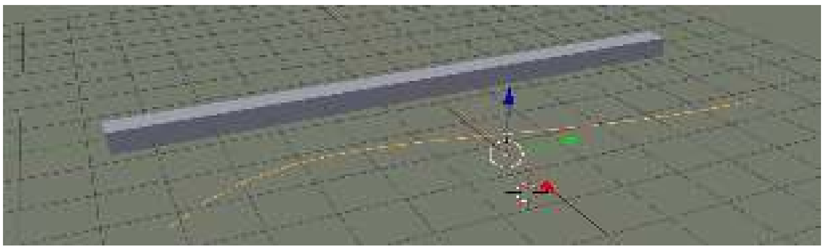


Figure 9.6

Deselect the Curve and **select the Cube**. Be in **Object Mode** and add a **Curve Modifier.** Enter **BezierCurve** as the name in the **Object** panel (Figure 9.7).

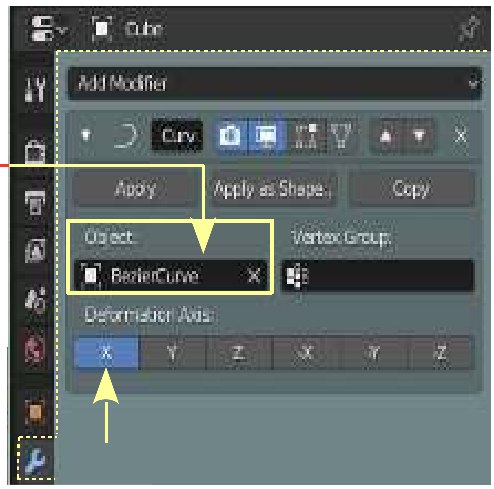


Figure 9.7

Click and select **Bezier Curve** in the menu.

Manipulate the Curve in **Edit Mode.** Change its shape and position to affect the shape of the Cube (Figure 9.8).

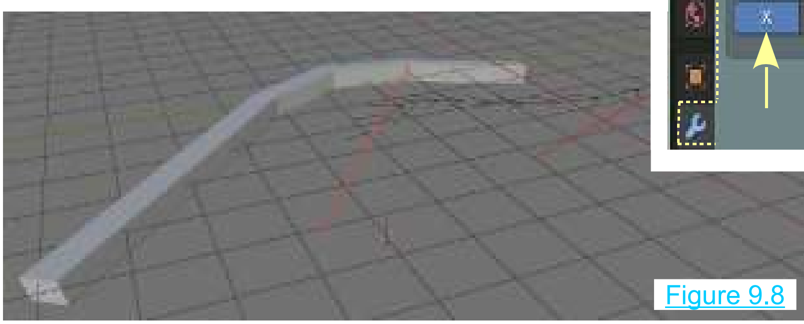


Figure 9.8

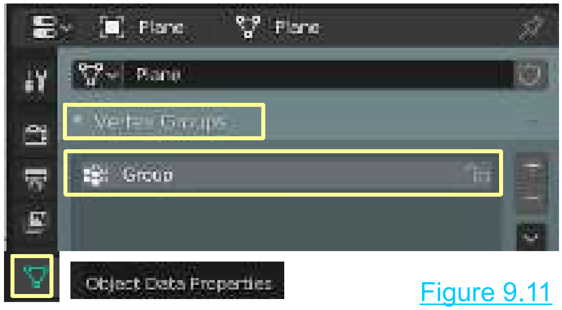
Note: in the Curve Modifier panel the **Deformation Axis** is the **X Axis**.

9.6 Displace Modifier

The **Displace Modifier** displaces the Vertices of a Mesh Object. If Vertices are assigned to a **Vertex Group** and the group is entered in the Modifier, only the Vertices belonging to the group will be affected. Incorporating a Texture displaces Vertices according to the dark and light values in the Texture (see also, Texture Displacement Chapter 16 – 16.26).

Start with the default Blender Scene and replace the **Cube** with a **Plane**. Have the Plane selected in **Edit Mode** and subdivide sixteen times. Select a group of Vertices and create a **Vertex Group** in the Properties Editor, Object Data buttons, see Chapter 5 - 5.9 (Figure 9.9, 9.10) .

Figure 9.9



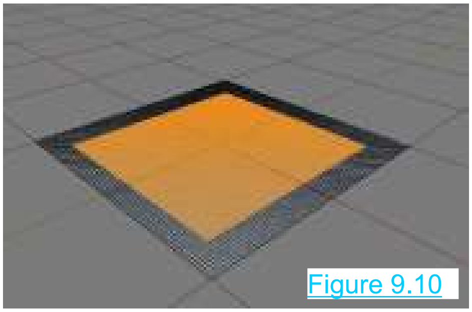
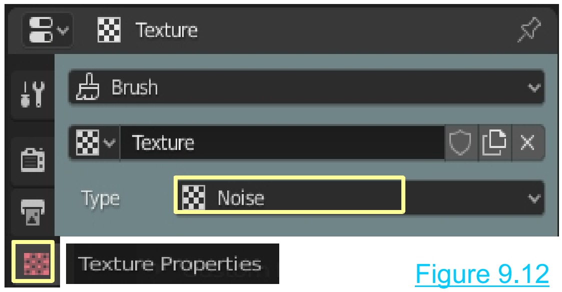


Figure 9.10

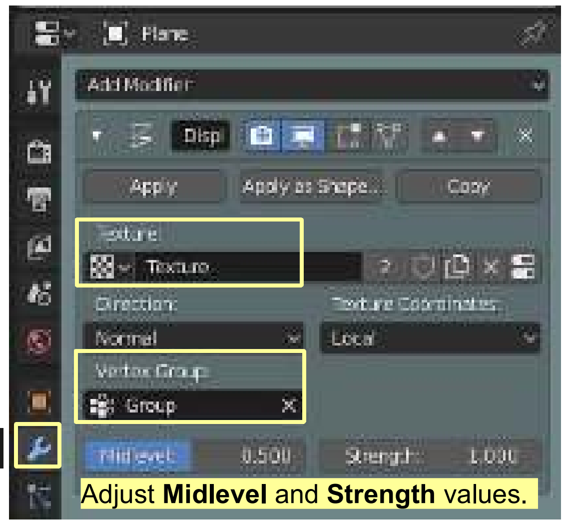
Tab back to **Object Mode.** Add a Material (default gray is OK) and in the Texture Buttons add a Noise Texture (Textures are discussed in Chapter 16 but for now, click the Texture button, click **New** and where you see **Type: Image or Movie**, click the bar and select **Noise** in the menu that displays. **Note** the Texture Name in this example is: Texture) (Figure 9.11).

Figure 9.11



In the Properties Editor, with the Plane selected , go to the Modifier buttons and add a **Displace Modifier** (Figure 9.12).

Figure 9.12



In the Displace Modifier panel enter the Texture and the Vertex Group to displace the Vertices (Figure 9.13).

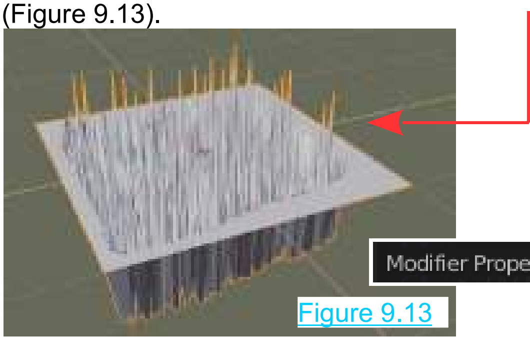


Figure 9.13

9.7 Hook Modifier

The **Hook Modifier** allows you to manipulate or animate selected vertices of a mesh while in Object mode. Vertices are assigned (hooked) to an **Empty** Object which is moved in Object Mode pulling the selected vertices with it. This can be used for a static mesh deformation or the movement can be animated.

Start with the default Scene with the Cube Object selected. Tab to **Edit mode** and select one Vertex (corner) only.

Press **Ctrl + H key** and select **Hook to New Object**. An **Empty Object** is added to the Scene. In the **Properties Editor, Modifiers button**, you will see that a **Hook Modifier** has been added named **Hook-Empty** (Figure 9.14).

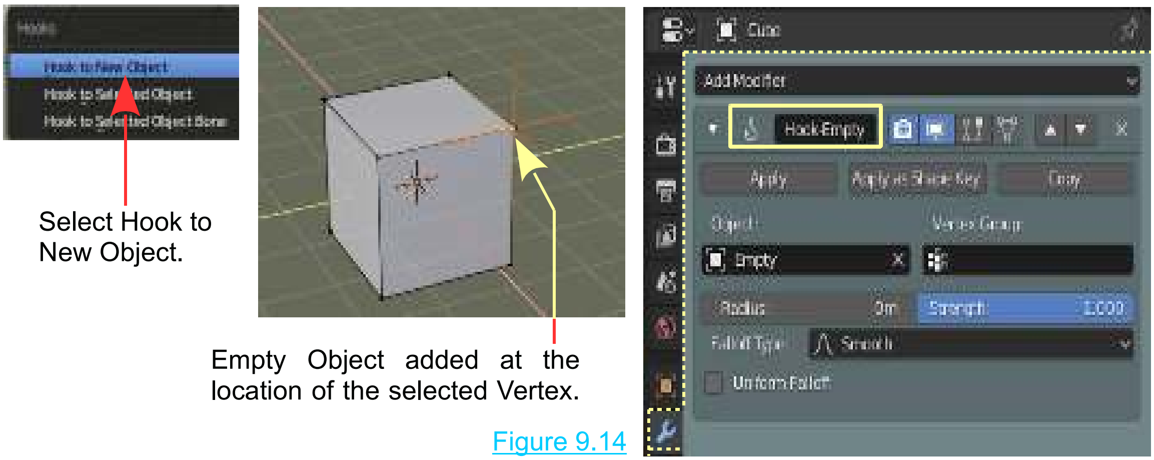
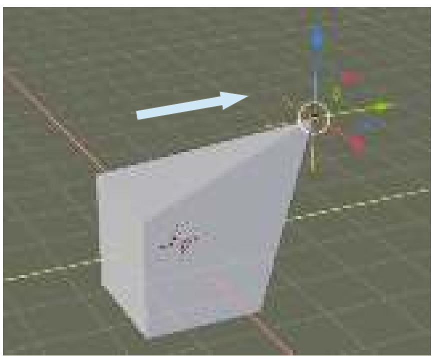
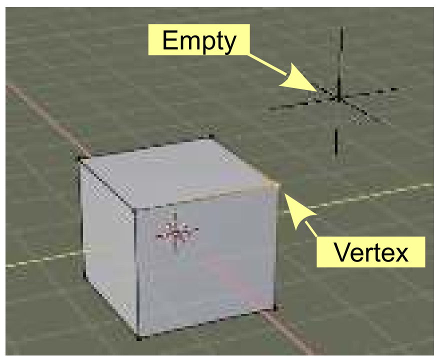


Figure 9.14

Select and move the **Empty** in **Object Mode** to move the Vertex (Figure 9.15, 9.16).



In Edit Mode you will see the Empty in the new location but the selected Vertex remains in its original position.



Object Mode Figure 9.15

Edit Mode Figure 9.16

In Object mode click **Apply** in the Modifier panel and the Cube deformation is made permanent. You may delete the Empty Object.

Alternative Add Hook Method

With the default **Cube object** in the default Scene, **Tab** to **Edit Mode** and select one Vertex only. In the **Properties Editor, Object Data buttons, Vertex Groups Tab** click on the plus sign to add a Vertex Group and click **Assign.** This creates a Vertex Group consisting of the one Vertex.

In **Object Mode** deselect the Cube and add an **Empty Object**. Position the **Empty** away from the Cube (Figure 9.16).

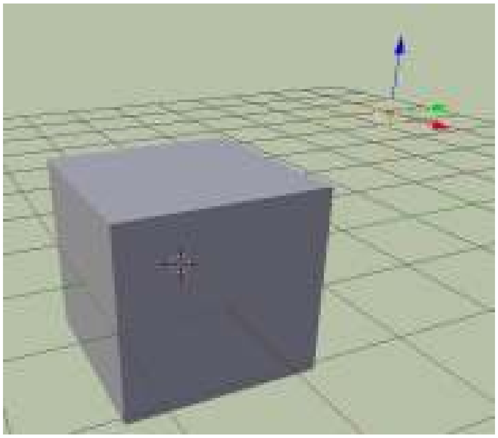


Figure 9.16

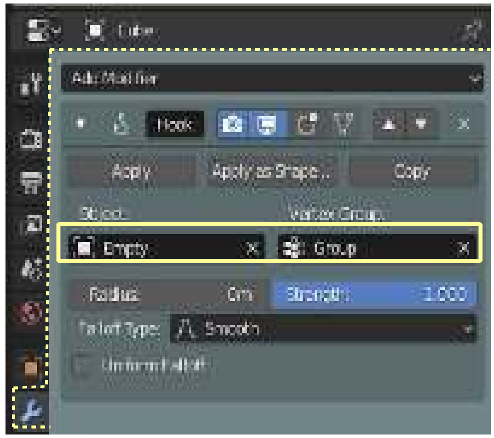


Figure 9.17

Deselect the Empty and select the Cube. In the **Properties Editor, Modifiers buttons** add a **Hook Modifier**. In the **Hook Modifier** panel click on the **Vertex Group panel** and select **Group**. This is assigning the Vertex Group consisting of one single Vertex to the Modifier. Click on the **Object panel** and select **Empty** to assign the Empty Object to the Modifier (Figure 9.17).

By selecting the **Empty** Object in the 3D Viewport Editor and moving it, the single Cube's Vertex in the Vertex Group will follow the movement (Figure 9.18).

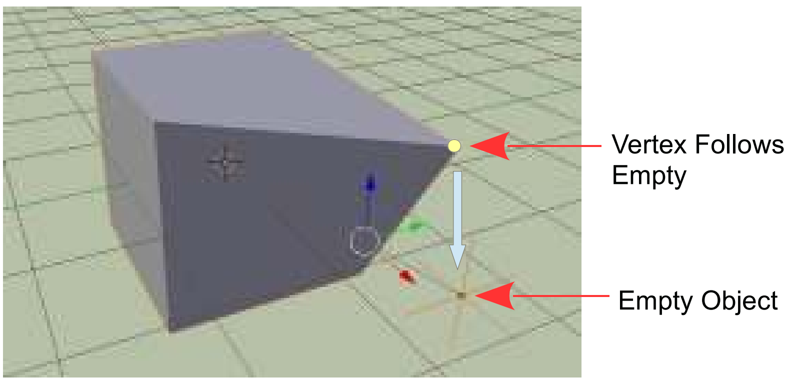
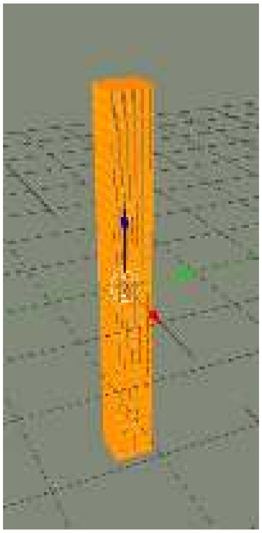


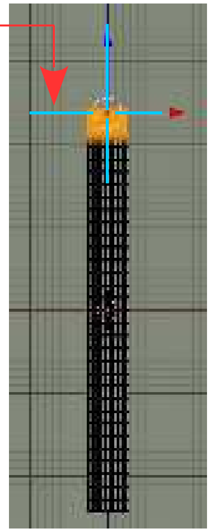
Figure 9.18

9.8 Laplacian Deform Modifier

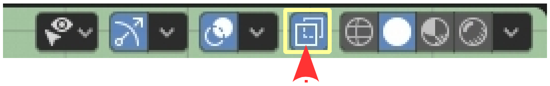
The **Laplacian Deform Modifier** allows you to pose a mesh while maintaining the geometry of the surface. Posing is accomplished by assigning **Hooks** to **Vertex Groups**. You must also assign **Anchor Vertex Groups. Note:** You must define an **Anchors Vertex Group.** Without a vertex group the modifier does nothing.



Hook Empty Assigned



To demonstrate the process Scale the default Cube down in size and elongate on the Z Axis. Tab to Edit Mode and Subdivide (eleven times) to create plenty of Vertices (Figure 9.22). Deselect the Vertices . Place the 3D View Editor in Front Orthographic View.



Activate Show X-Ray in the Header. Select a group of Vertices at the top. Press **Ctrl + H key** and select **Hook to New Object** in the menu that displays. This assigns a Hook-Empty to the group of Vertices (Figure 9.23).

Figure 9.22

Figure 9.23

Tab to Object Mode. The Hook-Empty will be selected. Translate the Hook on the X Axis.

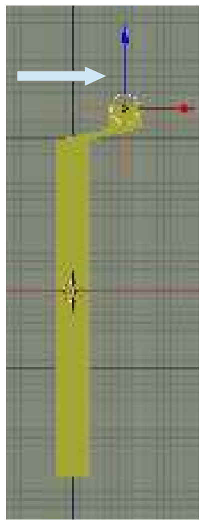
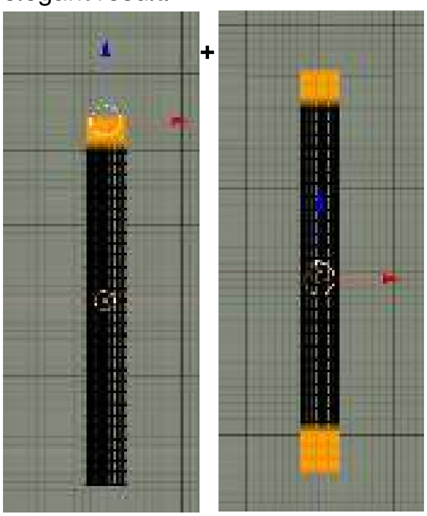


Figure 9.24

You see the group of Vertices moved with the connecting Edges and Faces stretched between the group and the main body of the Object (Figure 9 .24). This may be what you require but on the other hand you may wish for a more elegant result.



Cancel the last operation by pressing **Ctrl Z key** (returns the group to its original position).

Deselect the Hook and select the column (Cube). Tab to Edit Mode. The group of Vertices connected to the Hook remains selected (Figure 9.25). Leave the group selected and select a second group at the base of the column (press **B Key** and drag a rectangle).

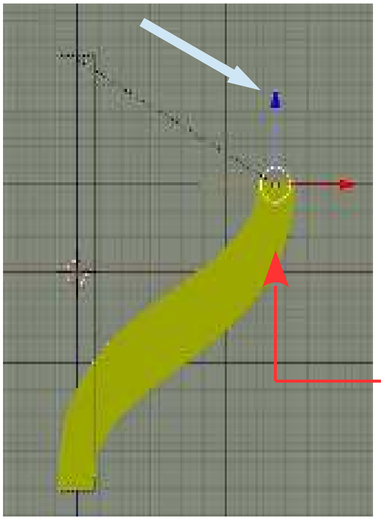
Figure 9.25

With both groups selected go to the **Properties Editor, Data buttons, Vertex Group Tab**. Click the Plus sign to create a Vertex Group and Assign the selected vertices to the Group.

Note: The Vertex Group is named **Group**.

Tab back to Object Mode and add a **Laplacian Deform Modifier.**

Note: A Hook Modifier was added when you assigned the Hook-Empty.

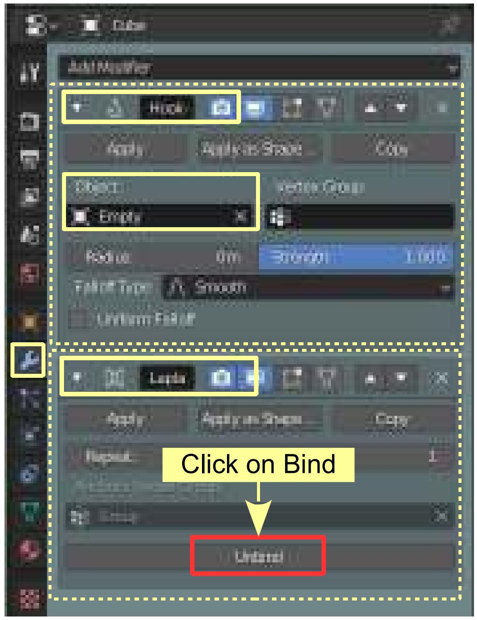


In the Modifier panel enter **Group** in the **Anchor Vertex Group panel** then click on **Bind** (Figure 9.26).

Figure 9.27

Deselect the column and select the Hook-Empty. Grab the Hook and translate to see the top group of vertices moved with the connecting mesh following in a smooth transition.

Figure 9.26

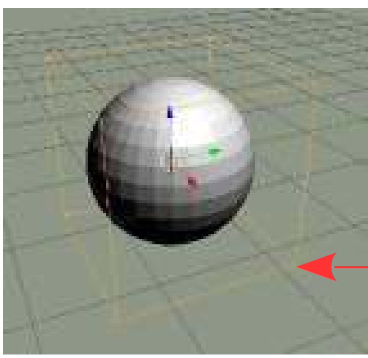


9.9 Lattice Modifier

The **Lattice Modifier** is used to deform a mesh Object or to control the **movement of Particles** (Chapter 22). By using the Modifier, it is easy to shape a mesh Object that has many Vertices. A Lattice is a non-renderable grid of Vertices, therefore, it does not render in the Scene. You can use the same Lattice to deform several Objects by giving each Object a Modifier pointing to the Lattice.

To demonstrate deforming a **UV Sphere** Object with a **Lattice Modifier,** delete the default Cube, add a UV Sphere to the Scene. **With the UV Sphere selected** add a **Lattice** (Shift + A key – Add - Lattice).

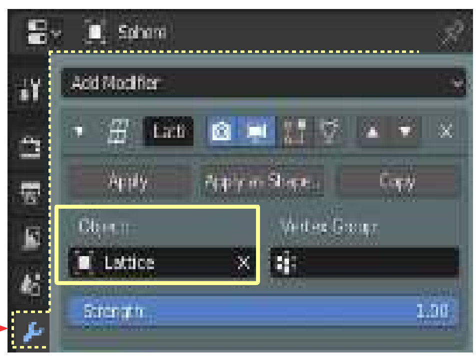
Figure 9.28



Change to **Wireframe Display Mode**. You will see the Lattice mesh as a Cube inside the Sphere. **Scale the Lattice up** (S Key + drag the mouse). The Lattice is entered as a simple mesh cube (Figure 9.28).

Modifier Button

Figure 9.29



Select the **UV Sphere** and add a **Lattice Modifier** . Enter **Lattice** under **Object** (Figure 9.29).

Select the Lattice, go to the **Object Data buttons** in the **Properties Editor**, and alter the *u*, *v*, and *w* values in the Lattice Tab to subdivide the Lattice mesh (Figure 9.30).

In **Edit Mode**, select a single lattice Vertex and move it to deform the UV Sphere mesh (Figure 9.31).

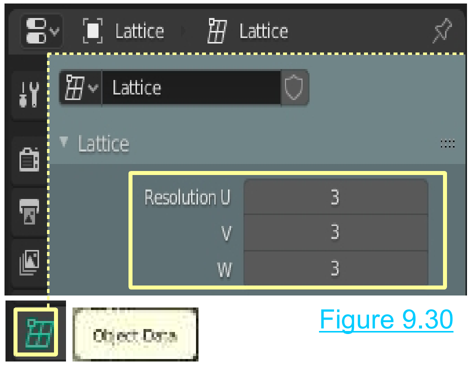


Figure 9.30

Lattice Object Data Button

You may select multiple vertices on the Lattice then scale, translate or rotate to deform the sphere.

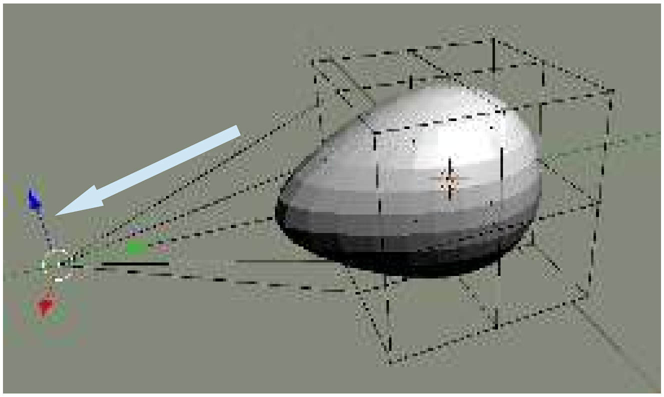
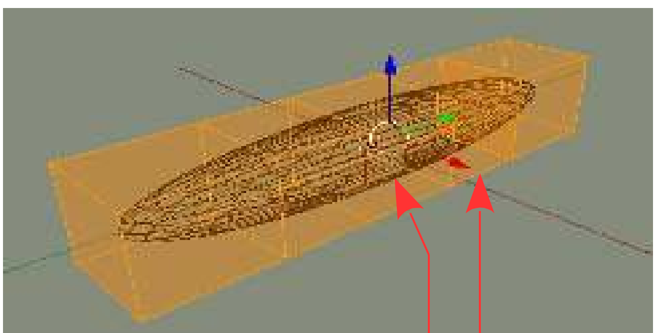


Figure 9.31

9.11 Mesh Deform Modifier

The **Mesh Deform Modifier** deforms a mesh with **Cage Mesh**. This is similar to a Lattice Modifier but instead of being restricted to the regular grid layout of a lattice, the cage can be modeled to fit around the mesh Object being deformed. The Cage Mesh must form a closed cage around the part of the mesh to be deformed, and only vertices within the cage will be deformed. Typically the cage will have far fewer Vertices than the mesh being deformed.

After modeling a UV Sphere Object as shown in Figure 9.32, surround it with a simple cage mesh by scaling a Cube to fit around the elongated Sphere, then select Vertices in **Edit Mode** and extrude (Figure 9.32).



UV Sphere Scaled on the Y Axis
Cube Extruded to form a Cage

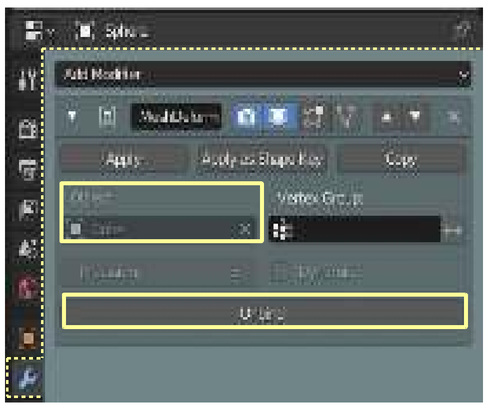


Figure 9.32

Add a **Mesh Deform Modifier** to the scaled UV Sphere. Enter the name of the cage mesh (Cube) and press **Bind** to link the two meshes. The Bind operation may take several seconds to calculate depending on the complexity of your model. Wait until **Bind** changes to **Unbind** before selecting Vertices on the cage (Figure 9.33). By Moving, Scaling and Rotating the selected Vertices, the Sphere mesh will be deformed . The proximity of the cage to the original Object has an influence on how the deformation reacts.

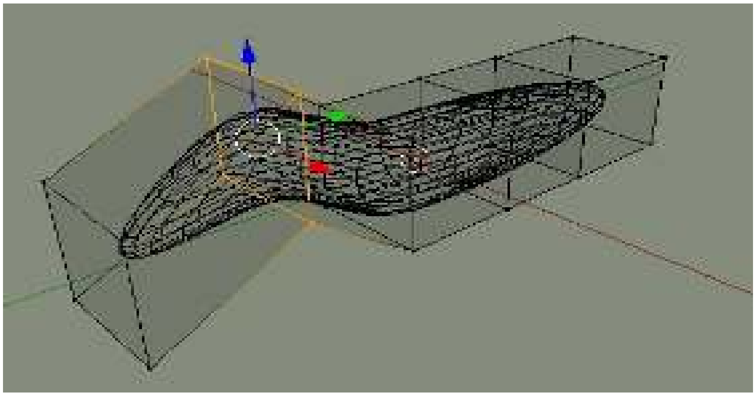


Figure 9.33

Note: The Cage Mesh will render in the Scene; Apply the Modifier and delete the Cage.

9.12 Shrinkwrap Modifier

Shrinkwrap Modifier added to the UV Sphere

The **Shrinkwrap Modifier** takes a mesh and shrinks it down, wrapping the mesh around another object. The deformed mesh can then be offset to produce shapes in between the original shape and the deformed shape.

Delete the Cube in the default Blender Scene and add a **UV Sphere** and a **Cone** mesh Object. The Cone should be located inside the UV Sphere, which is easy to see when both Objects are viewed in **Wireframe Mode** (Chapter 5 – 5.2) (Figure 9.34). Add a **Shrinkwrap Modifier** to the UV sphere, and enter **Cone** in the **Target panel** (Figure 9.35). Change the **Offset value**; notice how the shape changes when you increase the value (Figure 9.36 over).

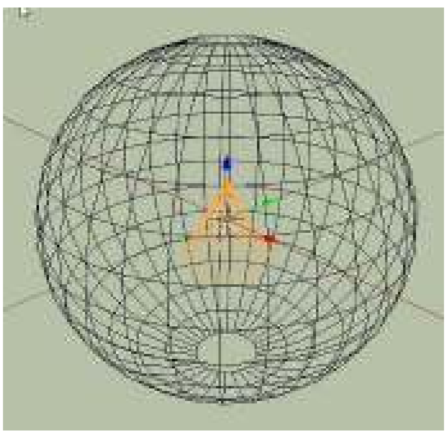


Figure 9.34

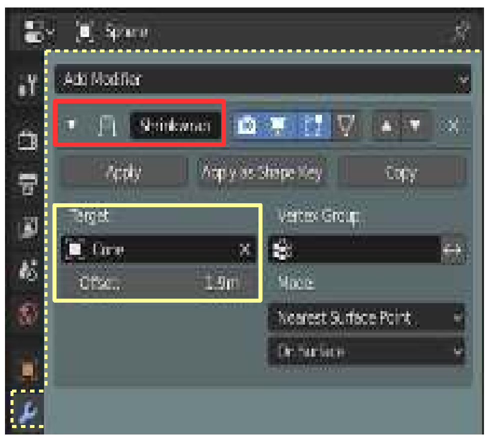


Figure 9.35

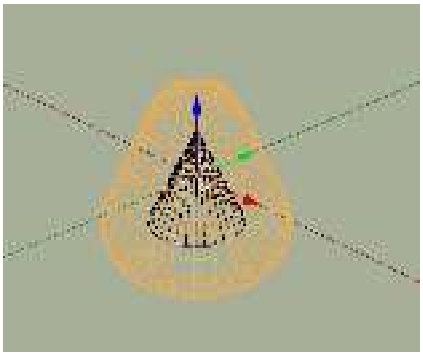
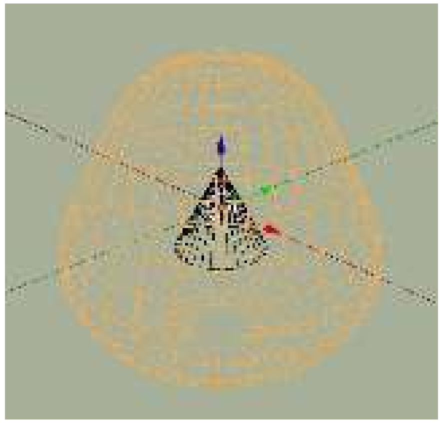


Figure 9.36

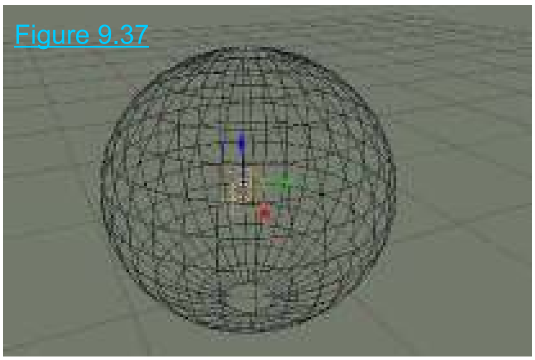


Altering the Offset value in the Modifier panel changes the size of the modified UV Sphere.

9.13 Simple Deform Modifier

The **Simple Deform Modifier** deforms a mesh by changing values in the Modifier and having a second Object with an influence. To see this Modifier in action, add a UV Sphere in the default Scene with a scaled down Cube located in the center of the Sphere (Figure 9.37). Activate **Wireframe Display Mode** and add the **Simple Deform Modifier** to the UV Sphere with Cube entered as the origin (Figure 9.38, 9.39). Drag the Limits slider to see the change to the Sphere (Figure 9.40). Select the Cube with the RMB and manipulate it on an axis to deform the Sphere (Figure 9.41).

Figure 9.37



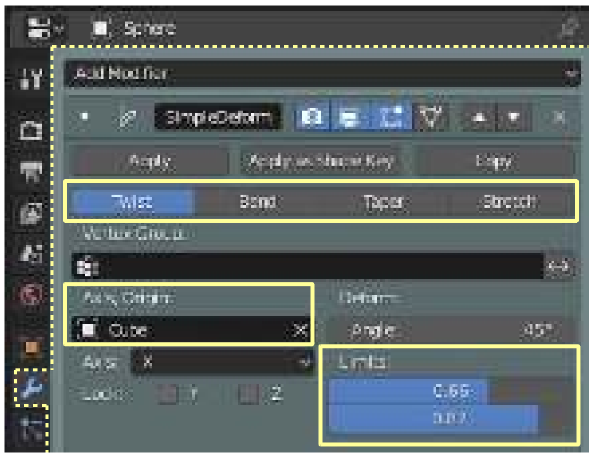
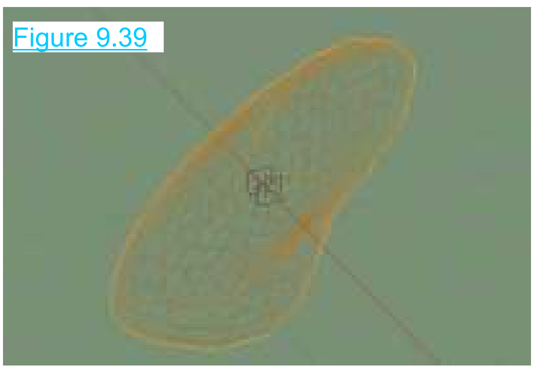


Figure 9.38

Figure 9.39



Note the skew in the mesh when the Modifier is added to the UV Sphere. Adjust the **Deform: Angle** slider and the **Limits** sliders to change the skew. Experiment with the Twist, Bend, Taper and Stretch buttons.

Figure 9.40

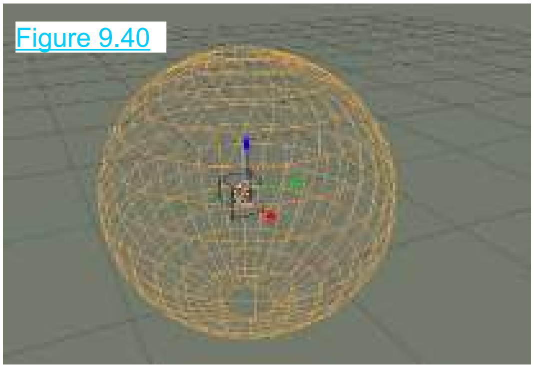
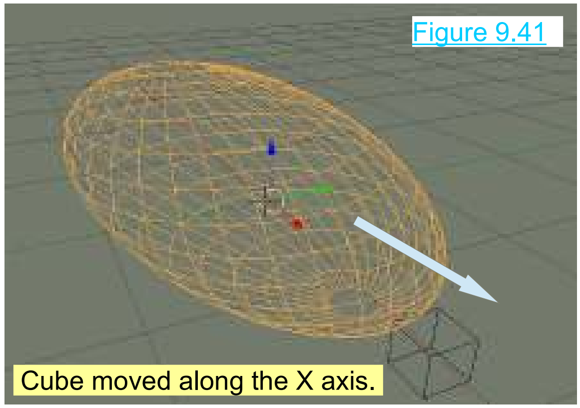
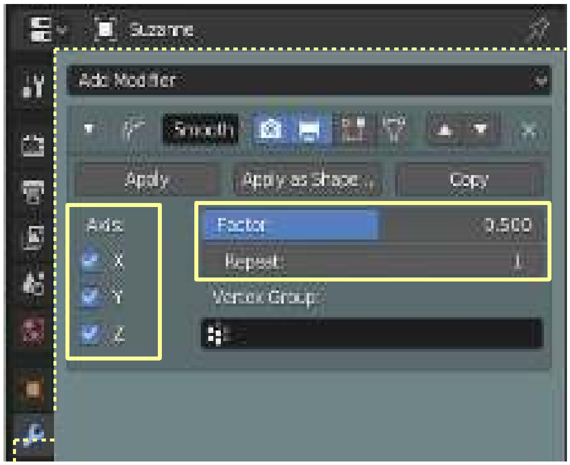


Figure 9.41



9.14 Smooth Modifier

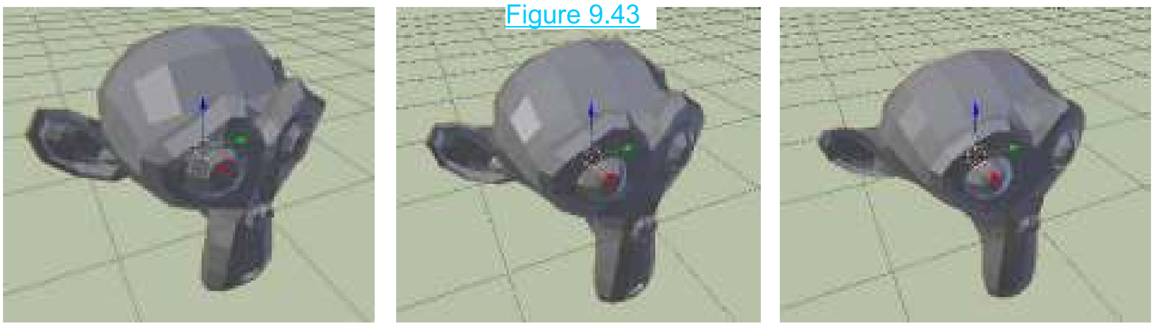
Figure 9.42



The **Smooth Modifier** smooths the mesh Object by softening the angles between adjacent Faces; this shrinks the size of the original Object at the same time. **Note:** The smoothing effect is only applied to how the Object's surfaces are drawn in the 3D Viewport . In smoothing, no additional Vertices, Edges or Faces are added to the Object. To use the Smooth Modifier select an Object in the 3D Viewport then Add the Modifier in the **Properties Editor, Modifier buttons** (Figure 9.42)**.**

Adjust the **Factor slider** to increase or decrease smoothing. The **Repeat value** multiplies the Factor value. The **X, Y** and **Z** axis confine the smoothing to a particular axis.

Figure 9.43



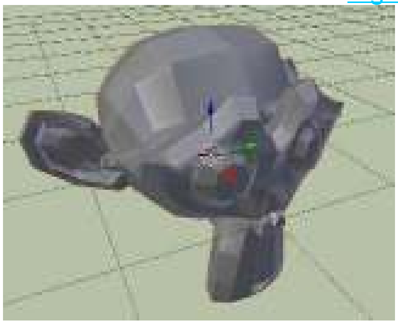
Factor: 0.500 – Repeat: 1 Repeat: 5 Repeat: 10

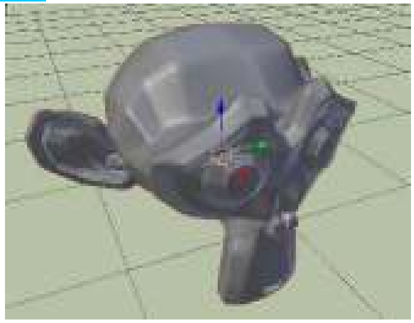
In applying the **Factor** and **Repeat** values the logic of the operation is to first set a value (the Factor) then perform the calculation (repeat) several times to achieve the desired smoothing. When the desired smoothing is achieved Apply the Modifier.

Note: An Object should have a reasonable number of Faces before the Modifier is effective. For example; the Monkey Object with its default Faces will shrink in size as **Repeats** are applied. When subdivided three or four times it will show a completely different effect.

Figure 9.44

Repeat: 1

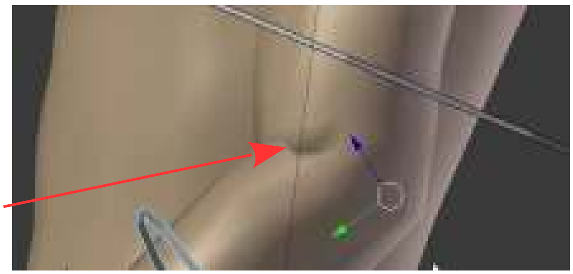




Repeat: 10

9.15 Smooth Corrective Modifier

Figure 9.45

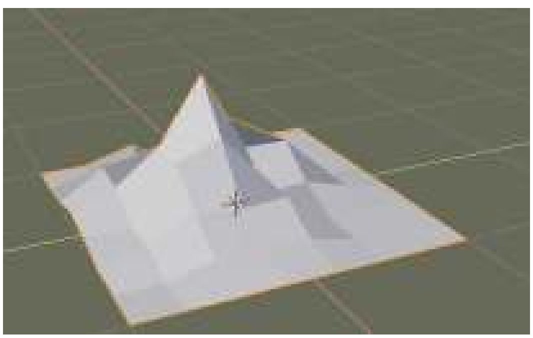


The Smooth Corrective Modifier is used to Smooth and Correct imperfections in a model which occur when the surface is deformed. Figure 9.45 shows a model of an arm which has been posed and in doing so creates an imperfection (see Chapter 20).

Imperfection

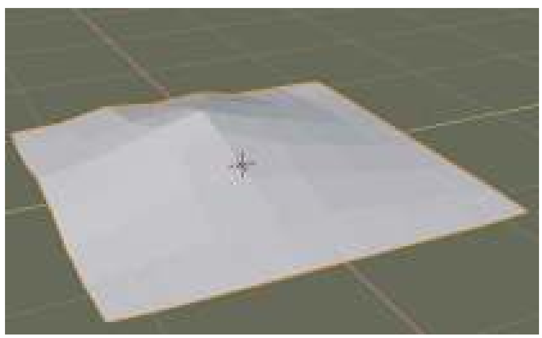
9.16 Smooth Laplacian Modifier

The Laplacian Smooth Modifier is used to smooth a mesh which has become irregular when Vertices have been manipulated during detailed modeling (Figures 9.46, 9.47).



Object Mode Figure 9.46

Plane Object, Subdivided – Number of Cuts: 7
One Vertex moved up with Proportional Editing enabled and Random Falloff.



Object Mode Figure 9.47

Smooth Laplacian Modifier added in Object Mode. Repeat Value: 5, Factor: 1.100.

With the Modifier added (NOT Applied) Edit Mode shows the Vertices in their original state (Figure 9.48).

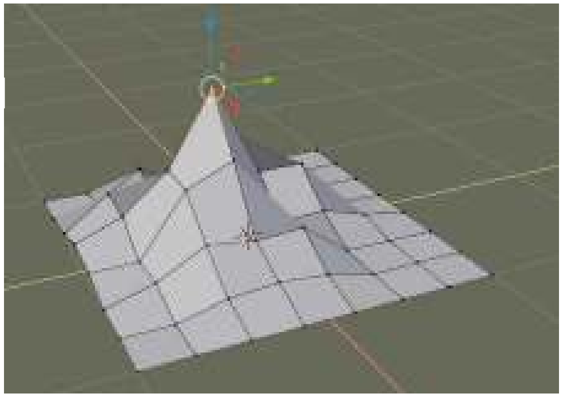


Figure 9.48

To permanently set the surface smooth, Apply the Modifier.

Practical application of the Smooth Laplacian Modifier.

9.16 Surface Deform Modifier

The Surface Deform Modifier is similar to the Mesh Deform Modifier in that one mesh is used to shape another. The difference being, the controlling mesh does not have to surround the Object being shaped.

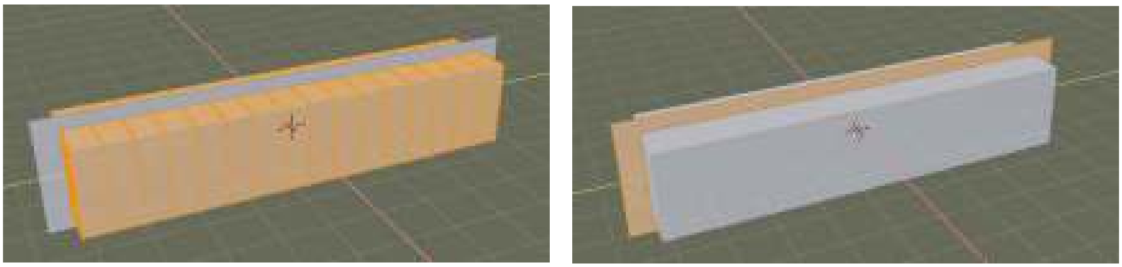


Figure 9.49

In Figure 9.49 a Cube Object has been Scaled along the Y Axis in Object Mode. In Edit Mode the Cube has been Subdivided with Number of Cuts: 10. A Plane Object has been added to the Scene, Rotated on the Y Axis and Scaled to bisect the elongated Cube. The Plane has also been Subdivided in Edit Mode, Number of Cuts: 10.

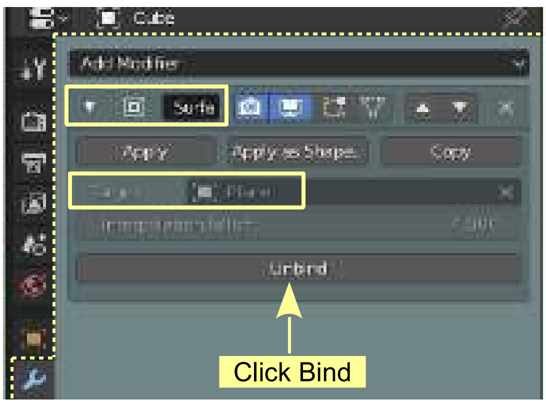


Figure 9.50

In Object Mode select the elongated Cube and add a **Surface Deform Modifier** (Figure 9.50). Enter **Plane** in the **Target Panel** as the controlling Object. **To set the Plane as the control click on Bind**.

Deforming the Plane will deform the elongated Cube (Figure 9.51 over).

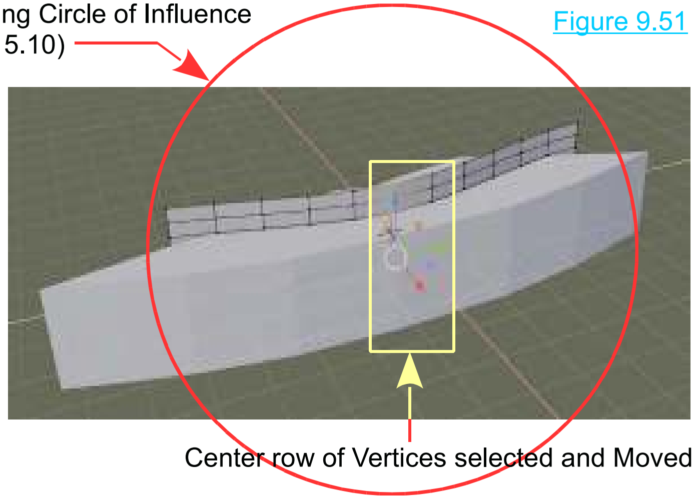


Figure 9.51

In Figure 9.52 the center row of Vertices of the Plane is selected (in Edit Mode) and Moved forward deforming the Cube. In performing this operation Proportional Editing has been activated with Smooth Falloff and a Circle of Influence expanded to encapsulate the entire Plane.

After using this method to shape the Cube, Apply the Modifier and delete the Plane.

Animating the vertices of the Plane to move is an effective way of introducing lifelike characteristics to a Model. Figure 9.52 shows a Plane being animated to make the tail of a fish model move. (Reference: YouTube Video by yojigraphics.

https://www.youtube.com/watch?v=EJLIaNhoSSs

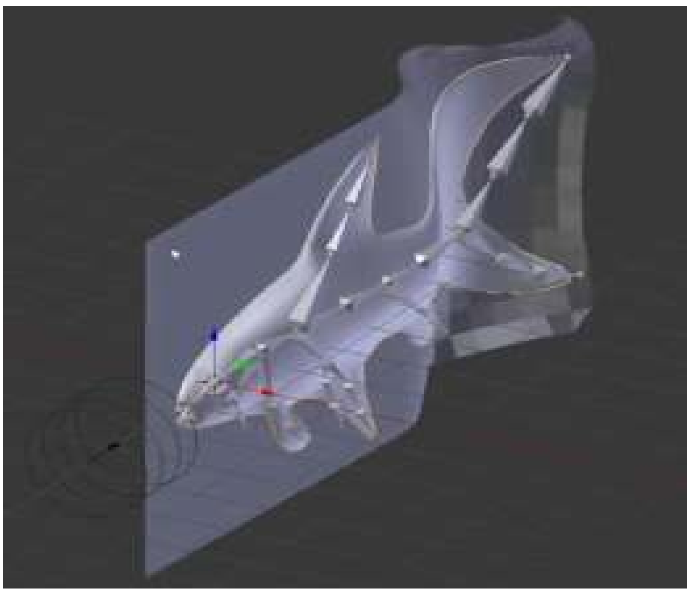


Figure 9.52

9.17 Warp Modifier

The **Warp Modifier** allows you to deform a mesh surface in Object mode by manipulating Target Objects. If you do not want the Targets to render in the Scene use Empty Objects. The deformation of the mesh takes place in a gradient between the two Targets.

This description requires clarification by a simple exercise.

In a new Blender Scene add a **Plane** Object, zoom in and **Subdivide** in Edit Mode (Cuts 10).

In Object Mode add two **Empty objects** and position as shown in Figure 9.53. Make note of the Empty names in the **Outliner Editor**; **Empty** and **Empty.001** (you may rename if you wish).

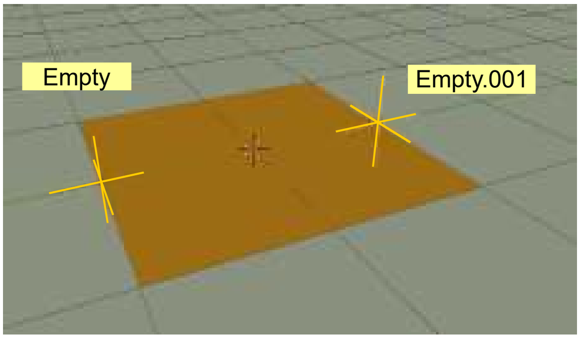


Figure 9.53

Select the Plane and in the Properties Editor, Modifier buttons add a **Warp Modifier** (Figure 9.54).

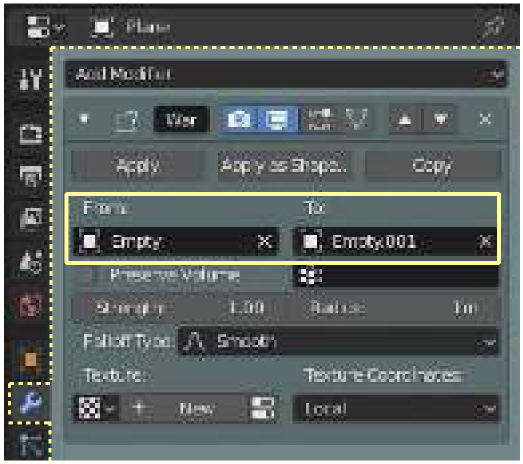


Figure 9.54

In the Modifier panel enter the names of the Empty Target Objects in the **From** and **To** panels (From: Empty and To: Empty.001). You will immediately see the Plane deform in the 3D View Editor (Figure 9.55).

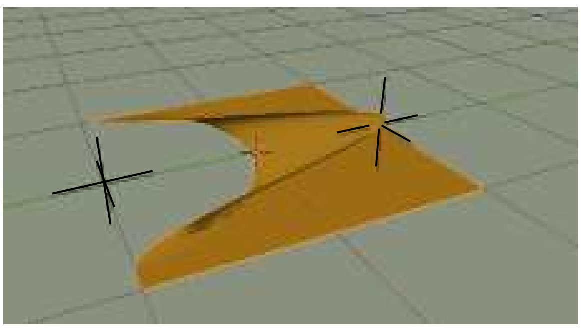


Figure 9.55

You may consider the Modifier as saying; deform the mesh From Empty to Empty.001.

By selecting either Empty in the 3D View Editor and translating the deformation of the Plane is affected (Figure 9.56).

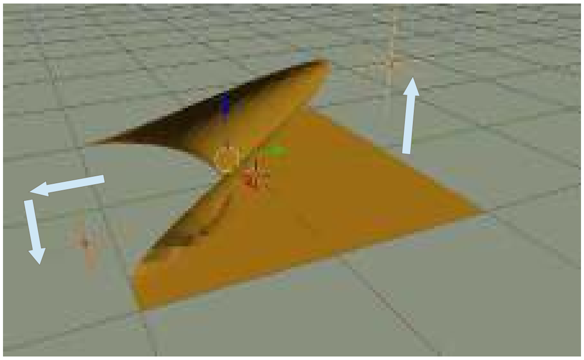
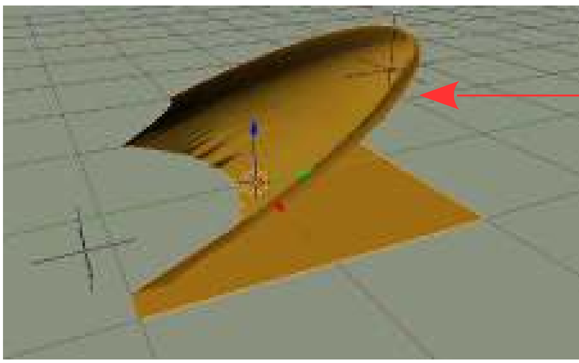


Figure 9.56

In the Modifier panel you may choose a different **Falloff Type** by clicking the bar to display a selection menu (Figure 9.57) and adjust the **Strength** and **Radius** sliders to modify the deformation (Figure 9.54).

Figure 9.57

When the Modifier is Applied the shape of the Plane is permanently set.



Spherical Falloff

Figure 9.58

Note: In Figures 9.58 ans 9.59 the position of the Empty target objects have NOT been moved.

Radius and Strength Sliders Adjusted

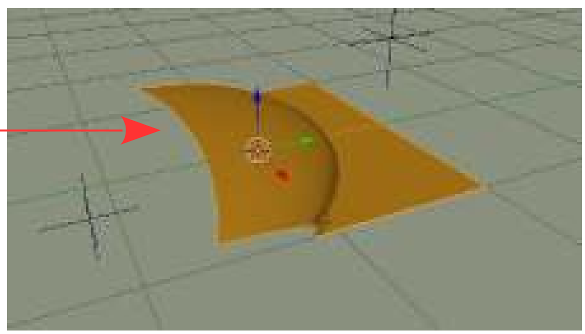


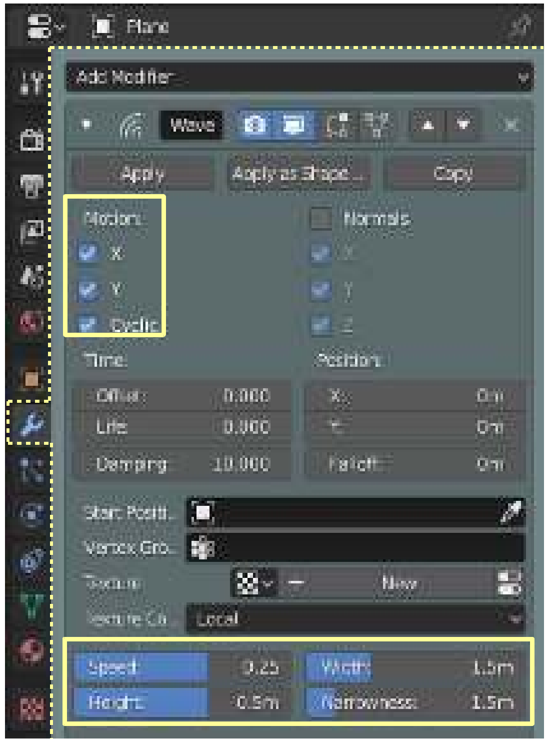
Figure 9.59

9.18 Wave Modifier

The **Wave Modifier** applies a deformation and creates an animation in a wave form. To demonstrate, in the default Blender Scene, delete the Cube and add a **Plane**. Scale the Plane up six times, Tab into **Edit mode**, and Subdivide the Plane by clicking **RMB** - **Subdivide** in the **Mesh Context** menu. In the **Subdivide** panel, make **Number of Cuts** 15. **Tab** back to **Object Mode**.

With the Plane selected, in the **Properties Editor, Modifiers buttons** add a **Wave Modifier** (Figure 9.60).

Figure 9.60



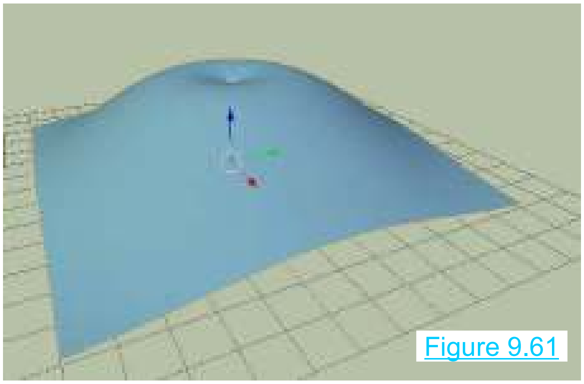
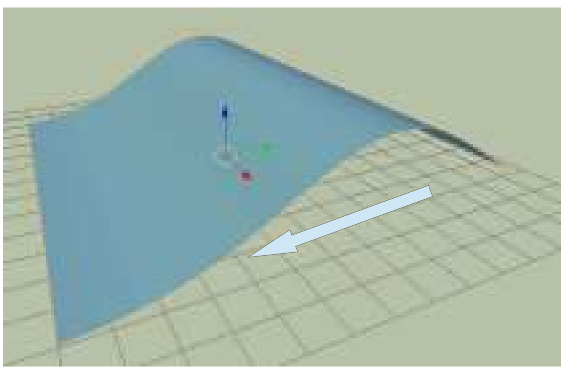


Figure 9.61

You immediately see the plane deform in the 3D Viewport Editor, pulled up in the middle and punched in at the top of the bulge (Figure 9.61).

The Wave Modifier has been applied on both the **X** and **Y** axis. In the Modifier panel you see **X**, **Y**, and **Cyclic** ticked. **X** and **Y** refer to the axis and **Cyclic** means that an animation of the wave will repeat over and over.

Figure 9.62



Press the **Play** button in the **Timeline Editor Header** to see the animation play.

Untick the **X Axis** in the Modifier panel and play again. A wave along the **Y** axis results Figure 9.62). At the bottom of the Modifier panel, change **Speed** to 0.09, **Width** to 1.08, and **Height** to 0.34 and Narrowness to 4.40 (Figure 9.60). You can change these values to whatever you want . Play the animation again and experiment with the values.

10

Editing Using Curves

10.1 Curves Circles and Paths
10.2 Bezier Curves
10.3 Bezier Circle
10.4 Nurbs Path
10.5 Nurbs Circle
10.6 Modeling from a Curve
10.7 Closed Loops
10.8 Using Nurbs Curves
10.9 Nurbs Circle
10.10 Nurbs Curve
10.11 Lofting

Introduction

In Blender a Curve is a line or a path used to control the shape of a mesh in modeling or the movement of an Object in animation.

In Blender there are three types of curves: **Bezier Curves, Nurbs Curves and Paths**. Bezier types are subdivided into Curves and Circles.

Each type of Curve entered in the Blender Scene as a basic line with control handles which allow the shape of the Curve to be modified. The curve can also be Scaled and Extruded and additional control handles may be added.

A Curve does not Render. It merely acts as a control for editing a Mesh Object. The Object renders but the curve is invisible to the Render process.

Bezier and Nurbs Curves can be circular (circles) in which case they form a closed loop.

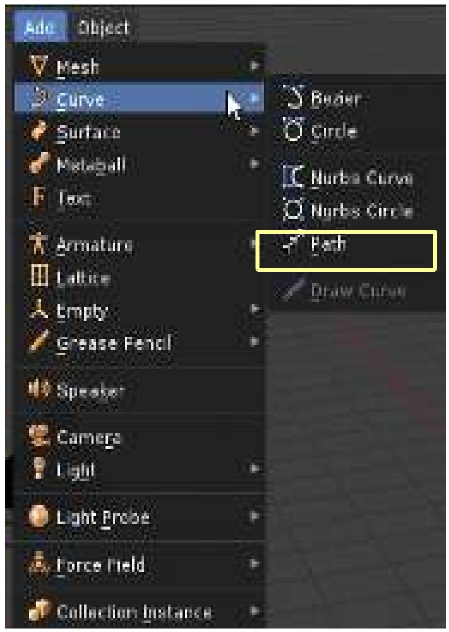
10.1 Curves Circles and Paths

In Blender, **Curves, Circles and Paths** are lines, giving a graphical representation of data or a line representing a path which controls direction or movement. Do not be confused with the Circle Object.

Curves are editable, which means that the shape of the curve may be altered to suit a particular application. An Object can be made to follow a Curve in an animation or it can be extruded along a Curve to affect its shape or it can be duplicated along a Curve. **Curve Circles** are merely circular Curves joined at the ends forming a continuous loop.

In Blender there are five basic Curve options which are accessed in the **Add menu in the 3D Viewport Editor Header** or by pressing the **Alt + A Key** with the Mouse Cursor in the 3D Viewport Editor (Figure 10.1).

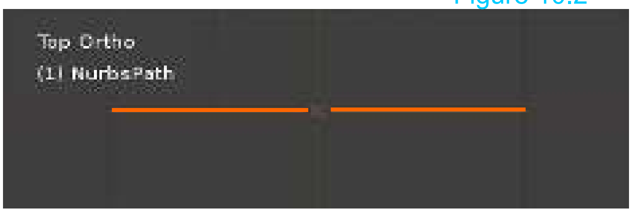
Figure 10.1



To examine the options place the 3D Viewport Editor in Top Orthographic View and delete the default Cube. Press **Alt + A Key**, select **Curve**, then **Path**.

Path: Entered in **Object Mode** in **Top Orthographic View.**

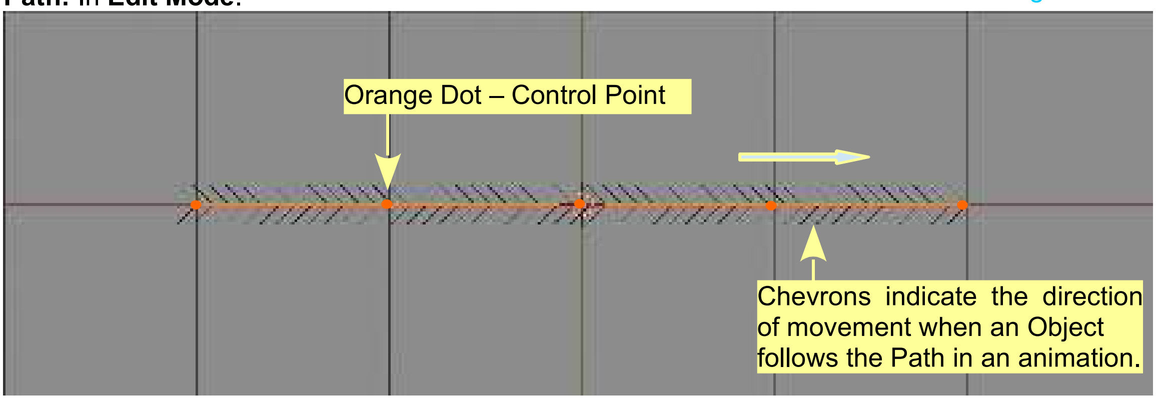
Figure 10.2



To improve visibility in the demonstration lighten the background of the 3D Viewport Editor (Chapter 2 -2.18).

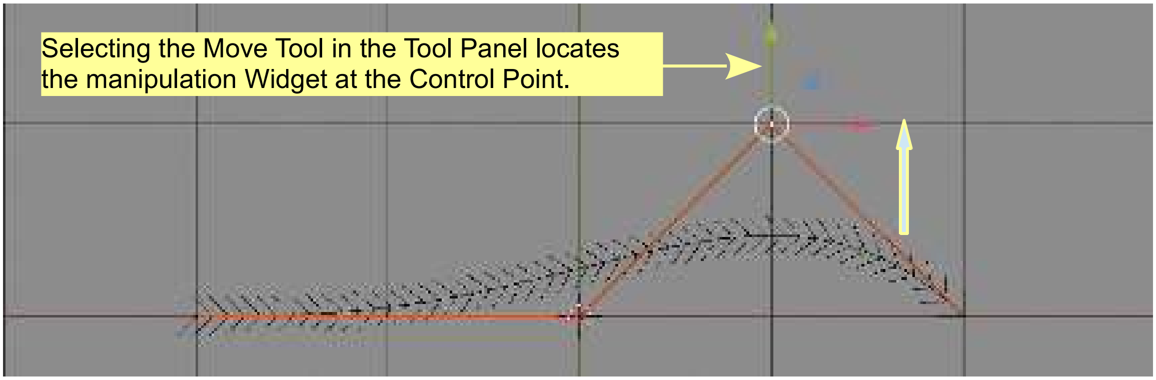
Path: In **Edit Mode**.

Figure 10.3



RMB click a Control Point and translate (move) to edit the Path shape.

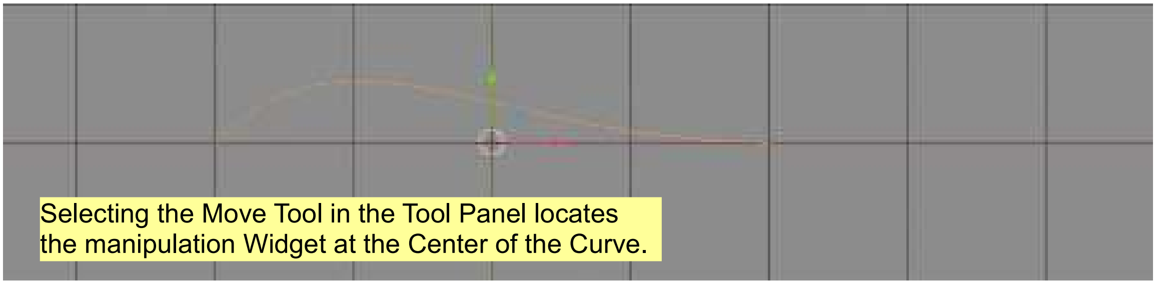
Figure 10.4



10.2 Bezier Curve:

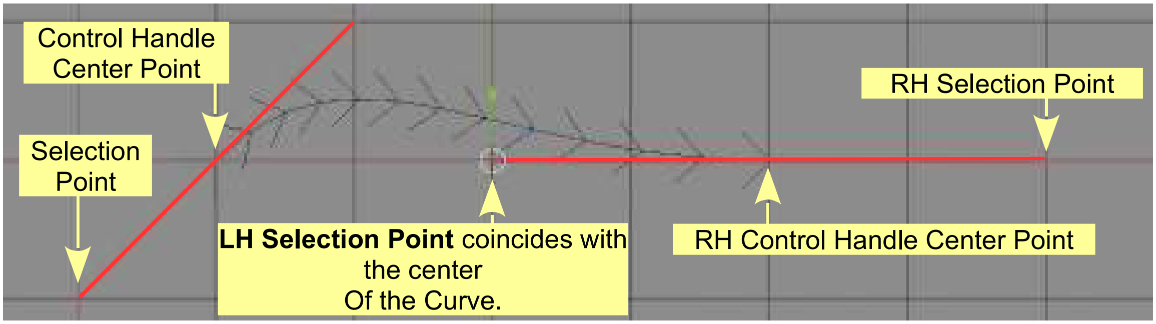
Bezier Curve entered in **Object Mode** in Top Orthographic View.

Figure 10.5



Bezier Curve in **Edit Mode** showing **Control Handles** (red lines) at the ends of the curve.

Figure 10.6



By default the Control Handles are **NOT** selected. By default the RH Control Handle has a LH Selection Point coinciding with the center of the Curve.

Selecting a Control Handle's center point (RMB click) and Moving alters the shape of the Curve.

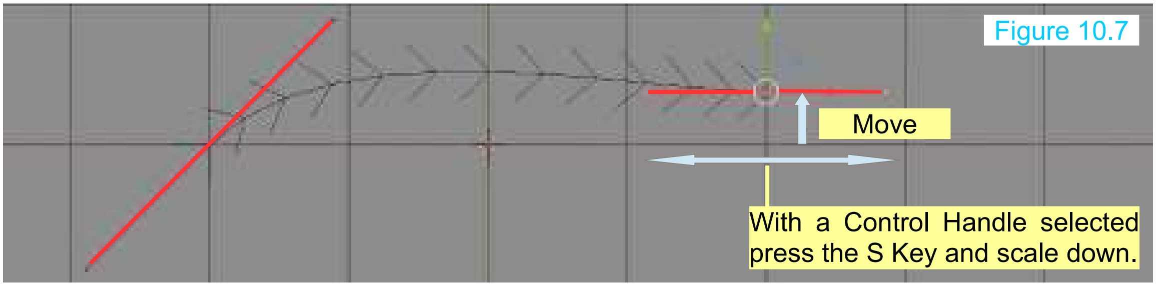
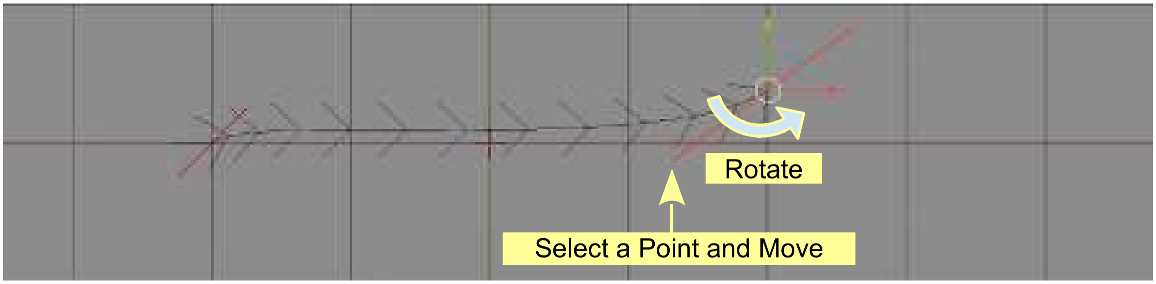


Figure 10.7

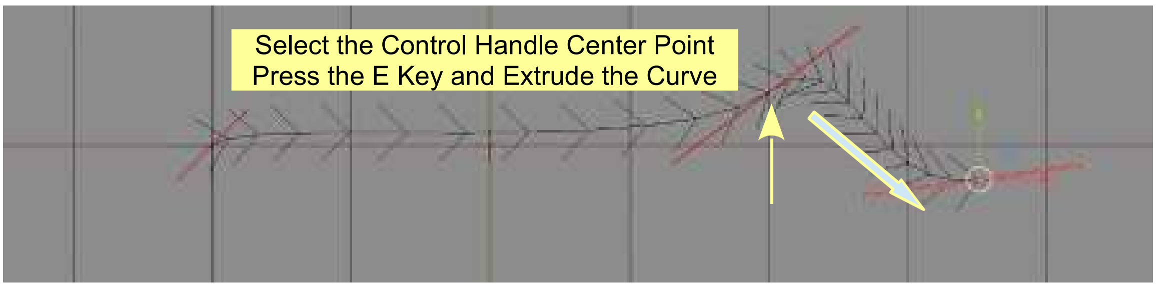
With the Control Handle selected press the **R Key** and rotate to shape the Curve.

Figure 10.8



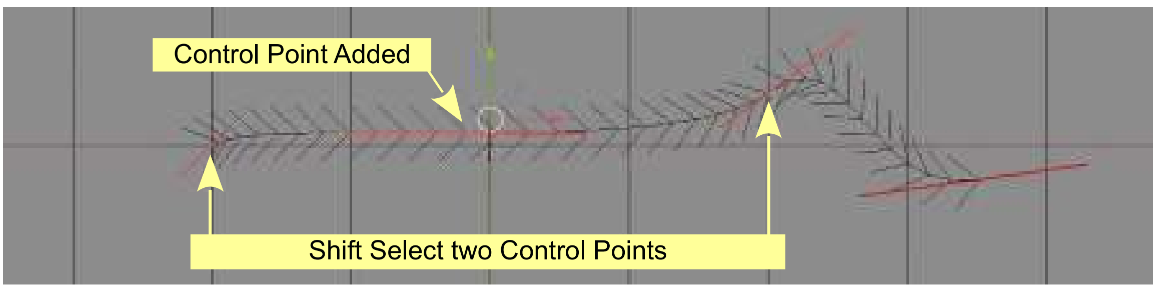
You may also click on a Handle Selection Point and Move (G Key) to rotate and shape the Curve. Extrude the Curve from the Control Handle.

Figure 10.9

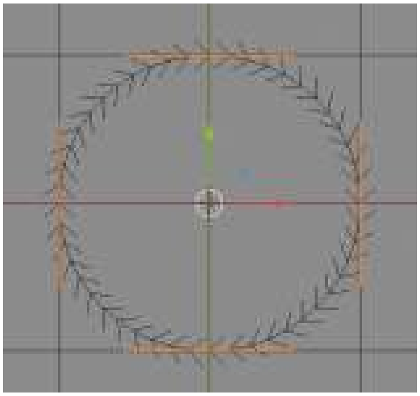


Control Handles can be added to the Curve by Shift selecting two Handles and **Subdividing**.

Figure 10.10



10.3 Bezier Circle



The **Bezier Circle** is similar to the Bezier Curve with control handles at the four cardinal points.

Click RMB to select a handle. **G Key** to grab and move to reshape the path. **R Key** to rotate and flatten the curve.

Note: The Bezier Circle, Nurbs Path and Nurbs Circle are shown in Edit Mode.

Figure 10.11

10.4 Nurbs Path

Select and Move, Control Handles.

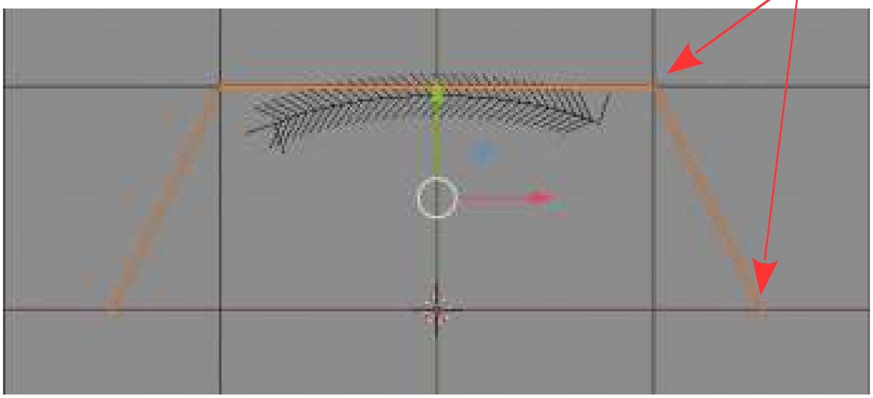
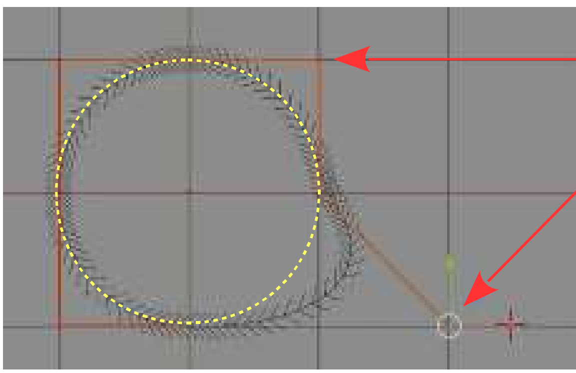


Figure 10.12

10.5 Nurbs Circle



The **Nurbs Circle** with Control Handles external to the Path.

Control Handle Moved reshaping the Circle Curve.

Note: The diagrams serve only to show you what the different Curves look like and how to Edit their shape.

Figure 10.13

10.6 Modeling from a Curve

Any Curve Path or Circle may be used to create a Mesh Object by Extrusion.

Enter a **Bezier Curve** in **User Perspective View,** zoom in and **Tab into Edit Mode**.

Note: The following is **NOT** the way to create a Mesh Object but to demonstrate what happens when the Curve is Extruded in Edit Mode. When Edit Mode is entered the Control Handles at both ends of the Curve are selected. Extrude down on the Z Axis (E Key+Z Key, drag the Mouse).

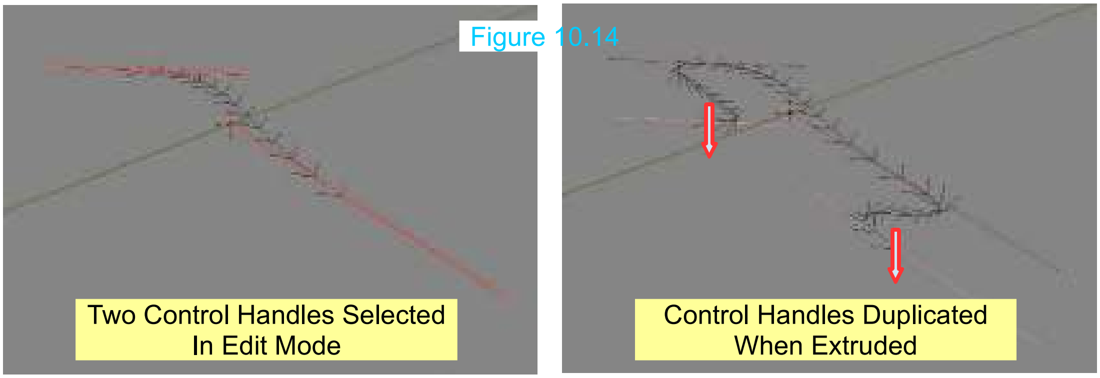


Figure 10.14

To create a Mesh from a Curve be in **Object Mode** with the default **Bezier Curve** selected (NOT Extruded). In the **Properties Editor, ObjectData buttons, Geometry Tab** change values as shown (Figure 10.16). Rotate the 3D Editor Viewport (Figure 10.15)

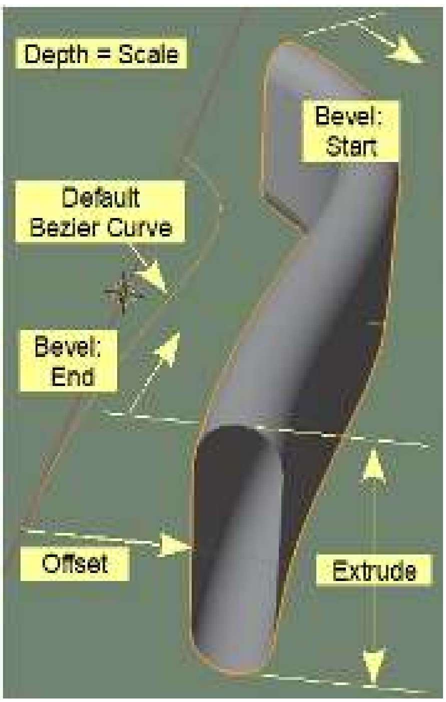


Figure 10.15

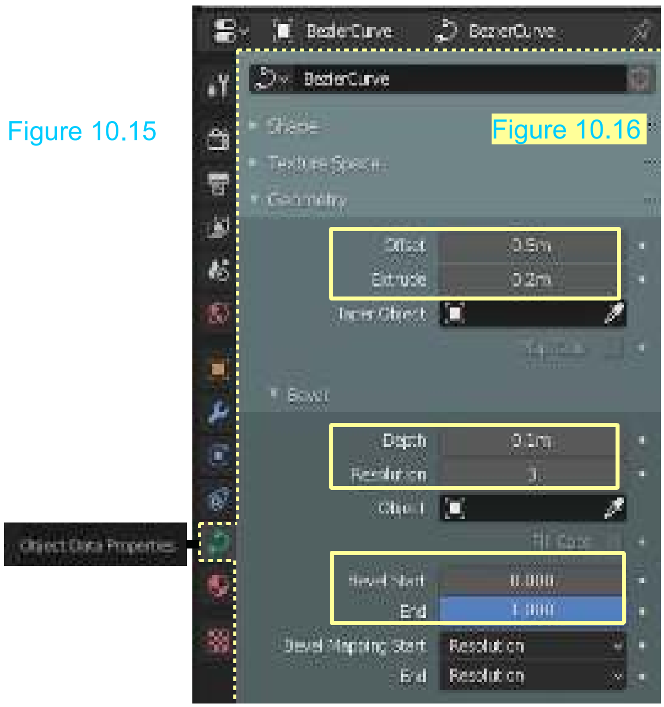
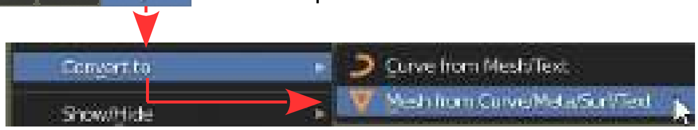


Figure 10.16

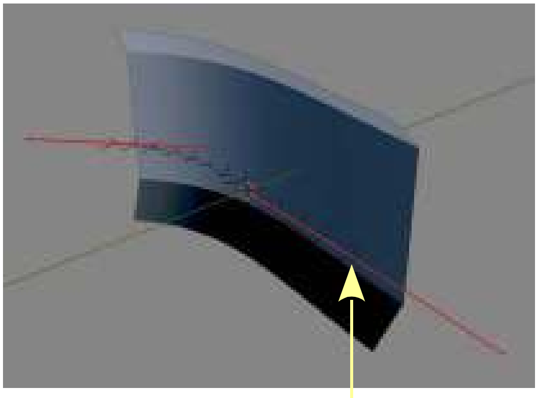
With the shape of the Mesh created, go to the **3D Viewport Editor Header**, click on **Object** and select **Convert to - Mesh from Curve**. In Edit Mode you will see that Vertices, Edges and Faces have been created.

3D Viewport Editor Header

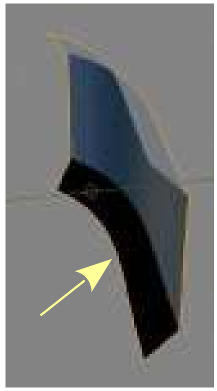


Note: Before converting to a Mesh, in Edit Mode, you can select the Control Handles on the original Bezier Curve and reshape the Object. Once converted to a Mesh the original Curve is deleted.

Figure 10.17



Select Control Handles and reshape before converting



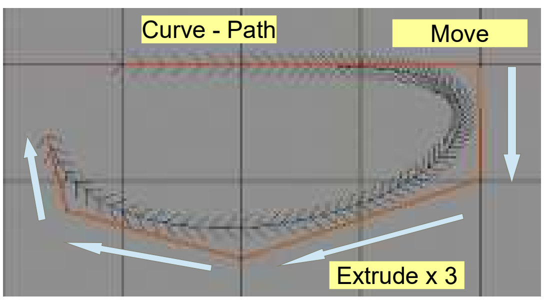
Original Curve Shape

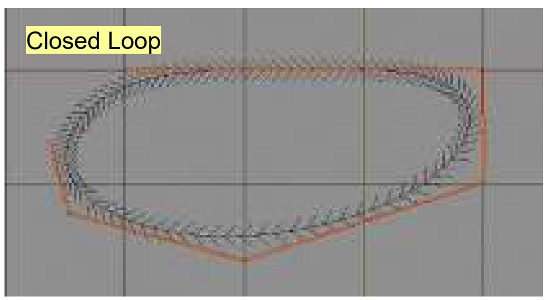
10.7 Closed Loops

Bezier and Nurbs Circles are Closed Loops which means they can be used to create tubular Objects or form a continuous path for an animation. Any Curve or Path may be converted to a Closed Loop.

The following shows a **Curve Path** entered in **Edit Mode** with the RH Control Point Moved then Extruded three times. **In Edit Mode**, click **Curve** in the Header and select **Toggle_Cylic** to form a closed loop.

Figure 10.18





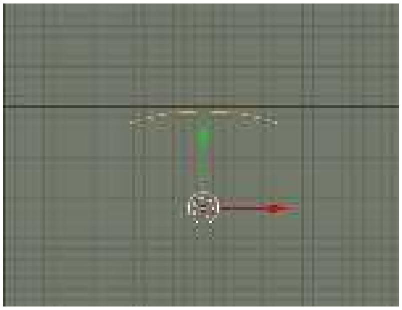
10.8 Using Nurbs Curves

Nurbs Curves are entered in the 3D Viewport Editor by pressing **Shift + A Key** or clicking **Add** in the 3D Viewport Header and selecting from the menu that displays. There are two options; **Nurbs Curve** and **Nurbs Circle** (Figure 10.19). **Place the 3D Viewport Editor in Top Orthographic View**.

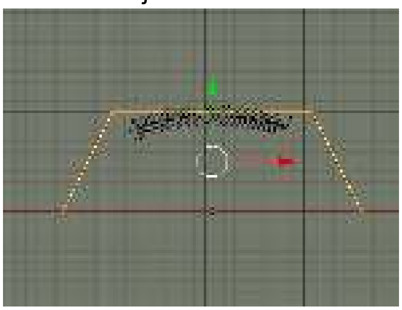
Menu

Figure 10.19

Nurbs Curve



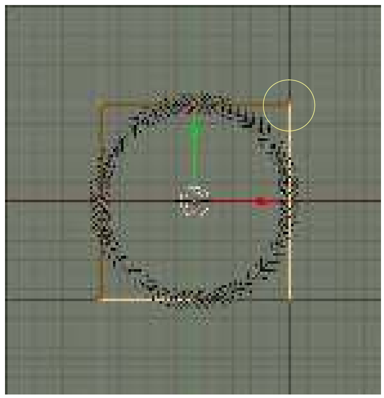
Object Mode



Edit Mode

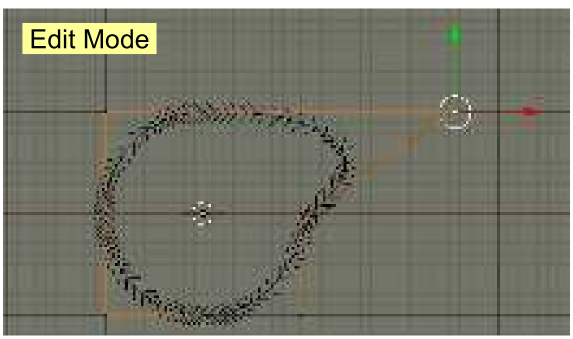
Nurbs Circle

Object Mode



Edit Mode

In Edit Mode, Nurbs Curves and Circles have control handles attached with which you manipulate the shape (Figure 10.20). In both cases you see chevrons spaced on the Curve indicating that they may be used as Paths for animation.



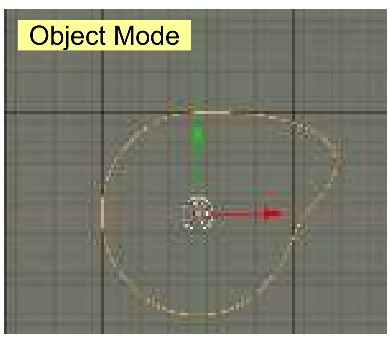


Figure 10.20

10.9 Nurbs Circle

Figure 10.21 shows a **Nurbs Circle** with a Control Point selected and Moved on the X Axis.

With the Nurbs Circle selected in **Object Mode** the shape may be expanded by changing settings in the **Properties Editor, Object Data buttons, Geometry tab** (Figure 10.22). To demonstrate, skew the 3D Viewport into a User Orthographic View as shown in Figure 10.21 (MMB Drag).

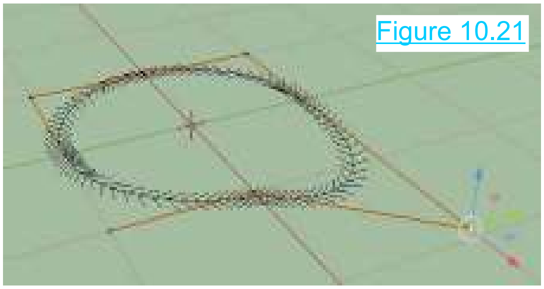


Figure 10.21

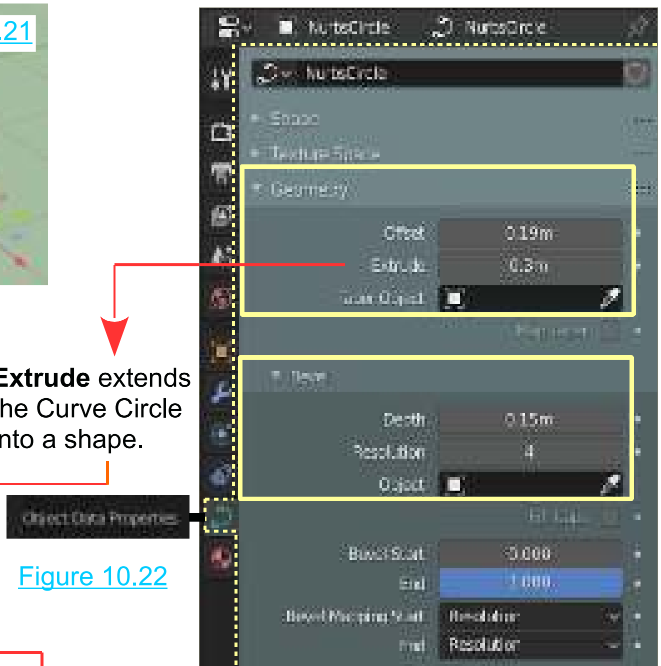
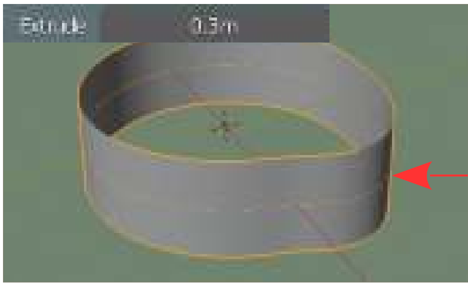
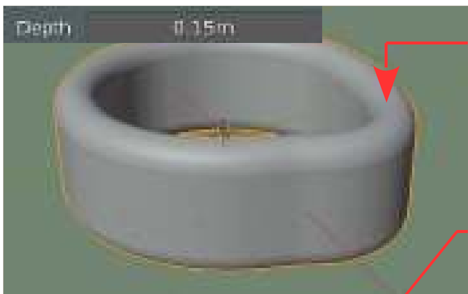


Figure 10.22



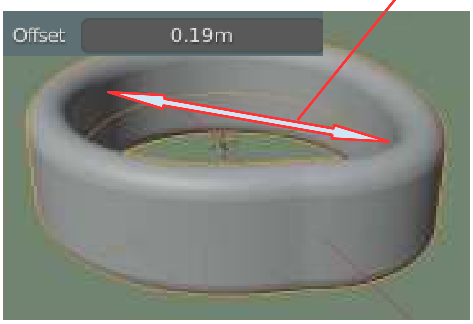
Extrude extends the Curve Circle into a shape.

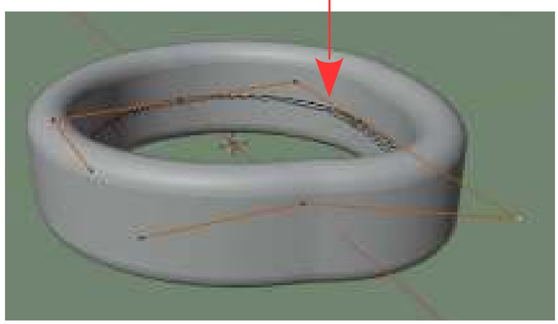


Bevel – **Depth** bevels the edge.

In Edit Mode the Control Points remain in place.

Geometry – **Offset** increases the size on the X and Y axis.

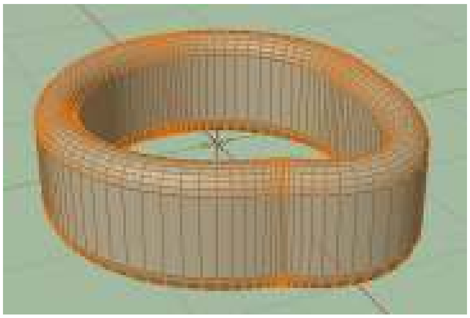




With the Circle expanded then selected in **Object Mode** you may convert the shape into a **Mesh Object** (in the Header, click Object, select Convert to – Mesh from Curve). You see the Object in Edit mode with vertices, edges and faces (Figure 10.23).

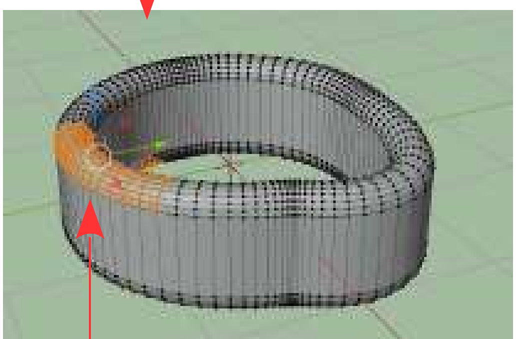
Note: When you convert to a Mesh Object the ability to use the settings in the Properties Editor, Data buttons, Geometry tab is no longer available.

Deselect the Vertices then select individual vertices for manipulation.

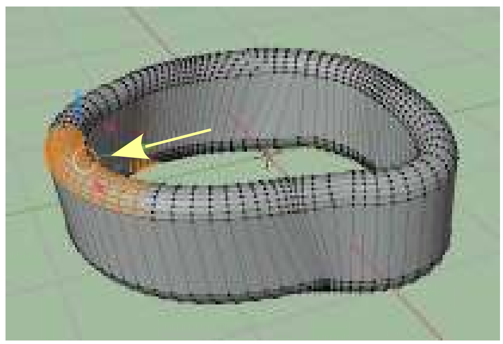


A key - Deselect

Figure 10.23



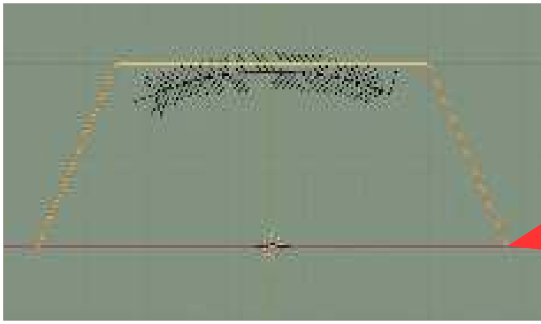
Vertices Selected



Vertices Translated – Proportional Editing Enabled

This procedure shows that by converting one type of object to another, you have different options for shape manipulation.

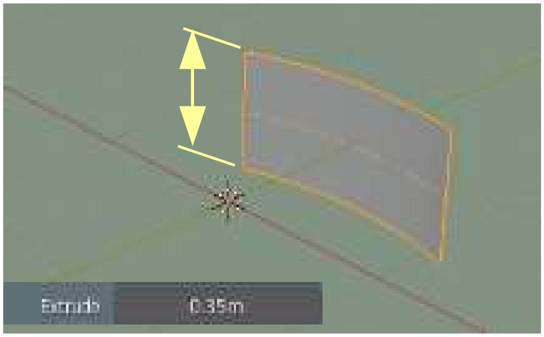
10.10 Nurbs Curve   Figure 10.24



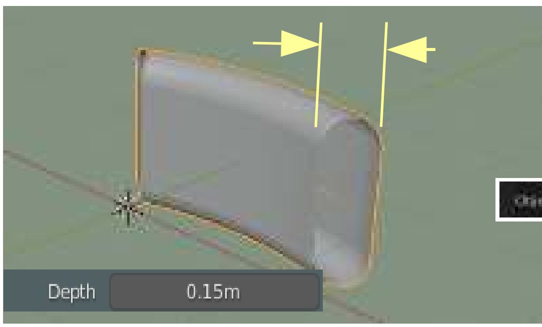
The **Nurbs Curve** is another starting place for creating shapes, objects or animation paths.

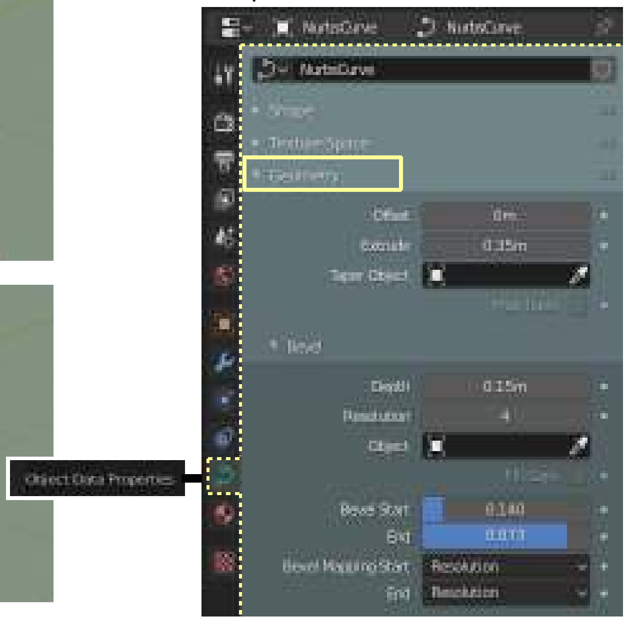
Edit mode shows the Curve surrounded by Control Handles (orange lines) with control points (orange dots)

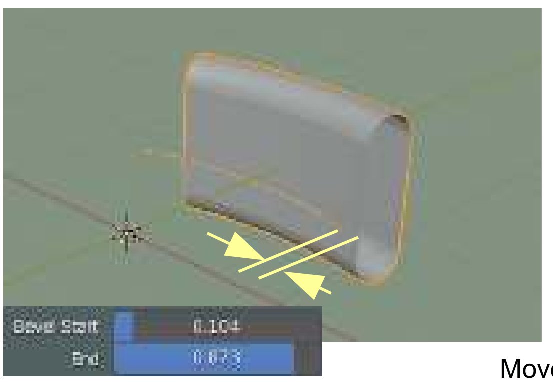
You may select a single point or multiple points then Move, Rotate or Scale to shape the Curve.

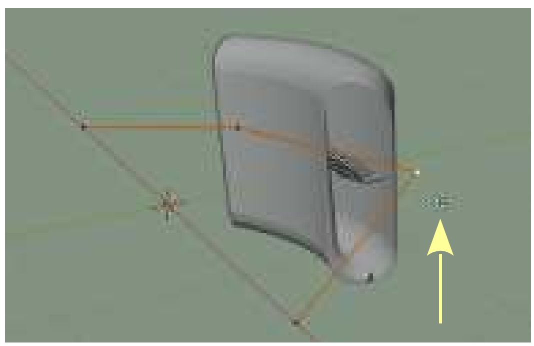


In **Object Mode** settings in the **Properties Editor, Object Data buttons, Geometry Tab** control the shape.









Move Control Handles to alter the shape in **Edit Mode**.

10.11 Lofting

Lofting is sometimes referred to as **Lathing** which is the process of generating shapes using Curves. The shape is generated then converted to a Mesh Object.

To demonstrate the process a **Bezier Circle** will be used in conjunction with a **Bezier Curve**.

Begin a new Blender Scene, delete the default Cube then add a Bezier Circle. Deselect the circle and add a Bezier Curve. Zoom in on the 3D Viewport Editor (Figure 10.25).

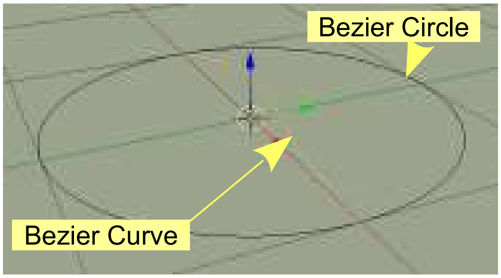


Figure 10.25

Deselect the Curve and select the Circle. In the **Properties Editor, Object Data buttons, Geometry Bevel Tab,** click on **Object** and select **Bezier Curve** (Figure 10.26). Check **Fill Caps**.

Figure 10.26

Figure 10.27

A shape is generated in the 3D Viewport Editor (Figure 10.27).

To understand what has occurred place the 3D Viewport Editor in **Wireframe Viewport Shading** Mode. Select the **Bezier Curve** by clicking on the name in the **Outliner Editor** (Figure 10.29). To see more clearly turn off the grid and floor display in the **Overlays**.

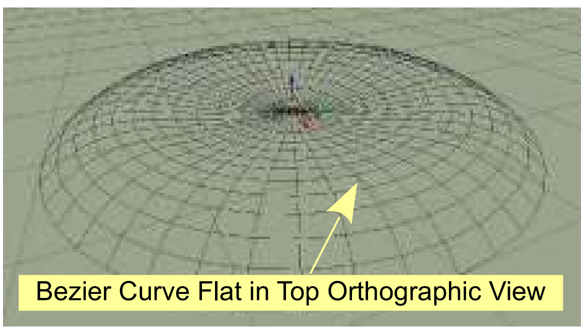


Figure 10.28

Figure 10.29

The profile of the Bezier Curve is presented flat in **Top Orthographic View** (Figure 10.25). With the curve selected press R + X + 90 to flip it on edge. Go into **Front Orthographic View** and translate the Curve to align with the profile of the generated shape (Figures 10.30 & 10.31.

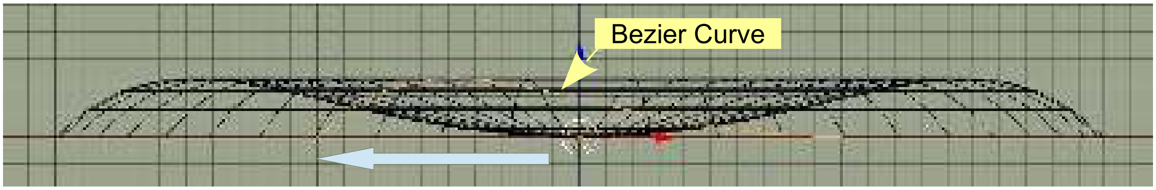


Figure 10.30

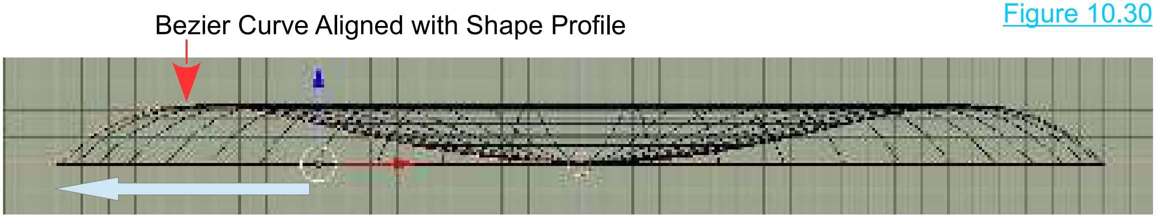


Figure 10.31

By skewing the 3D View Editor you will see that the shape has been generated by extruding the Curve profile through 360° (Figure 10.32).

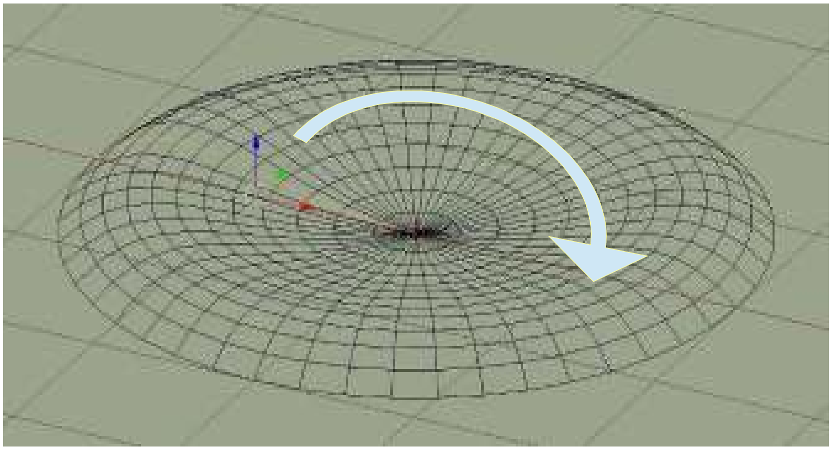


Figure 10.32

With the Bezier Curve still selected Tab to Edit Mode to see the **Control Handles** at each end of the Curve (Figure 10.33).

By selecting the Control Handle at the center of the shape and translating it along the **X Axis** towards the outside, you will see that it increases the inner diameter of the shape. Similarly translating the Control Handle at the outer diameter alters the outer diameter.

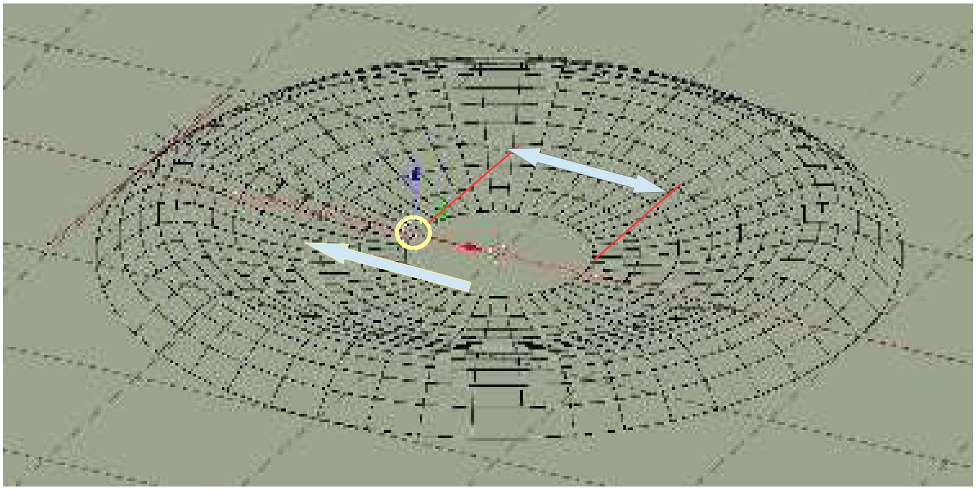


Figure 10.33

Shift select both Control Handles then press **R + Y + 90**. Doing this flips the Bezier Curve up on edge and changes the shape into something resembling a pot (Figure 10.34).

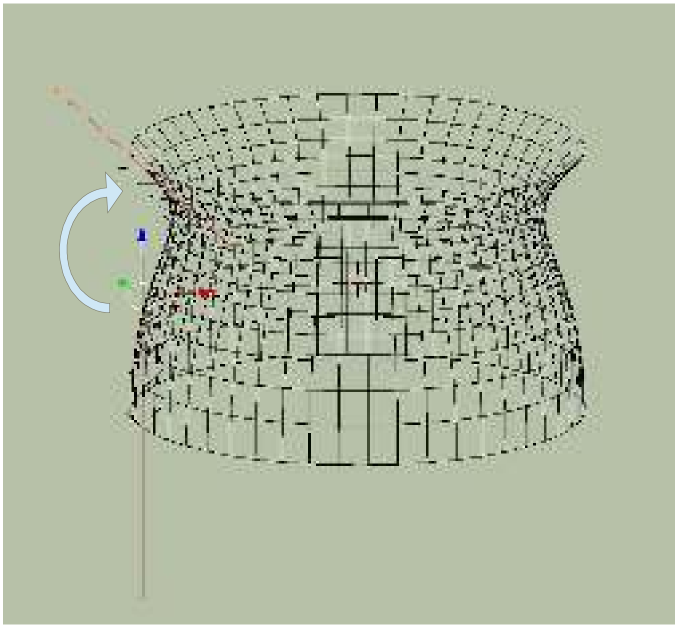


Figure 10.34

By manipulating the Control Handles you can modify the shape. Selecting both Control Handles and Subdividing (Click RMB in the Editor and select Subdivide in the Curve Context Menu) adds a third Control Handle (Figure 13.16). With the Control Handle selected, press the **V Key** to display the Handle type menu. Type **Vector** allows you to produce sharp corners when the handle is rotated.

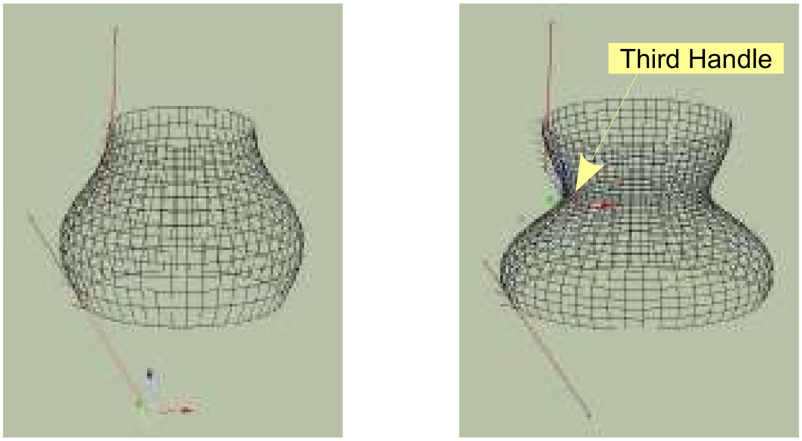


Figure 10.36

When you have completed shaping, Tab to Object Mode, deselect the **Bezier Curve** and select the shape itself. Change to **Solid Viewport Shading Mode** (Figure 10.37).

In the **Properties Editor, Object buttons (NOT Object Data), Viewport Display Tab** check (tick) **Wireframe** to view to see the subdivisions that will be created when the shape is converted to a Mesh Object (Figure 10.38). You may modify the subdivisions by altering values in the **Properties Editor, Object Data buttons, Geometry Tab.**

Figure 10.37

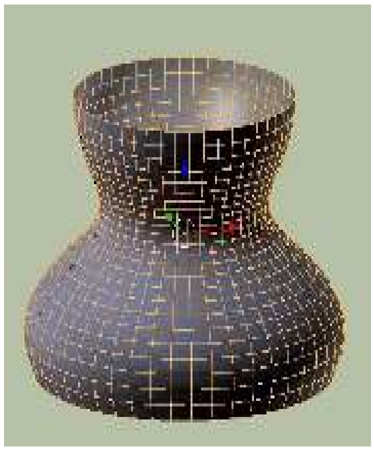


Figure 10.38

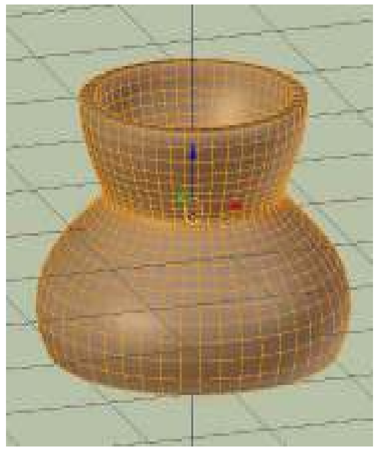


Figure 10.39

Finally, with the shape completed, click Object in the Header and select Convert to Mesh from Curve.

Add a **Solidify Modifier** (see Chapter 8 – 8.13) and increase the **Thickness value** to give the shape **wall thickness** (Figure 10.39).

11

Editing Techniques - Examples

11.1 Creating a Landscape
11.2 Dupliverts
11.3 Modeling an Aircraft
11.4 Sculpting – Sculpt Mode
11.5 Sculpting Demonstration
11.6 Creating a Humanoid Figure

Introduction

Becoming proficient at Modeling requires a knowledge of the tools that are available and how to combine the use of tools to create what you want. There are no hard and fast rules concerning which tool is used for any particular application. You use whatever suits what you are doing.

This chapter shows a very brief sample of how different tools are used in creating some basic models and effects.

What you can model using Blender is only limited by your imagination and your knowledge of what tools are available and where to find them.

11.1 Creating a Landscape – Proportional Vertex Editing

Proportional Vertex Editing can be employed to create a landscape or ground as a background for a Scene. Simply select Vertices on a subdivided Plane and move them up or down the Z Axis. Vertices moved down forming depressions can be turned into lakes or rivers by positioning a second Plane below the original and giving it a different color (Chapter 4 - 4.18). When the landscape is formed in Edit Mode, Tab to Object Mode, select the ground and select **Shading Smooth** in the **Object Context Menu** (RMB click in the Editor).

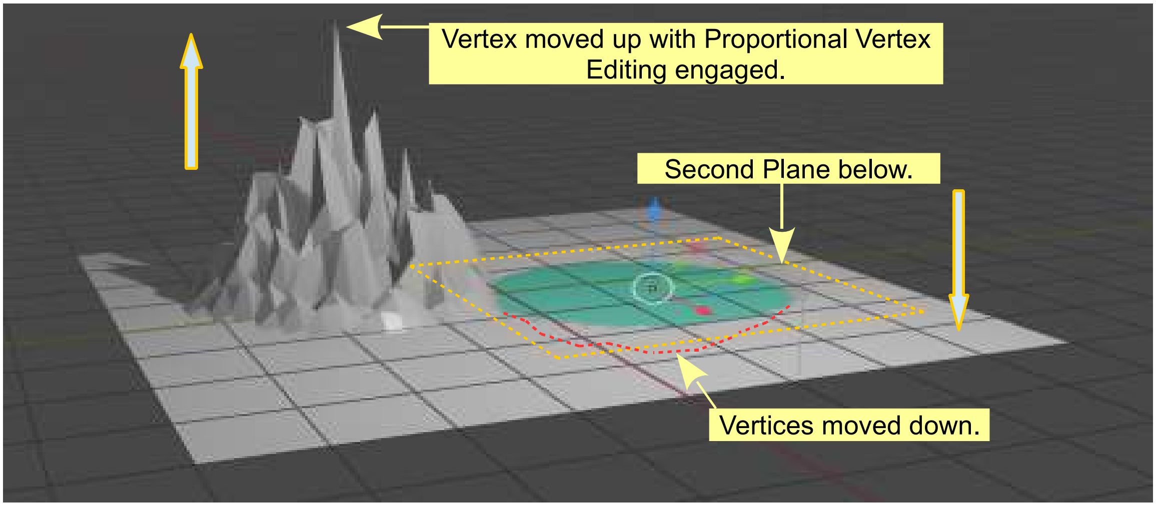


Figure 11.1

Cook Book Instructions

> **Note: The Add Mesh: A.N.T. Landscape** Add-on for Blender automates landscape generation. There are also external programs.

Delete the Cube from the default 3D Viewport Editor.
Add a Plane Object and scale up four times.
Tab to Edit Mode.
Subdivide the Plane.
In the Last Operator Panel increase the Number of Cuts to 10.
Subdivide again. Increase the Number of Cuts to 3 (10 + 3 = 13).
Deselect the Vertices and select a single Vertex.
Enable Proportional Editing and select Random Falloff.
Press G Key plus Z Key and drag the Mouse Cursor up.
Deselect the Vertex and select a second Vertex. Repeat the process for another mountain or with Spherical Fall off drag down creating a depression for a lake.
Add a second Plane to the Scene just below the first scaled to sit in the depression.
Give the new Plane a geen-blue color.

Note: When following these instructions, at this point, you will not see the view of the Scene in the 3D Viewport Editor exactly as shown in the diagram. What is seen in the Editor is dependent on how Material (Color) is applied (Chapter 16), what lighting (Lamps) have been been introduced (Chapter 15) and the Viewport Shading that is implemented (Chapter 14).

11.2 Dupliverts

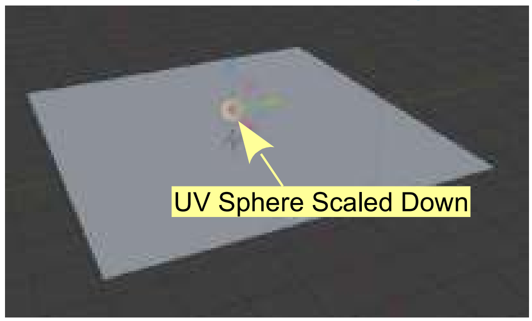
Dupliverts means **Duplicating at Vertices**, which means creating an Array of Objects by duplication. Each duplicated Object is positioned at the location of a Vertices of a secondary Object. To demonstrate, a **UV Sphere** Object will be duplicated at the position of each Vertex of a **Plane** that has been Subdivided.

Delete the default **Cube** Object in the default Blender Scene. In the **3D Viewport Editor** add a **Plane** Object. Scale the Plane up four times (S Key + 4, LMB click) then **Tab** to **Edit Mode** and **Subdivide.**

To replicate the Subdivision in the diagrams, in 3D View Editor Header, RMB click in the Editor and select Subdivide in the Object Context menu. In the Subdivide Last Operator Panel increase the Number of Cuts to 10. RMB click again, Subdivide a second time. In the Last Operator Panel the Number of Cuts resets to 1. Increase to 2. If you like to examine the subdivision in detail you will find you have 1156 Vertices.

How many times you Subdivide is arbitrary but having a decent number of Vertices produces a good effect.

Figure 11.2



Tab to **Object mode** deselect the Plane.

Add a **UV Sphere** object to the Scene, scale it down (Figure 11.2). In the Resize, Last Operator Panel make the Scaler values = 0.158.

With the **Sphere selected** (in Object Mode), **Shift** select the **Plane**. Press **CTRL + P key** and select **Set Parent to Object** to parent the Sphere to the Plane (Figure 11.3).

Deselect the Sphere and the Plane. Select the Plane only.

Figure 11.3

With the Plane selected go to the **Properties Editor, Object** buttons **(NOT Object Data), Instancing Tab** and select **Verts** (Figure 11.4). The **Sphere** is duplicated at the location of each Vertex on the Plane (Figure 11.5).

Figure 11.4

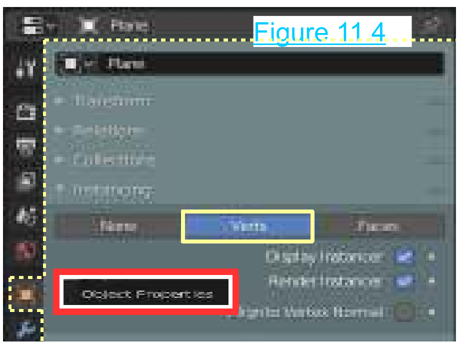
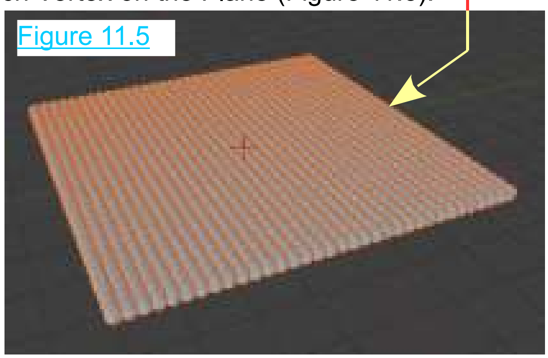


Figure 11.5



Deselect the Plane.


Figure 11.6

Scale the **Sphere** to adjust its size and create separation between the duplicates. Since the original Sphere is at the center of the Plane it is more than likely hidden among the duplications and difficult (impossible) to select.

To select the Sphere, go to the **Outliner Editor** and locate the Sphere in the File tree (Figure 11.6). Select the Sphere in the **Outliner Editor** (Click LMB) then in the **3D Viewport Editor** Scale the Sphere down to make gaps between the duplicates (Figure 11.7).

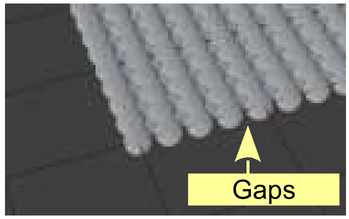


Figure 11.7

With Sphere selected, in **Object Mode**, Move up on the Z Axis (Figure 11.8). Deselect the Sphere.

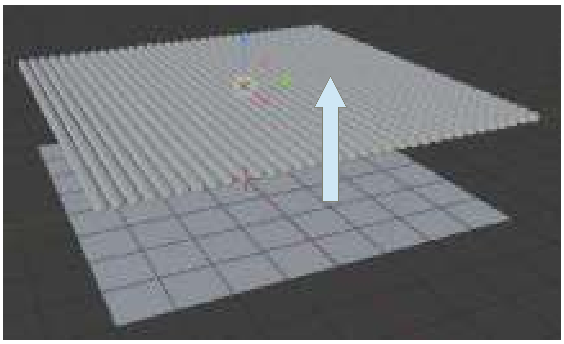


Figure 11.8

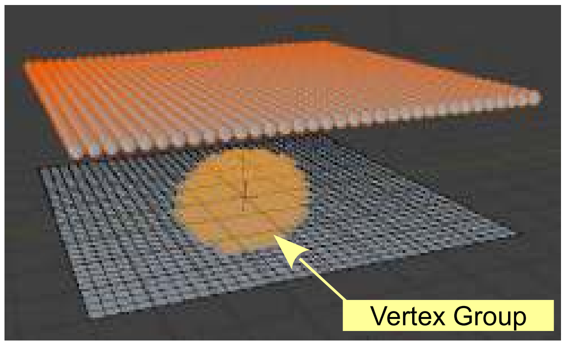


Figure 11.9

Select the **Plane,** then in **Edit Mode** a group of Vertices may be selected (Figure 11.9) and with **Proportional Editing** turned on, translated deforming the Array of Spheres (Figure 11.10).

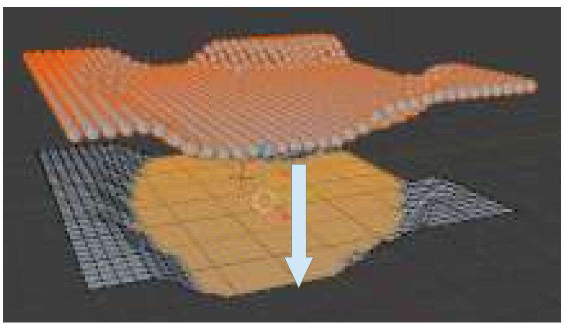


Figure 11.10

By animating the Vertices on the Plane to move and combining sound effects the Spheres can be made to dance in time to music.

11.3 Modeling Exercise – Aircraft

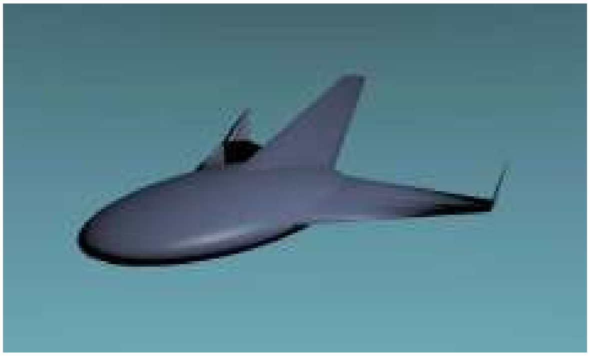
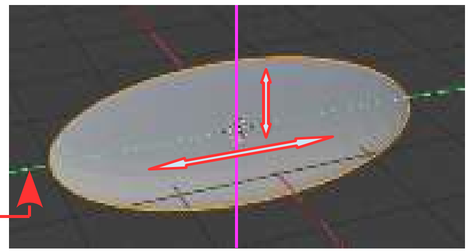


Figure 11.11

Vertical Z Axis

Figure 11.12



Y Axis (Green Line)

To model the aircraft shown in Figure 11.11 open a new Blender Scene. Delete the default Cube and add a **UV Sphere**. Zoom in (scroll MMB or press Num Pad +). Scale down on the Z Axis (S Key + 0.5 + Z Key). Scale the Sphere times 2 on the Y Axis (press S key + Y Key + 2 and LMB click) (Figure 11.12).

You will be modeling the reshaped Sphere and want it to be identical either side of the Y Axis (the green line). That is to say you want it to be mirrored **on the X Axis** (along the red line).

In Top Orthographic view, place the UV Sphere in **Edit Mode** and delete all the vertices on the LHS of the Y Axis (press the B key for Box select, place the Cursor as shown by the white cross, click and hold drag a rectangle around the LHS Vertices). **Don't forget; Activate Show X-Ray**. With the Vertices selected press the **X Key** and select **Delete Vertices** .

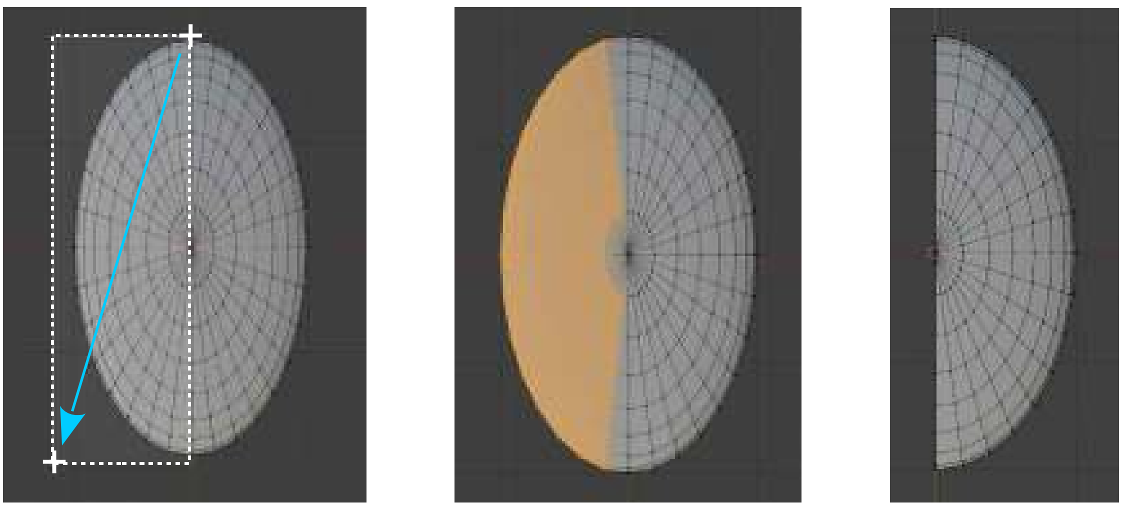
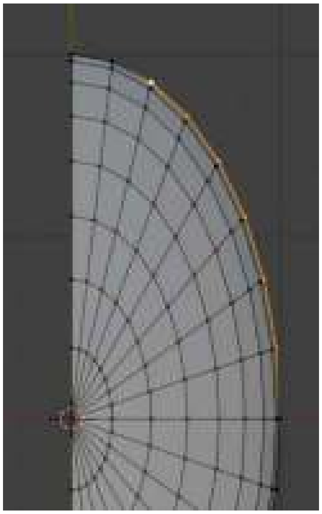


Figure 11.13

Place the UV Sphere in **Object Mode** (press Tab). Add a **Mirror Modifier** (Ref: Chapter 8 - 8.8) which by default is set to mirror on the X Axis. Change to **Right Orthographic** view (press the Num Pad 3 Key)

Figure 11.14

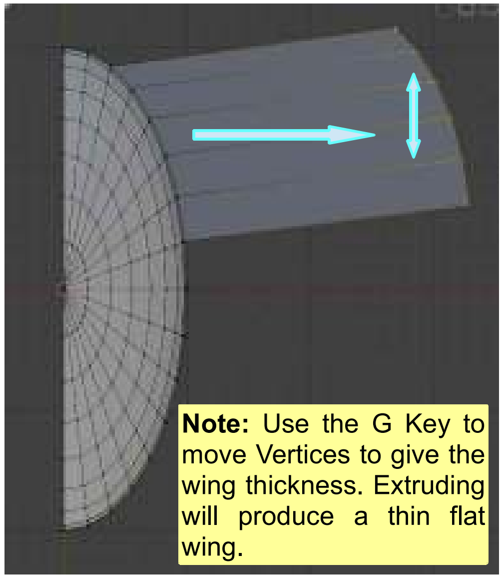


Tab to Edit Mode and select the Vertices as shown in Figure 11.14 (hold Shift and RMB click on each Vertex).

Change back to **Top Orthographic** view. Press the **G Key** (Move) and use the **Widget** to move the Vertices to the right (Figure 11.15).

With the **Vertex Group** still selected press the **S Key** (Scale) and Scale the group in.

Figure 11.15



Use the **Widget** to move the group towards the back of the aircraft forming a wing (Figure 11.16).

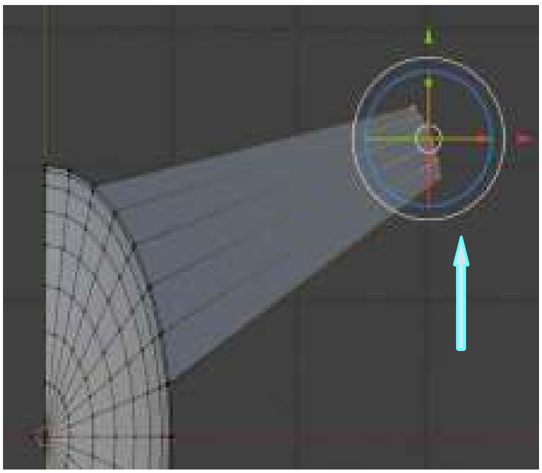
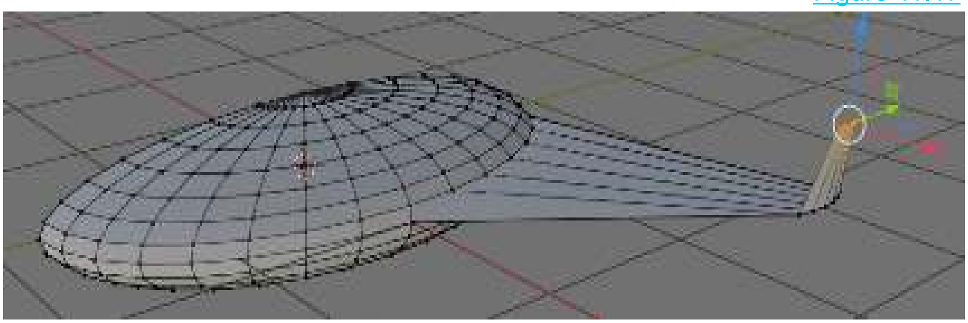


Figure 11.16

Rotate to align with the fuselage (Figure 11.16).

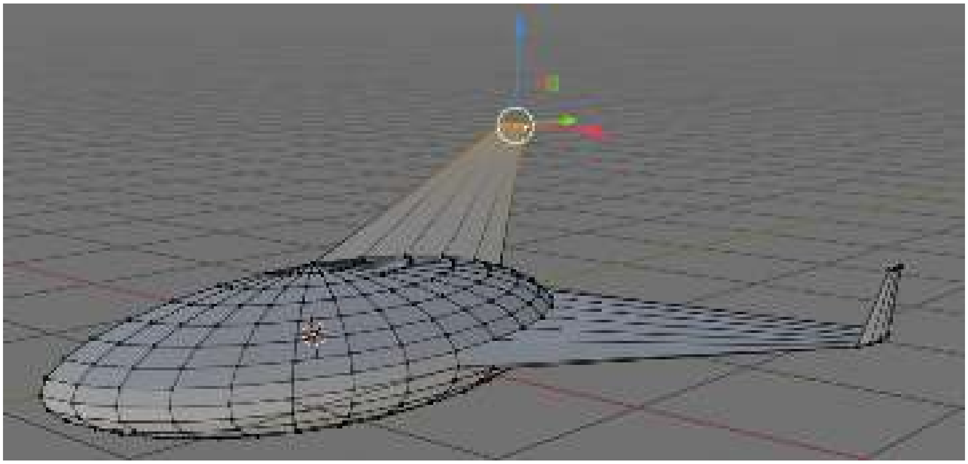
Extrude up, Scale the group in and move back forming the wing stabiliser (Figure 11.17)

Figure 11.17



Select vertices at the rear of the fuselage on the centerline, Move up and repeat the procedure for the wing stabiliser forming a tail (Figure 11.18)

Figure 11.18



Go into **Object Mode**, **Apply the Mirror Modifier**, add a **Material**. In the **3D View Editor Header** click on **Object** and select **Shade Smooth**. Rotate the 3D View Editor to see your super duper aircraft.

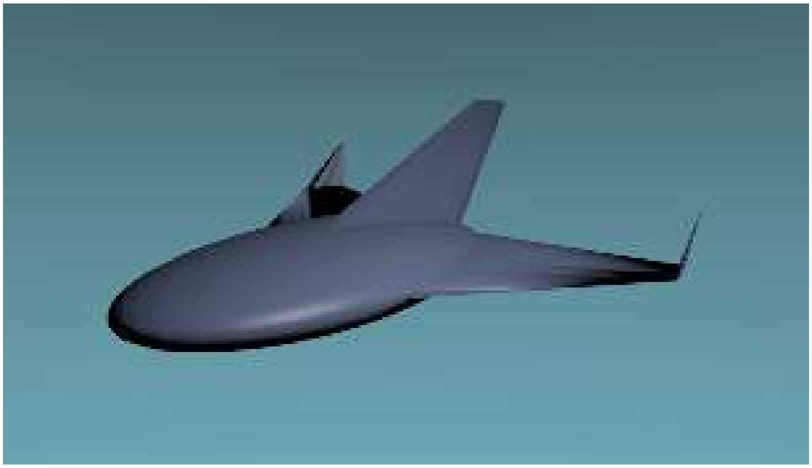


Figure 11.19

Note: Change the 3D Viewport Editor background color to get the blue sky effect.

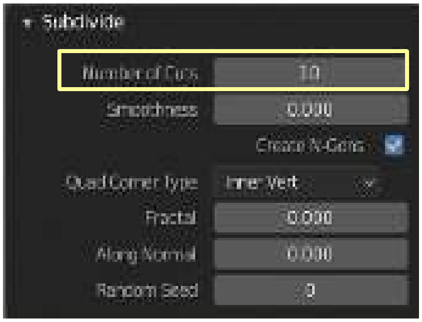
11.4 Sculpting

Sculpting, in Blender, allows you to add detail to the surface of a model by manipulating the Mesh Vertices. The process produces results similar to kneading a piece of clay. Vertices are pulled or pushed or added, by using of Tools which deform the mesh surface.

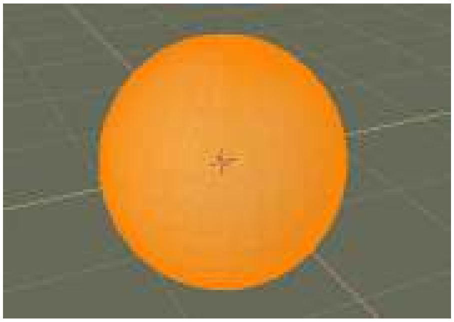
Sculpting is performed after you have created a model. To demonstrate the basics of the process a UV Sphere will be employed. The UV Sphere has a reasonable number of Vertices forming its surface but for Sculpting to be effective a high vertex count is required. Replace the default Cube Object with a UV Sphere in the 3D Viewport Editor. In the demonstration the whole surface of the Sphere will be used but in reality you would Subdivide the surface of a model in the area where detail is to be added.

With the UV Sphere selected in Object Mode, Tab to Edit Mode and with all Vertices selected, Subdivide with Number of Cuts 10 (Chapter 5 – 5.5) (Figure 11.20).

Figure 11.20



Last Operator Panel



UV Sphere – Edit Mode – All Vertices Selected

With the UV Sphere Subdivided, either **change to Sculpt Mode** or **select the Sculpting Workspace.**

Click and select Sculpt Mode

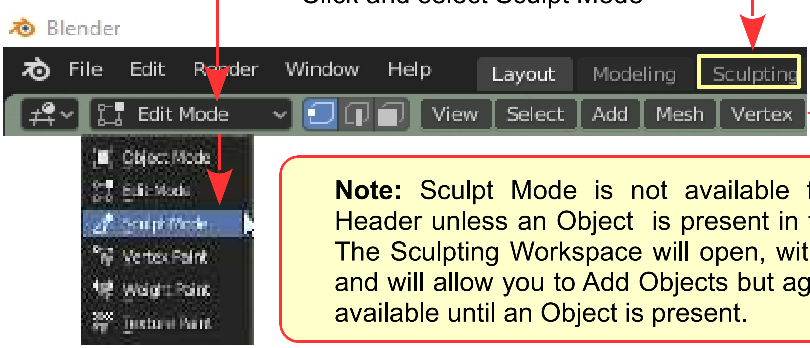


Figure 11.21

3D Viewport Header

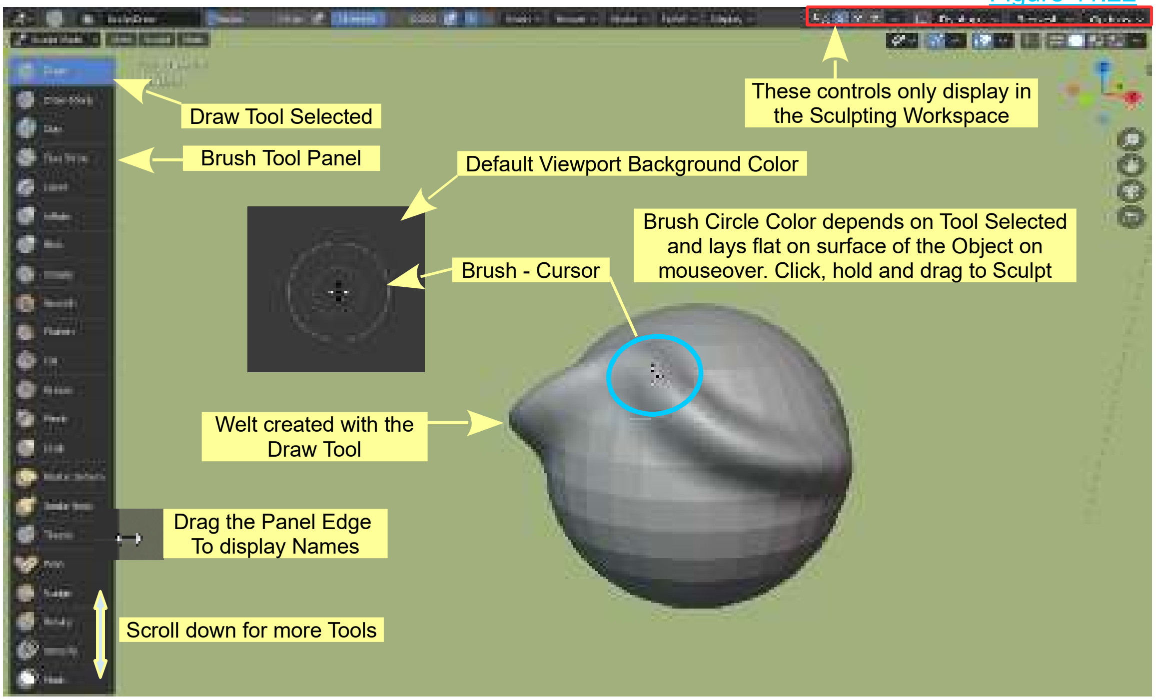
Note: Sculpt Mode is not available from the 3D Viewport Header unless an Object is present in the 3D Viewport Editor. The Sculpting Workspace will open, without an Object present and will allow you to Add Objects but again, Sculpt Mode is not available until an Object is present.

The first thing you will notice when changing to Sculpt Mode is the change in the 3D Viewport Editor Header and the arrangement of Tools down the LHS of the Screen. The second observation is, the subdivided UV Sphere is displayed as it would be in Object Mode with with Flat Shading. Changing back to Object Mode and selecting Shading - Smooth has no effect.

A third significant change is; the 3D Viewport Editor Cursor has a blue circle attached **when you mouse over the Sphere**. The circle is called the **Brush** (Figure 11.22).

Note: The color of the Brush Circle changes depending on the Tool selected.

Figure 11.22



Note: This display shows the 3D Viewport Editor in Sculpt Mode when the **Sculpting Workspace** is selected in the Screen Header.

To Sculpt you select a Tool, click, hold and drag over the surface of the selected Object. In Figure 11.22 the Draw Tool has been selected (blue icon in the Tool Panel = blue Brush Circle). The Sculpt effect is dependent on the Strength setting in the Header and the Brush Radius.

For example, with the Draw Tool selected (highlighted blue) click, hold and drag the mouse cursor (blue circle) over the surface of the UV Sphere. With the default settings Vertices forming the surface will be raised forming a welt. Note the deformation is mirrored about a centerline.

For detailed Sculpting you would select the Sculpting Workspace. Detailed controls for each Brush Type are found in the Properties Editor, **Active Tool and Workspace buttons**..

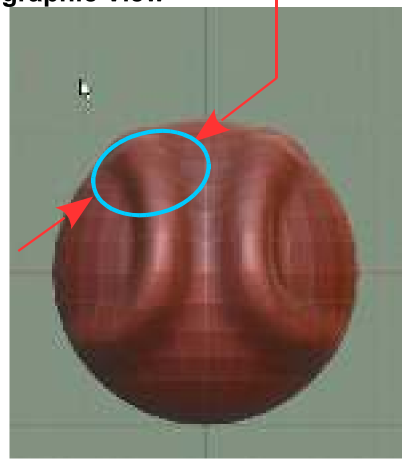
Sculpting Workspace Tool Header

Brush Influence

Pull / Push Vertices

Tool Selected

Front Orthographic View



Note: In this instance the affect of the Brush is cumulative. The Brush has been dragged over the same Vertices three times **with the Strength value = 0.500**

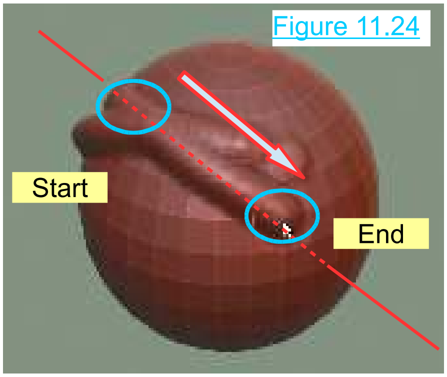
Controls duplicated in the Properties Editor

11.5 Sculpting Demonstration (Basic)

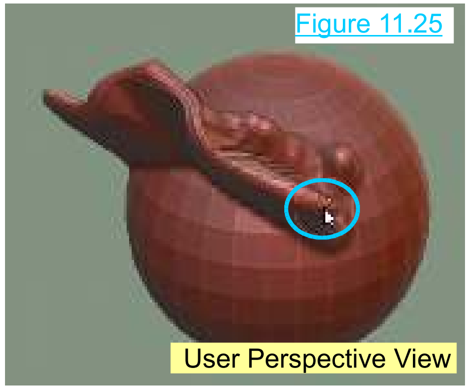
The Sculpt demonstration will be limited to the Draw Tool. Each Tool affects the Mesh Surface in a different way and the results vary depending on what settings are applied to the individual tools. As with any graphics drawing application proficiency is obtained by experimentation and practice.

It is worth noting that instead of the Mouse a Graphics Drawing Tablet with a Stylus may be substituted.

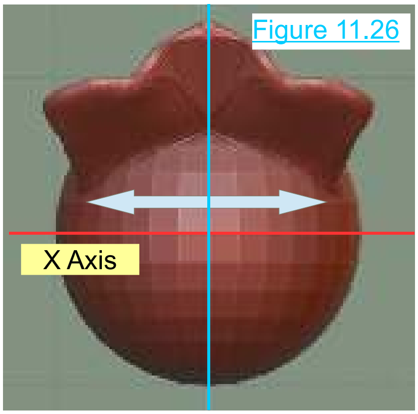
To see how the Draw Tools operates, select the Draw tool in the Tool Panel. The buttons in the Tool Header will control the properties of the Draw Tool. Set the Radius slider to approximately 30 px (pixels) and have the plus **+** setting for Pull engaged. Change the Strength value to 1.000 (drag the slider). The effect of the Tool will have a more pronounced effect with a higher value.



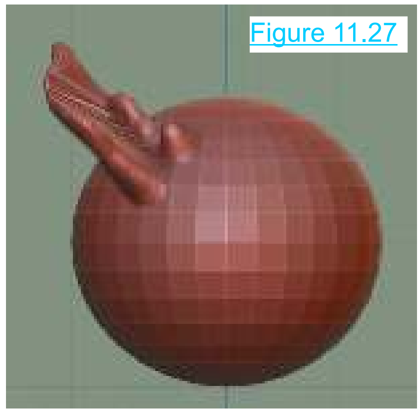
Position the Brush in the 3D Viewport Editor as shown in Figure 11.24, click and hold LMB and drag the Brush over the surface of the UV Sphere (generally along the red X Axis). At the end of the stroke release the mouse button.



As the Brush moves over the surface a welt appears as the Vertices are pulled away from the surface. Repeatedly dragging the Brush over the top of the welt further increases the deformation (Figure 11.25).



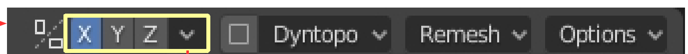
Front View



Side View

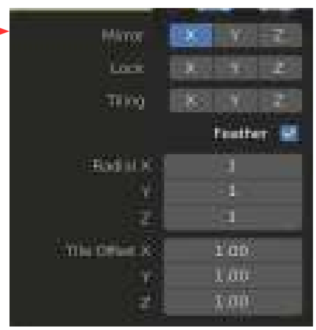
Click on Sculpt

Controlling the Mirror Sculpt



3D Viewport Editor Header
Sculpting Workspace RHS

Figure 11.28



In the Front View you see that the deformation of the surface has been mirrored along the X Axis, that is mirrored either side of the Z Axis. To turn the mirror effect off, in the 3D Viewport Editor Header (in Sculpt Mode) click on **X** to toggle **X Axis Mirror.** You may also elect to mirror the Sculpting about the Y or X Axis.

With Mirror toggled off you can stroke over the surface in any direction modeling freehand.

At this stage clarification in respect to the relationship between the options available in the Headers is required. Figure 11.29 shows some of the options available in the Headers.

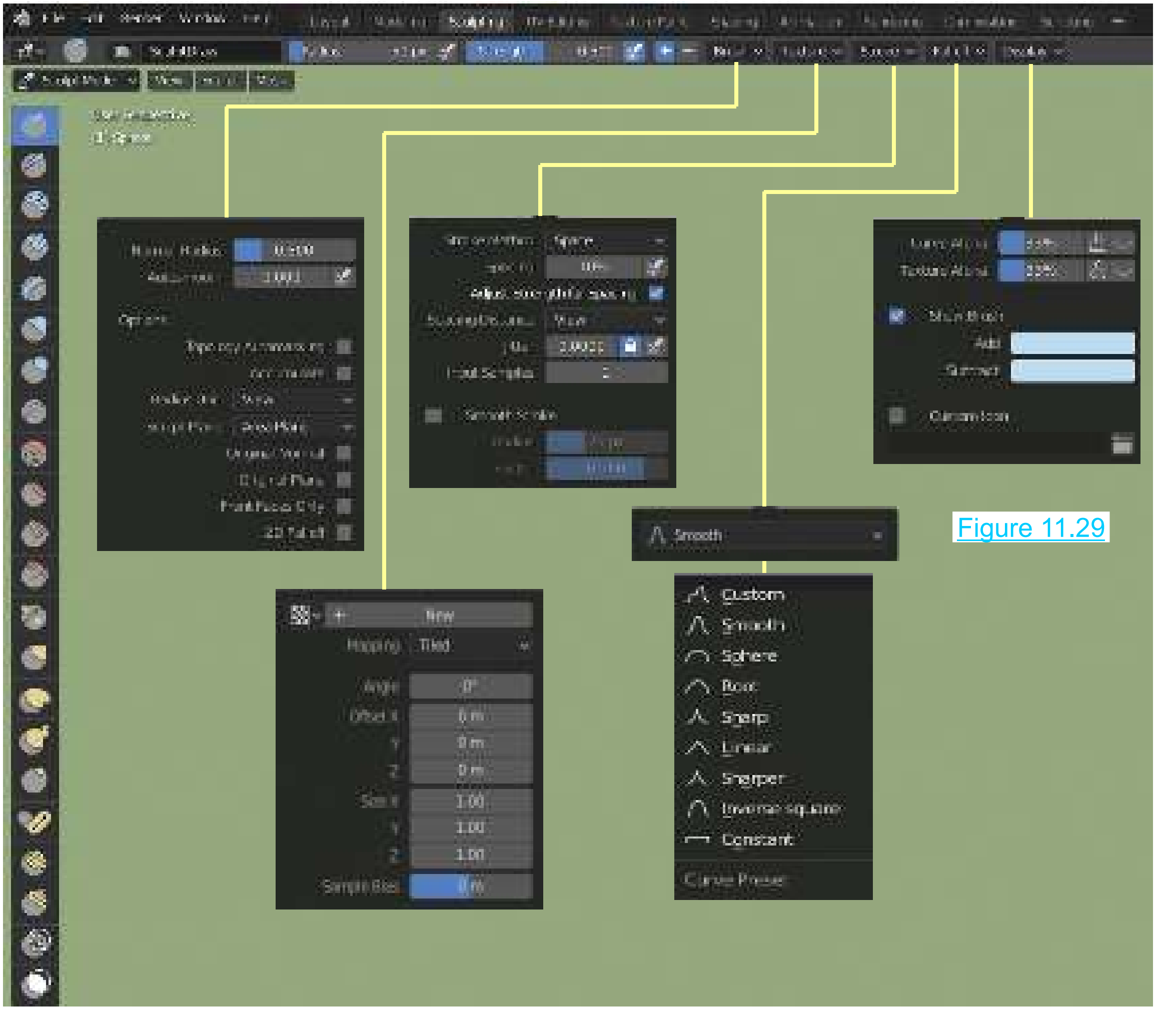


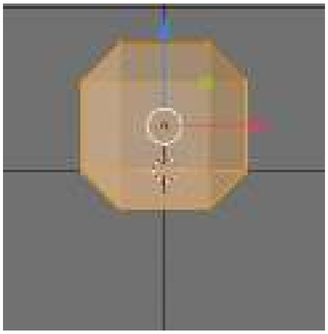
Figure 11.29

Controls in the Header alter depending on the particular Brush selected from the Brush Panel. In the diagram the Draw Brush is selected (highlighted blue). You see the icon representing Draw at the LHS of the Header.

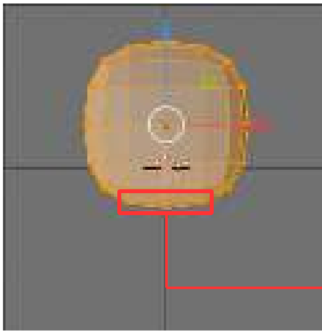
The Headers provide a variety of options for selecting how the Brush affects the mesh surface. Many of the selection options are duplicated. Knowing what Tools are available and where to access them will allow you to experiment and practice sculpting.

11.6 Creating a Humanoid Figure

At some stage you will want to make a character figure for animation. As with the Aircraft Modeling Exercise this starts with one of Blender's primitives (a Cube) and by a process of selecting Vertices, Extrusion, Scaling, Manipulation and the application of Modifiers a simple figure may be generated. The following is intended to demonstrate the technique and not to produce a refined result. Modeling requires time and patience and plenty of practice. Add a **Bevel Modifier** to the default Cube with Width = 0.401. Apply the Modifier and place the Cube in **Edit Mode – Front Orthographic View. Remember: Modifiers can only be Applied in Object Mode.**

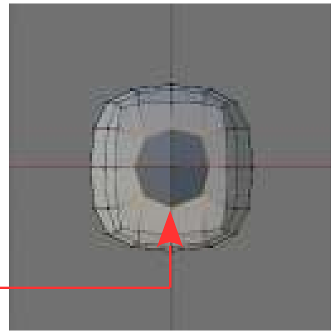


Cube with Bevel Modifier applied. Width = 0.401

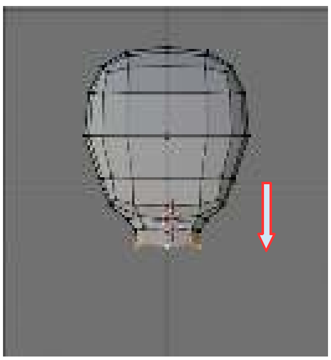


Apply a Subdivision Surface Modifier to add Vertices.

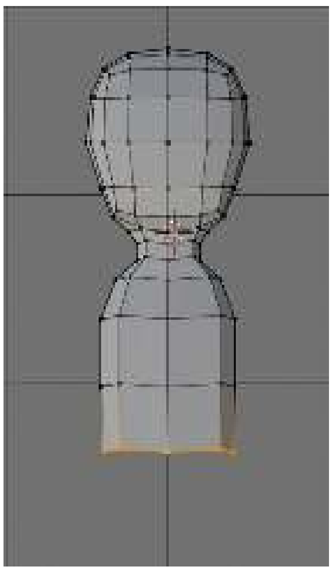
Figure 11.33



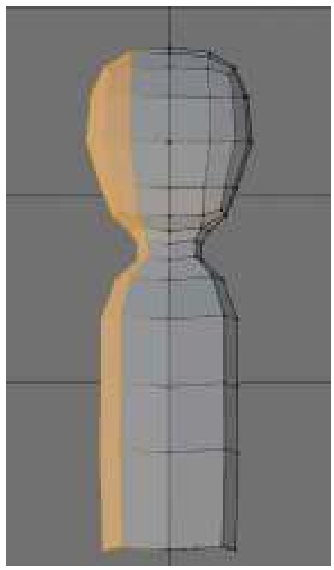
Remove the center Vertex and reshape perimeter of the hole on the base.



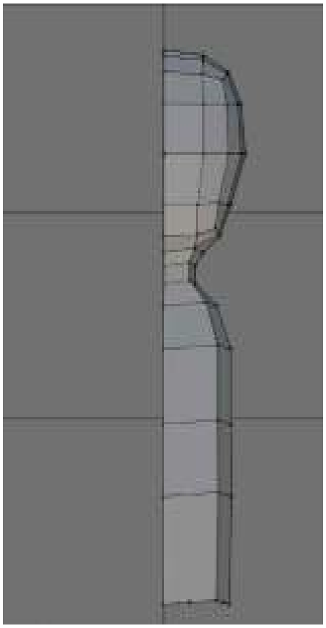
Select perimeter Vertices and Extrude down to form the neck.



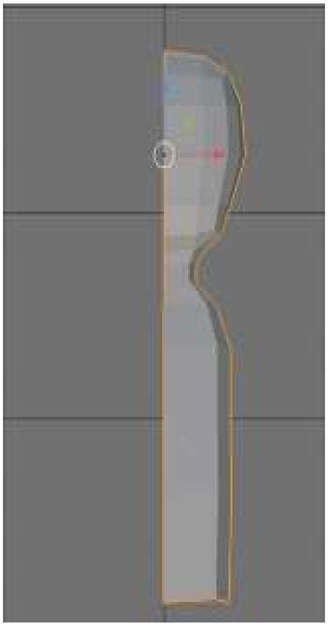
Continue extrusions and Scale out forming the body.



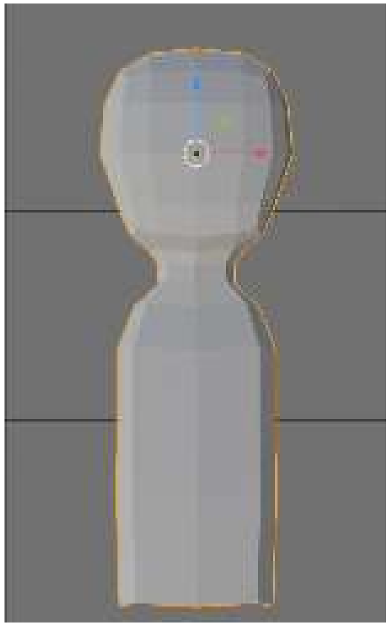
With the body formed select one half of the Vertices and delete.



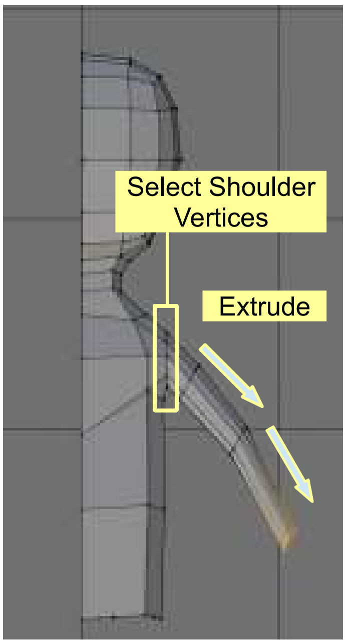
Edit Mode



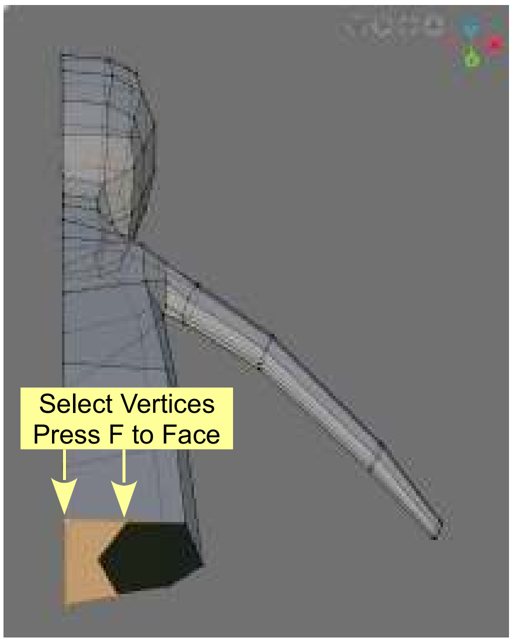
Object Mode



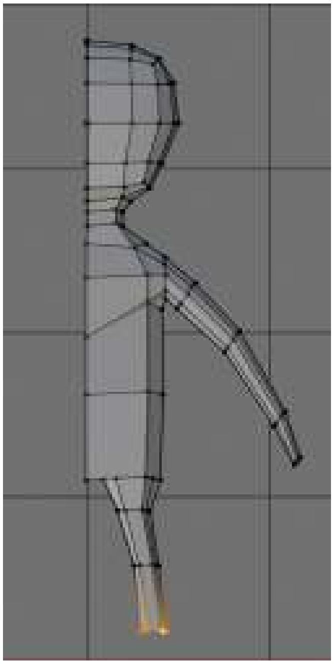
Add a Mirror Modifier in Object Mode (Do **NOT** Apply).



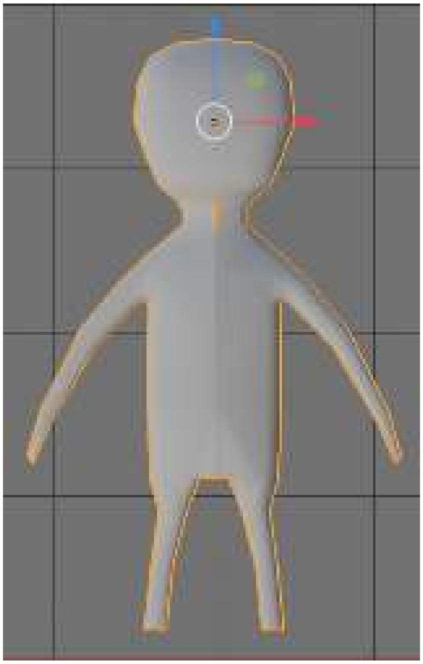
In Edit Mode, select Vertices in the shoulder. Delete one Vertex to create a hole. Extrude and Scale the arm.



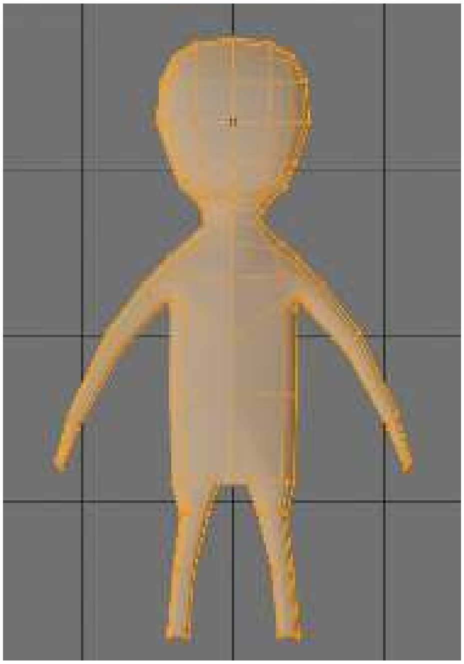
At the base, Subdivide to create Vertices and Face the center portion leaving a hole for the leg.



Extrude, Scale and position Vertices forming a leg and foot (not shown).



In Object Mode set Shading to Smooth and Apply the Mirror Modifier.



Edit Mode showing Vertices when the Mirror Modifier is Applied

Note: This is a very rough crude model shown for modeling technique only.

See CH20-20.19

12

The Outliner and Collections

12.1 Collections in the Outliner Editor

12.2 View Options in the Outliner Editor

The Outliner Editor

The **Outliner Editor** provides a visual display in the form of a **File Tree** showing everything in the Scene in the **3D Viewport Editor**. Each Object is listed showing its relationship to other Objects such as whether it is joined to another Object or has a Child Parent Relationship or whether it has Material or Texture applied. This information is the **Object's Data** which may be displayed in different configurations depending on the function being performed.

Collections

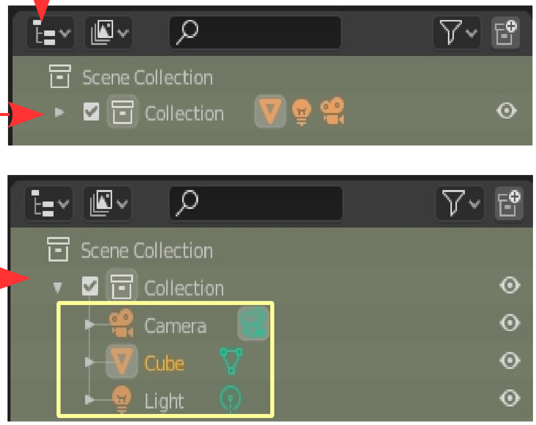
The File Tree in the **Outliner Editor** may be customised allowing Objects in the 3D Viewport Editor to be arranged in groups called **Collections**. Collections may be added and named and arranged in a hierarchy much the same as the folders on an operating system. Objects in the 3D Viewport Editor may be selected and deselected in the Outliner Editor or hidden from view in the 3D Viewport Editor by turning a Collection's visibility off. This assists when working on Objects in a complicated Scene.

12.1 Collections in The Outliner Editor

The **Outliner Editor** (upper RHS of the Screen) provides a visual display, in the form of a file tree, of everything in your Scene and shows how the different items are related (Figure 12.1).

Outliner Editor (default display)

Click LMB to expand the Collection File Tree.



The Scene in the default 3D Viewport Editor contains a Camera, a Cube and a Light.

Figure 12.1

To understand how Collections operate work through the following procedure.

Start with the default Blender Screen showing the four default Editors. The **Outliner Editor** is displayed in the upper right hand corner of the Screen (Figure 12.1).

The **Outliner Editor** contains information about the current Scene in the default 3D Viewport Editor. If, under **Scene Collection,** the single entry **Collection** displays. Click on the **expansion icon** preceding Collection to expand the File Tree showing a list of Objects in the current Scene in the 3D View Editor.

Expansion Icon 

The 3D Viewport Editor contains three Objects: a Cube, a Camera and a Light. The three Objects are grouped together and placed in the Collection named **Collection**.

Click on the expansion icon at the begining of the line where you see **Collection** to show the Camera, Cube and Light listed. Note that in front of each Object there is also an expansion icon. You click on each icon to display data beloning to the Objects.

Clicking the expansion icon in front of Cube reveals; **Cube** (the data creating the display of the Cube in the 3D Viewport Editor), Clicking on the next expansion icon reveals **Material** (the data producing the gray color of the Cube). Each line represents a **Datablock** (block of data) producing the display in the 3D Viewport Editor.

Blue highlight indicates that the Cube Object is selected in the 3D Viewport.

Data Displaying the Cube

Data Displaying the Material (color)

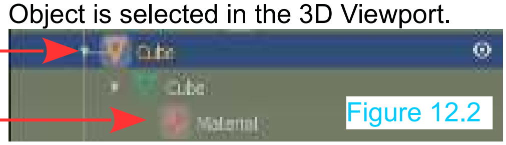
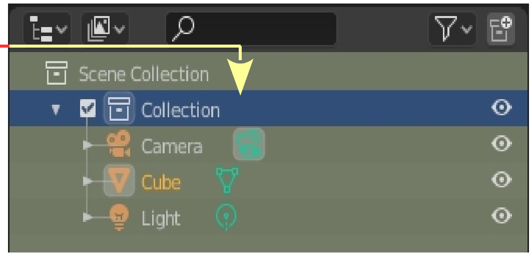


Figure 12.2

Adding Objects

Clicking LMB on the Collection name selects the Collection (highlighted blue).



When you add a new Object to the Scene in the 3D Viewport it is automatically added to the Collection that is selected, in this case **Collection**.

Add a UV Sphere Object to the Scene followed by an Icosphere Object.

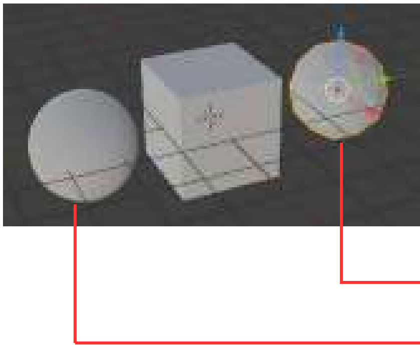
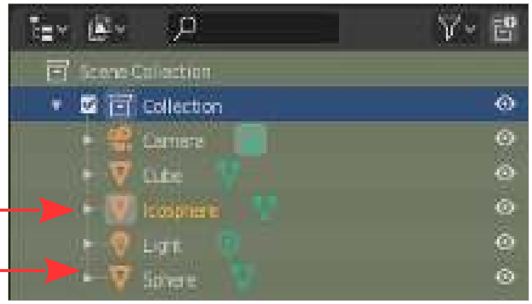


Figure 12.3



You immediatly see **Icosphere** and **Sphere** added to **Collection**. Note that they are placed in the list alphabetically.

Adding Collections

As the Scene is developed, with Objects being added, it can be advantageous to create new Collections, grouping Objects together. You add (create) new Collections by clicking the **New Collection** button in the Outliner Editor Header.

The New Collection Button

Figure 12.4

Where Collections are added depends on the location you select before adding. If you select **Collection** in the Outliner Editor a new Collection will be added as a sub entry under Collection . The sub entry will be named Collection 1. If you select (highlight) **Scene Collection** before adding the new Collection it will be added as a sub Collection named Collection 2. Selecting **Collection 1** and adding a new Collection produces **Collection 1.1**

Note the Collection Names: New Collection 2 under Scene Collection and new Collection 1.1 under Collection 1.

You may rename Collection to something meaningful by double clicking on the Collection Name.

Deleting Collections

In the Outliner Editor you select the Collection name (highlights blue) and press delete to remove the Collection.

Be aware that deleting a Collection in the Outliner Editor does not delete Objects in that Collection. When you delete a Collection, Objects in the Collection are automatacially transfered to the preceding Collection in the heirachy.

Deleting Objects

You may select Objects in the Outliner Editor then RMB click and select delete in the menu to remove the Object from the 3D Viewport Editor. Deleting a Collection in the Outliner Editor transfers all Ojects in the Collection to the preceding Collection in the hierarchy.

Hiding and Restricting Object Display and Selection

Objects in the 3D Viewport can be controlled in the Outliner Editor.

Click the Eye Icon to Hide the Object from View in the 3D View Editor

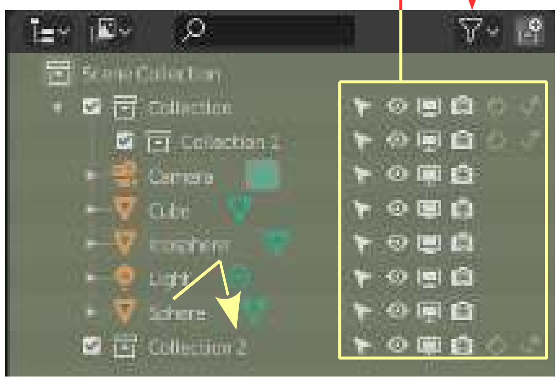
By default only the Eye Icon is displayed.

Additional controls may be added to the Outliner Editor from the **Filter Menu**.

All **Restriction Toggles** Activated

Filter Menu

The control options are applicable to individual Objects and Collections.



Click Sphere, hold and drag to Collection 2

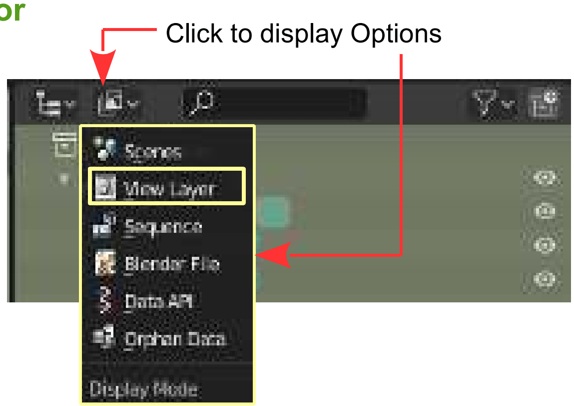
Moving Objects to Different Collections

Objects listed under a Collection in the Outliner Editor may be moved to a different Collection by simply clicking on the Object name (LMB), holding, dragging and releasing the mouse button with the Mouse Cursor positioned over the new Collection name. Alternativly press the **M Key** to display the **Move menu**. **Collections may be repositioned in a similar manner**.

12.2 View Options in the Outliner Editor

View Layer is the default display in the Outliner Editor which includes Collections.

Figure 12.6

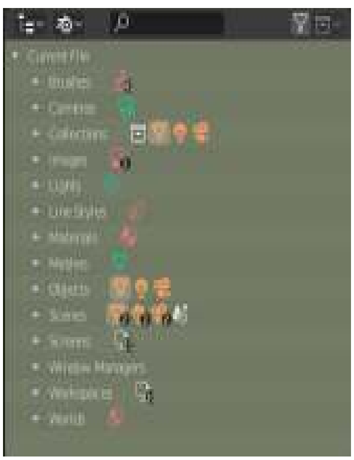


Alternative options are accessed in the Editor Header. The alternatives display information about the Scene in the 3D Viewport Editor and the current Blender File.

Scenes

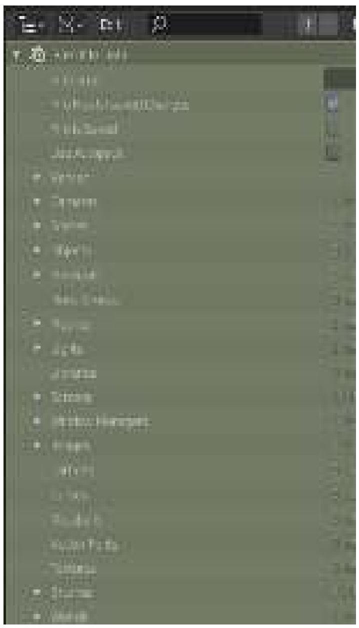
Sequence

Blender File

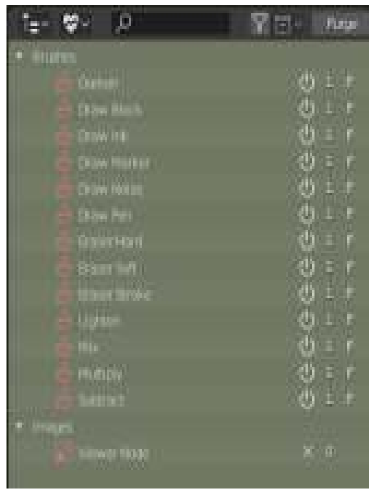


Data API

Figure 12.7



Orphan Data



As Scenes are developed the data contained in a Blender file increases accordingly. The display options in the Outliner Editor provide a record of the data and allow it to be organised.

13

3D Text

13.1 Creating 3D Text in Blender
13.2 The Object data Button “F”
13.3 Fonts
13.4 Creating Text on a Curve
13.5 Converting Text to a Mesh Object
13.6 Converting Text to a Curve
13.7 Entering External Font

Introduction to 3D Text

3D text can be a very important element to add to a Scene. Think of all the television advertisements that contain text and how it is animated. There are two ways of adding text to a Scene in Blender. One way is to use the built-in text generator and the other is to use an external program.

Text made in Blender can be easily edited in the **Properties Editor**. Text made in an external on-line 3D text generating programs may give you additional options and different fonts.

13.1 Creating 3D Text in Blender

To create text in Blender, place the Scene in top view with **Orthographic Projection** (Num Pad 7). Delete the Cube Object. Select the **Cursor Tool** in the Tool Panel and locate the Editor Cursor at the point in the Scene where you want your text to go. Press **Shift + A key** and select **Add - Text** (Figure 13.1). The word **Text** displays in the 3D Viewport Editor in Object mode.

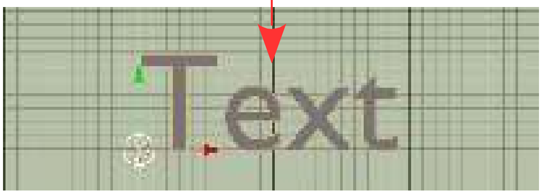


Figure 13.1

Tab into Edit mode—the word **Text** now has a Typing cursor at the end. (Figure 13.2).

Typing Cursor

3D View Editor Cursor

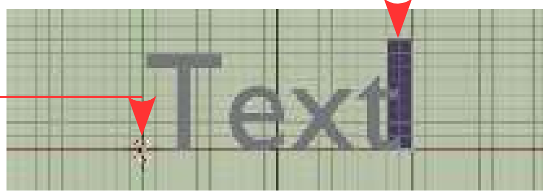
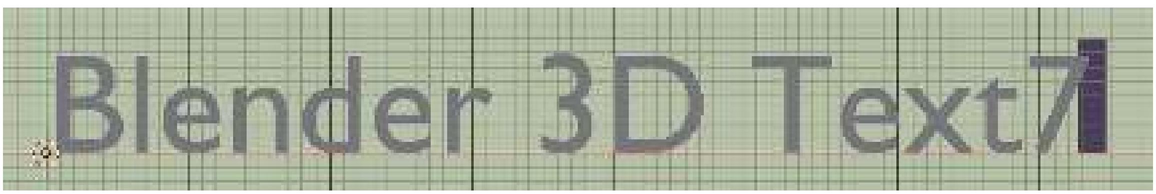
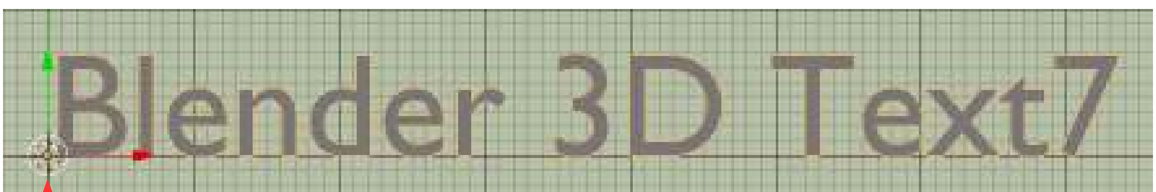


Figure 13.2

Backspace to delete letters and type in your own words just like in a text editor. Don't worry about the font style or size at this stage. When you have typed in the words, tab back into Object Mode; to shape and color the text (Figure 13.3).



Edit Mode: The word Text has been modified by retyping. Figure 13.3



Object Mode: Note the location of the Center Point.

Concept – Text in Blender

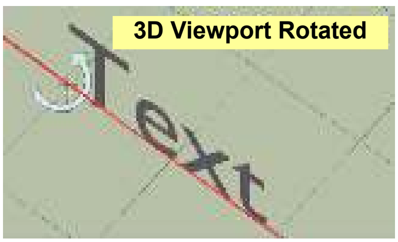
Properties Editor

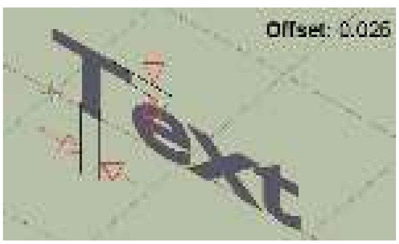
Typing Text in Blender is a little different to typing in a text editor program. When you Add Text in the 3D Viewport Editor, in Object Mode, the default word Text is an Object (a shape) similar to adding one of the Blender Primitives (Objects) such as a Cube, UV Sphere or Cone. When you entered Edit Mode, backspace and retyped a different word you modify the default Text Object. Besides modifying the letters in the the text (the two dimensional shape of the characters) you can extrude thickness, bevel and round the shape. You can also add Material color, Texture and other effects. Modifying the text is done in the **Properties Editor**. Select the text in the 3D Viewport Editor, then go to the **Properties Editor, Data buttons**. Note: For Text the **Data button** is denoted by an **a**.

Figure 13.4

13.2 The Object Data Button “a”

The Geometry Tab has settings for shaping the text into a three dimensional Object. To see the effect of the different settings rotate the text about the X Axis of the Scene then rotate the 3D Viewport as shown below.





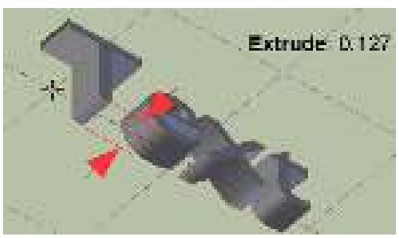
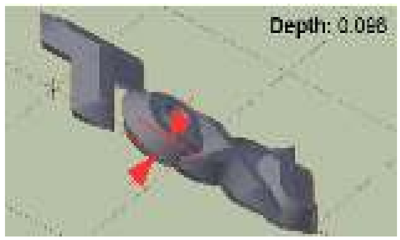
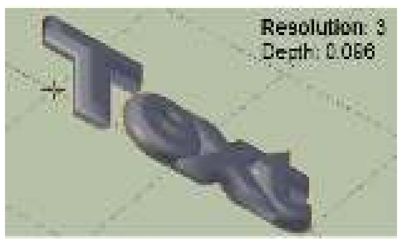


Figure 13.5

Bevel



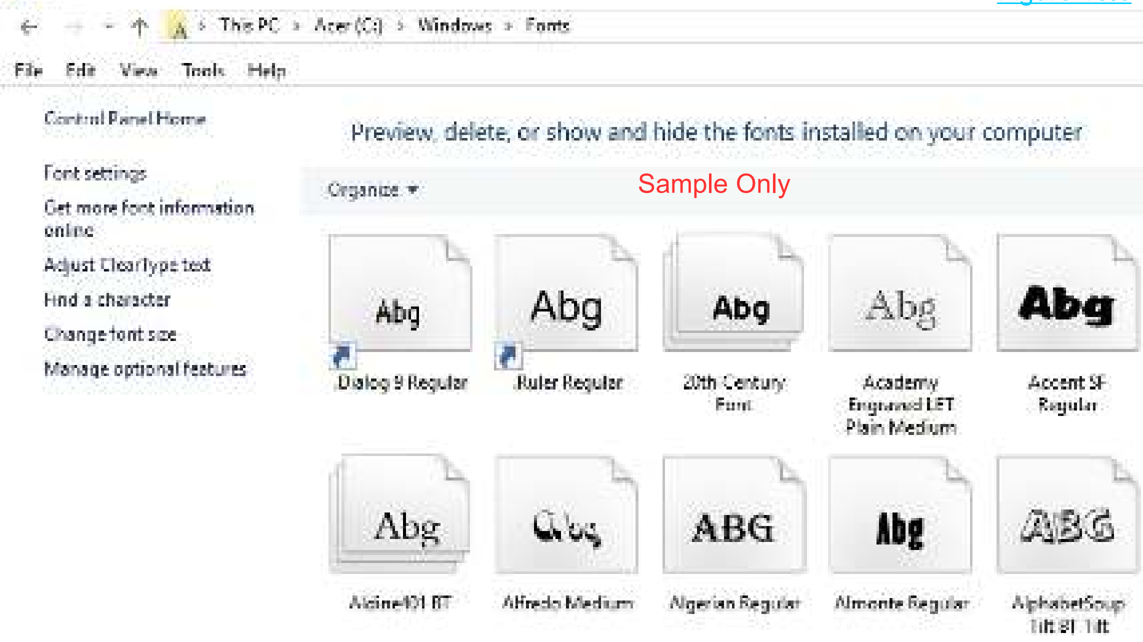


13.3 Fonts

The default **Font Style** is entered as **Bfont** as seen in the **Properties Editor, Object Data buttons, Font Tab**. **Bfont** is a **Vector Font for Text Objects** which is compiled into the Blender program and as such is not a standard font used in Windows or other operating systems. You can change the style to whatever font you have on your system. If you are using a Windows operating system, font styles can be found in **C:/Windows/Fonts.**

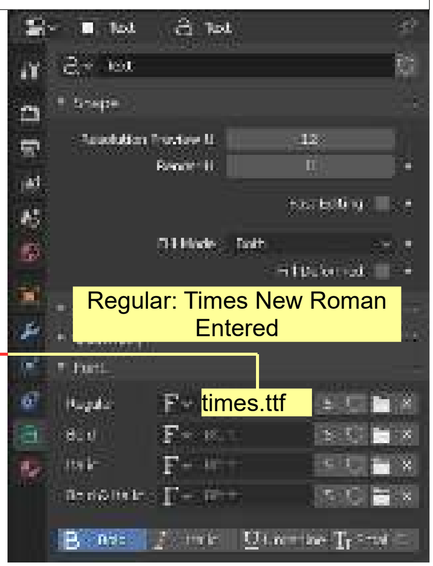
Windows 10 File Explorer

Figure 13.6



To use Windows fonts in Blender they have to be entered in the font slots in the **Properties Editor, Object Data button, Font tab** (Figure 13.7).

Figure 13.7



Note: In the Font tab there are four Font Style slots; Regular, Bold, Italic and Bold & Italic.

A Font Style has to be entered for each slot.

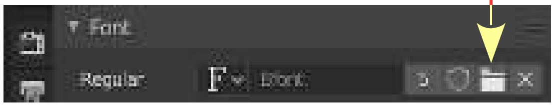
For Example: To use Times New Roman Font Style.

Regular: times.ttf **Bold**: timesbd.ttf
Italic: timesbi.ttf **Bold & Italic**: timesi.ttf

All four **.ttf** Font Types have to be entered.

To enter a Font Style click on the **Folder icon** (Figure 13.8).

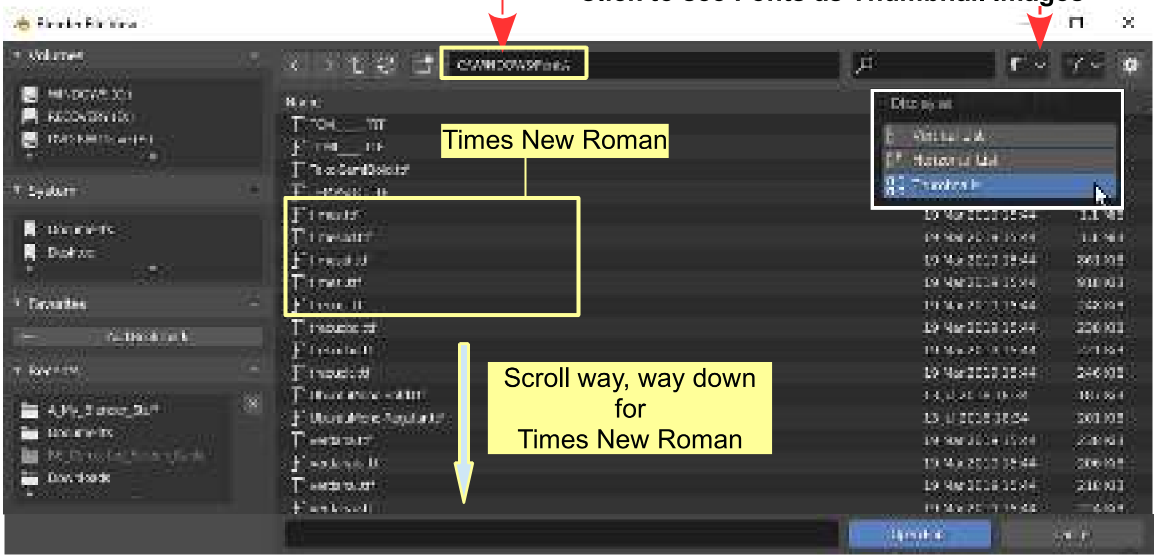
Figure 13.8



Clicking the Folder icon opens **Blender's File Viewer** where you navigate and locate the Font style (Figure 13.9). On a Windows system go to: C:\Windows\Fonts\

Figure 13.9

Click to see Fonts as Thumbnail Images



Note: Click in the Editor header to see the Fonts as Thumbnail Images.

Figure 13.10

Blender will accept any of the Windows fonts, but some may be distorted when they are extruded into 3D shapes.

Having selected a font click on the **Open Font button** in the lower RH corner of the File Viewer. Do this for each font slot.

Note: you can mix and match different font styles and options. For instance you can have one font for regular text and a different font for bold or italic.

> **Note:** Entering Fonts in the Properties Editor, Fonts buttons, Font tab modifies the data for the particular Text Object you are working on in the 3D Viewport Editor (the object you have selected). It does not set the Font type for every time you add Text into the 3D Viewport Editor. When you add a new Text Object it will be the default Blender **Bfont**.

By default, typing will enter text in the 3D Viewport Editor in **Regular** text. To enter text in one of the alternative options (Bold, Italic, Underline, Small Caps) click one of the option **buttons** in the **Font Tab** (Figure 13.11). **Note:** The options only display in Edit Mode

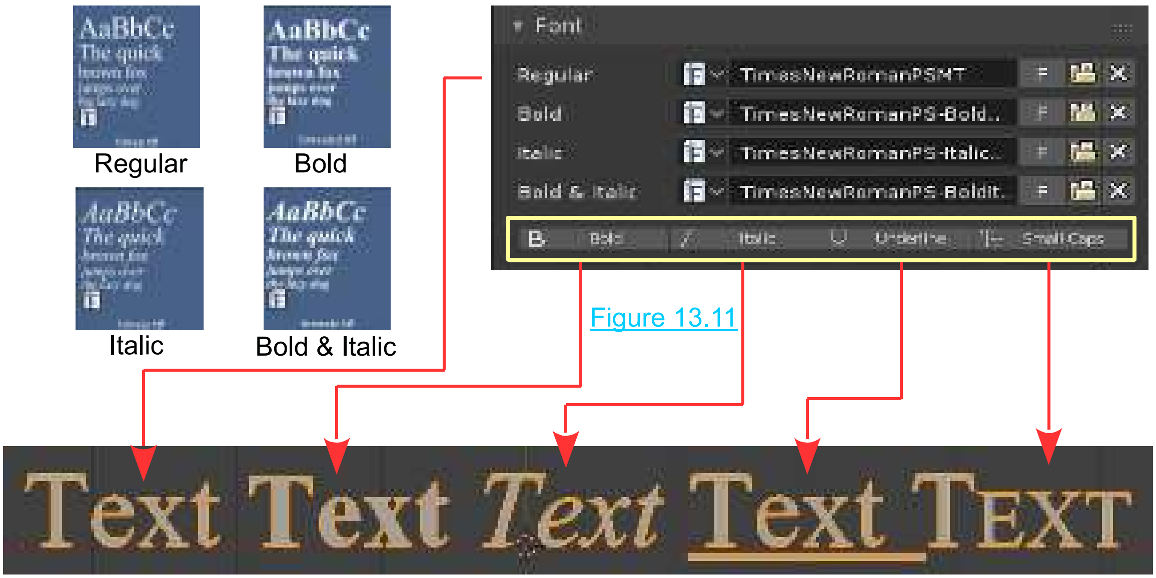


Figure 13.11

To change text that has already been entered, locate the **Text Cursor** (in Edit mode) using the arrow keys on the keyboard, press and hold shift while using the arrow keys to highlight text, delete the text then check one of the **Character buttons** to change the text option. Retype the text with the new option. Pressing **Ctrl + L or R** arrow keys moves the text cursor to the end of the word.

In the **Font tab**, the underline position and thickness values only operate when **Underline** is ticked under the **Character** heading. Underlining occurs as you type your text in Edit mode.

Also in the **Font Tab,** adjusting the Size and Shear value sliders increases the size of the selected Text object and shears the Text (similar to Italic – Figure 13.12).

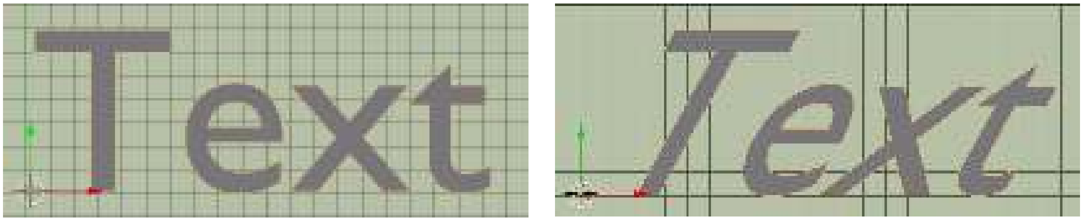


Figure 13.12

13.4 Creating Text on a Curve

Text in Blender can be made to follow the shape of a Curved Path. Add text to your Scene as previously described then in Edit mode type something to extend the text (Figure 13.13).

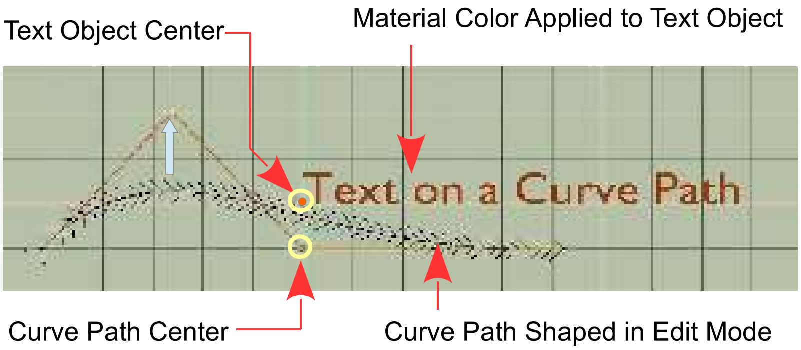
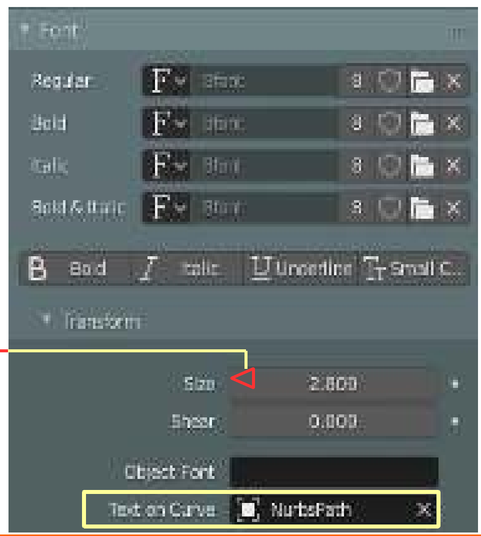


Figure 13.13

Add a **Curve - Path** to the Scene (**Shift + A key – Curve – Path)**. Note: By default the path is named **NurbsPath**.

The Curve Path is added to the Scene in Object Mode and appears as a straight line. Scale the Path to make it longer and reposition it in Object Mode.

Figure 13.14



In Edit Mode Extrude or shape the Curve (Figure 13.13). With the Curve shaped tab back to Object mode and deselect it.

Select the Text Object then in the **Properties Editor, Data button, Font Tab**, find the **Text on Curve panel** under **Transform**. Click on the little cube icon and in the drop down menu that displays select **NurbsPath** (Figure 13.14).

The text is shaped to follow the profile of the curve (Figure 13.15).

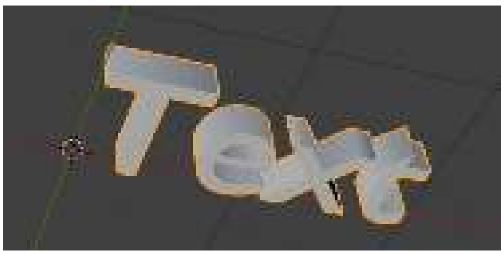
Tip: After entering Nurbs Path in the Text on Curve panel, click on Size increment to activate the Text Curving.

Figure 13.15

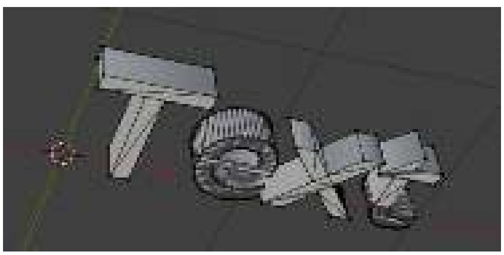
13.5 Converting Text to a Mesh Object

There is only limited functionality in the text **Object Data button, Geometry tab** for modifying the text shape (see 13.1 Figure 13.4).

When you add Text to a Scene it remains a 2D Plane Object unless you have extruded the text in the Geometry tab. Entering Edit mode only allows you to retype a text change. To perform editing, which actually changes the detailed shape of the Text, you have to convert to a **Mesh Object**. To do this, select the text in **Object Mode** then in the **3D Viewport Editor Header** click **Object**, **Convert to**, **Mesh from Curve/Meta/Surf/Text** . Tab to Edit mode and you will see that the text is now a Mesh Object with vertices that can be moved, rotated, and scaled (Figure 13.16).

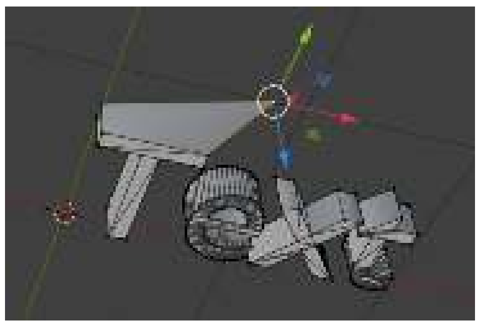


Object Mode with Text Extruded



Edit Mode after Conversion to Mesh

Figure 13.16



Vertices Selected and Moved

13.6 Converting Text to a Curve

If you would like to perform some fancy editing of a single letter, you can convert the letter into a Curve. The outline of the letter becomes a Curve with handles, which allows you to manipulate the shape into anything you wish.

Add **Text**, then in **Edit Mode** backspace until you are left with the single letter T . Scale, rotate, and move it where you like then tab to **Object Mode**. In the **3D View Editor Header** click **Object- Convert to** - **Curve from Mesh/Text**. In **Edit mode** you will see the outline of your letter as a curve with manipulating handles (Figure 13.18).

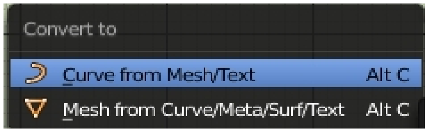
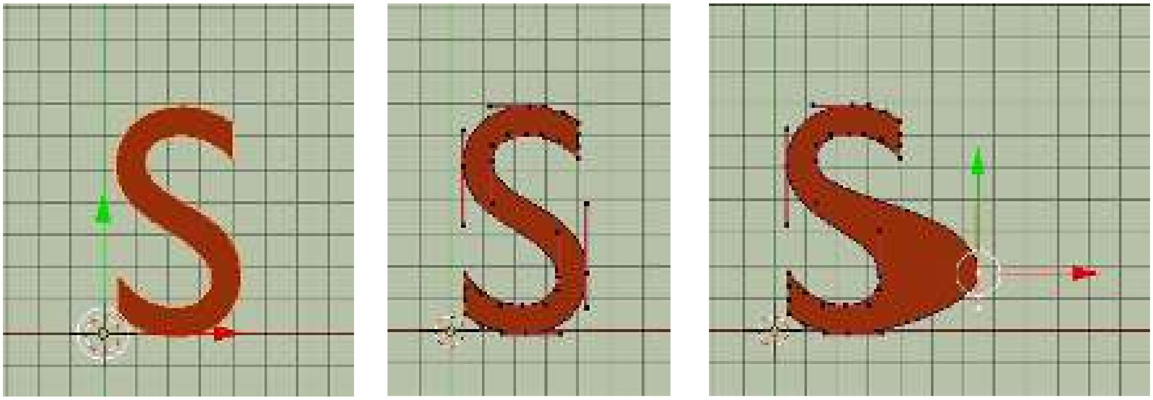


Figure 13.17



Object Mode – Convert Curve From Mesh Text

Edit Mode Control Handles

Handle Selected and Moved

Figure 13.18

13.7 Entering External Font

Text created in a Text Editor such as Word Pad or any editor that saves a file in .txt format may be entered into Blender.

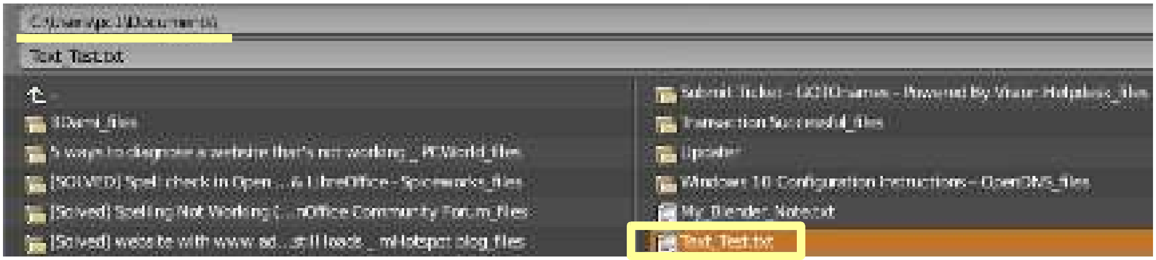
For example a **Text File** named **Test_Text.txt** created in **Word Pad**, using **Font Style: Courier New size 36** saved in **MyDocuments** folder. The file contains the single word **Texting**.

To enter this in Blender, click **Add - Text** in the **3D Viewport Editor Header** (alternatively press **Shift + A key** and select **Text** from the menu.

Remember have the **3D Viewport in Top Orthographic** View.

Tab to **Edit mode** and backspace deleting the default word **Text**.

In the **3D View Editor Header** click on **Edit** and select **Past File** from the menu. The File Browser window opens where you navigate and find the saved .txt file (Figure 13.19 over).



File Browser Window Figure 13.19

Click on the file name to highlight then click on **Paste File** in the upper RH corner of the window.

The text **Texting** is entered into the 3D View Editor in Edit mode (Figure 13.20).

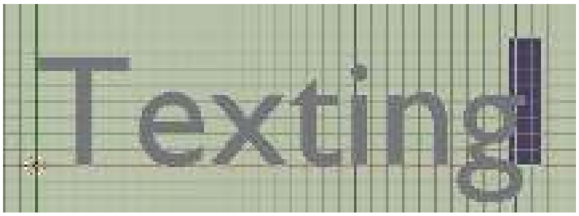
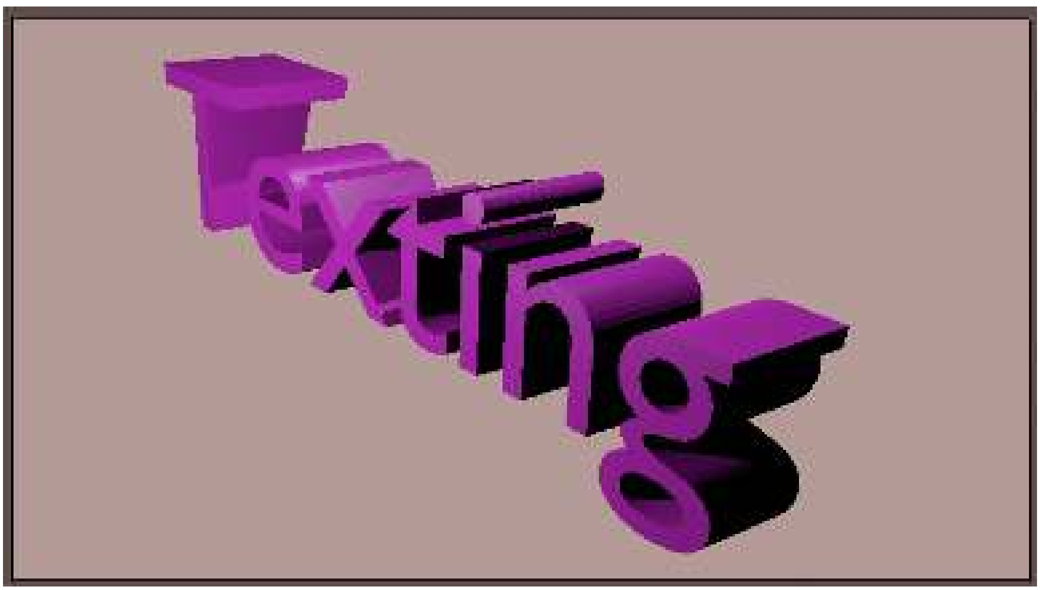


Figure 13.20

You may now convert the text to a **Mesh object** (see 13.5) or to a **Curve** (see 13.4).



14

Viewport Shading

14.1 Viewport Shading Options
14.2 Wireframe Viewport Shading
14.3 Solid Viewport Shading
14.4 Color Display Options
14.5 Background Display
14.6 More Solid Viewport Shading
14.7 Rendered Viewport Shading
14.8 LookDev Viewport Shading
14.9 World Settings

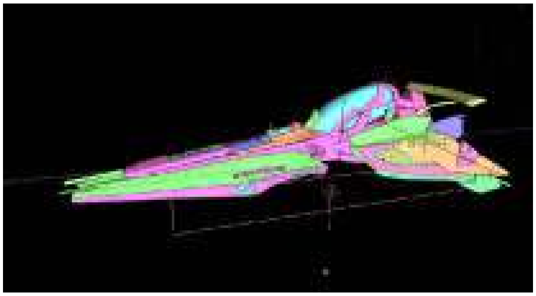
Viewport Shading

Definitions: Viewport: The View in an Editor. **Shading:** How the View in an Editor is displayed.

Blender provides a variety of shading options which allows a Scene to be previewed during construction. Previewing, in turn, allows editing to be performed as the Scene is developed.

As Scenes are created, with Objects being added and Materials (colors) applied and lighting effects and textures introduced, it can be difficult to isolate a particular Object or even a component of an Object. By shading the **Viewport**, making the Objects display in a simplified way, allows a selection to be Edited. You may also preview how a Scene will display before adding too much detail.

Rendered Viewport Shading

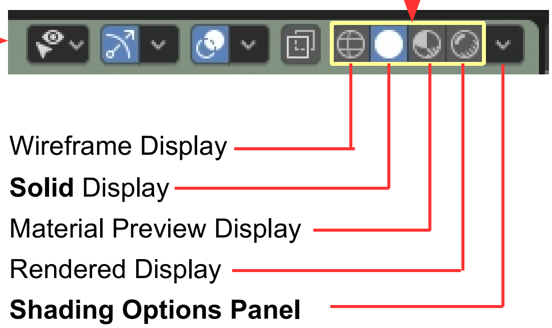


Simplified Viewport Shading

14.1 Viewport Shading Options

Options for Viewport Shading (displaying the 3D Viewport Editor) are found in the upper RH corner of the 3D Viewport Editor Header (Figure 14.1). Click LMB on one of the buttons to activate an option.

Figure 14.1 Viewport Shading Options



In Figure 14.1 The default Viewport Shading Option selected is **Solid**. Selecting **Wireframe**, **Material Preview** or **Rendered** displays different controls in the **Shading Option Panel**. **Note: Eevee Render System.**

Note: The controls in the **Shading Option Panel** are applicable to the Viewport Shading Option that is selected in the 3D Viewport Editor Header.

Wireframe Shading: Allows you the see Objects in the 3D Viewport Editor as a mesh or wireframe.

Solid Shading: The default display mode which has generally been used to produce figures for demonstration and is the basic construction mode.

Material Preview Shading: Provides a quick method of previewing **Scene Lighting Modes**.

Rendered Shading: Places the Viewport in Render Mode allowing you to see what you get when an image is rendered (produced).

Shading Options: The **Wireframe**, **Solid** and **Material Preview** Shading options have a **Shading Options Panel** (Sub Option Panel). **Solid** is the default Shading and has by far the most comprehensive choice of Options. As noted above the display in the Options Panels is different, depending on the Viewport Shading Mode selected.

14.2 Wireframe Viewport Shading

Wireframe Viewport Shading allow you to see Objects in the 3D Viewport Editor as a **Mesh** which is useful when one Object overlaps or hides another. In Figure 14.2 a Monkey Object is positioned inside a UV Sphere. In Solid Viewport Shading Mode you see the outline of the Monkey **when the Monkey is selected**. In **Wireframe Viewport Shading Mode** you see both Objects as a Mesh with the selected Object displayed orange (Figure 14.2)

Monkey Outline

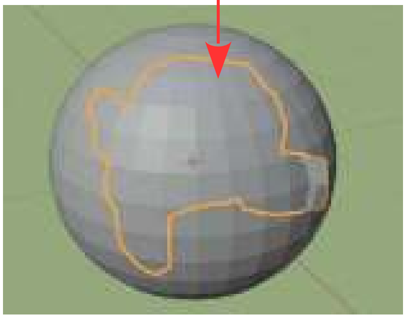
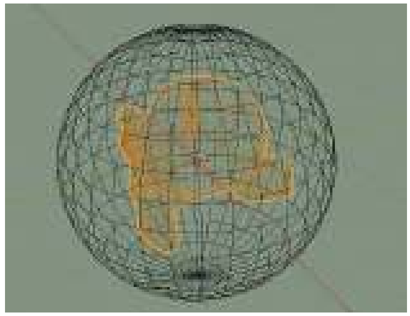


Figure 14.2



Solid Viewport Shading

Wireframe Viewport Shading

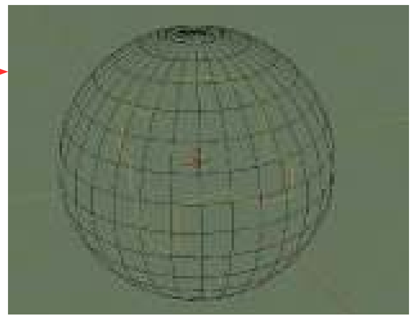
3D Viewport Editor Header

Note: When Wireframe Display Mode is activated, **X-Ray** is also activated

Wireframe

Figure 14.3

Wireframe display with X-Ray **deactivated**

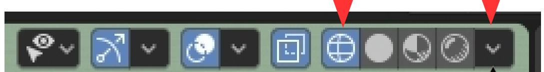


Remember: You may select Objects in the **Outliner Editor** when they are obscured from view in the 3D Viewport Editor.

Wireframe Colors: The Wireframe Mesh may be set to display in different colors for separate Objects. This is helpful when arranging Objects in groups. The Mesh display colors are independent of the Material color applied to an Object.

The Mesh color controlled in the Wireframe Display - Sub Options Panel.

Figure 14.4

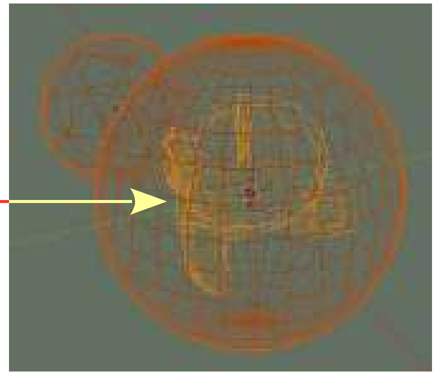


Remember: The Objects in the Scene have been assigned a Material color.

In the Sub Options Panel the default settings are **Single** and **Theme,** which means the Wireframe Mesh for all Objects will be the same color and Scene Background per the Theme settings i.e. The background is per the Gradient High/Off color selected in the Preferences Editor.

The Mesh color is the default orange, the same as the Object outline when selected. If multiple Objects are selected (Shift selected) the last Object selected displays with an orange Mesh while previous selected Objects display with a red Mesh.

Figure 14.5



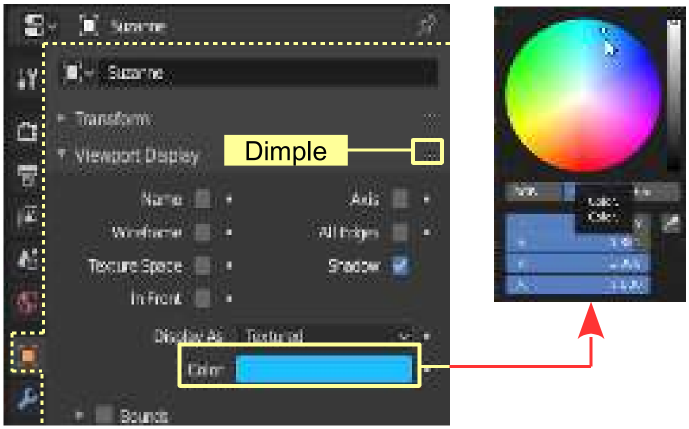
Suzanne (Monkey) last Object selected

Note: In Figure 14.5 Material colors have NOT been added to the Monkey, UV Sphere or the Icosphere. In Solid Viewport Shading Mode they all display with the default Gray Material.

To have different Objects display in separate colors in Wireframe display, select each Object in turn, then in the Properties Editor, Object buttons, Viewport Display tab, click the Color bar and choose a color in the color picker circle that displays.

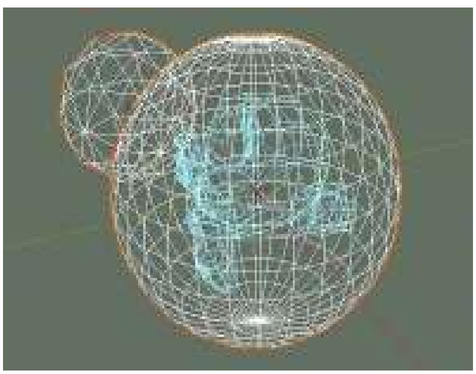
Note: In Figure 14.6 the Viewport Display Tab has been moved up in the stack by clicking on the dimples at the RHS, holding and dragging up.

Figure 14.6



Hold on! Nothing changes in the 3D Viewport Editor.

In the Wireframe Display, Sub Options Panel change Color from Single to Object. Suzanne's Mesh displays with the color you have chosen (Figure 14.7).



Remember, all Objects are selected, Susanne being the last. The UV Sphere and Icosphere Mesh displays white since Mesh colors are per the default setting in the **Viewport Display Tab**.

Figure 14.7

With colors set for each Object in the Viewport Display Tab the different Meshes display in different colors (Figure 14.8).

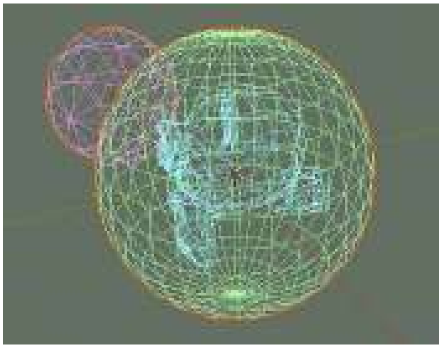


Figure 14.8

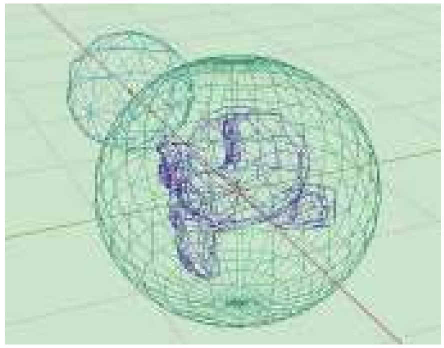
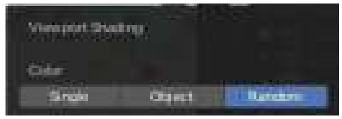


Figure 14.9



An alternative to assigning individual Mesh colors is to select **Random** in the Viewort Shading Sub Options Panel.

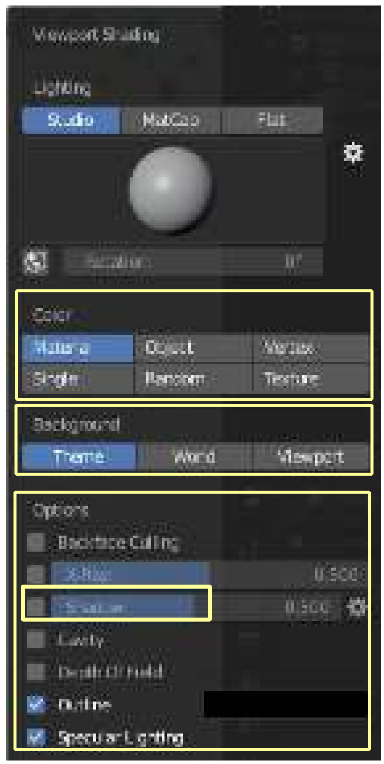
14.3 Solid Viewport Shading

Figure 14.10

Solid Viewport Shading is the default Shading Option for the 3D Viewport Editor when Blender Opens and is the basic Viewport display for modelling.

The Sub Options for **Solid Viewport Shading** are categorised into four sections; **Lighting**, **Color**, **Background** and **Options** (sub, sub options).

Figure 14.11



Lighting: A Scene is illuminated by placing Lamps (Lights) at strategic positions or having Emitter Objects (Objects that emit light) located thorough the Scene (Chapter 15). In the course of construction complicated Scene Lighting can be a hindrance, therefore, a simplified Viewport display is preferable.

Solid Viewport Shading provides three lighting methods; **Studio, MatCap** and **Flat**. These lighting methods are all independent of any Lamps placed in the 3D Viewport Editor. While in Solid Viewport Shading Mode Lights in the 3D Viewport Editor have no effect. **Studio Lighting** is the default method.

Studio Lighting is an arbitrary lighting arrangement which is independent of the Lights in the Scene. When the Viewport is rotated mesh faces are shaded for visualisation but the shading is not influenced by light sources such as the Lights in the Scene. Rendering the Scene produces a different shading based on the lighting generated by the Lights.

To examine and understand the relationship of Object illumination, shadows can be used. To see the effect of shadows there has to be something on which the shadows will be cast. In the default Scene add a Plane Object. The Plane is positioned on the Mid Plane Grid and scaled up. Position the Cube Object just above the Plane (Figure 14.12). With Solid Viewport Shading active, in the **Sub Options Panel**, **Options** (at the bottom of the panel) **check Shadow**.

With the Scene rotated the shadow is cast relative to the Cube demonstrating that the light source is fixed relative to the Scene and is not relative to the Point Light.

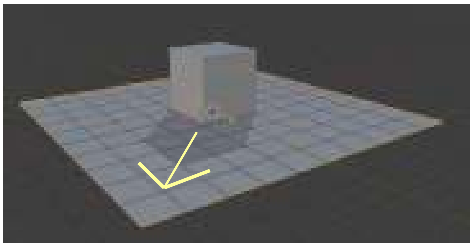
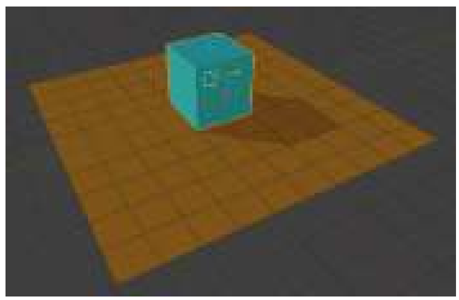


Figure 14.12

In the Figure 14.12 the Cube and the Plane do NOT have Material (color) applied. To continue with the demonstration add color (Reference Chapter 4 - 4.18). Figure 14.13 shows Studio Lighting with color added.

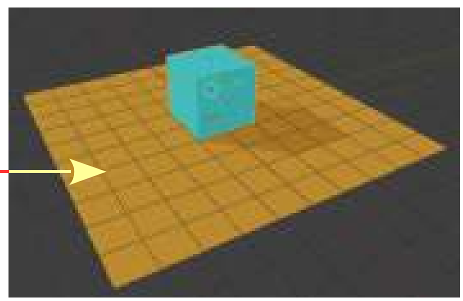


By clicking on the sphere below Studio, MatCap Lighting Tones display. Clicking either of these alters the lighting tone in the 3D Viewport Editor.

Click the sphere

Figure 14.13

Lighting Tones

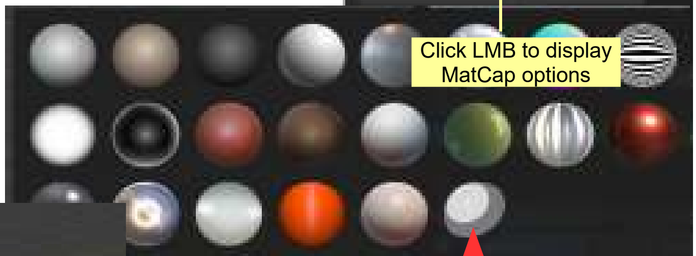


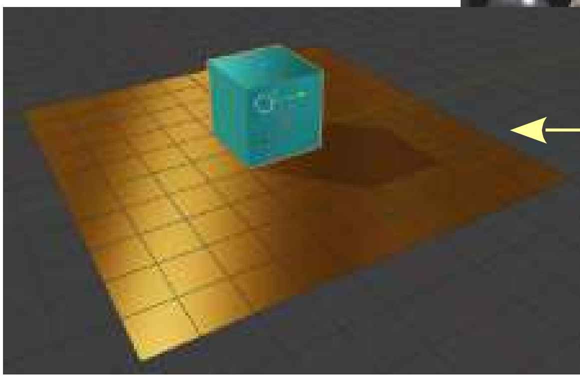
Click LMB on the sphere to preview **Lighting Tones**.

Matcap Lighting stands for **material capture** – it is a complete material including lighting and reflections. A Matcap is added for quick feedback, to see how an Object's shape is changing under different lighting conditions. This is a preview only, not a permanent lighting set-up.

Figure 14.14

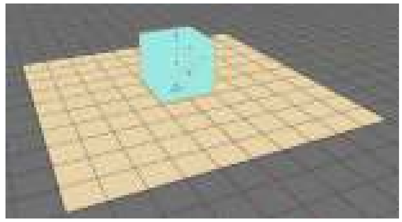
With **MatCap** selected, clicking on the Sphere in the Sub Options Panel displays a selection of MatCap shading options which when pressed show you how Objects will display under different shading effects.





Click LMB to apply the MatCap to the Scene (Figure 14.15).

Figure 14.16



Flat Lighting applies the Material (color) set in the Properties Editor, Material buttons as a plain flat color (Figure 14.16).

> **Note:** In the diagram, the Objects in the Scene have a Material (color) applied. The MatCap generates a lighting effect which affects the colors of the Objects giving an indication of how the Scene will appear. This effect does not render in an image.

14.4 Color Display Options (Figure 14.17)

With either **Studio Lighting, MatCap Lighting** or **Flat Lighting** there are six **Color Type** settings in the **Sub Options Panel.** The default is **Material,** which means Objects in the Scene (Viewport) are displayed with the Material color that has been assigned to the Object in the **Properties Editor, Material buttons,** when Nodes are deactivated.

Color Types

Figure 14.17

Material Color Display (Figure 14.18)

Material Color

Properties Editor

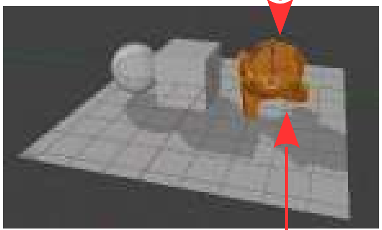
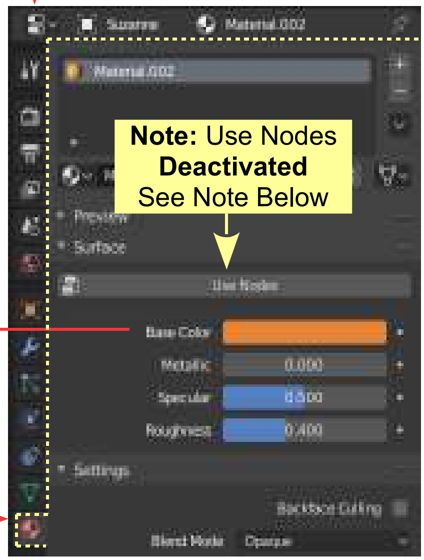


Figure 14.18



The **Base Color** applied to an Object in the Scene in the Properties Editor, Material buttons, Surface tab is displayed in the Viewport.

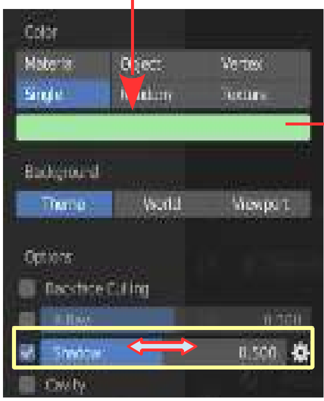
Note: In the diagram a Brown Material has been assigned to the Monkey Object. The Cube, Sphere and Plane Objects have the default gray Material applied.

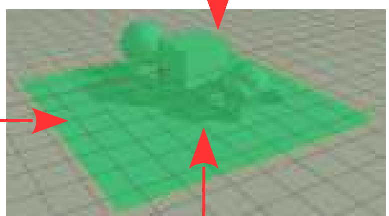
Single Color Display (Figure 14.19)

Material Button

Click to select the Single Color

Figure 14.19





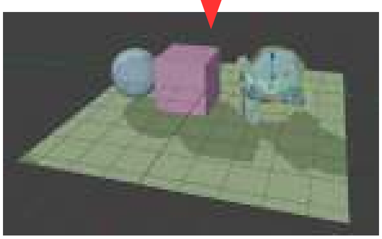
Shadows are cast when Shadow is checked with the intensity of the shadow adjustable using the slider.

Note: Material Type - When employing the **Material Type** option, the colors only show when Nodes have been **deactivated**.

Random Color Display (Figure 14.10)

Random Color

Figure 14.20



Random Color displays each Object in the Scene with a different color. The color assignment is automatic.

Texture Color Display (Figure 14.11)

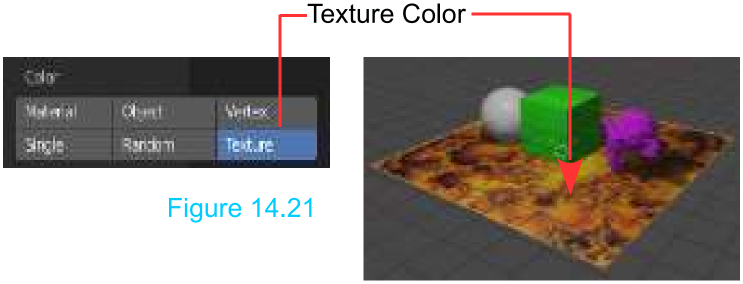
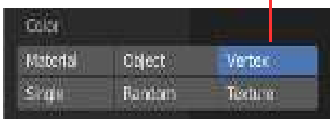


Figure 14.21

Textures are effects which give the surface of an Object characteristics. Texture Color displays Objects with a Texture that has been previously set as the Base Color in the Properties Editor, Material buttons (Reference Chapter 16).

Note: You can only set the Base Color as a Texture in the Material buttons when the Node System is active.

Vertex Color Display



Shows the Active Vertex colors.

Figure 14.22

14.5 Background Displays

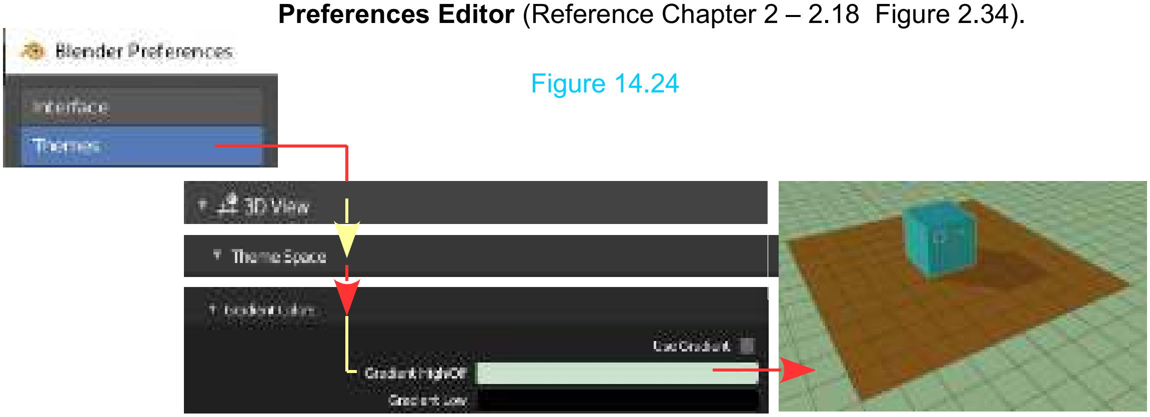
In **Solid Viewport Shading Mode** there are three **Background** display options.

Figure 14.23

Theme

Background option **Theme** displays the Viewport with the Theme that has been set in the **User Preferences Editor** (Reference Chapter 2 – 2.18 Figure 2.34).

Figure 14.24

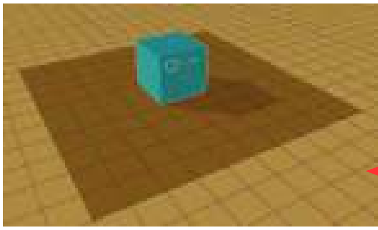


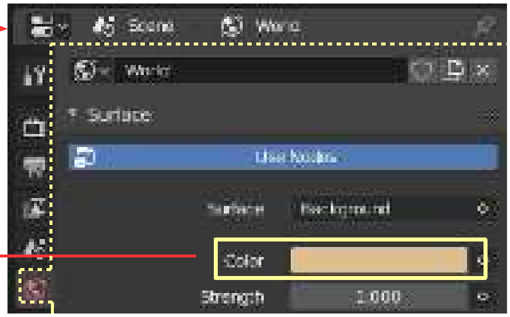
World (see 14.9 World Settings)

Background option **World** displays the Viewport with the Background that has been set in the **Properties Editor, World buttons, Surface tab**

Properties Editor

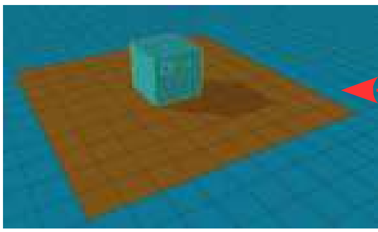
Figure 14.25





Viewport

A preview of the Scene Background may be set in the Shading Sub Options Panel.



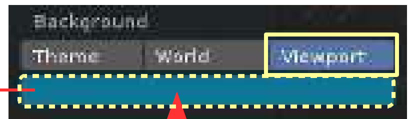


Figure 14.26

Click the color bar to display the color picker circle. (**Note: The default color bar displays black on black.**)

14.6 More Solid Viewport Shading

X-Ray:

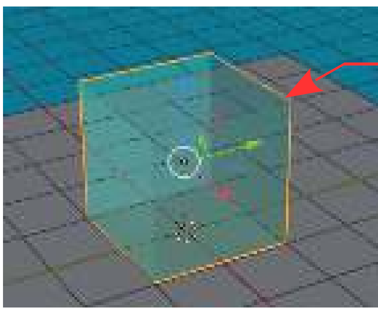
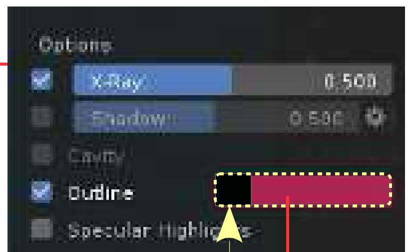


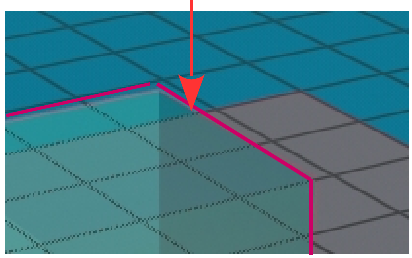
Figure 14.27



Color bar displays Black on Black

X-Ray view of the selected Object

Figure 14.28



Shadows: Previously discussed.

Outline: Object Outlines are displayed orange when selected. When **deselected** they display with a color which you choose by clicking the color bar next to **Outline** in the Sub Options panel. The colored outline may be turned turned off by unchecking (unticking) **Outline** in the panel.

14.7 Rendered Viewport Shading

Figure 14.29

Rendered Viewport Shading gives a quick access to a preview showing exactly what you will see in a Rendered view. Unlike Solid and LocDev Viewport Shading Modes it has no sub options. Clicking Rendered Viewport Shading displays the 3D Viewport Editor as a Rendered view and as such, the Lighting in the view is influenced by the Lamps and lighting arrangement set in the Scene.

Note: Textures used to color objects will NOT display in a Rendered view unless the Material **Node System** has been employed.

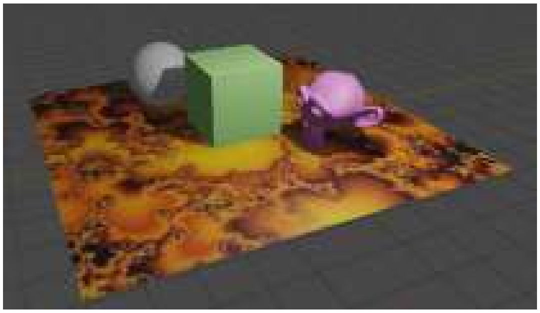


Figure 14.30

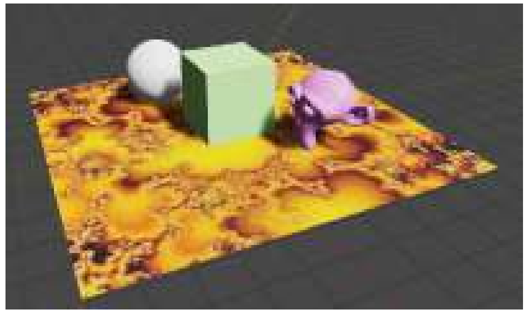
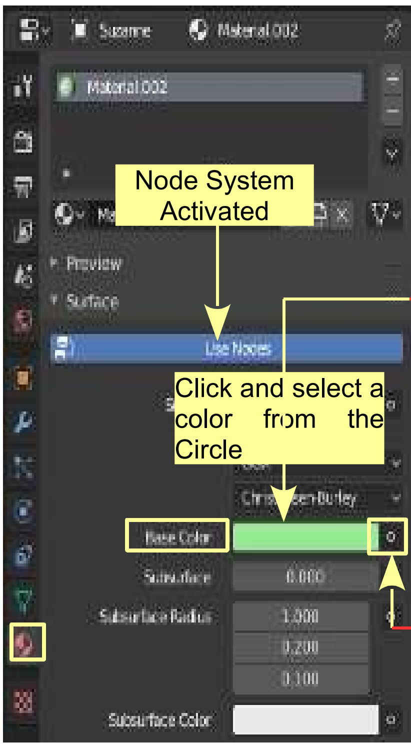


Figure 14.31



In Figures 14.30 and 14.31 the Objects have Materials (colors) applied using the Material Node System (Reference: Chapter 16) in the Properties Editor, Materials buttons (Figure 14.32). The Materials Shader Editor has NOT been used, instead, with Use Nodes active in the Properties Editor Base Colors have been selected by clicking on the Base Color bar.

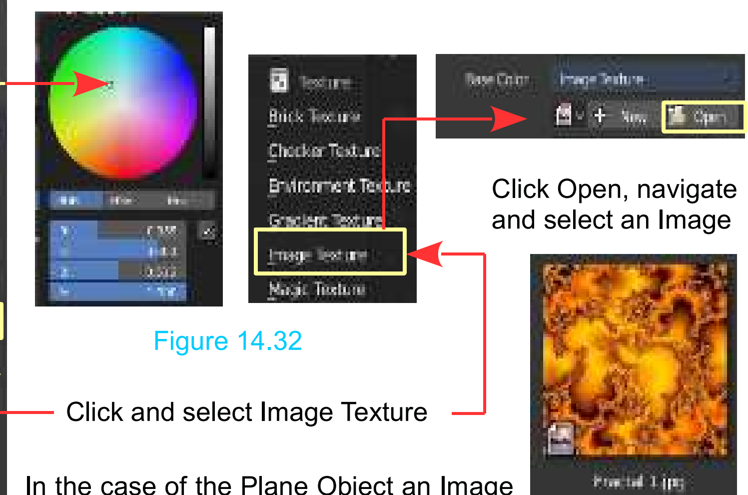


Figure 14.32

In the case of the Plane Object an Image Texture has been used for the color.

14.8 Material Preview Shading

Figure 14.33

When creating or modifying a Scene using Solid Viewport Shading you may wish to quickly view the Scene as it appears with illumination provided by the Lamps instead of the illumination from the Solid Shading Mode. At times illumination is provided by special HDRI images used as a background to the Scene (Reference Chapter 15 – 15.8). If an HDRI image has been installed and you are in Solid Viewport Shading Mode Material Preview provides a quick preview.

Figure 14.34

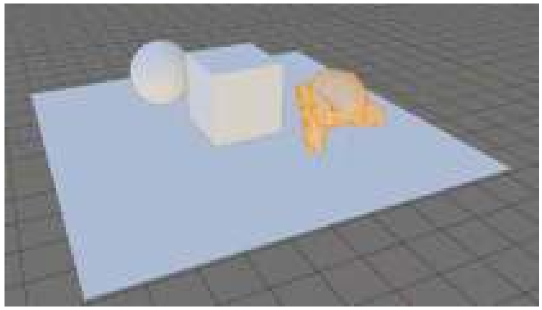
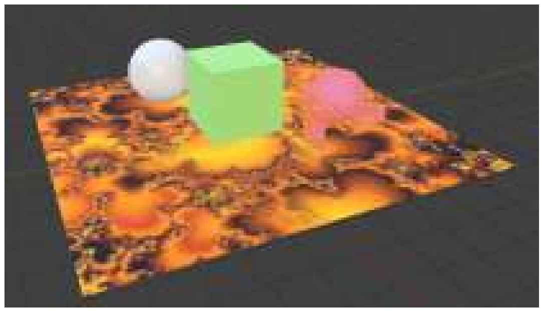


Figure 14.34 shows the Scene in the 3D Viewport Editor in Solid Viewport Shading Mode with the Monkey Object selected in Edit Mode. If this were a complicated Scene where the Monkey was obscured by shadow you could clearly see the Monkey and manipulate Vertices.

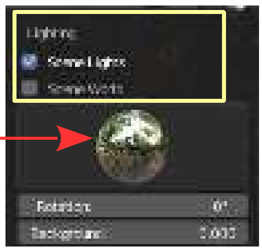
The Scene is viewed under Studio Lighting.

Figure 14.35



To quickly see how the Scene looks with the edits to the Monkey select **Material Preview Shading** (Figure 14.35).

In the Sub Options select **Scene Lighting** to view the Scene using the lighting effects in the Scene (Lamps)



You may use the **Matcap** to preview how adjustments to Lamp setting would affect the display.

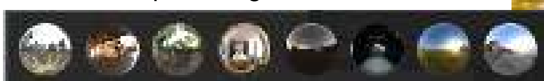


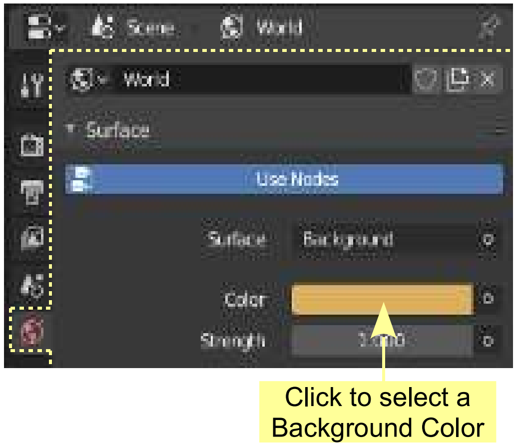
Figure 14.36

If an image has been used to illuminate the Scene select **Scene World** instead of Scene Lights to preview the Scene (Figure 14.36)

HDRI Image used as Scene background (Reference Chapter 15 – 15.8).

14.9 World Settings

Figure 14.37



World background color settings in the Properties Editor, World buttons also influence the display in the 3D Viewport Editor (Figure 14.37).

Note: The background color set in the World buttons can only be seen in the 3D Viewport Editor in Renderer Viewport Shading Mode.

15

Scene Lighting and Cameras

15.1 Scene Lighting
15.2 Lamps
15.3 Cameras
15.4 Camera Settings
15.5 Camera Switching
15.6 Camera Tracking
15.7 Basic Scene Lighting
15.8 Background Scene Lighting
15.9 Images as Background
15.10 Volumetric Lighting

Scene Lighting

Scene Lighting creates the mood of a Scene determining whether it depicts a bright happy sunny event or something that is dark and sinister. This applies to still images or animation sequences.

To understand Scene lighting you should understand what does NOT contribute to the lighting effect.

The default Blender Scene is displayed in **Solid Viewport Shading Mode** with the default option settings, **Lighting: Studio** and **Color: Material**. Solid Viewport Shading is primarily used for creating models and setting up the physical aspects of the Scene. Objects may be colored to distinguish components and the Screen Theme background may be colored to aid in visualisation during the construction process. There is a single point light (Lamp) in the default Scene. Non of this contributes to how the final Scene will be viewed when Rendered. If you delete the Light there is no change to the view in the 3D Viewport Editor.

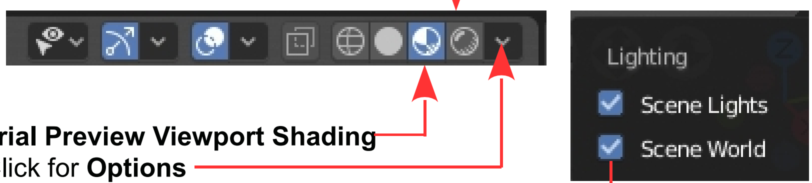
The default Scene is illuminated by an arbitrary light source which is perceived to be above the mid-plane grid to the left of the default Scene displayed in User Perspective View.

15.1 Scene Lighting

The default Scene in the 3D Viewport Editor is illuminated by **Studio Lighting** when in **Solid Viewport Shading Mode** (Reference Chapter 14 - 14.1). This Shading Mode is independent of Light Objects (Lamps), therefore, the default Point Light in the default Blender Scene has no affect. To discuss Blender Lights, change the Viewport Shading to **Material Preview Viewport Shading** and activate **Scene Lights** and **Scene World** in the **Options**.

Viewport Shading Options are located in the **3D View Editor Header** at the RH side of the Editor.

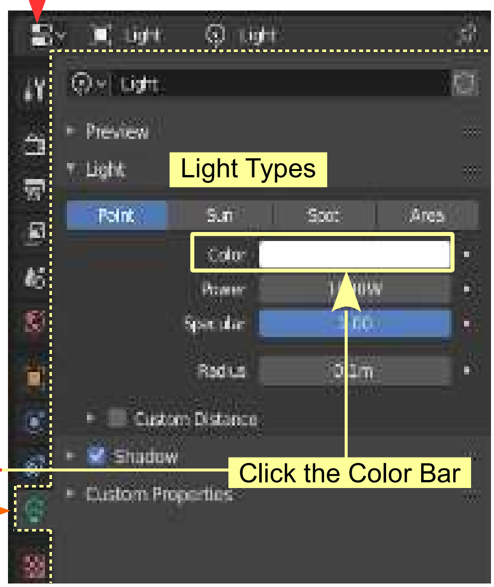
Figure 15.1



Click to activate **Material Preview Viewport Shading**
Click for **Options**
Check **Scene Lights and Scene World**

15.2 Light Type

Properties Editor

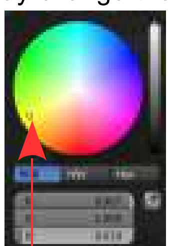


Object Data Button

The default Blender Scene contains a single **Point Light Object.**

Figure 15.2

With the Light selected in the 3D Viewport Editor, go to the **Properties Editor, Object Data buttons** to display the setting options (Figure 15.2). You may change the Light by selecting one of the types in the **Light Tab**.

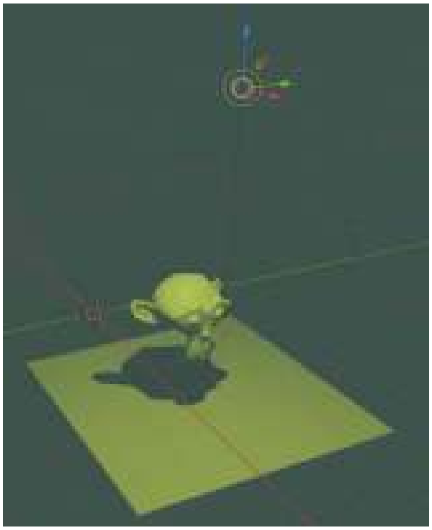


The Properties Editor display will vary depending on the Light Type selected.

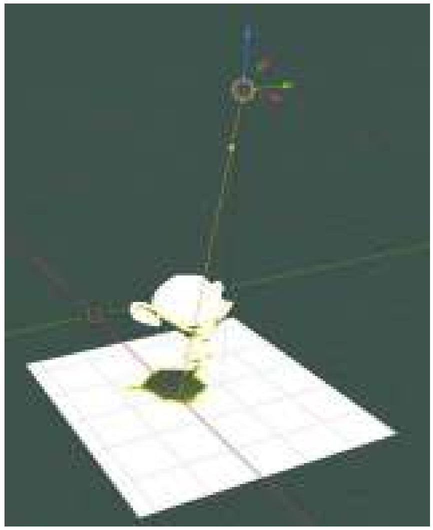
The color of light may be selected by clicking the color bar to display a color picker circle.

Lights in **Blender** are considered to be Objects and as such they may be Translated, Rotated and Scaled like any other Object. Each Light Type has properties which may be adjusted in the Properties Editor when the Light is selected in the 3D Viewport Editor.

The diagrammatic representation of the Light Type changes in the 3D Viewport Editor (Figure 15.3).

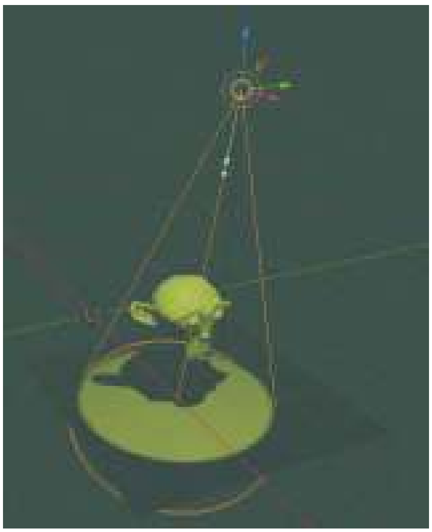


Point Light

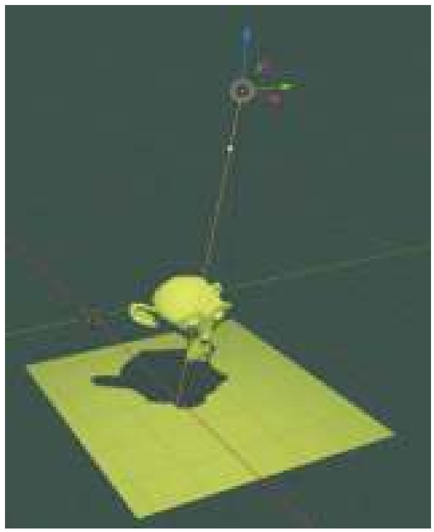


Sun Light

Figure 15.3



Spot Light



Area Light

Remember the 3D Viewport is in **Material Preview Viewport Shading Mode** with Scene Lights and Scene World checked in the Options. In Figure 15.3 the different Light Types illuminate the Scene. In each example the Light Color, set in the Properties Editor Light buttons, with the Light Object in the 3D Viewport Editor selected, casts the color (green) on to the Monkey and the Plane. The Monkey and the Plane do not have a Material (color) applied and, therefore, would display with the default gray without the Light Color being cast by the Light. In conjunction with the illumination from the Lights the World Surface Background settings in the Properties Editor, World buttons are influencing the way in which the Scene displays.

Properties Editor

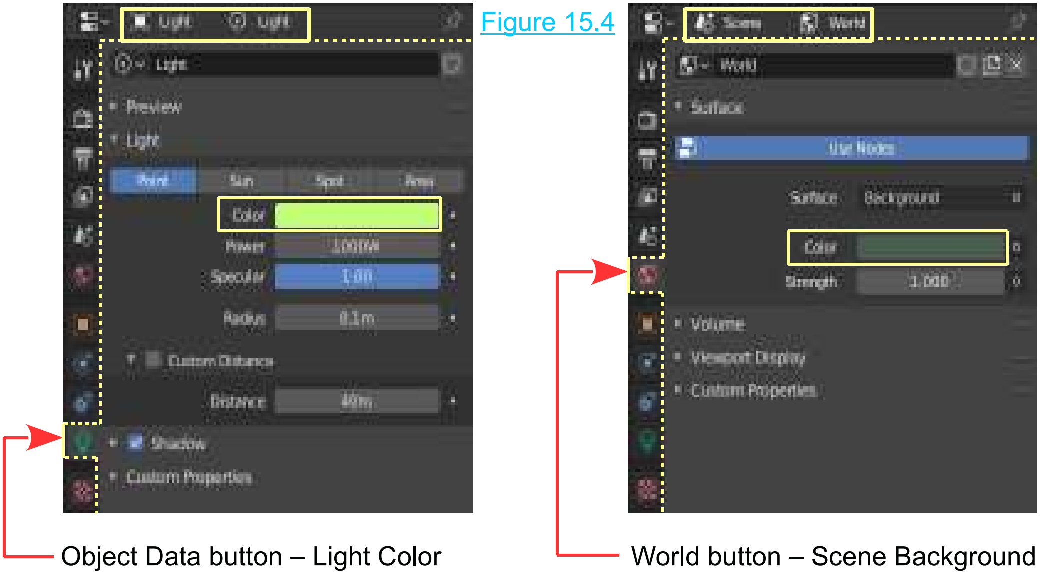


Figure 15.4

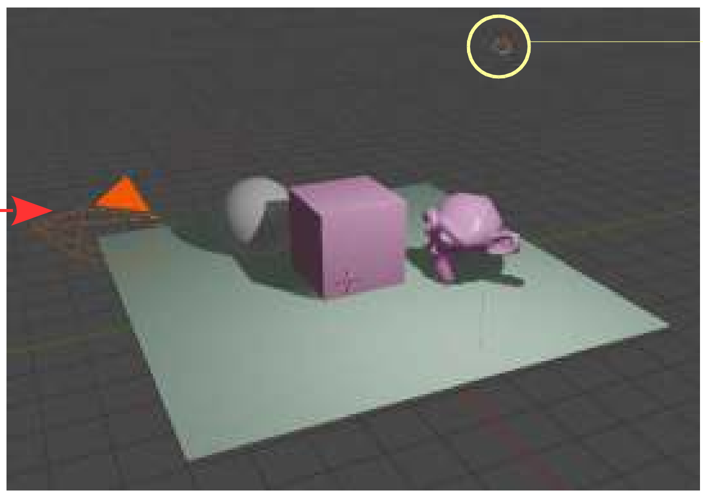
Object Data button – Light Color

World button – Scene Background Color

Adding Lights

To add additional Lights to the Scene, position the cursor in the 3D Viewport Editor, press **Shift + A Key** and select **Light** from the menu that displays. You can choose **Point, Sun, Spot or Are**a.

To see the effect of the different Light Types and settings create a Scene as shown in Figure 15.4.



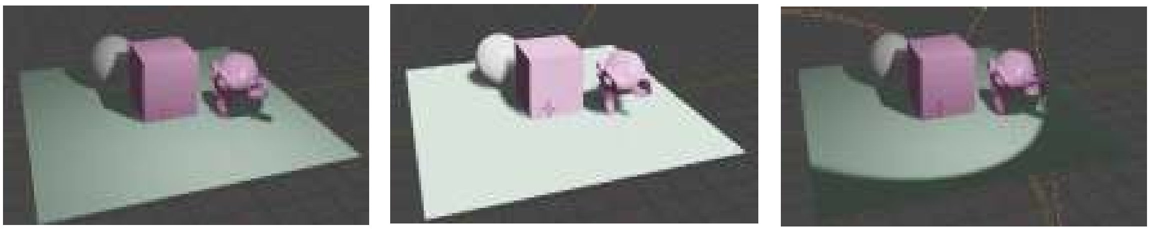
Point Light

Camera

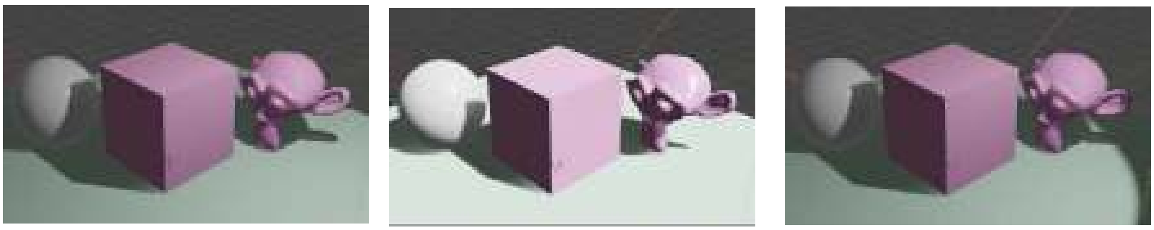
Figure 15.5

In the Scene a Plane has been added and scaled up five times. The Plane has been Translated (Moved) up, just above the Midplane Grid. A UV Sphere and a Monkey have been added and positioned each side of the default Cube. The Cube, UV Sphere and Monkey have been Translated up to sit just above the Plane. Colors have been added with the Node System deactivated (Reference: Chapter 4 – 4.18).

The Camera and the default Point Light are in their default positions. The 3D Viewport Editor is in Material Preview Viewport Shading Mode (Chapter 14 – 14.4). Make note of the different effect when you change the Light Type in the Properties Editor, Data buttons, Light tab (with the Lamp selected).



Point Lamp Sun Lamp Figure 15.5 Spot Lamp



The upper row of images show part of the 3D Viewport Editor. The lower row shows Camera View. By leaving the default Point Light in position, then adding an additional Spot Light and directing it towards the left hand face of the Cube you remove the shadow on the Cube and the Monkey.

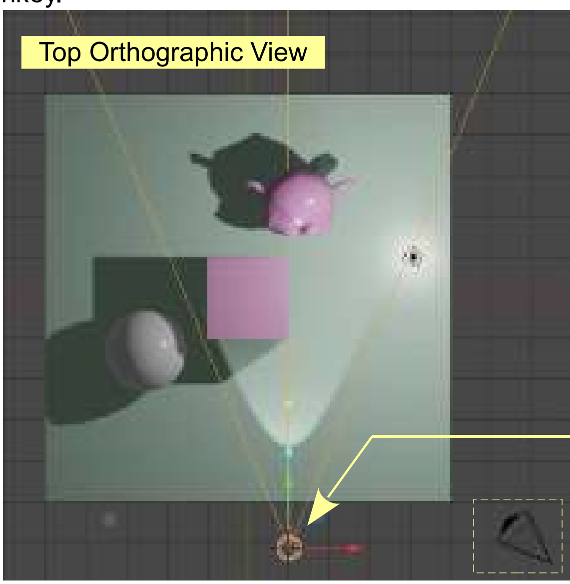
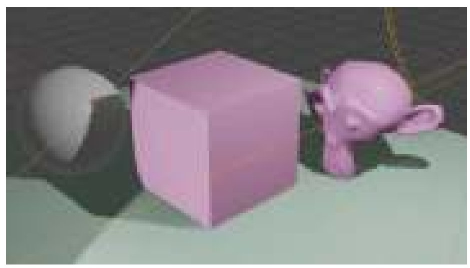


Figure 15.6



Camera View

Additional Spot Light pointing towards the Cube and the Monkey.

The Camera in its default position.

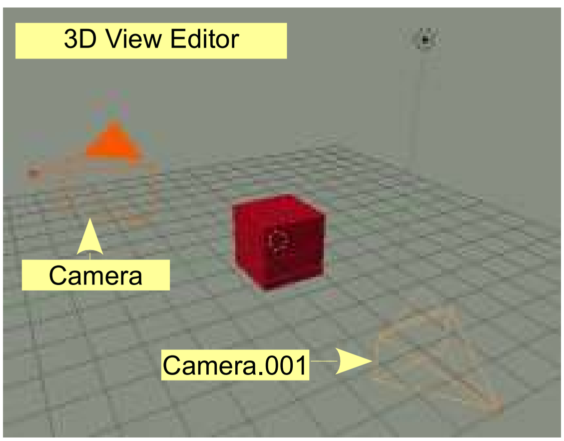
15.3 Cameras

By default the Scene has one Camera which is positioned to capture an image of the Cube Object. What the Camera sees and what is captured as an image is called **Camera View**. You can see Camera View in the 3D Viewport Editor by pressing Num Pad O on the Keyboard. To return to User Perspective View, press Num Pad 5 (User Orthographic View) then Num Pad 5 again for User Perspective View. **You have to rotate the View to reinstate the default Scene (press Num Pad 6)**.

In a complex Scene you may wish to add more Cameras to capture shots from different angles. You add Cameras by pressing **Shift + A key** and selecting **Camera** from the menu or click Add in the Header and select Camera. The new Camera will be located where the 3D Viewport Cursor is positioned. If you add a Camera in the default Scene with the 3D Viewport Cursor at the center of the Scene it will coincide with the default Cube Object. Click the Move Tool in the Tool Panel and move the Camera to one side. You have to rotate the new Camera to capture the part of the Scene you require.

Depending on the Scene arrangement the Cameras may or may not be visible in the 3D Viewport. Camera View depends on which Camera is selected. If the Camera is visible LMB click to select. If it is not visible you can select it in the Outliner Editor by clicking LMB on the name. The original Camera is named Camera the new Camera is named Camera.001. You may rename these to something meaningful if you wish.

> **Note:** If you select Camera (the original Camera) and press Num Pad 0 you will get a Camera View taken by the original Camera. To get Camera View from Camera.001, have Camera.001 selected then press **Ctrl + Num Pad 0**. Similarly if you have been using Camera.001 for Camera View and you select the original Camera, press **Ctrl + Num Pad 0** you get a Camera View from the original Camera..



Select a Camera press Ctrl + Num Pad 0 For Camera View.

Figure 15.7

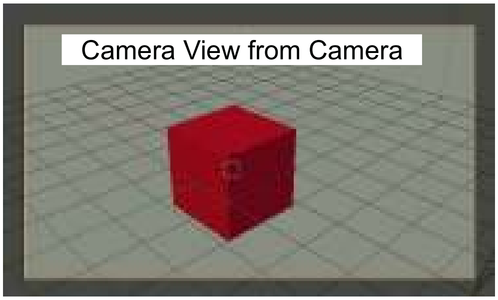
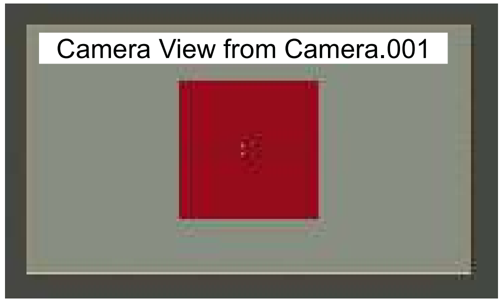


Figure 15.8



15.4 Camera Settings

Properties Editor

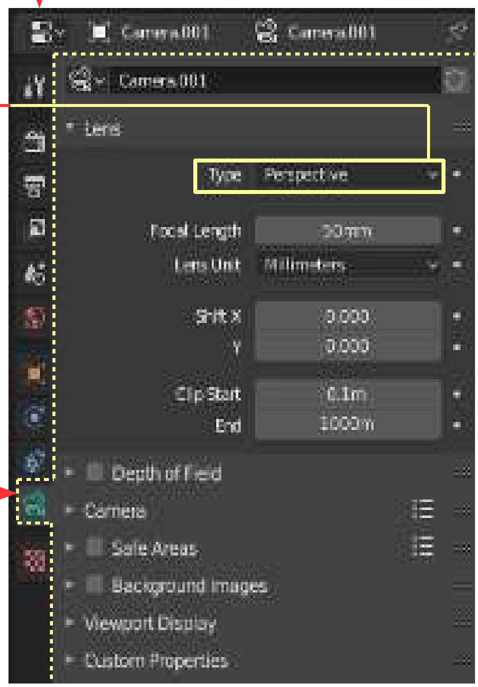


Figure 15.9

Settings are found in the **Properties Editor, Object Data Properties buttons** for the selected Camera (Figure 15.9).

Lens Tab: (Figure 15.10)

Perspective, Orthographic or Panoramic: Used to change the camera from showing a true-life perspective view to an orthographic view.

Figure 15.10

Focal Length: Sets up a lens length much like a real camera; 35mm is a good safe setting but wide and tight angle settings work for different needs.

Object Data

Shift: Pushes the camera's view in a direction, without changing perspective.

Clip Start: How close an object can be to the camera and still be seen (Figure15.11).

Clip End: How far away objects can be seen by the Camera; in very large Scenes, this needs to be set higher or objects disappear from view (Figure 15.11).

To view Limits, check **Limits** in the Viewport Display Tab (Figure 15.15)

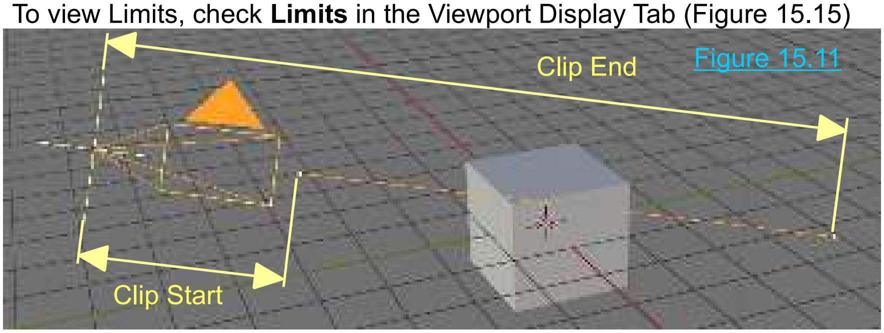


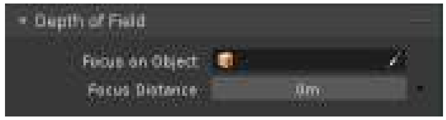
Figure 15.11

Camera Tab: (Figure 15.12)

Figure 15.12

Camera Presets: Allows matching the virtual Camera in the Blender Scene with a real camera used to record video. This produces a more realistic effect when Camera Tracking (see Camera Tracking 15.6).

Depth of Field Tab: (Figure 15.13)



Used with **Nodes** to blur foreground and background objects (Nodes are discussed in Chapter 16). Figure 15.13

Aperture Tab: (Figure 15.14)

Mimics f-stop settings on a real camera which controle the amount of light entering the camera.

Figure 15.14

Viewport Display Tab: (Figure 15.15)

Composition Guides: Check options to display guidelines in Camera View (see Figure 15.18).

Size: How big to draw the Camera on the Screen; you can also control the size with scale.

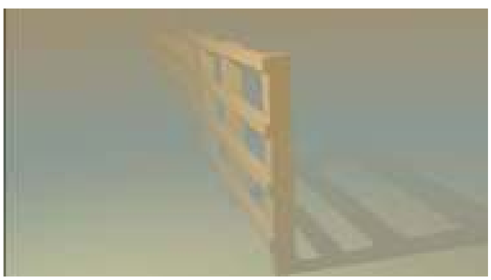
Figure 15.15

Passepartout: Is also in the Display Tab and when checked Shades the area on the Screen outside of the Camera View (Figure 15.18).

Alpha: Controls the darkness of the shaded area with the slider.

Limits: Draws a line in the scene to help you visualise the Camera's range (Figure 15.17)

Mist: Gives you a visual display of how far the Camera sees if you are adding a mist effect.



See: Volumetrics 15.9

Figure 15.16

Sensor: Shows the sensor size (Film Gate) in Camera View (Figure 15.18).

Name: Displays the name of the active Camera in Camera View (Num Pad 0) (Figure 15.18).

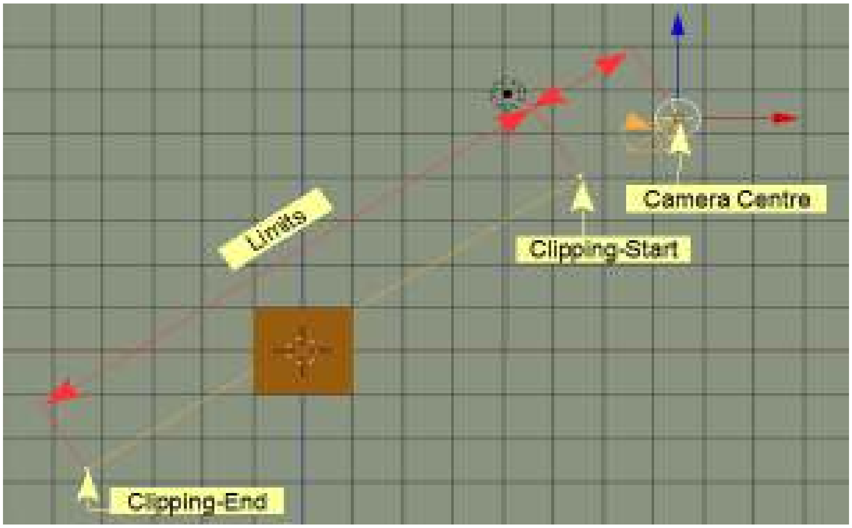
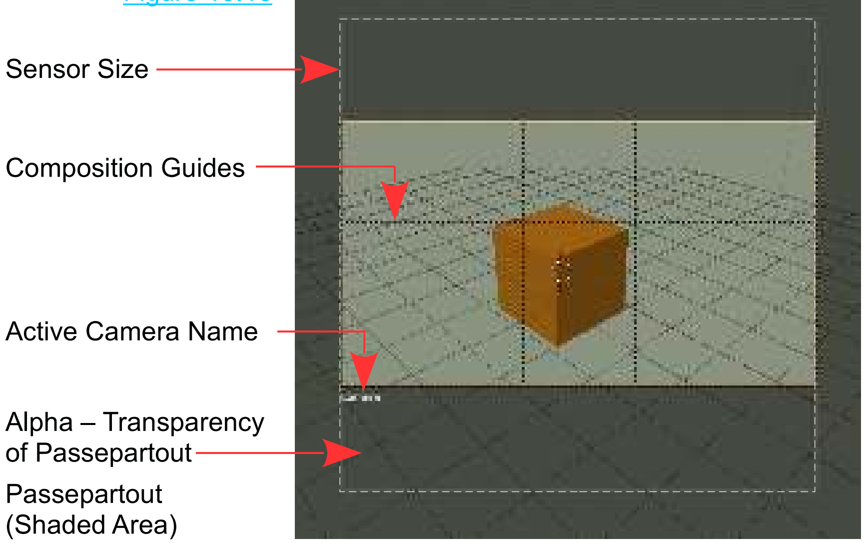


Figure 15.17

Objects in front of the **Clipping Start** point or beyond the **Clipping End** point will not be seen in Camera View.

Figure 15.18



15.5 Camera Switching

In **Cameras 14.3** it was shown that you may have more than one Camera in a Scene and you can switch between Cameras by selecting one, then pressing **Ctrl + Num pad 0**. This makes the selected Camera active and opens **Camera View** showing what is seen by that Camera. Manual selection is fine for rendering single images of an object from different viewing perspectives but you may want to animate the switching so that when rendering an animation you switch between Cameras as the animation plays.

Animation is discussed in Chapter 18 but the inclusion of a prelude in the following demonstration will be beneficial.

Set up a Scene similar to that shown in Figure 15.19, with three **Cameras** pointed at **Suzanne** (Monkey) from different locations. You can use the default Camera and add two others.

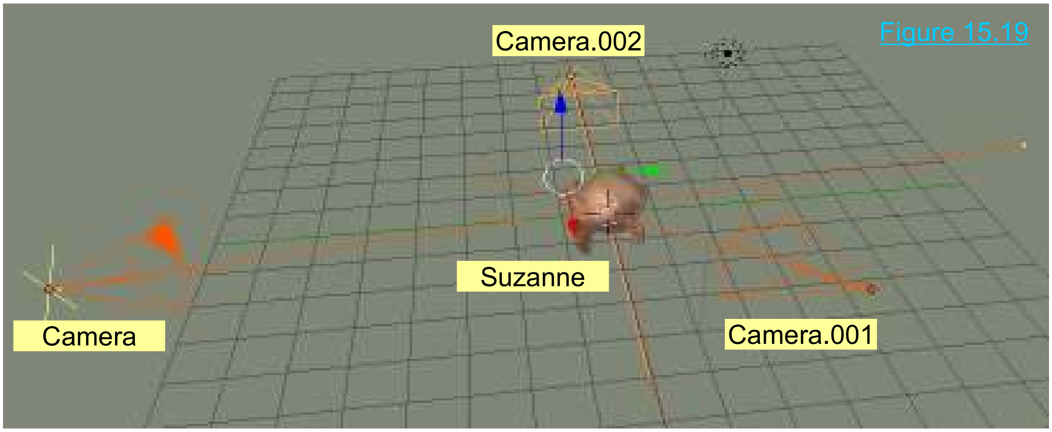


Figure 15.19

In the 3D Viewport Editor select the default Camera named **Camera**. In the **Timeline Editor** with the vertical blue cursor line at Frame 1 and the **Mouse cursor in the Timeline Editor** press the **M Key** to place a **Marker** at frame 1. **Note:** You can only place the marker when the **Mouse Cursor** is positioned in the Timeline (Figure 15.20).

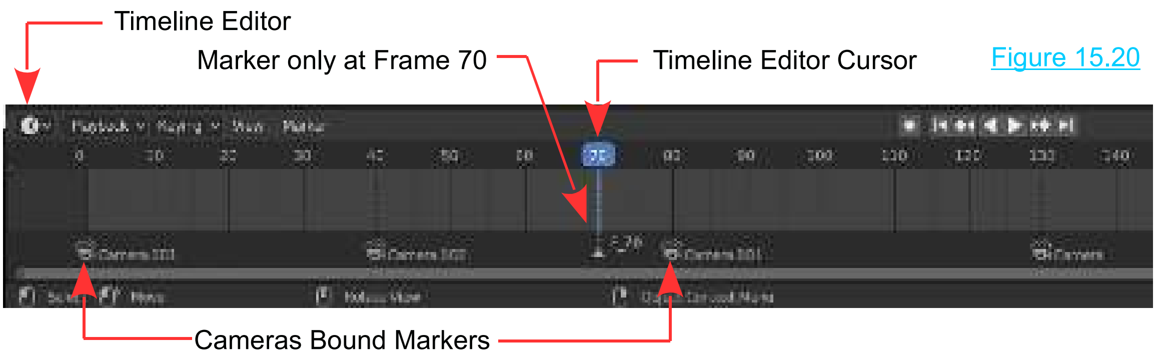


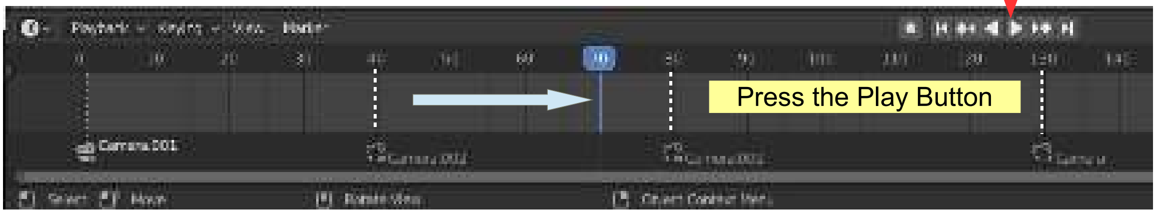
Figure 15.20

The selected **Camera** has to be **Parented** to the **Marker**. Click on **Marker** in the **Timeline Editor Header** and select **Bind Camera to Markers**.

Select one of the other Cameras. In the Timeline Editor move the blue cursor line to another Frame. With the **Mouse Cursor** in the Timeline Editor press the **M Key** to place a second marker and bind the Camera to the Marker.

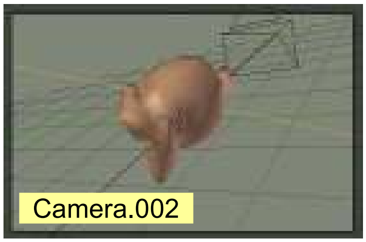
Note: You can place a Marker without a Camera being selected by pressing the **M Key** with the Timeline Cursor positioned at a Frame then select a Camera and Bind to the Marker.

Repeat the process for the 3^{rd} Camera. Remember, select a different frame in the **Timeline** and when you place a marker have your **Mouse cursor** in the **Timeline Editor**. Select Camera (the original) and press **Ctrl + Num Pad 0** for Camera View. When you press **Play in the Timeline Header** an animation will play switching from one Camera View to the other.

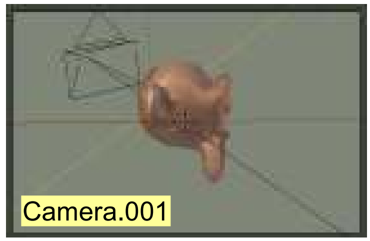


The Animation plays from Frame 1 to Frame 250 then repeats. Figure 15.21

Camera View F1 to F40



Camera View F40 to F80



Camera View F80 to F130

15.6 Camera Tracking

Camera Tracking is a technique that imitates the real Camera motion which occurs when recording a video. This motion is applied to a 3D Camera in a Blender Scene providing a realistic effect when a 3D model is superimposed over a video background (Figure 15.22). Without this effect the Blender 3D Camera would track to a stable imaginary point or to a predetermined curve track in the Scene. This would be fine for the superimposed 3D Object but the actual video used as a background would move differently and produce an unrealistic effect. The essence of the technique is to plot the movement of multiple points in the video Scene and feed that information to the motion of the Blender 3D Camera.

At this point the technique is mentioned to make you aware of its existence and the following video tutorial is suggested: https:www.youtube.com/watch?v=O3fGc_QM3yI//w

Figure 15.22

15.7 Basic Scene Lighting

To demonstrate **Basic Scene Lighting,** create a Scene as shown in Figure 15.23 including a Cube, a UV Sphere, a Plane and a Monkey Object. **Note**: The Plane has been Translated up slightly on the Z Axis. When the Plane is added to the Scene with the 3D View Editor Cursor located at the center of the Scene, the grid lines show in the surface of the Plane. Translating up, puts the Plane above the Grid. The Cube, UV Sphere and Monkey are all Translated and positioned above the Plane.

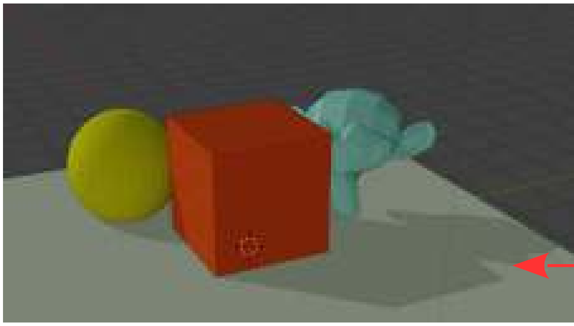


Figure 15.23

Note: Direction of shadows due to the Studio Lighting

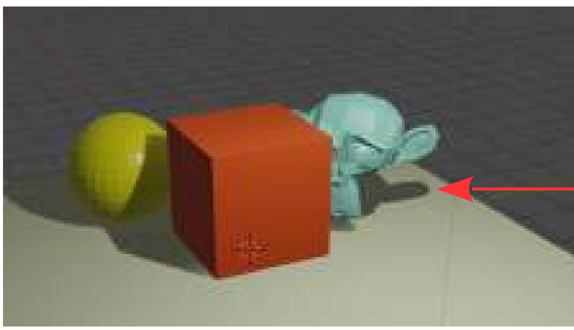
You may create the Scene with the 3D Viewport Editor in **Solid Viewport Shading Mode** (Chapter 14). The default settings in the Sub Options Panel can be left as they are, with the one exception, **check Shadows**.

Note: The default color setting is **Material,** meaning the Material (color) added to the Objects will be displayed.

Add a basic Material (color) to all Objects (Chapter 4 - 4.18).

Figure 15.24 is a screen capture of part of the view in the 3D Viewport Editor approximating Camera View (what the Camera sees).

With the Scene created, change to **Material Preview Viewport Shading Mode** (Chapter 14) and check **Scene Lighting** in the Sub Options panel. You will immediately see a difference in the view since the effect of the single default Point Lamp is displayed.



Colors brightnes and the direction of shadows changed due to the single Point Light in the Scene

Figure 15.24

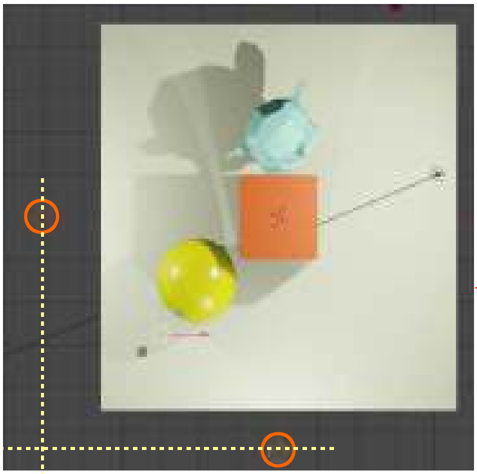
Make note that the Light emitted by the Point Light, by default, is white (RGB 1.000).

In the **Outliner Editor** click on **Light** to select the Point Light in Collection. Selecting in the Outliner Editor selects the Light in the 3D Viewport Editor.

In the Properties Editor, Object Data buttons the settings will be applicable to the Light in the 3D Viewport Editor (the selected Object). Change the Light setting Point to **Area**. Again you see a change to the lighting in the 3D Viewport Editor demonstrating the effect of Light settings (Figure 15.25).

Figure 15.25

In the 3D Viewport Editor add two more Point Lights and position as shown in Figure 15.26.



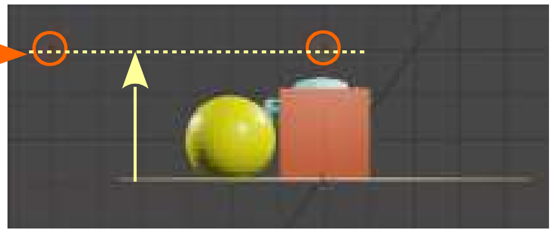


Figure 15.26 Front Orthographic View

Top Orthographic View
Orange circles showing the approximate location of the additional (two) Lights.

With the 3D Viewport Editor in **User Perspective View** go to the **Outliner Editor** and toggle hide and display of the new Lights to see the different Lighting effects.

Note: The new Lights listed in the Outliner Editor are named **Point** and **Point.001** Figure 15.27

Area Light only, Point and Point.001 Hidden (off)

Area Light + Two Point Lights

15.8 Background Scene Lighting

Beside the effect of Lights in the Scene you should be aware that the Scene Background plays a part in determining how Materials display. As in the real world the ambient light surrounding Objects determines how they are seen. In Blender, the World Background light has a similar effect.

Background Color Lighting

To demonstrate this phenomena replace the Cube Object in the default Scene with a UV Sphere and set the Sphere's surface to Shade Smooth (Chapter 4 - 4.21).

Have the 3D Viewport Editor in **Rendered Viewport Shading Mode** (Chapter 14).

With the UV Sphere selected, In the Properties Editor, Material buttons, click **New** to add a Material. Since this is a new Object in the Scene, **Use Nodes** will be activated.

Use Nodes, means that the **Blender Node System** for applying Materials is being used. An explanation describing what Nodes are and how to use them is given in Chapter 16.

For the moment, with **Nodes active**, click on the **Base Color** bar to display the Color Picker Circle and give the UV Sphere a yellow color by setting the RGB color values (R: 0.753, G: 0.531, B: 0.002). Have the intensity slider cranked all the way to the top (very bright).

Remaining in the Properties Editor, click on the **World button** and in click **Use Nodes**. By default **Surface** is set as **Background**. Click on the Color bar (the default color is gray) and change to a blue color (R: 0.011, G: 0.789, B: 0.900). Move the Intensity Slider up to about half way.

Result: Blue Background causing the Yellow Sphere to appear Green.

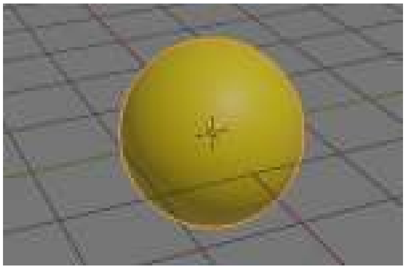
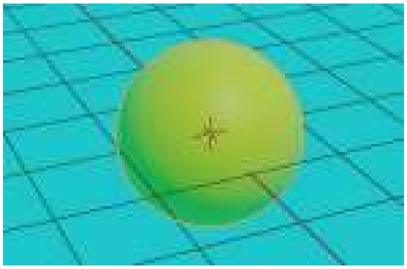


Figure 15.28



15.9 Images as a Background

HDRI Maps

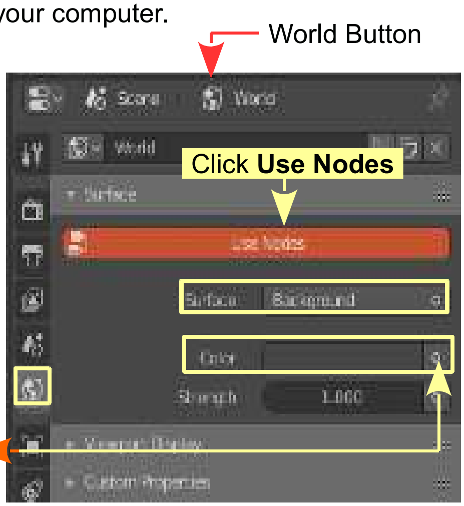
Colored Scene backgrounds are suitable in many cases but an image used as a background can significantly add atmosphere. Special images called **HDRI Maps** are particularly spectacular in giving a three dimensional effect when the Scene is rotated. This type of image adds lighting to the Scene thus affecting how Objects are seen.

One source of HDRI images is: https://hdrihaven.com

To demonstrate the use of HDRIs use the Scene arrangement in Figure 15.23. Deselect all the Objects in the Scene and have an **HDRI image** saved on your computer.

In the **Properties Editor, World buttons** click on **Use Nodes**. In the Surface tab you will see that Surface is set to **Background**.

Figure 15.29



Click on the dot at the end of the **Color Bar** and select **Environmental Texture** in the menu that displays. Click on **Open** and navigate to your HDRI file in the Viewer.

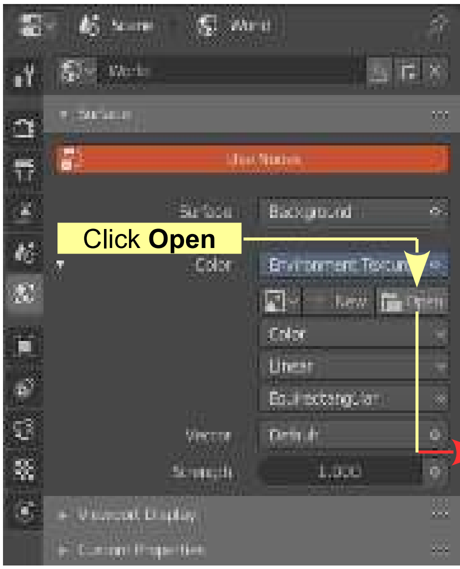
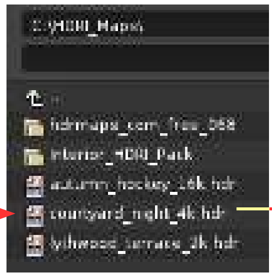


Figure 15.30

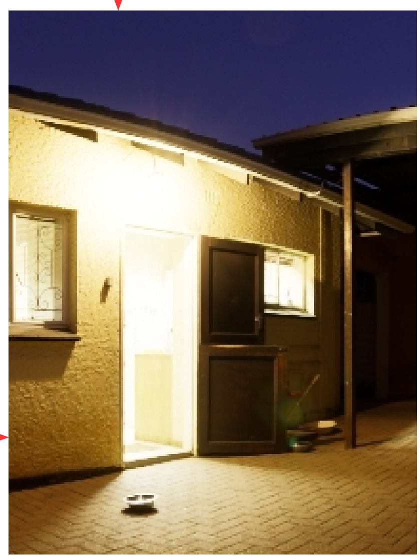


HDRI Images

Figure 15.31

Have the 3D Viewport Editor with **Material Preview Viewport Shading** and with **Scene World checked** in the Shading options. The HDRI image will display as the Background to your Scene.

Image courtyard_night_4K.hdr



At this point you manipulate the view in the 3D Viewport Editor and move the Objects to position in the Scene as shown in Figure 15.32 over.

In Figure 15.32 the Objects have been positioned to appear as if they are sitting on the floor just outside the open door. All the Lights in the Scene have been deleted showing that the Light from the image affects the Objects.

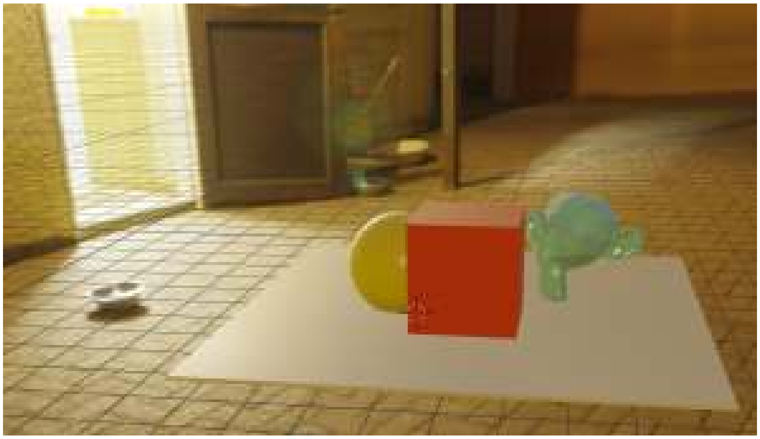


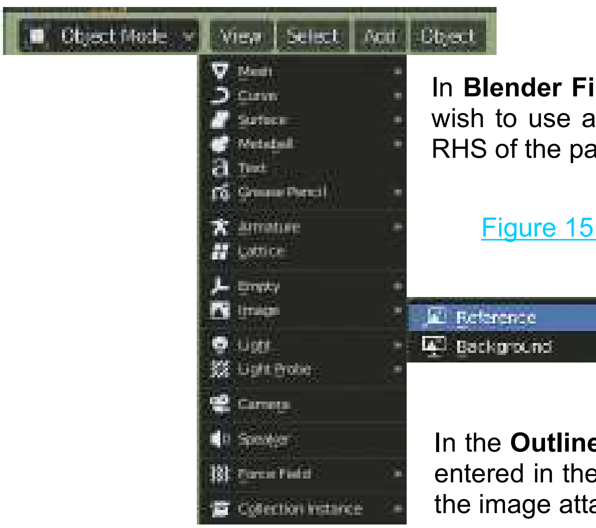
Figure 15.32

Images for Tracing and as Scene Backgrounds

HDRI Images will provide Scene Lighting but it may be that, simply place an Image in the Scene to act as backdrop will do the job. Images may also be used as a template for Modeling.

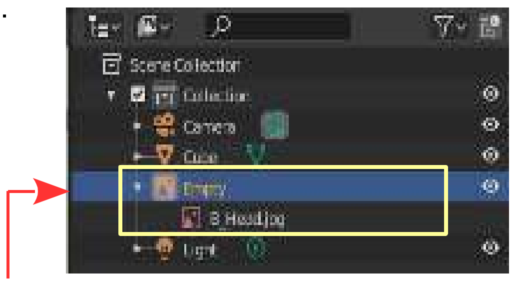
Images for Tracing

To use an Image as a template for creating models you add an image file into the 3D Viewport Editor as a **Reference Image**. Be aware that in using this method the Image does **NOT Render**. Reference images are typically used for modeling. For example a front and side view of a human head (mugshot). To us an image in this way have the 3D Viewport in Front or Right Orthographic View. To enter an Image click **Add** in the Header and select, **Image** then **Reference** (Figure 15.33).



In **Blender File View** that opens navigate to the image you wish to use and click **Load Reference Image** in the lower RHS of the panel.

Figure 15.33



In the **Outliner Editor** you will see that the image has been entered in the 3D Viewport Editor as an **Empty Object** with the image attached.

On mouse over in the 3D Viewport Editor and the Empty (image) may be Translated, Rotated and Scaled but remember an Empty Object does **NOT** Render. As such, the image is suitable as a tracing template only.

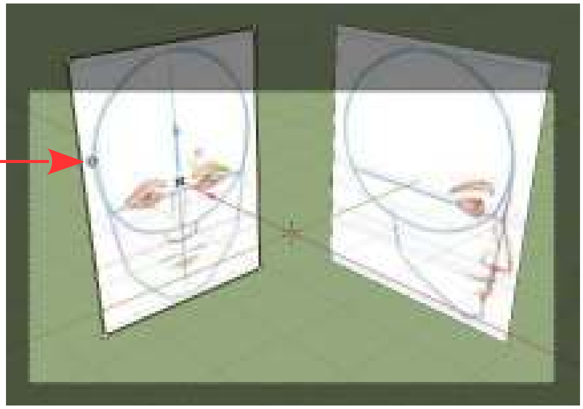


Figure 15.34

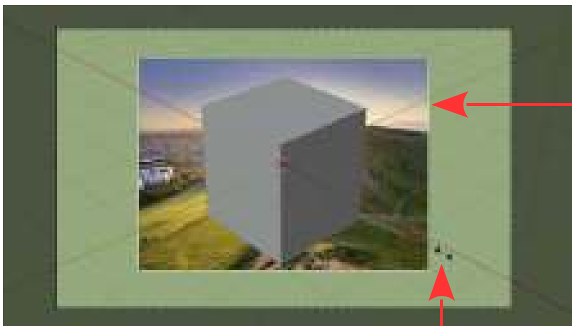
Mouse Over to manipulate the Image.

Reference Images positioned for Modeling.Camera View.

Image as a Scene Background

To introduce an image which Renders as a background to the Scene, be in Camera View and repeat the previous selection procedure, this time, selecting **Background**. Find your Background Image in Blender File View and click **Load Background Image**.

Figure 15.35



Select the Image and Scale up to fill Camera View.

Rotating the Viewport shows the Image positioned behind the default Cube (Figure 15.35).

Note: Entering the Image as Background allows you to see the Image in all Viewport Shading Modes **BUT it does NOT Render.**

To Render an Image as a background you have to Add the Image as a Plane and to do this you have to activate the **Import-Export Images as Planes** Add-on in the Preferences Editor. With the Add-on activated you will have the option to **Add Images as Planes** from the Add Menu.

Entering the Image in Camera View shows the Image (Plane) aligned along the Y Axis of the Scene at a reduced Scale (Figure 15.36 over). The Image (Plane) is located at the center of the Scene. You are required to Scale and Rotate the Image to fit the Camera View and move the Image back in the Scene behind any Objects. When the Image is entered as a Plane it is , in fact, an Object. Positioning the Image in the Scene, to be captured in Camera View, and relative to Scene Lighting has to be considered. You can have shadows being cast on the Image.

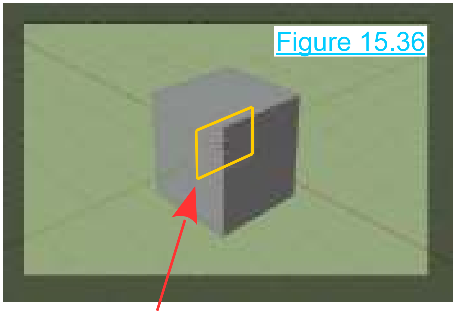


Figure 15.36

Image Plane entered in Camera View at the center of the Scene inside the default Cube.

One method of positioning and Scaling the Image Plane is to be in Camera View with the Image Plane selected and have the Object Properties Panel opened (press the N Key). By adjusting values in the Properties Panel you will see the Image Plane fit the Camera View. Figure 15.37

Properties Values

Figure 15.38

Camera View (Rendered Viewport Shading) with Properties Values adjusted.

Figure 15.39

Viewport Rotated showing the Image Plane located behind the default Cube.

Figure 15.40

Rendered View

15.10 Volumetric Lighting

Using HDRI Maps as a background can give you a quick way to illuminate a Scene and combine a background but you are limited to what you can source in an image. You may want something completely unique and maybe not as complicated. Volumetric Lighting may be the answer.

Volumetric Lighting uses the light provided by Blenders Lights and scatters or diffuses the light in the Scene. A simple demonstration is to place a light source in a Scene behind an Object such that the diffuse light shines through the Object, casting shadows towards the Camera.

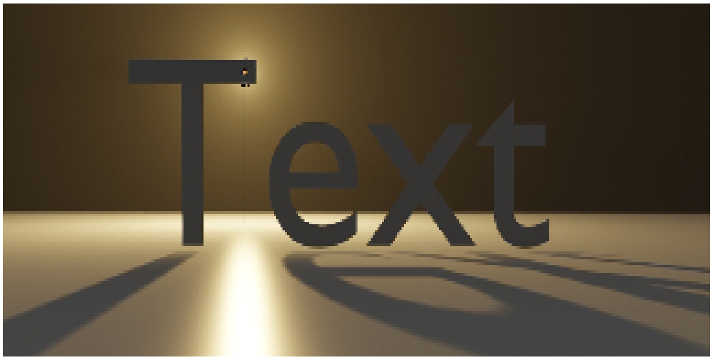


Figure 15.41

To produce a Volumetric Lighting effect as shown in Figure 15.41 Blender's Node System is used. How to use Nodes is explained in Chapter 16 – 16.22 with a full description of creating this simple effect and advanced options.

With the Eevee Render System Volumetric Lighting is also used to create a Mist or Fog effect.

16

Materials – Textures - Nodes

16.1 Definition
16.2 Materials in the Properties Editor
16.3 Multiple Material Slots
16.4 Materials Using Nodes
16.5 Accessing and Viewing Nodes
16.6 Noodle Curving
16.7 The Shader Editor
16.8 The Shader Workspace
16.9 Scene Arrangements
16.10 Mixing Material Example
16.11 Simple Node Arrangement
16.12 Texture Nodes
16.13 Unwrapping a Surface
16.14 Unwrapping with Seams
16.15 Applying a Texture
16.16 Mapping to a Surface
16.17 Texture Painting
16.18 Vertex Painting
16.19 The Principled BSDF Node
16.20 Quick Example using BSDF
16.21 Transparency Using Nodes
16.22 Other Node Uses
16.23 Grouping Nodes
16.24 Compositing Nodes
16.25 Ramp Shader
16.26 Texture Displacement

Materials and **Textures** add color and define the surfaces of Objects. The application of Materials and Textures in Blender utilises a graphical display called a **Node System** which represents the computer code generating the effect of Material and Texture.

Since the subject is extensive this chapter will be an **introduction only**. The examples provided will act as a starting point and assist in understanding detailed tutorials for advanced applications. Proficiency in the application of Materials and Textures using Nodes will only come with practice and experience and the accumulation of a library of Node Arrangements.

The discussion will be limited to the use of Nodes with the **Eevee Render** system active. Although the principles of operation apply to both Eevee and Cycles Render Systems the latter , at this point in time, has a more extensive Node system.

Before delving into the use of Nodes, Materials and Textures will be discussed with the Node System disabled. How Material color and Texture display is affected by Scene Lighting which has many variables (Chapter 15) , therefore, to begin, basic lighting will be employed.

16.1 Definition

In Computer Graphics, how the surface of an Object displays is determined by three factors; Material, Texture and Lighting.

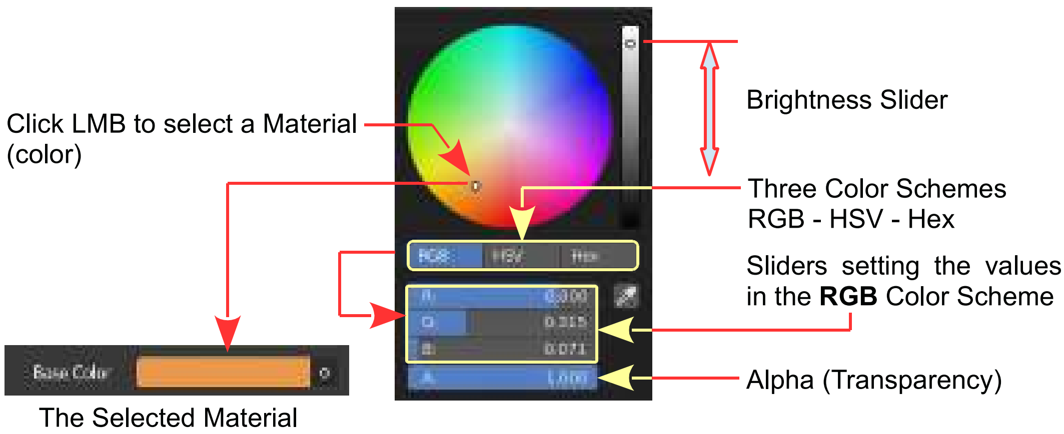
Material:	The Base Color of the surface.
Texture:	The physical characteristics of the surface.
Lighting:	The background illumination or light emitting from Lights (Lamps).

Materials

In computer graphics, a **Material** is the color of an Object which is how the visible spectrum of light reflects from the Object's surface. A Material also defines whether the surface appears dull (matt) or shiny (metallic).

In practice, Material (color) is selected in a **Color Picker Circle**.

Figure 16.1



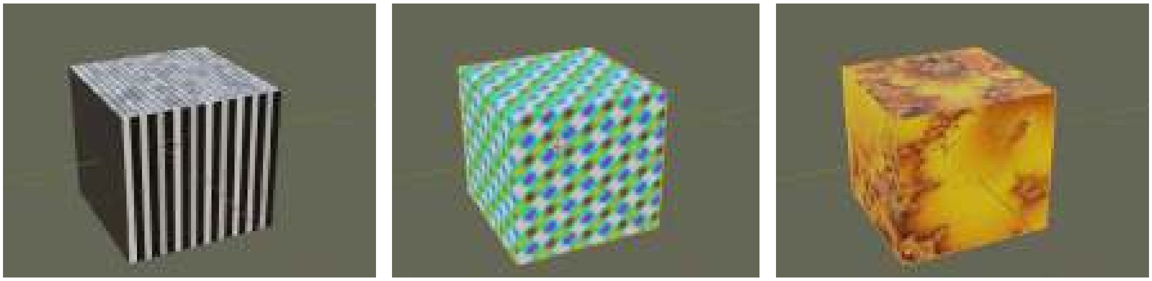
Materials (color) can be displayed in accordance with three color schemes i.e. **RGB, HSV or Hex**. How the color appears in each scheme is also dependent of an **Alpha** value which is the amount of transparency the material (color) is given and the brightness. (Chapter 1, 1.12 – Coloring).

The color picker circle in Figure 16.1 is typical and is accesses from a variety of locations in the interface.

Textures

A Texture defines the physical appearance of a surface such as how lumpy or bumpy it appears or its patternation which visually defines the perception of the physical make up of the Object. This definition determines what you perceive the surface to be; wood, brick, water etc.

Textures are generated by computer code built into Blender (Procedural Textures) or from images saved on the computer (Image Textures) (Figure 16.2).

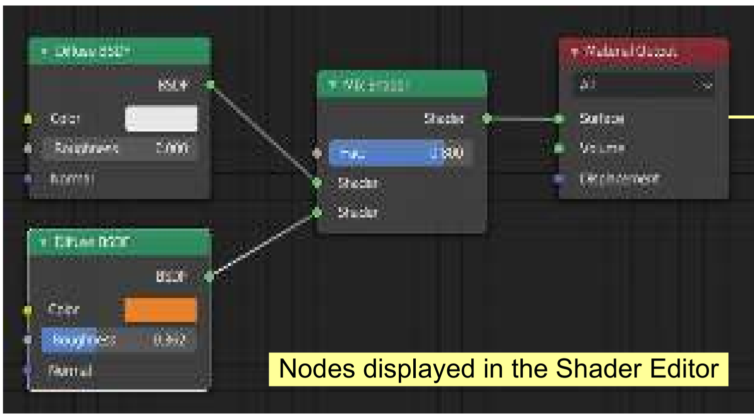


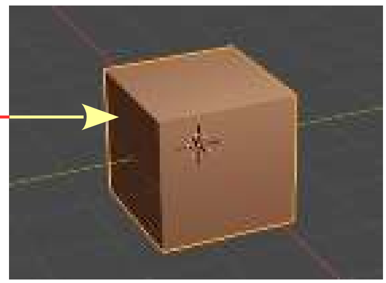
Procedural Textures Figure 16.2 Image Texture

Nodes

Nodes are graphical representations of blocks of computer data (datablock) which instructs the computer how to display Materials and Texture. In Blender, Nodes (datablocks) are arranged in a chain or pipeline to produce effects. In the case of Materials and Texture the arrangement of Nodes create the visual affect of an Objects' surface appearance.

Figure 16.3





Node arrangement producing the Material (color) of the default Cube Object.

Nodes may also be used for creating Scene backgrounds and in the enhancement of **Images** or **Video**. In fact there are many uses.

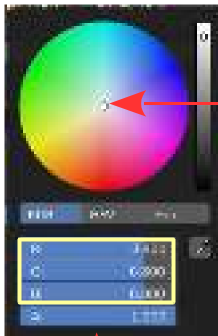
For simplicity, how to add color to an Object by cancelling the Blender Node System was explained in Chapter 1.

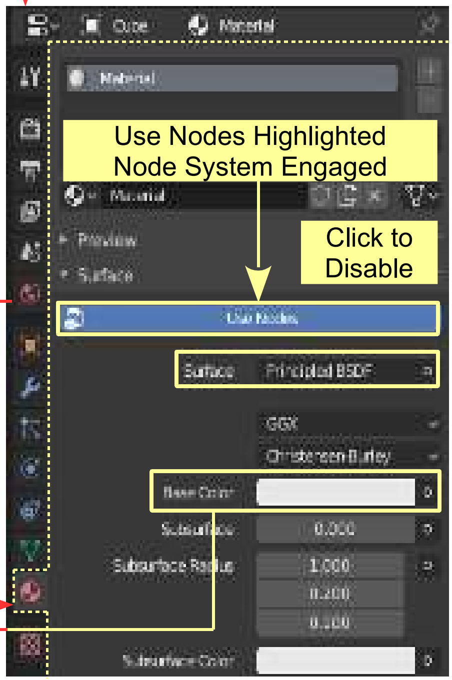
Before investigating the use of Nodes to apply Materials and Textures it will be beneficial to understand the application of Materials in relation to the Properties Editor with the Node System disabled.

16.2 Materials in the Properties Editor

Properties Editor Figure 16.4

In Chapter 4 - 4.18 **Material** was applied to Objects in the 3D Viewport Editor with the Blender Node System disabled. **In the default Blender Scene** the default Cube in the 3D Viewport Editor is selected and displays with a gray Material (color). In the Properties Editor, Material buttons, **Use Nodes** is highlighted blue indicating that the **Node System is engaged** (Figure 16.4). Click on the Base Color bar and you will see in the color picker circle that the R, G and B values are all 0.800 which are the values producing the default gray Material (R,G,B all 1.000 = White. R,G,B all 0.000 = Black).





Note: Surface – Principled BSDF.

Principled BSDF is the name of the Node being used.

RGB: 0.800

Material Button

Before exploring the Blender Node System look at Materials in relation to the controls in the Properties Editor, Material buttons with the **Node System disabled**.

Displaying Materials

When Nodes are cancelled, by clicking the **Use Nodes** button, a basic Material application is used (Reference: Chapter 4.18). The Material selected as the Base Color for the Object's surface will display in all three **Viewport Shading Modes**. The Material Base Color selected **with Use Nodes active** only displays when the Viewport Shading is in LookDev Mode or in Rendered Mode (see Chapter 14).

The term **Material** is used to distinguish between simple Color and how the surface of an Object is seen under certain lighting conditions. Material includes color, reflection, transparency, shadows etc., in fact the inclusive reflective characteristics of the surface. Materials do not include visible characteristics such as how lumpy or bumpy a surface is. These visible characteristics are called **Textures**.

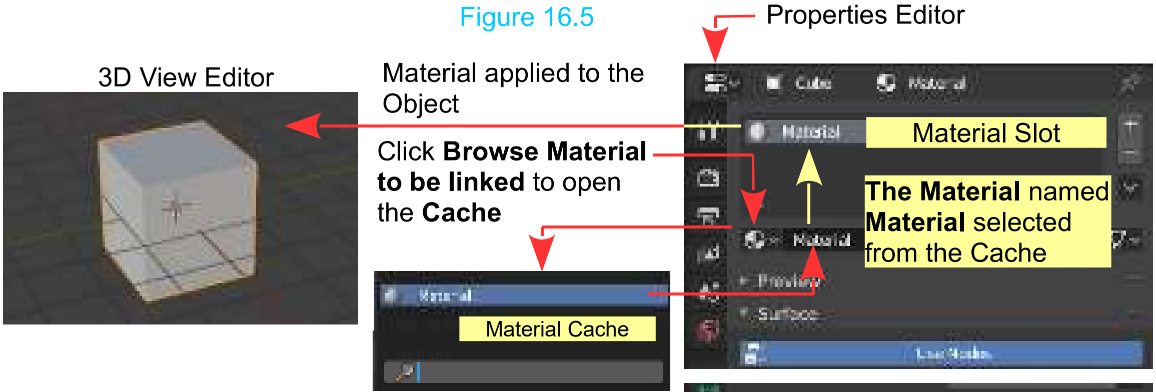
Creating Materials

A **Material** is created when you modify the data producing the default gray color on the surface of the selected Object and apply the data (apply the Material Color) to the Object. The modified data (Material Datablock) is stored in a **Cache** making it available for application to other Objects in the Scene in the particular Blender file being worked.

To understand the process, open a new Blender file with the default Scene containing the Cube Object. The Cube is selected and the 3D Viewport Editor is in **Solid Viewport Shading Mode** (Chapter 14). In the **Properties Editor** select the **Material button.**

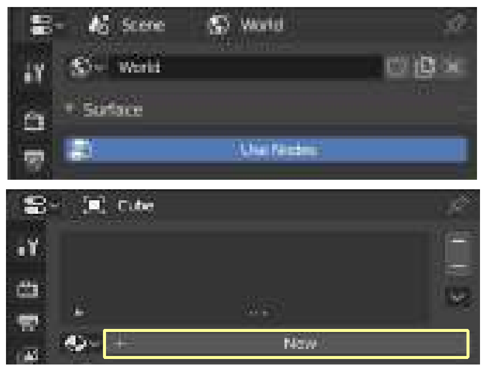
The Cube displays with the default Gray Material which is named **Material**. The data (datablock) producing this gray color is stored in the **Material Cache**. In the default Scene, the Material named **Material** has been automatically selected from the **Cache**. With the Cube selected the Material named **Material** is entered into the **Material Slot** which is then applied to the Cube Object. The default gray **Material** is used to display all new Objects entered into a Scene.

Figure 16.5



Note: The only time the controls for the Material buttons automatically display is when you click the Material button for the default Cube Object in the default Blender Scene.

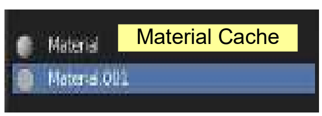
To demonstrate, delete the Cube. On deleting the Cube the Material button in the Properties Editor disappears. The **World button** becomes active, therefore, the Use Nodes button in the Properties Editor will activate the Node System applicable to the World settings **NOT** for Materials.



Add a new Cube to the Scene in the 3D Viewport Editor. The Material buttons are reinstated but are empty except for the **New** button. Click **New** then click **Use Nodes** to cancel the **Node System.**

You will see a new Material named **Material.001** in the Material Slot.

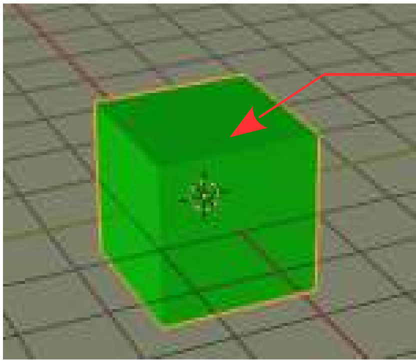
Figure 16.6

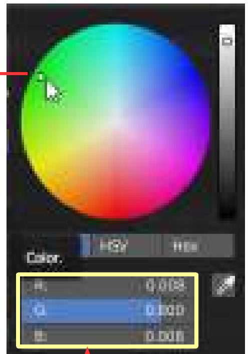


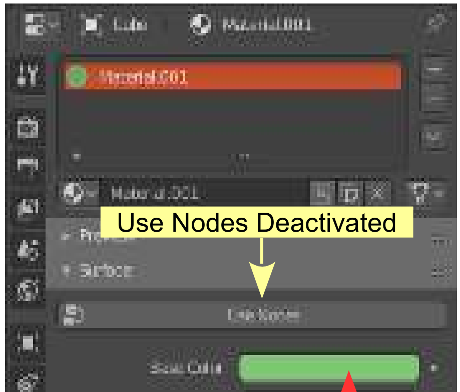
Click the **Browse Material to be linked** button to open the **Cache** and you will see two Materials, one named **Material** (the default) and the other named **Material.001.**

Entering the new Cube has created the new Material which by default is identical to the original, the default Gray.

With Material.001 in the Material Slot, selecting a Base Color in the Color Picker modifies Material.001 to display the chosen color. The color displays on the surface of the Cube.



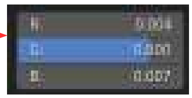




RGB Values before clicking green.

Figure 16.7

RGB Values after clicking green.



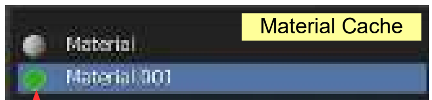
Material button

Click LMB to display the color picker

Figure 16.8

Remember: The Material Node System is **NOT** being used.

The entries in the Material Cache indicate the material color.



Be Aware: The controls displayed in the Properties Editor, Material buttons are only applicable to the selected Object in the 3D View Editor. To reinforce this concept, deselect the Cube and add a UV Sphere to the Scene. The UV Sphere displays gray.

With the UV Sphere selected the Properties Editor, Material buttons, are empty except for the **New** button.

Figure 16.9

Click the **New** button to add to add a new Material. The Material buttons will display with **Nodes** active as indicated by the **Use Nodes** bar highlighted. Click **Use Nodes** to cancel the Node System. With the UV Sphere selected click the Base Color bar and in the Color Picker, note the RGB values 0.800 (the default grey) (Figure 16.7). In the top panel of the Material buttons (Material Slot) you will see a new material named **Material.002** which has been selected from the Material Cache, entered in the Material Slot and applied to the UV Sphere in the 3D Viewport Editor. Material.002 is gray (the default color). If you open the Cache you will see three Materials. Material (gray), Material.001(green) and Material.002 (gray). With the UV Sphere selected click on the Base Color bar and select a color from the Color Picker Circle. This changes Material.002 from the default gray to the color you choose (brown) and applies it to the UV Sphere.

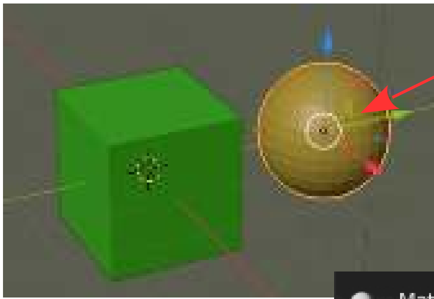
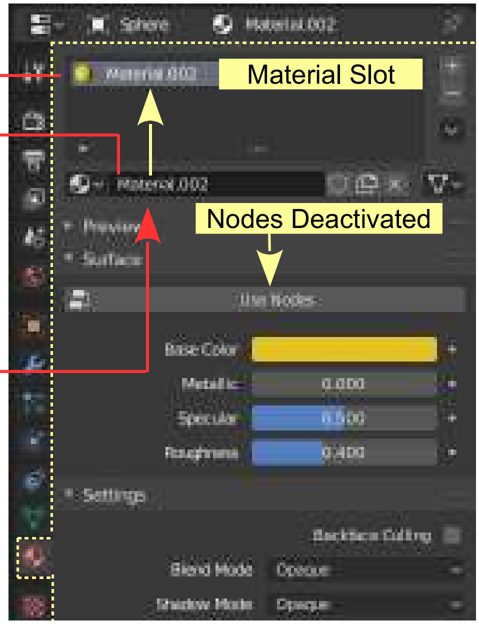


Figure 16.10



The new Base Color (brown) is named Material.002

Material Cache

Deselect the UV Sphere and select the Cube in the 3D Viewport Editor. In the Properties Editor open the Cache and select Material.002 (brown). The Cube will display brown (Figure 16.11).

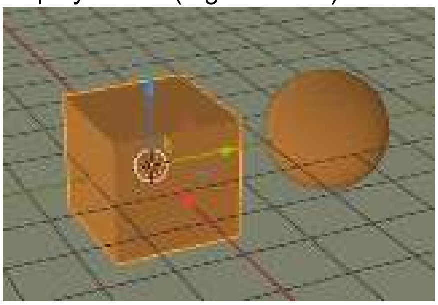


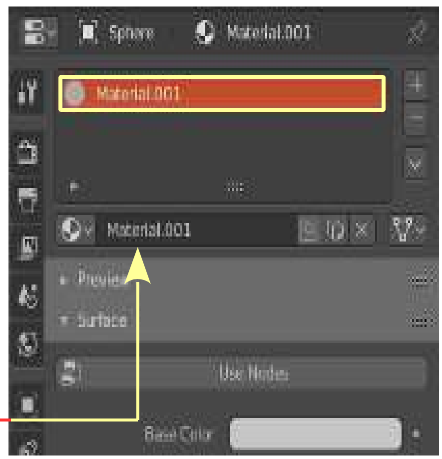
Figure 16.11

Note: The demonstration has been performed **without using the Material Nodes (Nodes Deactivated).** The colors display in all Viewport Shading Modes (Chapter 14). With the Node System active the Material colors only display in LookDev and Rendered Viewport Shading Mode. You may Render by pressing F12 (press **Esc** to cancel).

Solid Viewport Shading Mode is there to provide a simplified environment for modeling and compiling a Scene. You can Render the Scene and generate an image but for more sophisticated Material and Lighting effects the Node System is employed.

16.3 Multiple Material Slots

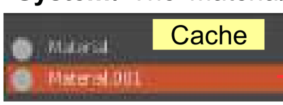
Figure 16.12



Before considering Material Nodes look at **Multiple Material Slots**. Start a new Blender file and replace the default Cube with a UV Sphere.

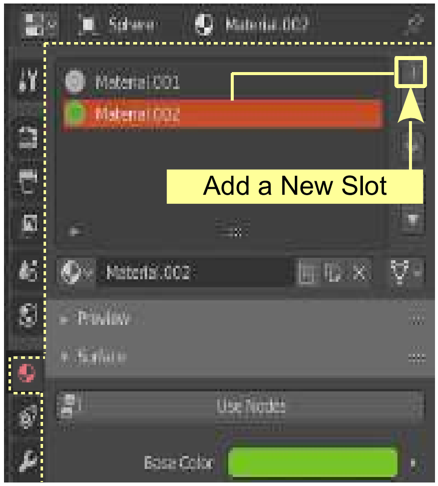
There are occasions when you require more than one Material color to be applied to an Object.

In the Properties Editor, Material buttons, click on New to add a Material. **Cancel the Node System**. The material will be entered in the Material Slot as Material.001 (Figure 16.12) and will be the default gray.



You may click in the Base Color bar and change Material.001 from gray if you wish. The Cache contains Material and Material.001

Figure 16.13



Click on the **plus button** adjacent to the Material slot to add a second Slot (Figure 16.13). You may open the Cache and select a Material to enter in the new Slot or alternatively, click the New button, cancel the Node System and select a new Base Color to create a new Material. The new Material is entered in the new Material Slot and is named Material.002.

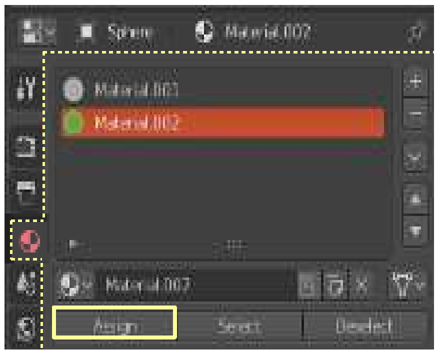
The UV Sphere does not change color since Material.001 is being applied from the original Slot.

Figure 16.14

One way to use a second Material Slot is to apply it to a **Vertex Group**.

With the UV Sphere selected, Tab to Edit Mode, deselect the Vertices then select a group of vertices (Figure 16.14). In the **Properties Editor, Data buttons** create a Vertex Group (Chapter 5 – 5.9 Figure 5.24).

Figure 16.15



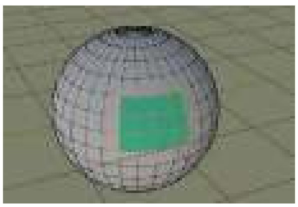


Figure 16.16

In the Properties Editor, Material buttons with the second slot selected (highlighted) containing Material.002, click the **Assign** Button (Figure 16.15). Material.002 is displayed on the Vertex Group in the 3D Viewport Editor (Figure 16.16).

Note: The Assign button only displays with the selected Object in **Edit Mode**.

In Figures 16.13 and 16.15 the Material button is shown repositioned towards the top of the button stack in the Properties Editor. This is for diagrammatic display only.

16.4 Materials Using Nodes

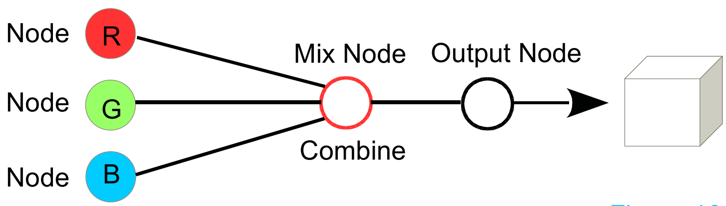
Material Nodes, in their basic application, allow you to add color to the surface of an Object. In Chapter 4 - 4.18 instruction is provided describing how to color an Object **with the Node System disabled**. When the Properties Editor, Material buttons are opened the default controls are for the **Application of Materials (colors) using the Node System** (Use Nodes, highlighted blue). Some **Material Nodes** are called **Shaders**. Material Nodes are accessed in the **Shader Editor,** but before opening the Editor run through some preliminaries so you know what to expect.

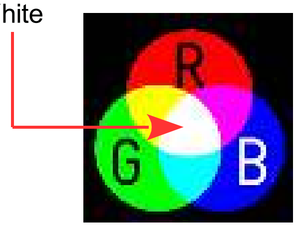
For the purpose of the discussion consider a Node as a point in a pipeline of information which contributes to a result. In the case of Material Nodes the result is the appearance of the surface of an Object in the 3D Viewport Editor. There are usually numerous Nodes connected together producing the result, each of which may be disconnected, rearranged or replaced to vary the final display.

The **Node** is a graphical representation of computer data or instruction which is arranged in a pipeline. Think about mixing colors. The primary colors are Red, Green and Blue, which when mixed in equal proportions produce White (Figure 16.17).

In a Node System this would look like:

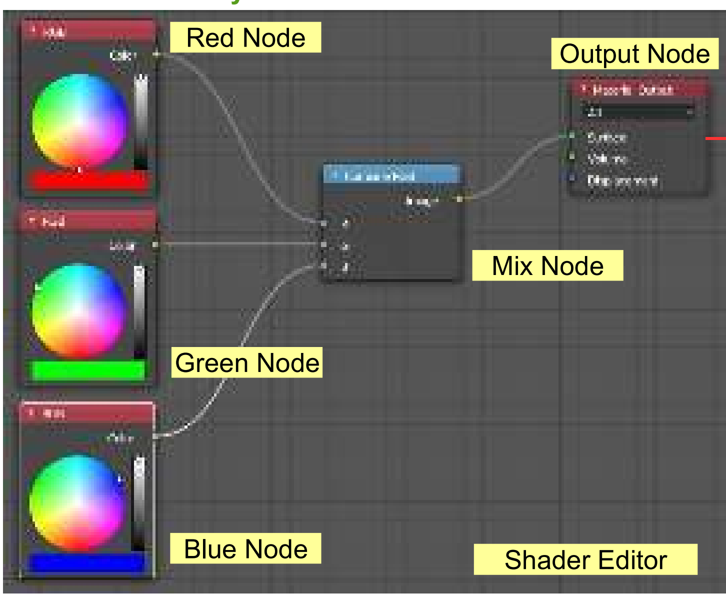
R + G + B = White

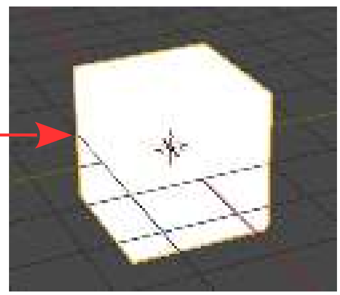




The Blender Node system looks like this:

Figure 16.17





3D Viewport Editor
The Cube is the selected Object

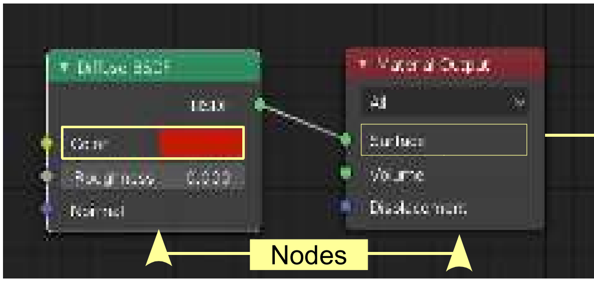
A simple Node arrangement Figure 16.18.

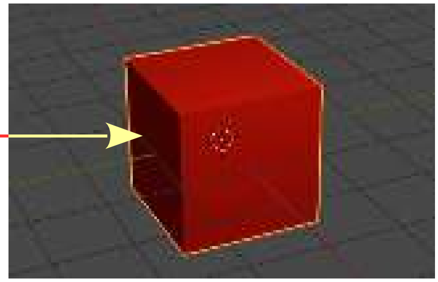
Computer Code

```
shader simple_material(
   color Diffuse_Color = color(0.6, 0.8, 0.6),
   float Noise_Factor = 0.5,
   output closure color BSDF = diffuse(N))
{
   color material_color = Diffuse_Color * mix(1.0, noise(P * 10.0), Noise_Factor);
   BSDF = material_color * diffuse(N);
}
```

Text Editor

Computer Code written in **Python**, is represented by the **Diffuse BSDF Node**, which outputs data to the **Material Output Node.** This in turn applies Material (color) to the surface of the **Cube** Object in the 3D Viewport Editor.





Shader Editor Figure 16.18 **3D Viewport Editor**

16.5 Accessing and Viewing Node Effects

To view Node effects it is advantageous to have an Object with a nice smooth surface.

Start over with a new Blender file. Delete the default Cube and replace it with a UV Sphere. Scale the UV Sphere down in the Z Axis forming a flat disk and set Shading Smooth (3D Viewport Editor Header in Object Mode – Click Object – Click Shade Smooth in the menu).

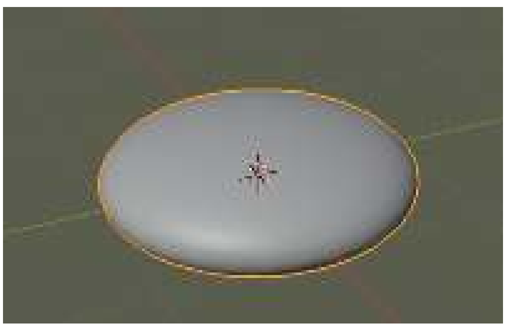


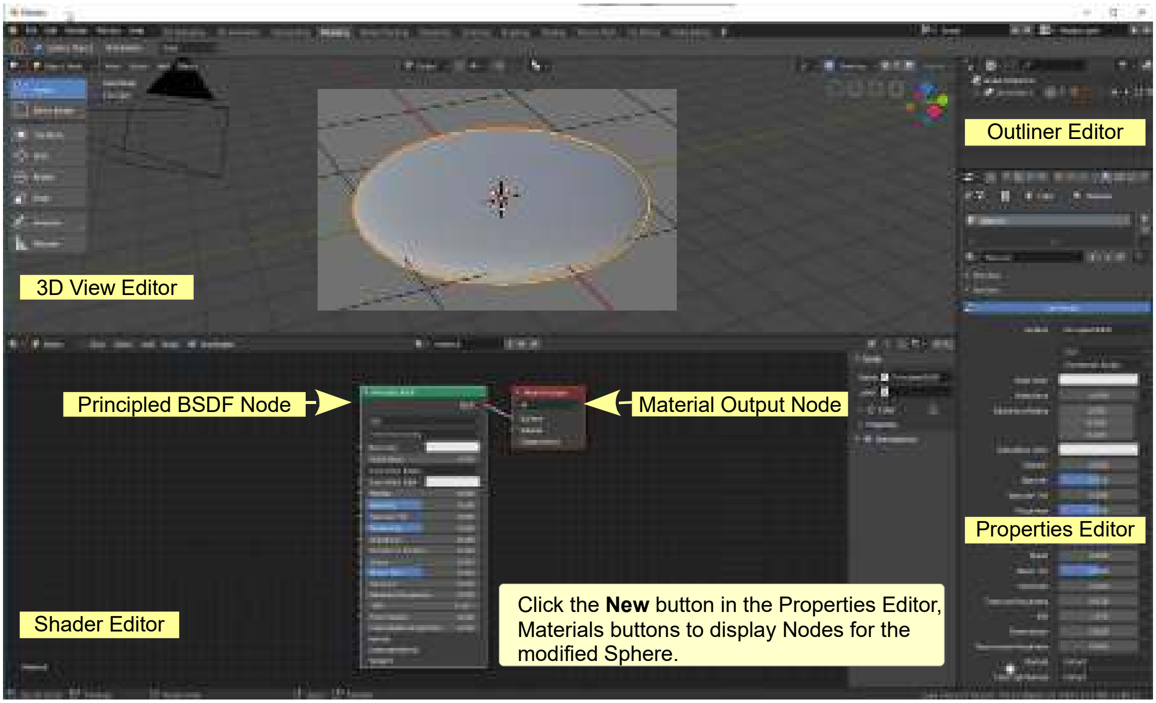
Figure 16.19

It is also advantageous to have the Scene adequately illuminated. Set the Scene lighting similar to that described in Chapter 15 Figure 15.26. You may also position a ground Plane below the modified Sphere.

Nodes are accessed in the **Shader Editor**. You could change the 3D Viewport Editor to the Shader Editor but it is advantageous to have both Editors displayed at the same time allowing you to see the effect in the 3D Viewport Editor as you compile a Node Arrangement.

To work with Nodes divide the 3D Viewport Editor in two, horizontally and make the lower half the **Shader Editor** (Figure 16.20). Having both Editors displayed allows you to see changes to Objects in the Scene as adjustments are made via the Nodes.

Figure 16.20



In the new Scene with the flat disk selected go to the Material buttons in the Properties Editor and click **New**. Before clicking **New** the Shader Editor will be empty.

> **Note:** If you open the Shader Editor with the default Cube Object selected in the 3D Viewport Editor, Nodes are displayed which control the Material color for the Cube. This occurs since the default Cube has a Material pre-applied (default Gray).

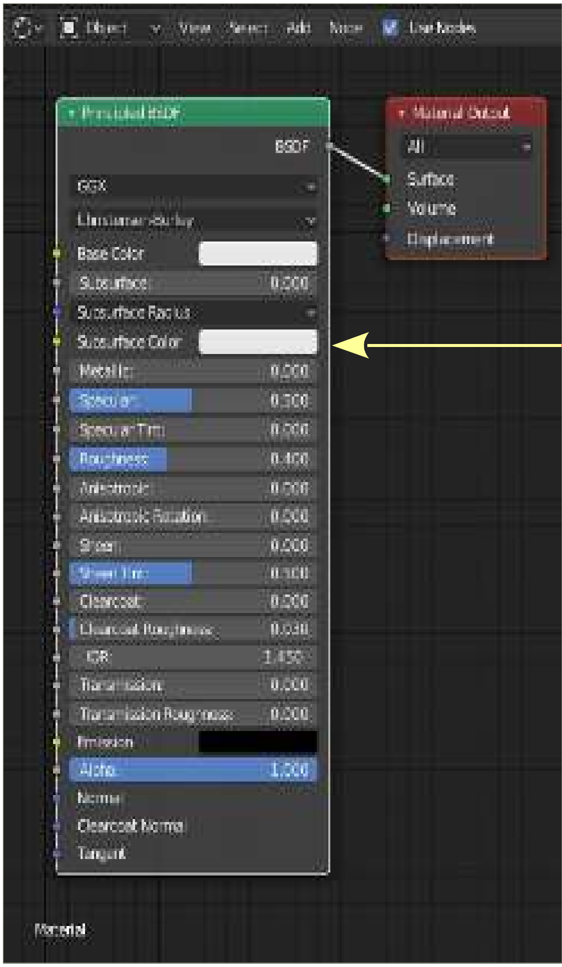
The Material buttons display with **Use Nodes** highlighted blue indicating that the Node System is active. In the **Shader Editor** two rectangles are displayed, one labelled **Principled BSDF** and the other **Material Output**. The rectangles are the Nodes. (zoom in – scroll MMB or press plus + or minus – on the Keyboard. You may also click MMB, hold and drag the Mouse to pan the view.)

Note: The **Principled BSDF Node** is not typical of all Nodes. This Node is what you might call a Super Node when you compare it with the **Diffuse BSDF Node** shown in Figure 16.18. It is shown here since it is displayed by default when Nodes are activated by clicking **Use Nodes** in the **Properties Editor**.

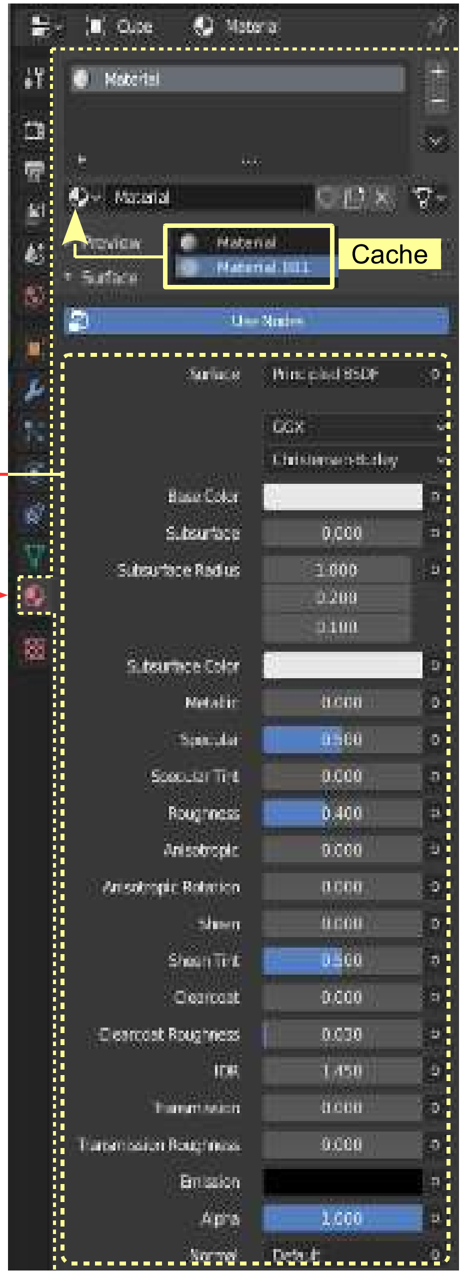
Note: The Principled BSDF Node displays values and controls identical to the controls in the Properties Editor, Material buttons when the Node System is active (Figure 16.21 - over).

Compare the Principled BSDF Node to the content of the Properties Editor, Material buttons. You will see that the controls are identical.

Nodes in the Shader Editor Figure 16.21



Properties Editor Material Buttons

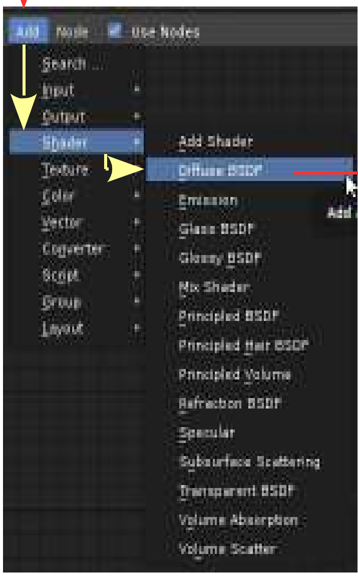


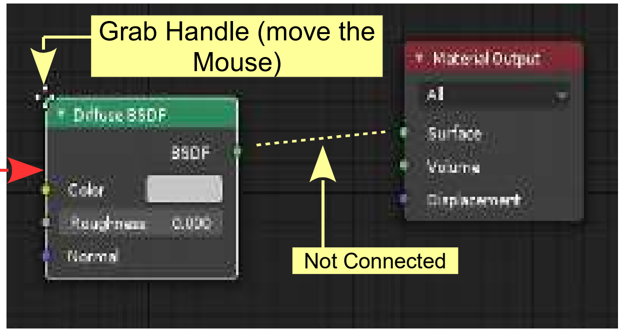
Note: The Material Button is in the vertical column at the side of the Properties Editor.

To simplify the introduction to Nodes replace the Principled BSDF Node with the **Diffuse BSDF Node**. With the Mouse Cursor in the **Shader Editor**, press Alt + A Key on the Keyboard to deselect both Nodes. LMB click on a blank part of the Principled BSDF Node. The outline of the Node will display white. Press the **X Key** on the Keyboard to delete. Only the Material Output Node remains.

In the **<u>Shader Editor Header</u>** click **<u>Add</u>**, then navigate the menu that displays and click on **Diffuse BSDF**. **Note:** You may alternatively press **Shift + A Key**

Figure 16.22





The Diffuse BSDF Node displays in the Shader Editor with a **Grab Handle** attached which follows Mouse movement allowing you to position the Node in the Editor. LMB click to set in position. The handle is cancelled.

To adjust the position LMB click and hold on the Node (Grab Handle reappears) hold and drag the Mouse. Release.

The purpose of the **Diffuse BSDF Node** is to add a Diffuse Material (color) to the surface of the Object selected in the 3D Viewport Editor. To achieve this it has to be connected to the Material Output Node. At this point the Diffuse BSDF Node is not connected (Figure 16.22). To connect, click LMB on the green dot at the RHS of the Node, hold the Mouse button down and drag over to the green dot next to Surface at the LHS of the Material Output Node. Release the Mouse button to connect the Nodes (Figure 16.23 - 24). The connecting line is called a **Noodle**. The green dots are called **Sockets**.

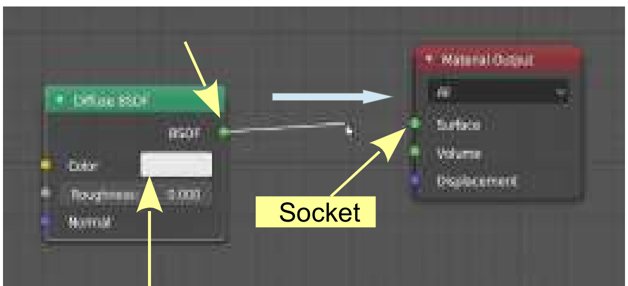
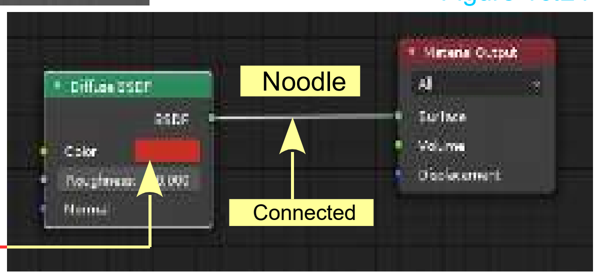


Figure 16.23

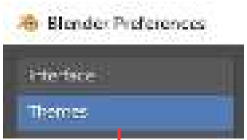
Figure 16.24



Note: Clicking the Color bar in the Diffuse BSDF Node displays the color picker allowing you to change the surface color of the selected Object.

16.6 Noodle Curving

Note: The Shader Editor is sometimes called the **Node Editor**



The default Noodle is drawn as a Straight line connecting Sockets. You may adjust the curve between 0 (straight line) or 10 in the **Preferences Editor** (Chapter 2 – 2.17). Go to **Themes - Node Editor** and scroll down to **Noodle curving** and adjust the value.

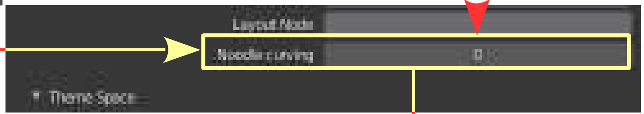
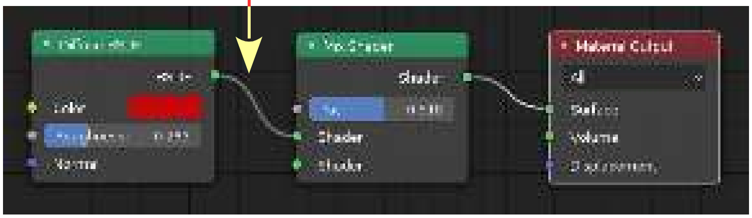


Figure 16.25

When Noodles are drawn they have a nice curve leading out and into the Sockets. This is purely a matter of preference and how much curve is up to you.



16.7 The Shader Editor

Examine the content of the **Shader Editor Header**. The buttons generally display selection menus which, by and large, are self explanatory. One button of note is the **View button** with the **Toggle Sidebar (N)** and **Toggle Tool Shelf (T)** entries in the menu (Toggle display On / Off).

The **Sidebar** is the panel at the RHS of the Editor with Tabs for displaying information about the Item (the selected Node), the selected Tool, the View and Options.

The Tool Shelf displays (press T Key) at the LHS of the Editor and contains three Tools; click to select (highlight blue).

Figure 16.26

Selection Box – Click in the Editor, drag a selection rectangle around Nodes to select.

Annotation – Click LMB and hold to see Annotation Tool options.

Link Cut

Click LMB, the Cursor becomes a Knife, drag across a Noodle to disconnect.

Click LMB, hold and drag to draw Notes.

Click LMB, hold and drag to draw a straight line.

Click LMB, hold and drag to draw a line. Click LMB a second time to create a connected line.

Click LMB, drag cursor Circle over a stroke to delete.

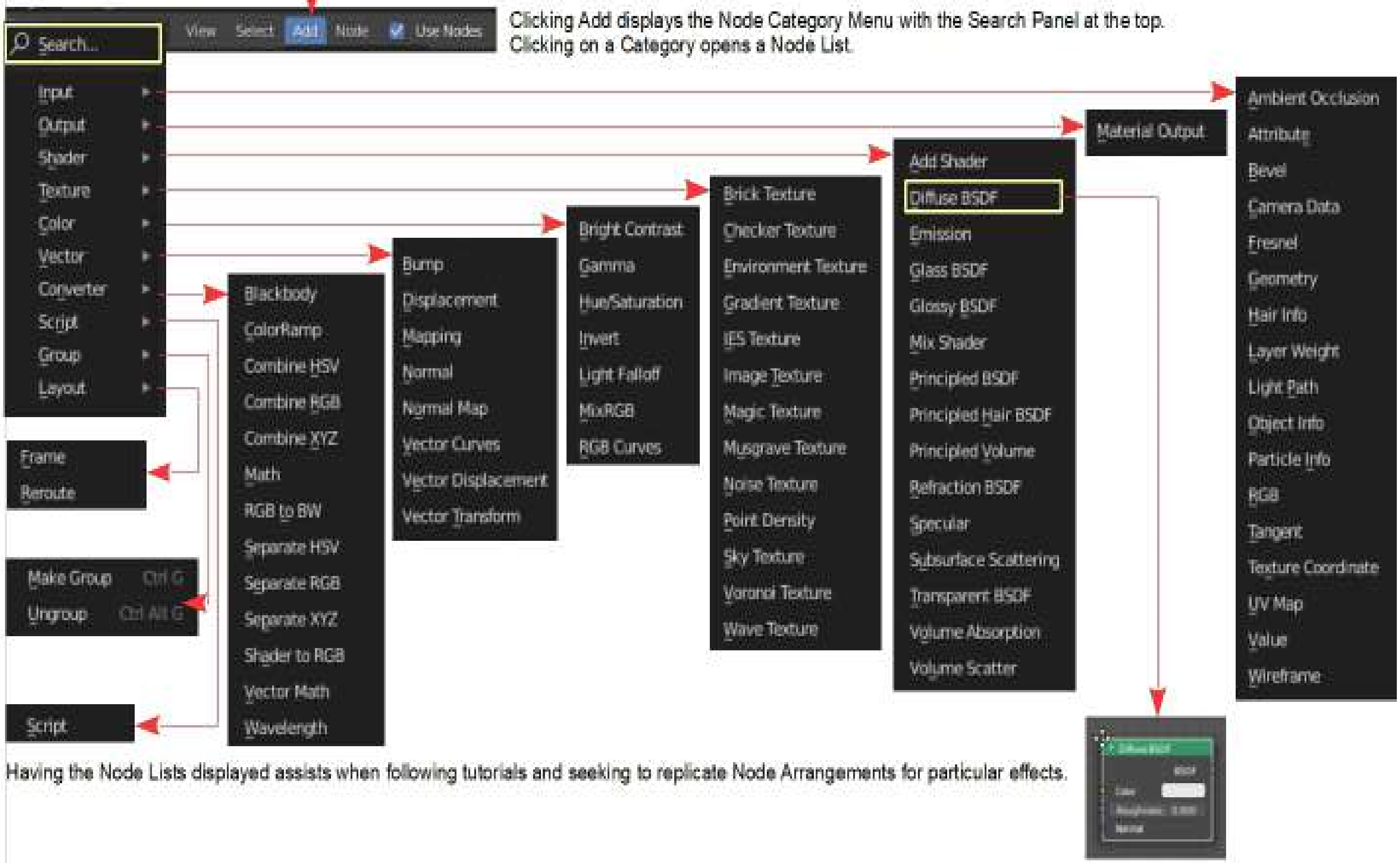
The Add Menu (See Adding Nodes following - Figure 16.27 - opposit)

Node Selection Menu

Figure 16.26

To add a Node click the **Add** button

Clicking Add displays the Node Category Menu with the Search Panel at the top.
Clicking on a Category opens a Node List.



Having the Node Lists displayed assists when following tutorials and seeking to replicate Node Arrangements for particular effects.

To Add a Node into the Editor click on the Node Name. Clicking On **Diffuse BSDF** in Shader Category enters the Node into the Shader Editor. While the Node is selected you position it to suit the Node Arrangement.

Adding Nodes

Figure 16.22 introduced the procedure for adding Nodes into the Editor by demonstrating entering a Diffuse BSDF Node. Clicking the **Add button** in the Shader Editor Header opens a category list where you select a category to display the relevant Nodes. The categories assist when you are conversant with the function of each Node and how to arrange them to produce an effect. Knowing which Node to select and how to connect comes from experience which in the beginning is gained by following tutorials and copying and experimenting. In practical terms the Add button in the Shader Editor Header is the gateway to the maze of Nodes. When following tutorials you find a particular Node by either entering the name of the Node in the search panel at the top of the Category list or by navigating through the different categories.

Figure 16.27 on the preceding page displays the different categories which will assist in your search.

Becoming proficient in the use of Nodes comes with a certain amount of experimentation and organisation. When you have created a Node arrangement which produces a result, save it in a Blender file for future use. You may wish to use it again in another project or use it as a starting point for further development.

16.8 The Shading Workspace

You may arrange the Blender Screen as previously described in 16.5 and shown in Figure 16.20 or alternatively activate the **Shading Workspace** in the Screen Header.

Figure 16.28

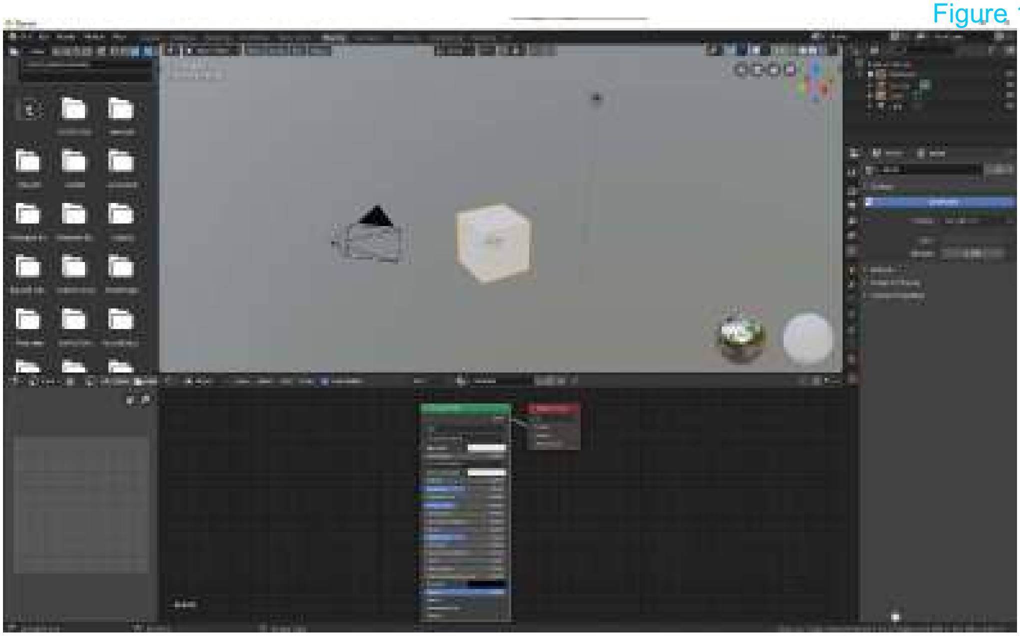


Figure 16.29

The Shading Workspace displays with six Editors forming a working environment for working with Nodes. At this stage it is suggested you stick with the Screen Arrangement as shown in Figure 16.20.

16.9 Scene Arrangements

Before trying examples of Node Arrangements set up a Scene as previously described, with a smooth UV Sphere scaled down on the Z Axis forming a flat disc. Have the disc sitting above a Plane and place Lamps similar to those in Chapter 15 – 15.7 (Basic Scene Lighting). Have the 3D View Editor in Camera View with LookDev Viewport Shading and Scene Lights checked in the Options. Alternatively be in Rendered Viewport Shading Mode.

To understand how Nodes operate replicate the Node arrangements in the following examples.

16.10 Mixing Material Example

With the Node arrangement in Figure 16.30 two Material colors (red and blue) may be mixed together. The colors for mixing are selected in the **Diffuse BSDF** Nodes and mixed by adjusting the Factor slider in the **Mix Shader** Node.

In this instance the Nodes are found in the **Add menu** in the **Shader** category.

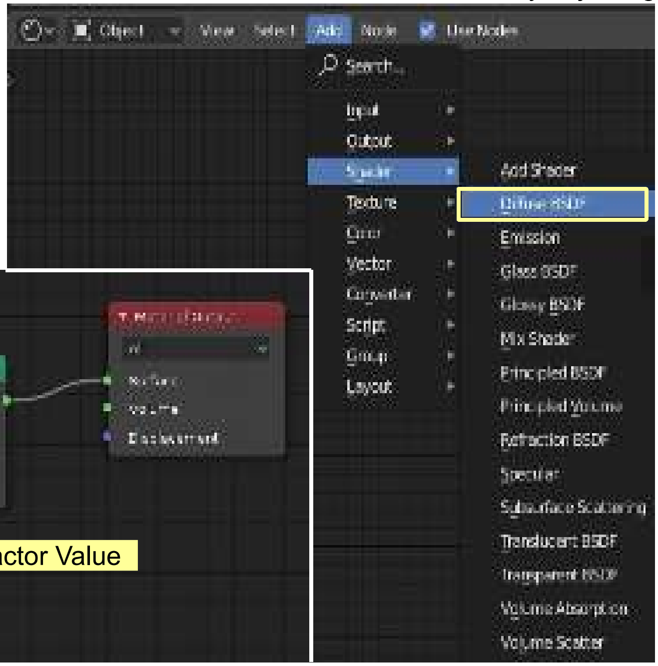
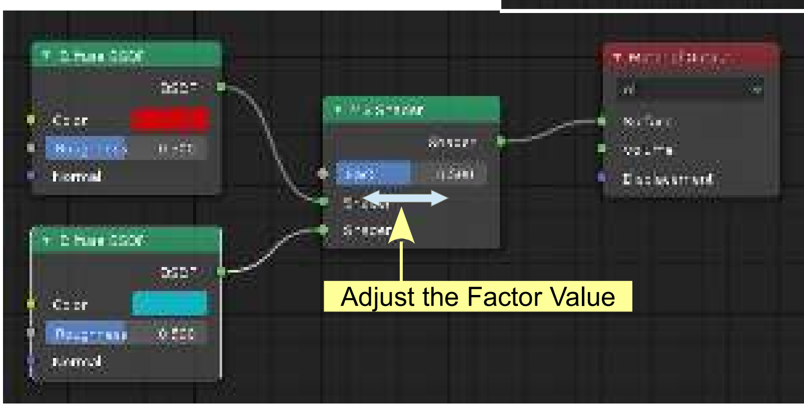
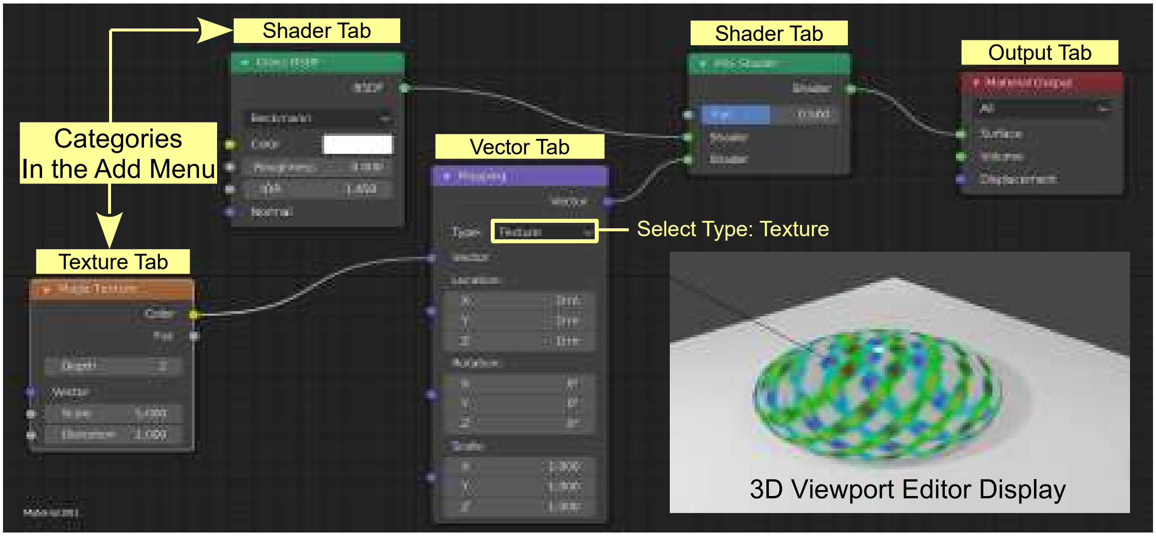


Figure 16.30



16.11 Simple Node Arrangement

Figure 16.31



With the Node arrangement shown in Figure 16.31 the disk takes on a **Magic Texture** which is one of Blenders procedural or in built **Textures** and at the same time is given the look of glass by the **Glass BSDF** Node. The Nodes are accessed from the Shader Editor, Add Menu.

By **deselecting the Disk** (UV Sphere flattened) and selecting the Plane, then **applying the following Nodes to the Plane**, the disk sits above a Textured surface.

Note: In the 3D Viewport Editor be in Material Preview or Rendered Viewport Shading Mode.

Image Texture Node
Click **Open** and navigate to an image stored on your computer.

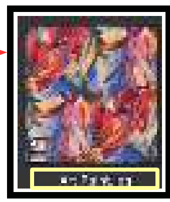
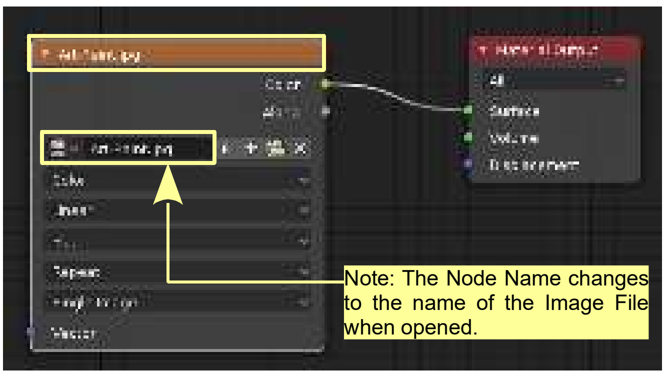
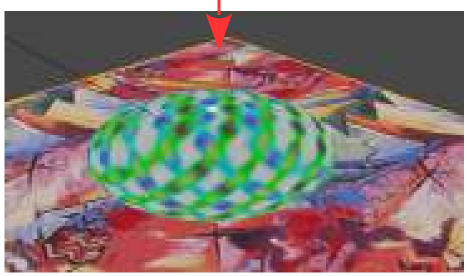


Figure 16.32





16.12 Texture Nodes

In the Simple Node Arrangement (Figures 16.31, 16.32) a Magic Texture and an Image Texture were introduced. The use of Nodes prior to this referred to the application of Materials (color). Nodes are also used to apply **Texture** to the surface of an Object which defines surface characteristics or patternation such as how lumpy or bumpy the surface appears or whether the surface is wood, gravel, bricks or glass etc.

Texture Nodes are similar to Material Nodes in that they represent code that produces the effect on the surface of an Object. Texture code is also created and stored in a Cache similar to Materials.

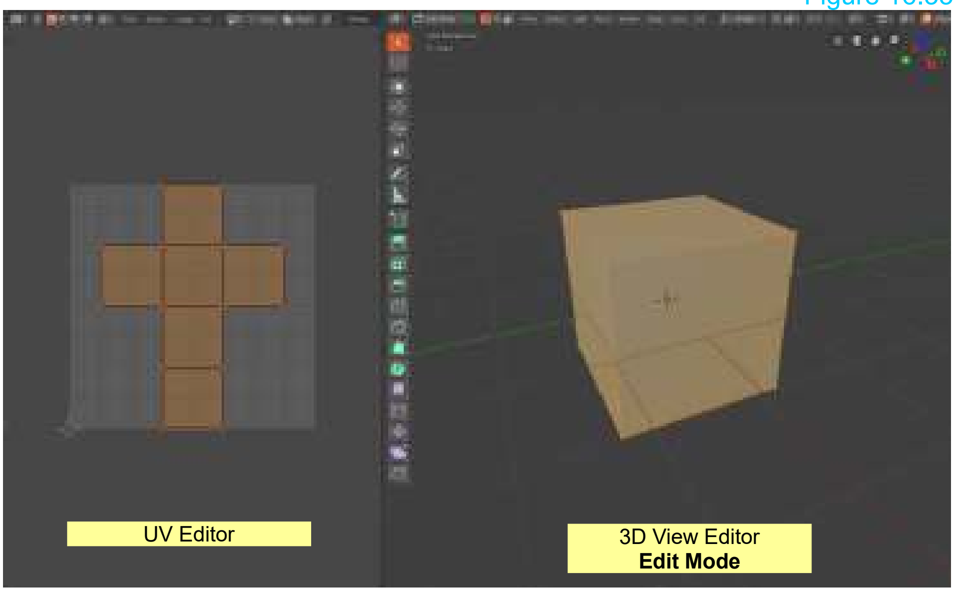
The major difference between Textures and Materials is, to make a Texture appear realistic on the surface, the surface has to be **Unwrapped** and the Texture has to be Mapped to the surface. Think of a Texture which represents the surface of the Earth being applied to a UV Sphere. The surface of the UV Sphere is Unwrapped (laid out flat as if you carefully pealed an orange and laid the skin flat) then the Texture is mapped to (overlaid in the flat surface) such that when the peel is put back on the orange it looks like the Earth as viewed from Space.

Note: In Figure 16.32 no action was performed to Unwrap the surface but, in fact, Blender automatically performed the operation.

16.13 Unwrapping a Surface

To demonstrate Unwrapping use the default Cube Object. Divide the 3D Viewport Editor in two and make one half the **UV Editor** (Figure 16.33).

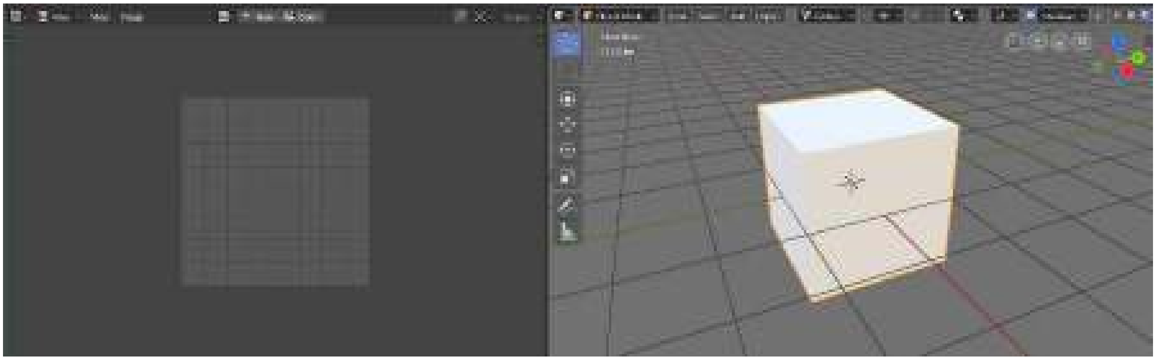
Figure 16.33



With the 3D Viewport, in Edit Mode, the Cube is shown with its Faces laid flat in the UV Editor.

With the 3D Viewport in Object Mode with the Cube selected and the UV Editor is empty (Figure 16.34).

Figure 16.34



In Edit Mode the Cube is automatically **Unwrapped**. The Unwrapped profile has Vertices, Edges and Faces which may be selected and deselected, Translated, Rotated and Scaled as you would in the 3D Viewport Editor in Edit Mode. You will see **selection Mode buttons** in the **UV Editor Header** (Figure 16.35).

Figure 16.35

Vertex, Edge, Face, Island

Figure 16.36 shows the Unwrapped Cube selected (press the A Key) and Rotated (R Key).

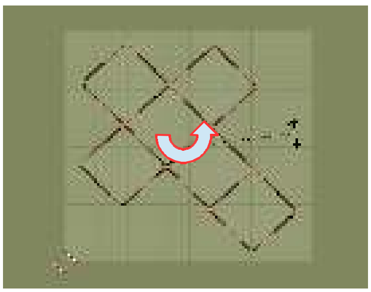
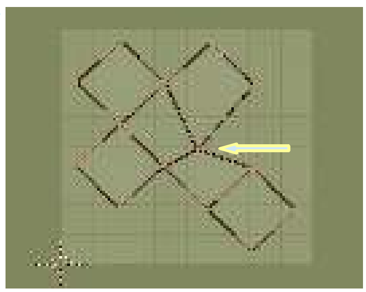


Figure 16.36

Figure 16.37

Figure 16.37 shows a Vertex selected and Translated.

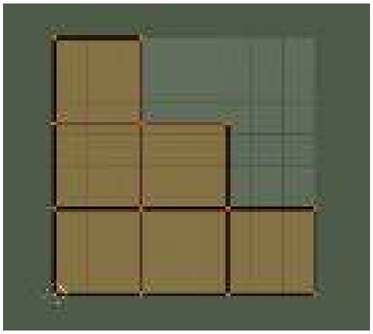


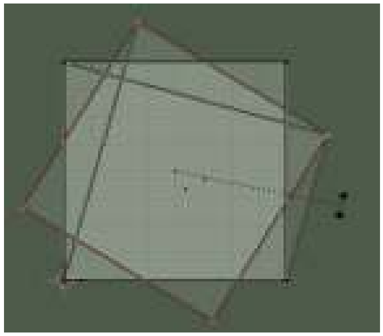
The automatic Unwrapping may be considered as Simple Unwrapping which is one of several methods. Alternative methods are found in the **3D Viewport Editor Header** (in Edit Mode) **UV button**.

Which Projection method is used depends on how you want a Texture to be displayed.

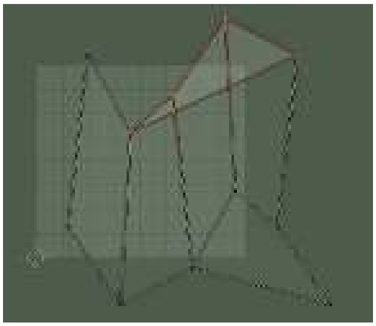
Figure 16.38

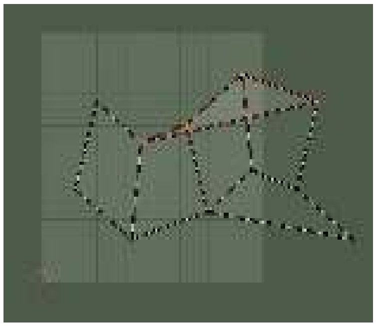
3D Viewport Editor UV Button Projection Options

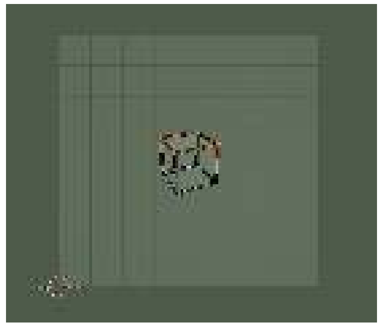




Smart UV Project Figure 16.39 Cube Project





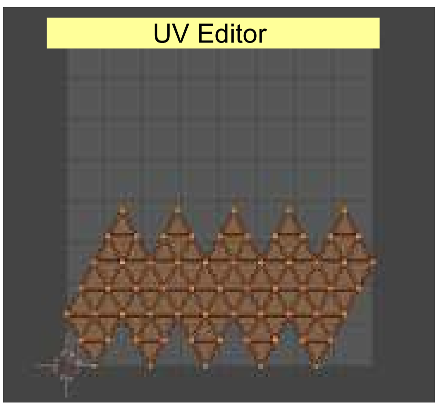


Cylinder Project Sphere Project Project from View

16.14 Unwrapping with Seams

Mesh Objects may also be Unwrapped by selecting Edges and marking as Seams.

Figure 16.40



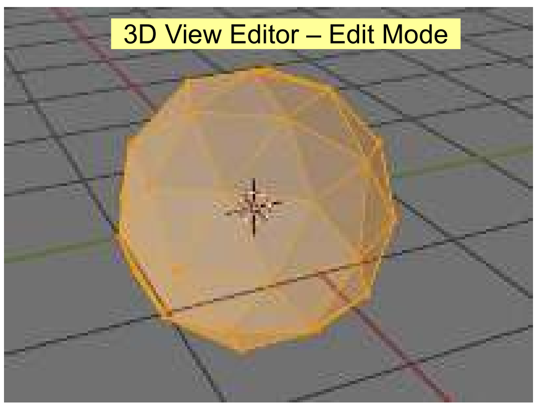
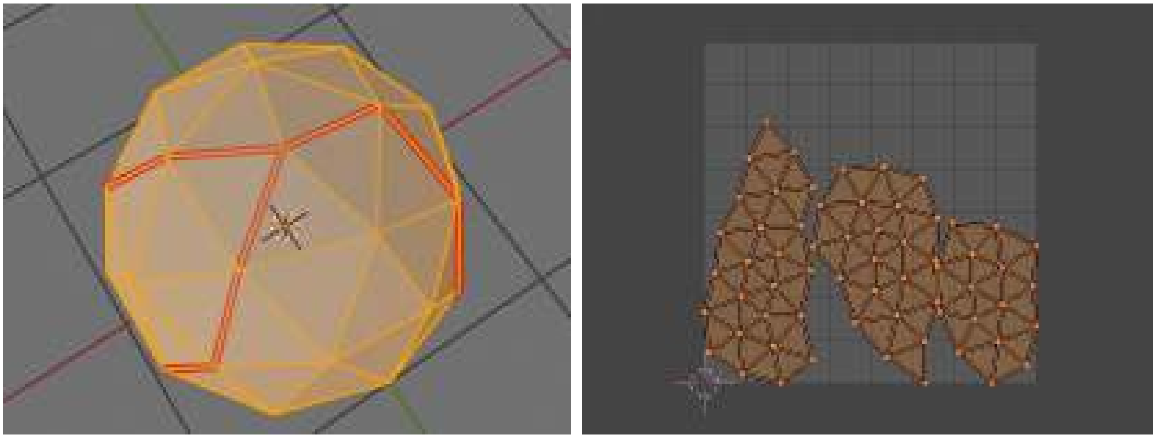


Figure16.40 shows an **Ico Sphere** selected and automatically unwrapped.

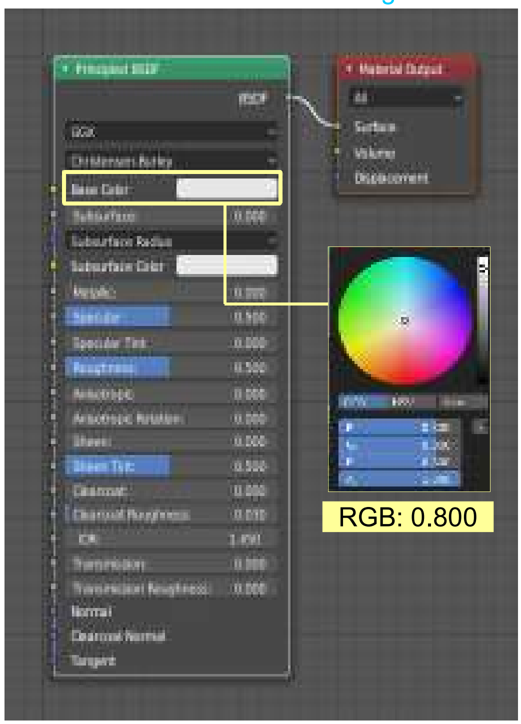
To Mark Seams, have the Ico Sphere in the 3D Viewport Editor in Edit Mode with **Edge Select** active. Deselect all Edges, then shift select individual Edges while rotating the View, dividing the surface into three sections. With the Edges selected click **Mark Seams** from the menu that displays when you click the **UV button** in Header. The selected Edges change color indicating that they are now **Seams**. Press the **A Key to select all the Edges**. From the UV button in the Header menu click **Unwrap**. The Unwrapped sections are displayed in the UV Editor.



Seams Marked – All Edges Selected Figure 16.41 Sections Unwrapped in the UV Editor

16.15 Applying a Texture

Figure 16.42



In the previous examples of Simple Node Arrangements, Textures were shown applied to the surface of an Object. The fact that the Textures were able to be applied was due to the Automatic Unwrapping of the Object's surface. To apply a Texture there are two prerequisites; the surface must be Unwrapped and a Material has to be applied.

To demonstrate, continue with the Unwrapped Icosphere.

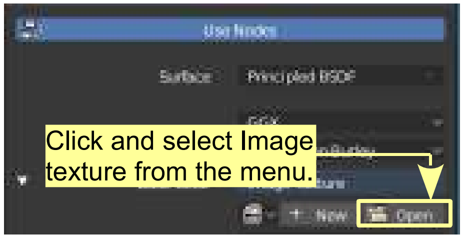
The Ico Sphere was a new Object added to the Scene, therefore, it has no Material applied. In the Properties Editor, Material buttons click **New** to add a Material. By default the material is the default gray color.

In the Shader Editor you will see the Principled BSDF Node connected to a Material Output Node. The Base Color in the Principled BSDF Node is the default gray, RGB values all 0.800 (Figure 16.42).

In Figure 16.21 the similarities between the Principled BSDF Node and the Materials button with Use Nodes active were pointed out. Herein lies two methods of introducing a Texture.

Method 1: In the **Shader Editor** select an **Image Texture Node** from the Add Menu. In the demonstration an Image Texture will be used.

Material Buttons



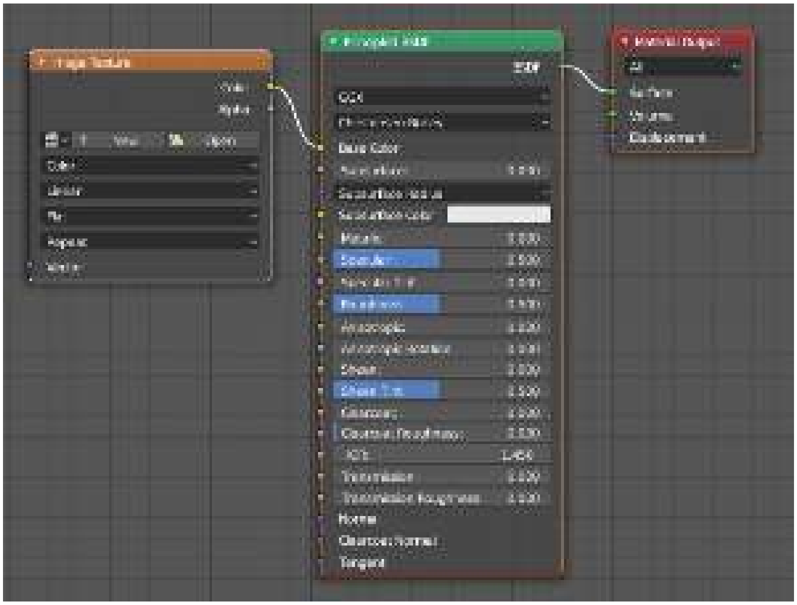
Method 2: In the **Properties Editor, Material buttons**, with Use Nodes active, click on the button at the end of the Base Color bar and select Image Texture from the menu.

Figure 16.43

In using Method 2, the Image Texture Node is automatically entered in the Shader Editor and connected to the Principled BSDF Node. With Method 1 you have to position the Node and manually connect.

> **Note:** When a new Object is added to a Scene in the 3D Viewport Editor it is automatically unwrapped.
>
> The unwrapping displays in the UV Editor when the Object is in Edit Mode in the 3D Viewport Editor.
>
> By default the Unwrapping Method is **Angle Based**.
>
> Alternative Unwrapping Methods are found by clicking **UV** in the 3D Viewport Editor Header.

Figure 16.44

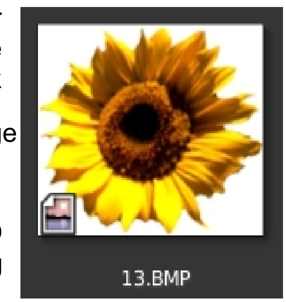


With an Image Texture Node you have to open an image saved on your computer to be used as the Texture. Click Open in the Node (or in the Materials Buttons) navigate in the File Browser and select an image. Click Open in the Upper RH corner of the File Browser.

See Chapter 03-3.6 Navigation

Selected Image File

Figure 16.45



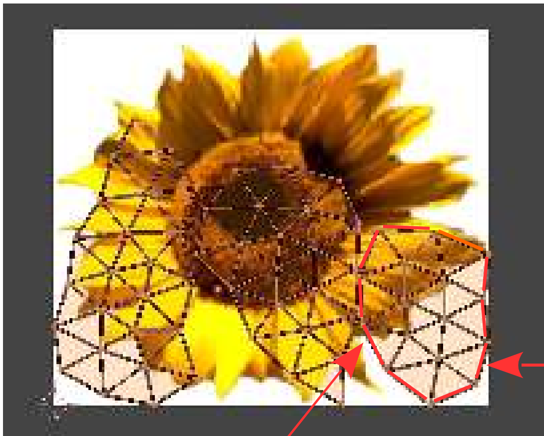
Important: To see the image Mapped to the Icosphere make sure the 3D View Editor is in **Material Preview** or **Rendered Viewport Shading** Mode.

To position the Texture on the Object's surface (The Ico Sphere) open the same Image File in the UV Editor by clicking Open in the Header and navigating to the file.

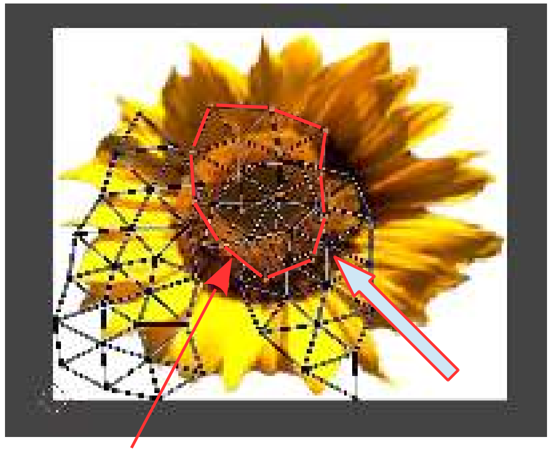
16.16 Mapping to a Surface

In the UV Editor you may select part of the Unwrapping and position it in the image to have that part displayed on the corresponding Faces in the 3D Viewport Editor. Click UV in the Header (Edit Mode) and select– Show/Hide Faces to display the unwrapped surface.

Figure 16.46

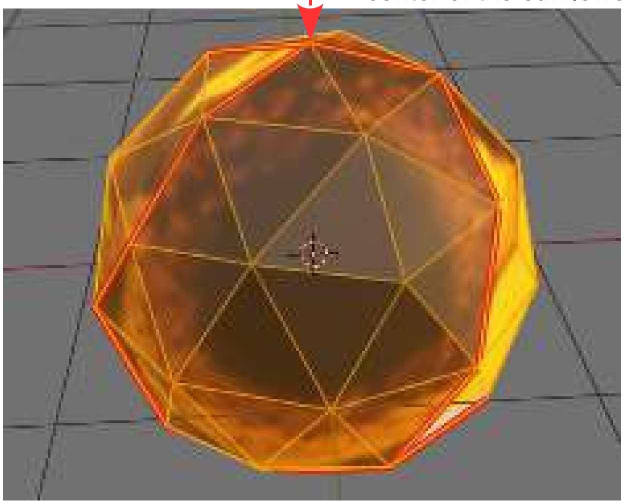


Part of Unwrapping Selected in UV Editor



Part Translated positioning over the dark center of the sunflower.

Figure 16.47



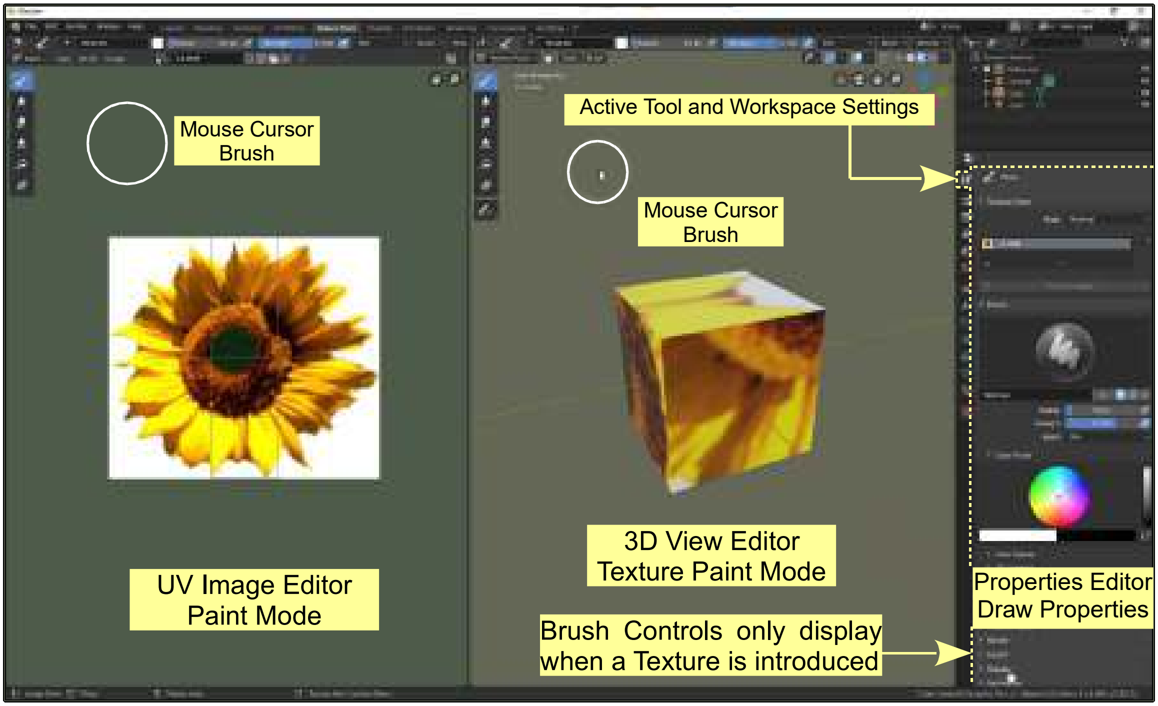
Rotating the view in the 3D Viewport Editor shows the dark center of the sunflower inside the Unwrapped selection.

16.17 Texture Painting

Texture Painting allows you to paint or draw, modifying a Texture that has been Mapped to the surface of an Object. The following procedure will provide a basic introduction showing controls.

Have the default Cube Object in the 3D Viewport Editor with the sunflower Image Texture mapped to the surface. You could modify the Screen arrangement by changing the UV Editor from View Mode to Paint Mode and pressing the T Key to toggle the Tool Panel open but for convenience select the **Texture Paint Workspace** from Header at the top of the Screen.

Figure 16.48



The **Texture Paint Workspace** displays with the UV Editor in **Paint Mode** and the 3D Viewport Editor in **Texture Paint Mode**. The Mouse Cursor in both Editors displays as a white circle (Brush). In the Properties Editor, with the **Active Tools and Workspace Settings** button selected, Draw Properties display.

By default the Brush Radius and the Strength values are displayed in the Header.

Figure 16.49

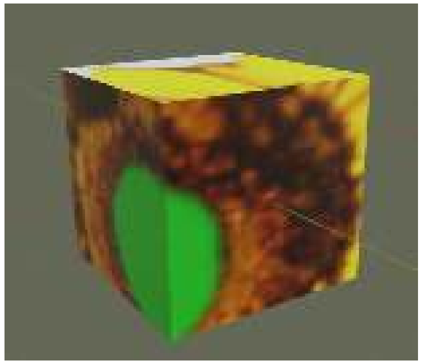
Both values allow Tablet Pressure Sensitivity

Change the 3D Viewport Editor to Object Mode (in Material Preview Shading Mode) to show the Cube with the sunflower Texture Mapped to its surface unencumbered by Edge lines. Changing to Object Mode also removes the Unwrapping from the image in the UV Image Editor.

As a quick demonstration, reduce the Brush Radius to 6 px. Click on the **Draw Tool** in the Tool Panel in the Image Editor or the 3D Viewport Editor. Click in the color button in the Header to select a Brush Color and Paint (click, hold and drag) the Mouse Cursor Circle over the image in the UV Image Editor. **Note:** You may also adjust the Brush Radius in the slider just above the color picker circle in the Properties Editor.

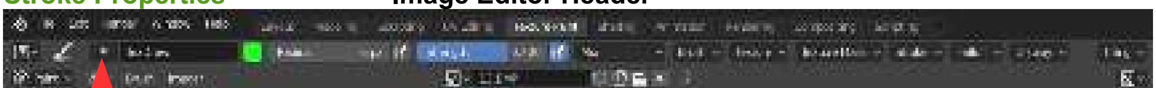
Figure 16.50

Paint applied in the UV Image Editor



Paint applied in the 3D View Editor View rotated to display the center of the sunflower.

Stroke Properties **Image Editor Header**



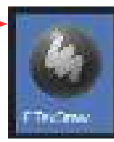
Click to see the Brush Type – F TexDraw

Properties Editor

Image Editor Tool Panel

Active Tool

Figure 16.51



There are six Brush Types available in the **Image Editor** Tool Panel at the LHS and in the **3D View Editor** in **Texture Paint Mode**.

With a Brush Type selected adjustments can be made in the **Image Editor Header** or in the **Properties Editor** with the **Active Tool** button selected.

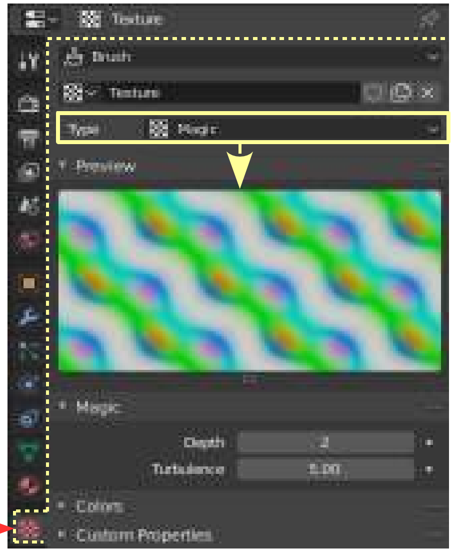
Note: When a Brush Type is selected in the Image Editor or in the 3D Viewport Editor, Brush controls display in the Properties Editor. Brush controls in the Image Editor Header and the Properties Editor are different fore each Brush Type.

Brush Controls

Texture Paint Tool Panel – Texture Tab

In the Properties Editor, Texture buttons you can select a Procedural Texture (Blender Inbuilt Texture) and paint it to the image Mapped to the Object in the 3D View Editor. The first step in this procedure is to enter the texture in the Cache.

Properties Editor (Figure 16.52) Figure 16.52



In the Properties Editor, Texture buttons, click New to open the Texture Tabs. Change Type: Image or Movie to Magic (or any of the types in the menu). Make note that in the Texture Cache the Texture named Texture displays as Type Magic.

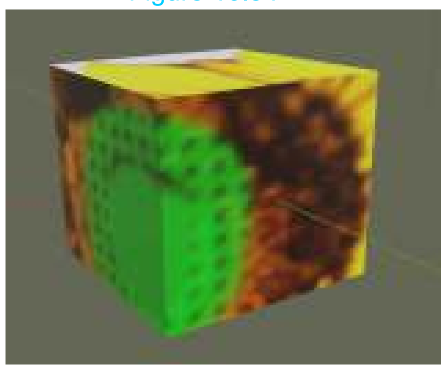
Drawing on the image in the UV Editor paints the Magic Texture (Figure 16.50) which displays in the 3D Viewport Editor **when in Object Mode** (Figure 16.53).

Texture Buttons

Figure 16.53

Magic Texture Painted in the UV Image Editor

Figure 16.54



Display in the 3D View Editor

Rember: While discussing **Texture Paint** the **Image Texture Node** has been residing in the Shader Editor connected to the **Principled BSDF Node**.

Figure 16.55

At this point the **Principled BSDF Node** has been briefly mentioned in relation to 16.5 Accessing and Viewing and 16.18 Applying Textures. As previously stated you could consider this Node as a Super Node since it has in-built properties which can be employed and connection sockets for other Nodes.

16.18 Vertex Paint

Vertex Paint tool allows you to manually paint a Material onto the surface of an Object. The tool is accessed in the 3D Viewport Editor Header by changing to **Vertex Paint Mode** (Figure 16.56).

In **Vertex Paint Mode** you will be able to paint a selected Object immediately, but before you can render an image with the paint showing, you must have a Material added and configure Nodes in the Shader Editor. Have the 3D Viewport Editor in LocDev Viewport Shading Mode.

Remember: A new Object added to the 3D View Editor displays with the default gray color, but there is no Material applied. **Apply a Material**.

As **Vertex Paint** suggests, the process involves painting vertices. The default Cube in the 3D Viewport Editor has only eight vertices, therefore, it doesn't provide much scope for a demonstration. Delete the Cube and add a **UV Sphere**. The default UV Sphere has 32 segments and 16 rings, which provides a vertex at each intersection point of the mesh. In **Edit mode** subdivide to add more vertices or alternatively, add and apply a **Subdivision Surface Modifier** to the UV Sphere.

Vertex Paint Mode

Change the 3D Viewport Editor to Vertex Paint Mode.

Figure 16.56

Click and select Vertex Paint

In the 3D Viewport Editor, in Vertex Paint Mode the Cursor has a circle attached (Figure 16.58). The circle is called the **Brush**.

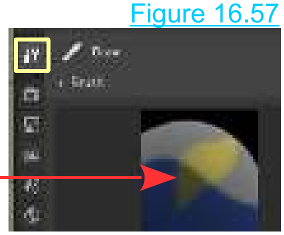
By default Vertex Paint is in **Draw Mode** as seen by the **Draw Tool** highlighted in the Tool Panel at the LH side of the Editor.

Brush Controls

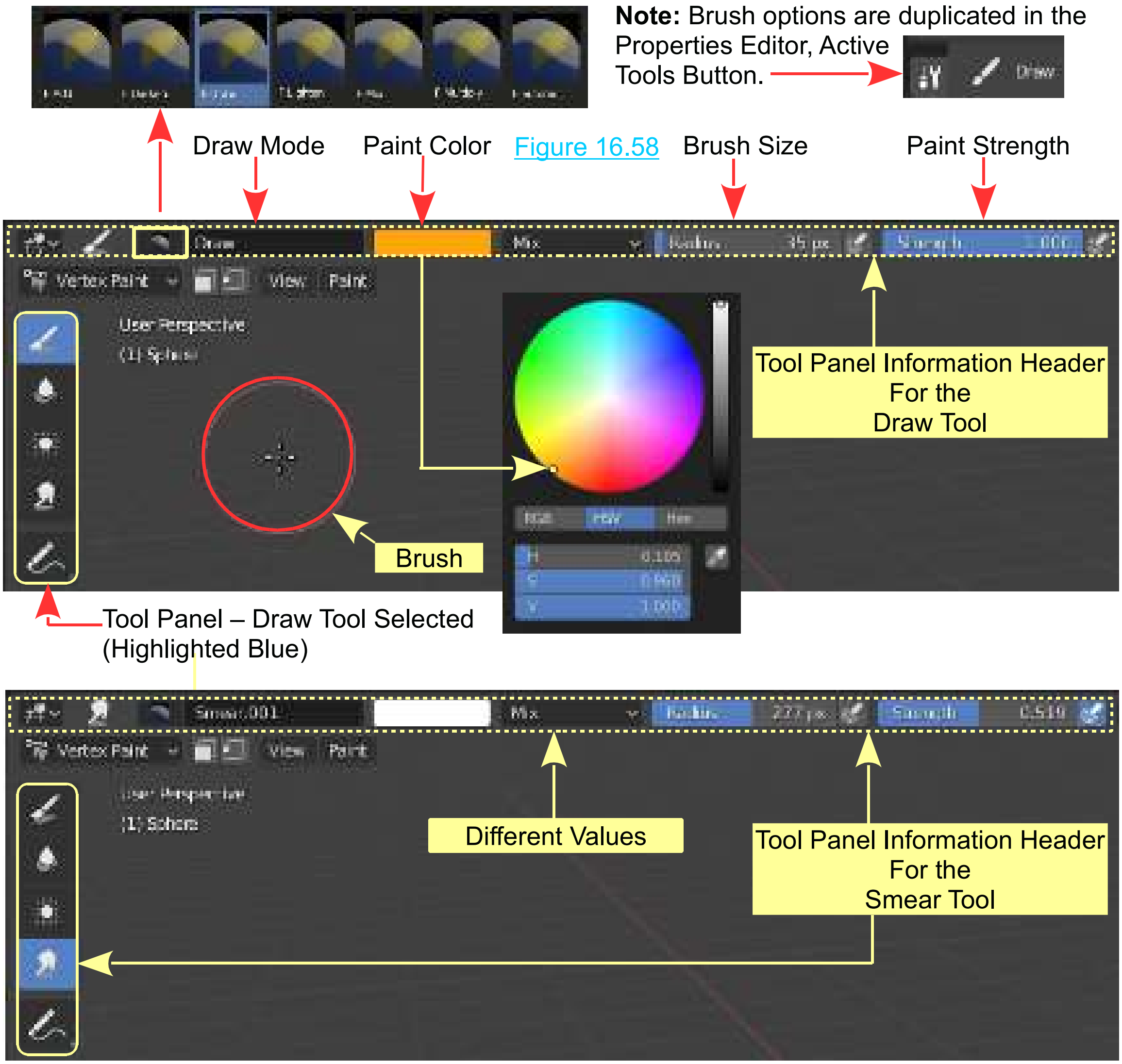
The **Bush Properties** are controlled in the **Tool Panel Information Header** which displays when **Tool Settings** is checked in the **View** Menu in the Header.

Clicking on the icon next to **Draw** in the Header displays options for a selection of **Brush Types**. These same options are duplicated in the **Properties Editor, Active Tool and Workspace Button** (Figure 16.57).

Figure 16.57



Click on the preview to display the options (Figure 16.58).



As shown above the Tool Panel Information Header displays different values depending on the Tool selected.

Note: Although the Brush Color Picker displays for all Tool Types it is only applicable to the draw tool and the Annotation Tool.

The Annotation Tool allows you to freehand draw symbols and text notation to assist in construction. This notation does not render in a final image.

Having painted vertices you will be disappointment to find that your painting also does not render.

Drawing Strokes to Render

To Draw a Stroke (Paint) on the surface of the Object simply click, hold and drag the Brush (circle) over the surface. You will be drawing on the Vertices that are in the visible surface. Rotate the Object or the Viewport to draw on the reverse side surface.

Be aware that, with the surface painted, when you revert to Object Mode or attempt to render an image **you will NOT see what has been drawn**. At this point you have to configure the Material Nodes producing the color.

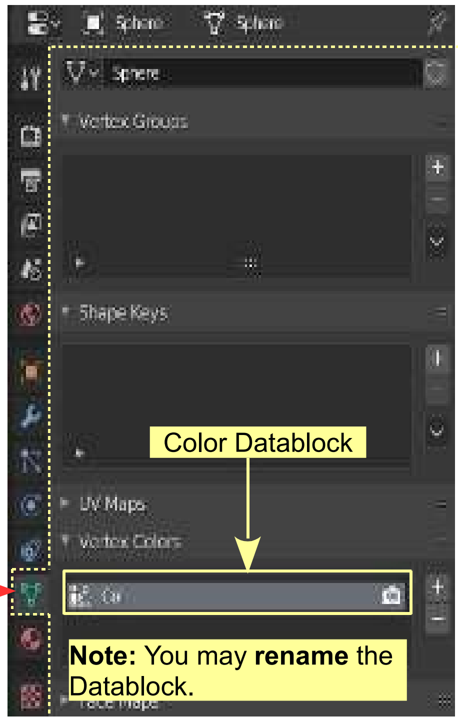
Node Configuration

If you forgot to add a Material to the Object, add one now. Default gray is fine.

Open the Shader Editor (drag the upper edge of the Timeline Editor up and change it to the Shader Editor). By default adding a Material activates the Material Node system. In the Properties Editor, Material buttons you see **Use Nodes** highlighted blue.

In the Shader Editor you will have the **Principled BSDF** Node connected to a **Material Output** Node.

Figure 16.59



In the Properties Editor, open the Object Data buttons and expand the **Vertex Colors Tab**. **Note:** The data block named **Col**.

In the Shader Editor add an **Input - Attribute Node**. Enter the name of the Vertex Colors Data Block (Col) in the Attribute Node Name panel and connect the Node to the Base Color input Socket of the Principled BSDF Node.

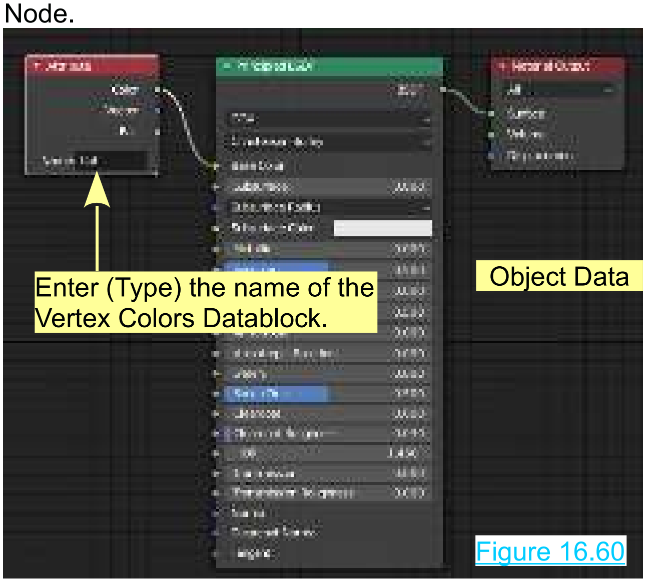


Figure 16.60

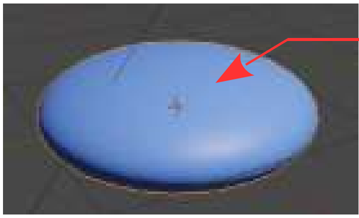
With the Nodes configured as shown Vertex Color Paint will be visible in Object Mode and in Material Preview and Renderd Viewport Shading Modes

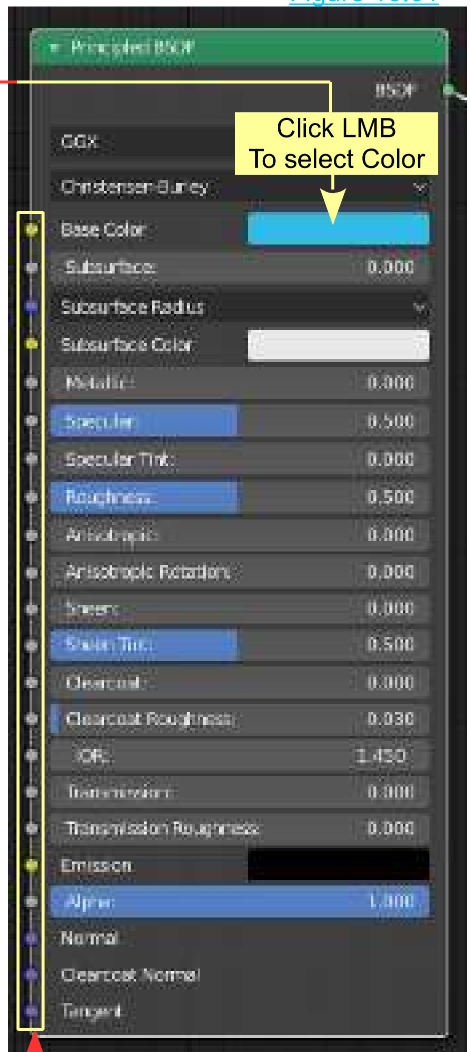
16.19 The Principled BSDF Node

When discussing Material Nodes 16.5 the comparison was made between the **Principled BSDF Node** which displays in the Shader Editor and the controls in the Properties Editor, Materials buttons (Figure 16.21). In effect the controls are identical in both cases.

Figure 16.61 shows the **Principled BSDF Node** in the **Shader Editor** listing some of the functions contained in the Node.

Figure 16.61





Base Color: The Material color of the selected Object in the 3D Viewport Editor.

Subsurface: Controls how much light shines through translucent substances e.g. wax.

Metallic: Defines weather the Object appears Metallic (1.000) or Non Metallic (0.000).

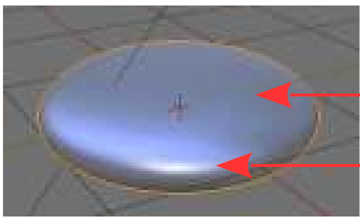


Figure 16.62

Specular: Controls the amount of Specular Reflection (shiny highlights on smooth rounded corners).

Specular Tint: Uses some of the Base Color in highlights.

Roughness: Controls how blurry or sharp reflections are.

Clearcoat: Produces extra layers of gloss, like car paint.

IOR: Transmission factor for Glass materials

Node Connection Sockets

With the Principled BSDF Node connected to the Material Output Node in the Shader Editor, adjusting controls (sliders) in the Node, affects the surface appearance of the selected Object in the 3D Viewport Editor.

The controls for the **Principled BSDF Node** are replicated in the **Properties Editor, Materials buttons**.

Additional Nodes may be selected and automatically connected to the Principled BSDF Node in the **Properties Editor.**

Figure 16.63

For example; Clicking LMB on the button at the RH end of the Base Color bar displays a Node selection menu.

Selecting **Magic Texture** in the menu automatically connects the **Magic Texture Node** to the **Base Color** input socket of the Principled BSDF Node (Figure 16.64).

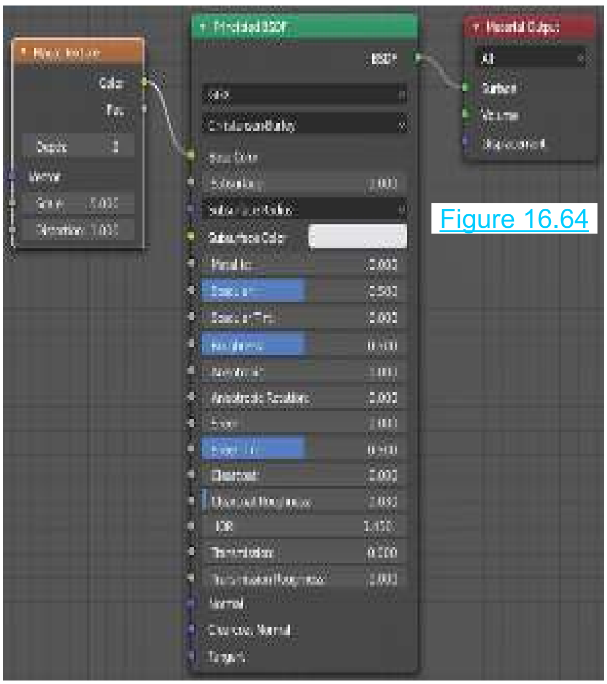


Figure 16.64

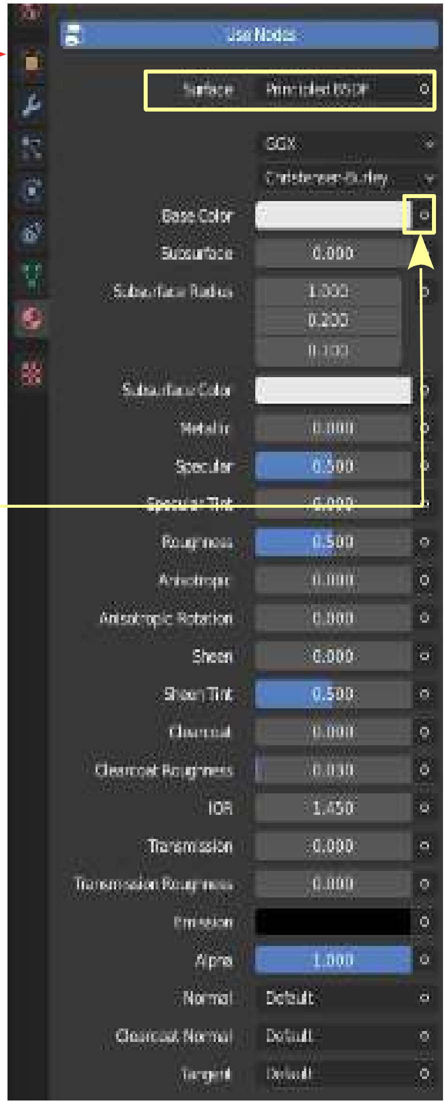
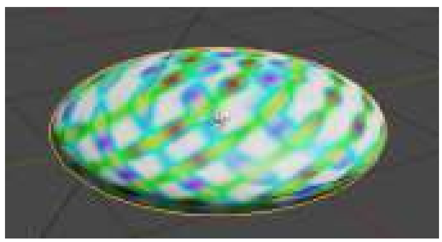


Figure 16.65



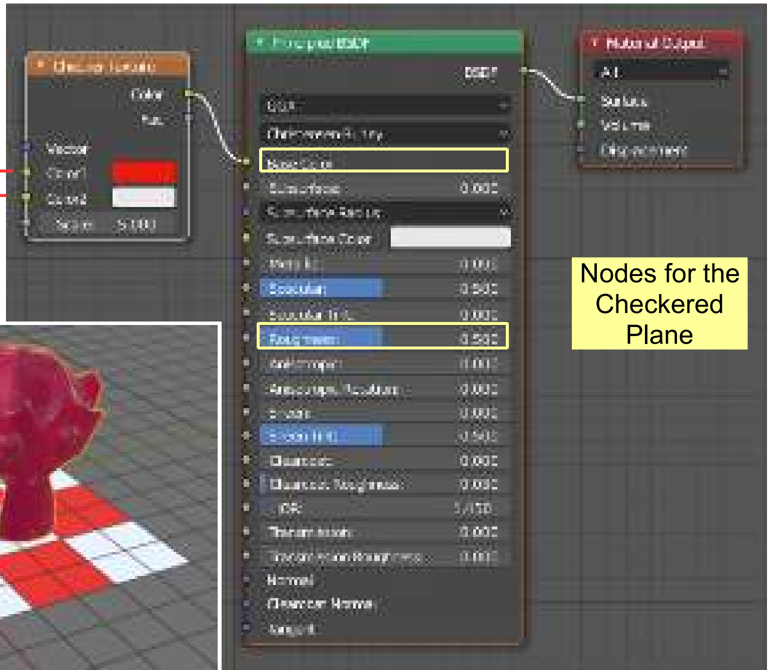
The selected Object in the 3D Viewport Editor displays with the Magic Texture applied **in Material Preview Viewport Shading Mode**.

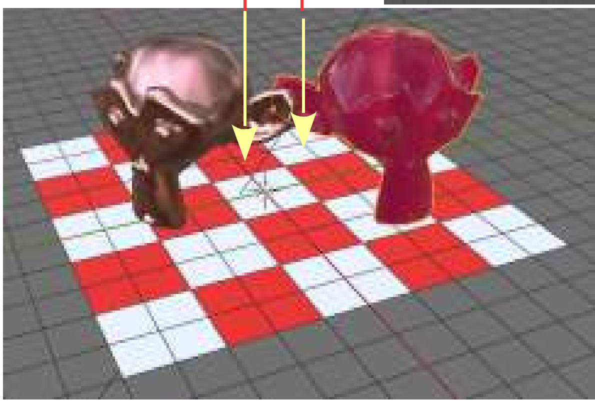
16.20 Quick Example using BSDF

Figure 16.66

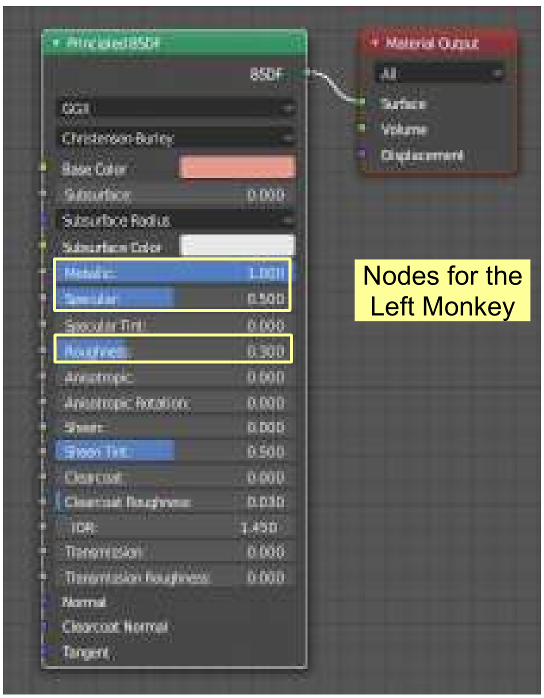
Principled BSDF Nodes for two Monkeys and a Plane.

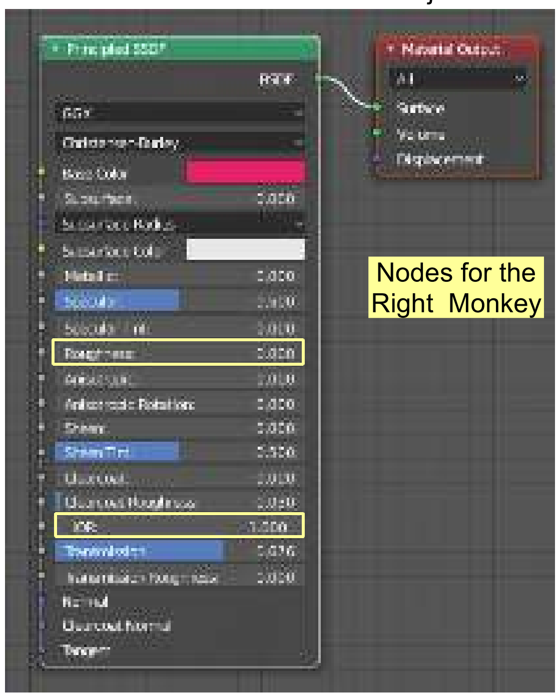
Remember: Selecting an Object displays Nodes for that Object.





Arrange the Scene and experiment with the controls in the Nodes for each Object

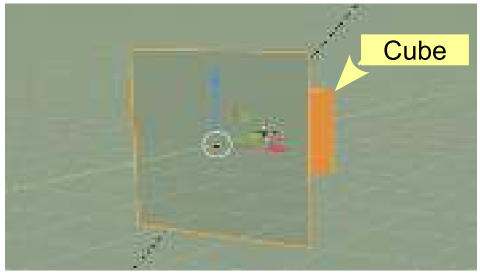




16.21 Transparency Using Nodes

To demonstrate Transparency a Plane Object will be turned into a pane of glass. Add a Plane to the default Blender Scene. Stand the Plane on edge and position in front of the default Cube. Give the Cube a Material (Figure 16.67).

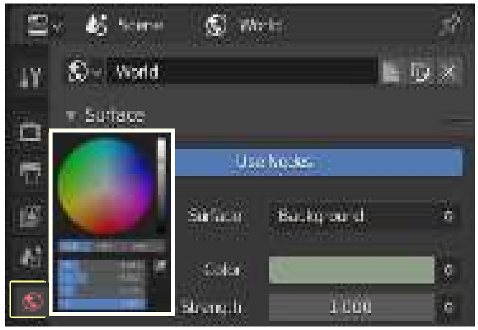
Figure 16.67



Change the default Point Lamp to an Area or Sun Lamp.

Ensure that the **3D Viewport Editor** is in **Material Preview Viewport Display Mode or Rendered Viewport Display Mode.**

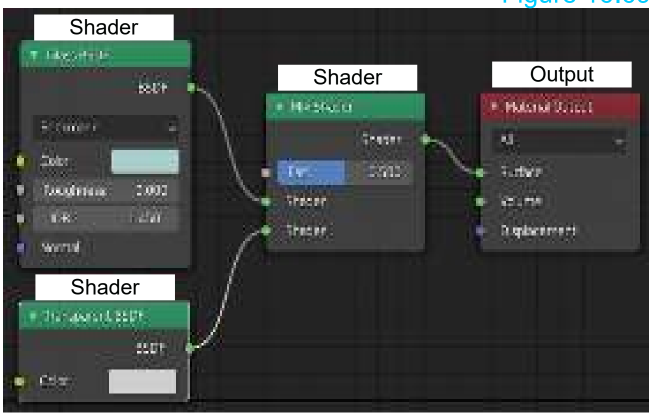
Figure 16.68



In the **Properties Editor, World buttons, Surface Tab** set the Background as shown in Figure 16.68.

Select the Plane Object, add a Material, then in The Shader Editor create the Node arrangement in Figure 16.69. Pay attention to the settings.

Figure 16.69



In the Material buttons, Settings Tab change the Blend Mode to **Alpha Blend**.

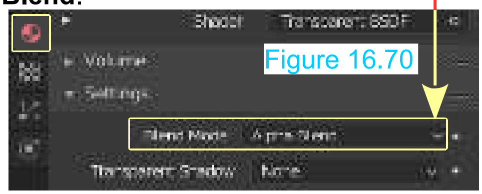


Figure 16.70

In the Render buttons, check **Screen Space Reflections** and **Refraction**.

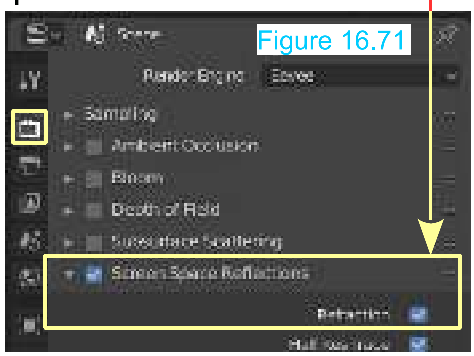


Figure 16.71

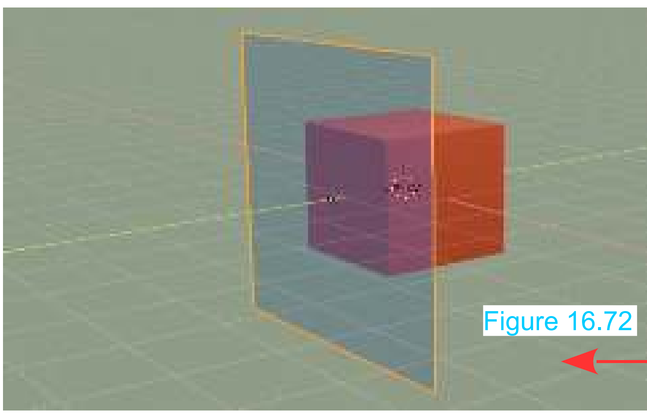


Figure 16.72

3D Viewport showing the Plane as Transparent Glass with a slight blue tint.

With the identical Node arrangement but with an HDRI image (Ref Chapter 15 – 15.8) used in the World Background fantastic results can be generated.

Figure 16.73 shows the pane of glass partially in front of the Cube. With the view rotated the glass reflects light cast by the background HDRI image.

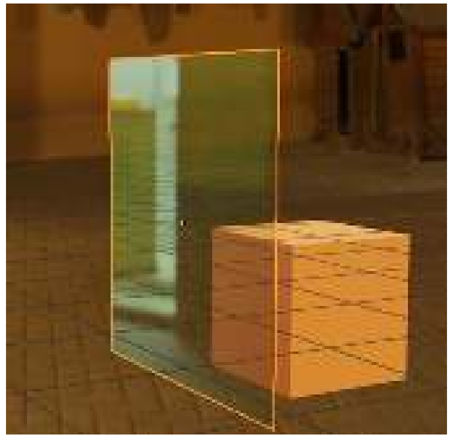


Figure 16.73

16.22 Other Node Uses

Using HDRI Maps as a background can give you a quick way to illuminate a Scene and create a background but, you are limited to what you can source in an image. You may want something completely unique and maybe not as complicated. **Volumetric Lighting** may be the answer.

Scene Illumination – Volumetric Lighting

Volumetric Lighting is a technique used in 3D computer graphics to add lighting effects to a rendered scene. It allows the viewer to see beams of light shining through the environment; seeing sunbeams streaming through an open window is an example of Volumetric Lighting, also known as God rays. In Volumetric Lighting, the light cone emitted by a light source is modeled as a transparent object and considered as a container of a volume: as a result, light has the capability to give the effect of passing through an actual three-dimensional medium (such as fog, dust, smoke, or steam) that is inside its volume, just like in the real world.

Volumetric Lighting is concerned with the background to the Scene which is part of the 3D World and has its own set of Nodes.

World Nodes

The use of Nodes, so far, has been concerned with the application of Materials and Textures to Objects and, therefore, has been confined to the use of **Object Nodes**. In the **Shader Editor Header** you see the **Object button** with a cube icon which when clicked opens a selection menu.

To access **World Nodes** click on **World** in the menu. In the **Properties Editor, World buttons**, click on **Use Nodes**.

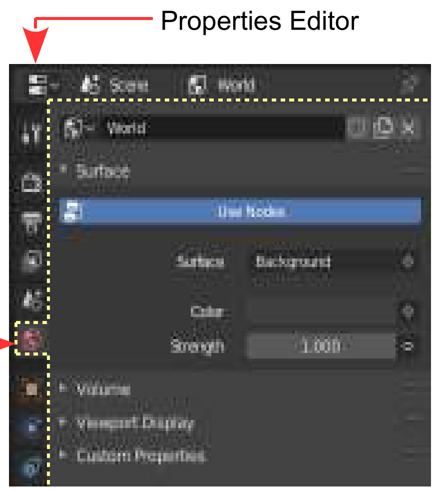


Figure 16.74

In the **Shader Editor** change from Object Nodes to World Nodes

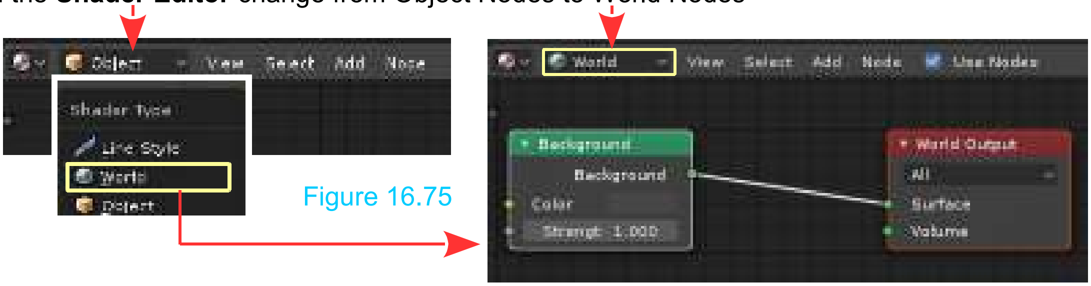
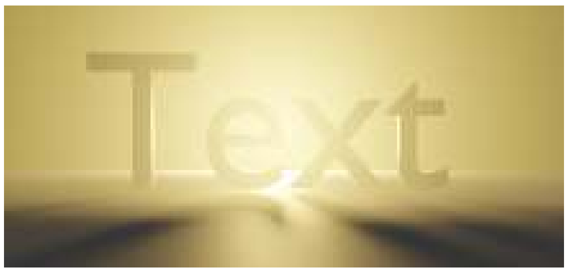


Figure 16.75

Activating **Use Nodes** in the **Properties Editor** and **Shader Type**, **World** in the **Shader Editor**, displays the **Background** and **World Output** Nodes.

Scene Illumination – Volumetric Lighting

Figure 16.76

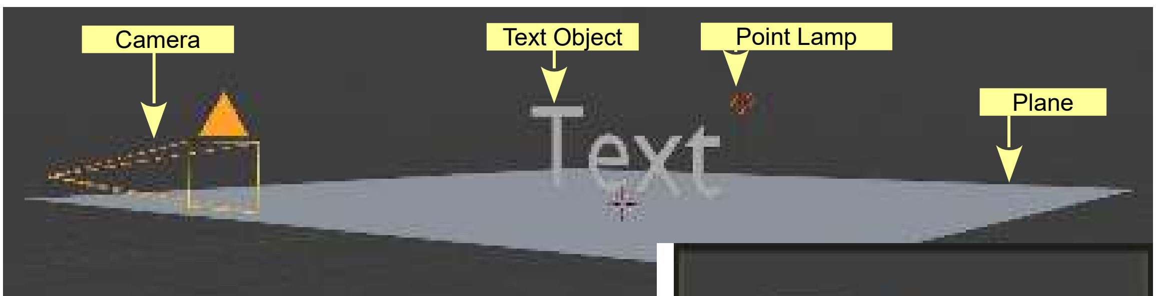


Chapter 15 – Figure 15.53 shows a light source placed behind Text Object, with the emitted light being dispersed in the atmosphere (the Scene), creating a fog effect.

To create this effect have a Text Object placed between a Camera and a simple Point Light. The Text Object is positioned just above a Plane.

Scene Arrangement

Figure 16.77



In Figure 16.77 a Text Object is stood on edge sitting just above a Plane between a Camera and a Point Lamp. The Camera and Lamp are positioned low down close to the Plane surface facing each other to produce the Camera View.

Volumetric Light

In the **Shader Editor** change from the default **Object Node** display to the **World Node** display and create the Node arrangement shown in Figure 16.78.

World Nodes

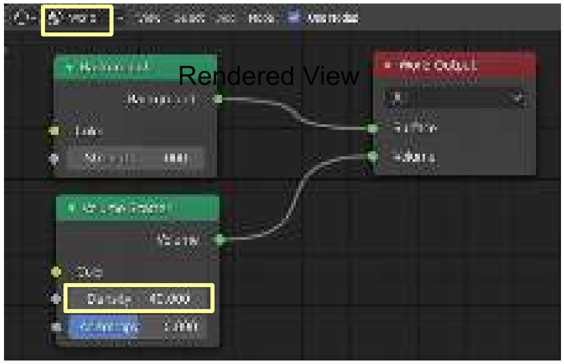
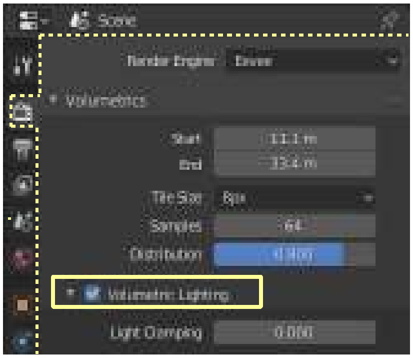


Figure 16.78

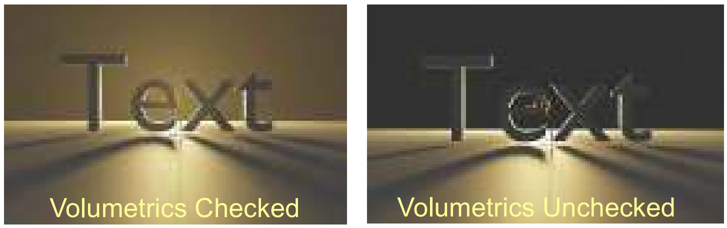
Note: The Background Node Color is the default dark gray RGB: 0.045 as seen in the Properties Editor, World Properties buttons (click the Color Bar to see the values in the Color Picker).

The **Volume Scatter Node** disperses the Scene Light from the Point Light. **Note:** The Density value 40.000.



The effect using the Node arrangement is only possible when **Volumetric Lighting** is enabled (checked) in the Properties Editor, Render Properties buttons, Volumetrics Lighting Tab.

Figure 16.79



External Volumetric Lighting

In the preceding example the Light source is a Point Light positioned in the Scene directly in Camera View. You may consider the Light to be an external light in the sense that it is outside of any enclosure. Another example of such a lighting arrangement, with a Light outside, but with a Camera positioned inside a room directed at an Object (Monkey) beside an opening (a window) is shown in Figure 16.81. The default Render Property settings are employed and the World Background color is a very dark gray per the settings in the color picker Figure 16.80.

Figure 16.80

In this case a white **Sun Light** is located outside the window and directed towards the Monkey. **Volumetric Lighting is enabled**.

Figure 16.81

Figure 16.82

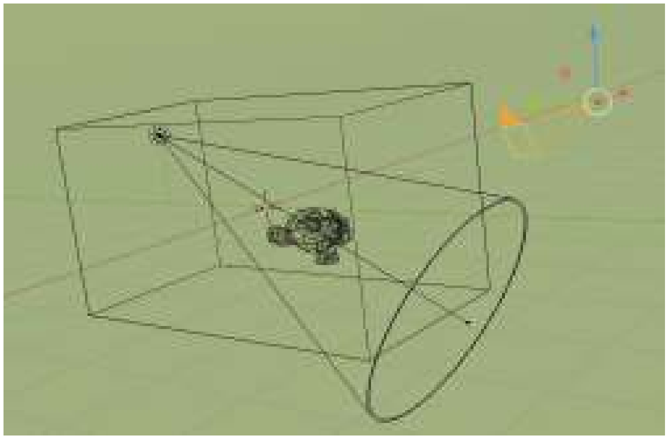
Internal Volumetric Lighting

Internal Volumetric Lighting places a Light Source inside an enclosure limiting the lighting effect to the volume of space defined by the enclosure. Whereas, in the preceding example the Camera in the Scene had to be positioned inside the room to capture an image of the Monkey Object ,using Internal Lighting, allows the Camera to see the Object (Monkey) from outside.

Figure 16.83 shows a Scene arrangement in Wireframe Display Mode. A Monkey Object and a Spot Light are positioned inside an enclosure (Cube Object) with a Camera directed, at the Monkey, outside of the enclosure.

The Monkey is also positioned in the Spotlight beam.

Figure 16.83



With the Cube enclosure selected create the Material Node arrangement shown in Figure 16.84 by replacing the default Principled BSDF Node with a Principled Volume Node and connect the Volume sockets. In the Principled Volume Node select a color.

Make sure Volumetric Lighting is activated in the Properties Editor, Render buttons,Volumetric Tab. The Spotlight beam will display inside the enclosure illuminating the Monkey.

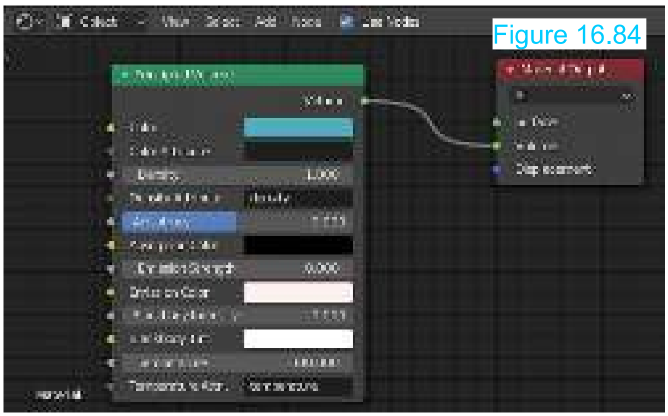


Figure 16.84

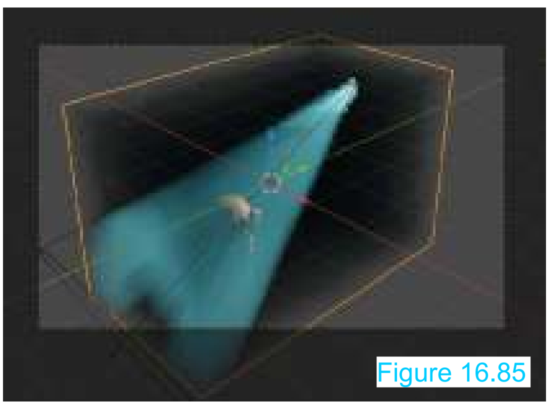


Figure 16.85

Camera view captures a portion of the Scene.

Figure 16.86

A Rendered view shows the Monkey captured inside a blue foggy atmosphere.

Figure 16.87

16.23 Grouping Nodes

Figure 16.88

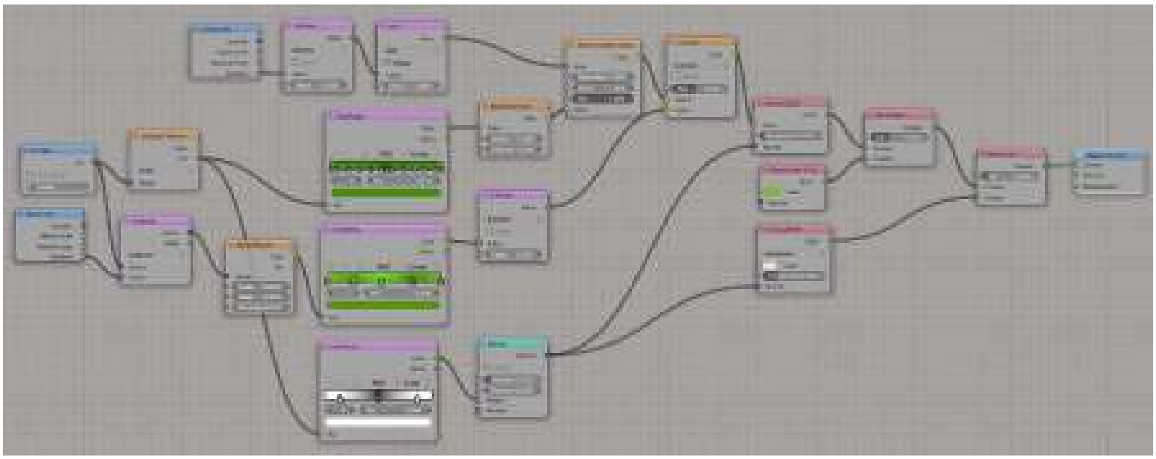
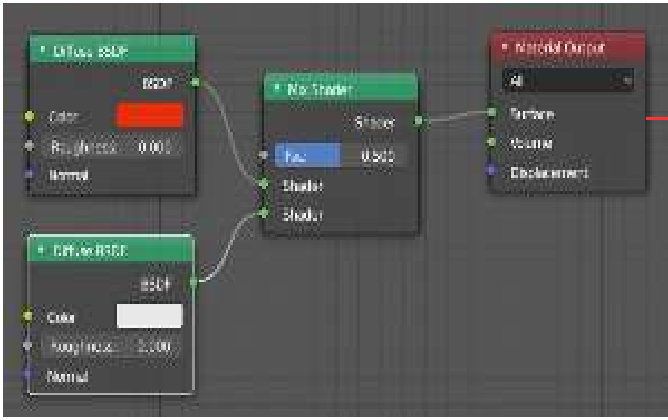


Figure 16.88 shows a reasonably complex Node arrangement and they can become even more complex. Creating such an arrangement involves a considerable amount of work and possibly a good deal of experimentation in achieving the result. This being the case you may wish to save the arrangement for future use. To do this you create a Node Group.

To simplify the explanation of how to achieve the above a simple Node arrangement similar to that previously used in demonstrating Mixing Materials 16.10 will be employed (Figure 16.89)



Node Arrangement in the Shader Editor

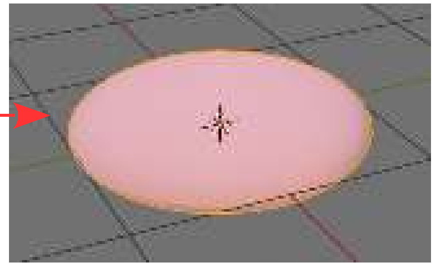


Figure 16.89

UV Sphere Scaled and Smoothed In the 3D Viewport Editor in Material Preview Viewport Shading Mode.

A Node Group will be created for the two Diffuse BSDF Nodes and the Mix Shader Node. This Node combination is producing the Material applied to the modified UV Sphere which is selected in the 3D View Editor.

It is assumed you wish to save this arrangement to reproduce the Material in the future.

In the **Shader Editor,** select the three nodes to be Grouped and press **Ctrl + G Key**. Alternatively click **Node – Make Group** in the Header.

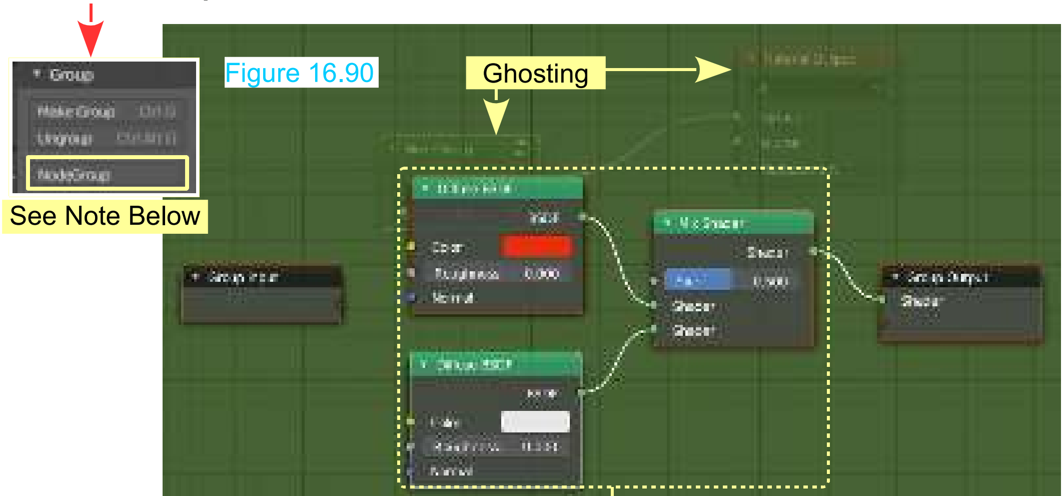


Figure 16.90

The Shader Editor display changes showing the three grouped Nodes in the configuration shown in Figure 16.91. You will see Node Group and the Material Output Node ghosted in the background.

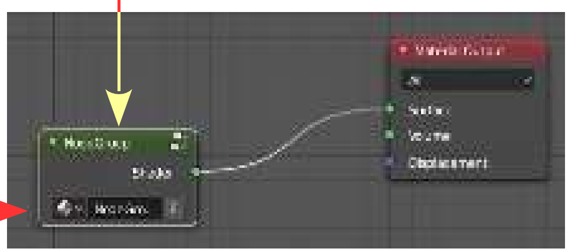


Figure 16.91

Press **Tab** to consolidate the Group

Note: When the Group is consolidated a **NodeGroup** button is entered in the Add menu (Figure 16.92). Clicking this button enters an instance of the Node Group into the Shader Editor.

Figure 16.92

When a new Object is added to the Scene in the 3D View Editor, connecting the instance of the Node Group to the Material Output Node, produces a copy of the Material.

With the instance of the Node Group or the original selected in the Shader Editor, pressing the Tab Key expands the Group allowing the Mix Shader Slider value to be adjusted altering the Material. Note the Group is associated with both Objects in the 3D View Editor, therefore, both have their material altered. You may **Tab** to consolidate then click the **Ungroup** button in the Tool Panel. This will allow individual Object Material modification.

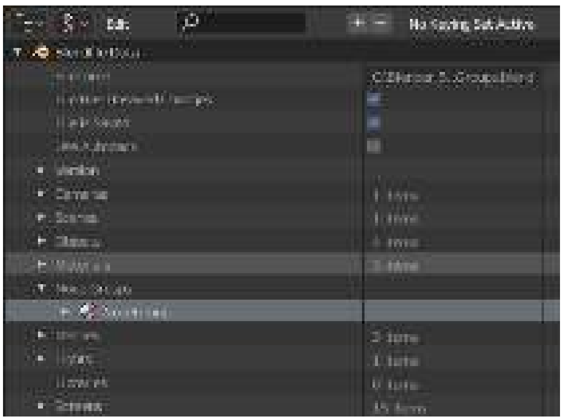
As well as using the Node Group in the current Blender file the Group may be appended to a new file (providing the current file has been saved).

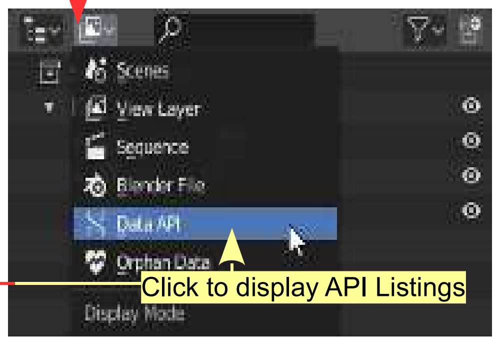
Appending and Renaming a Node Group

Figure 16.93

Click to display Options

When a Node Group is created it becomes part of the data for the Blender File. This is found in the **Outliner Editor** under **Data API** (Figure 16.93).





In the Api Listing expand the Node Groups and Node Group entries. Where you see **Name : Node Group** click on Node Group (white text) delete, <u>backspace and retype a new name.</u>

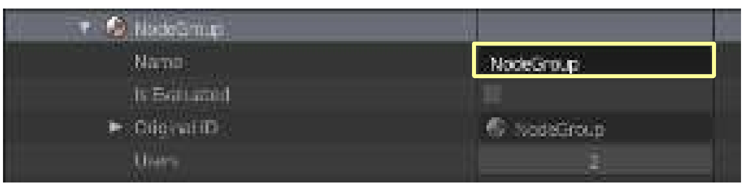


Figure 16.94

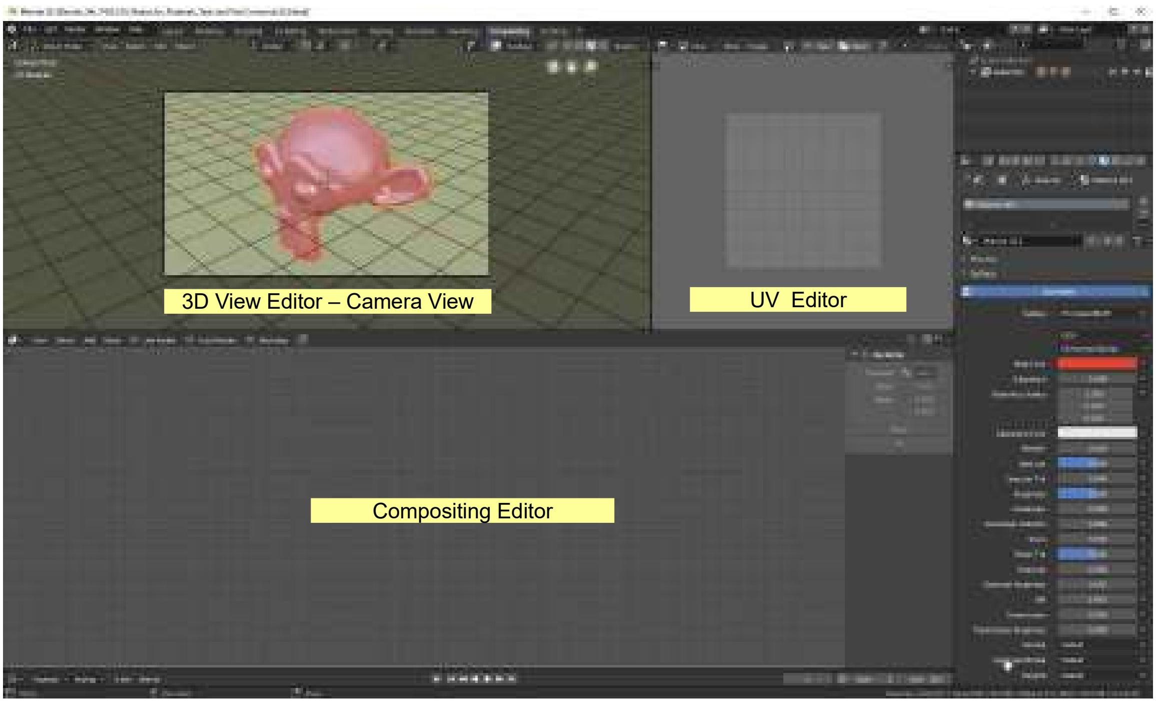
In a new Blender file you may Append the Node Group Data from this location.

16.24 Compositing Nodes

Compositing Nodes (or composite, for short) allow you to create and enhance image files and video files. The contents of the Blender Scene can be the basis for the image or you may use an image already saved on your computer. A pre-saved image can be combined with other images or the Blender Scene to create a new image. Unlike Material and Texture Nodes, it is not necessary to have an Object selected in the 3D Viewport Editor or to have a Material applied to an Object. Of course, by default, any Object added to a Scene has the default material added to it even though this does not display in the **Properties Editor** until the **New** button is pressed.

To demonstrate the **Compositing Node Editor**, change the Screen arrangement as shown in Figure 16.95. To create this arrangement, start by changing the default **Layout Workspace** to the **Compositing Workspace.**

Figure 16.95

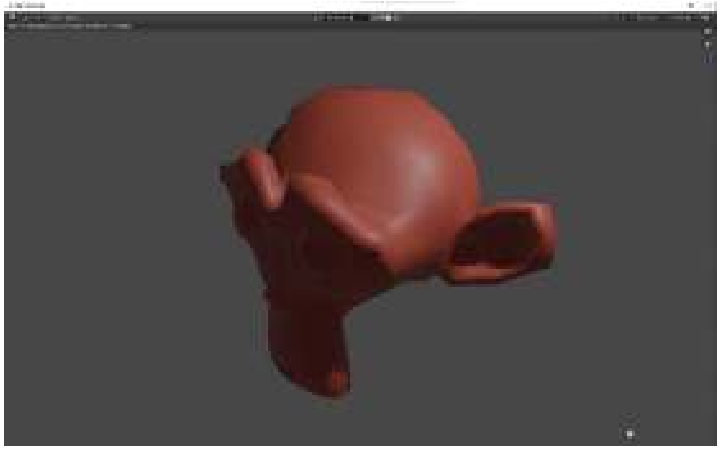


The **Dope Sheet Editor** at the bottom of the Screen will not be required in the demonstration since only still images will be used. Change the Timeline to the Composite Editor, change the existing Compositing Editor to the 3D Viewport Editor, divide in two and make one half the UV Editor.

In this demonstration an image rendered from the Scene in the 3D Viewport Editor will be combined (composited) with an image file downloaded from the internet.

In the 3D Viewport Editor, delete the default Cube and add a **Monkey Object.** Give it a nice bright Material (color). Change the **Viewport Shading to Material Preview Mode to see the Material**. Go into Camera View, Scale Monkey up to fill the view then deselect it in the 3D Viewport Editor (Figure 16.96).

Camera View
3D Viewport Editor
Figure 16.96



Rendered View
Image Editor

Figure 16.97

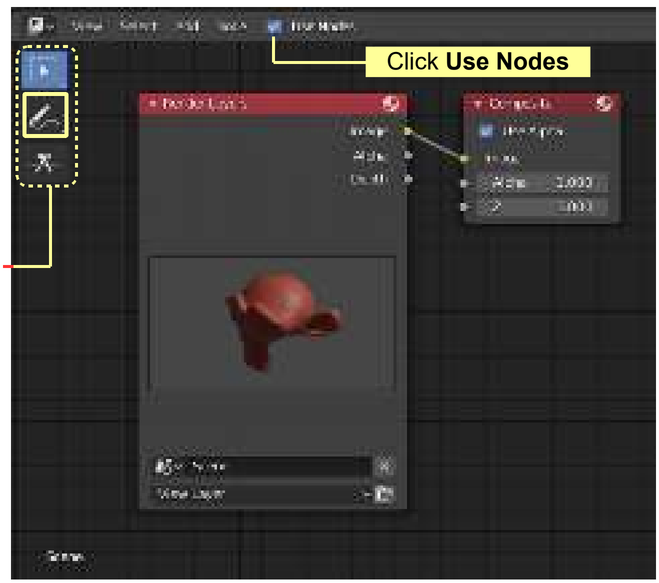
Render a view of Camera View. In the Screen Header click **Render** and select **Render Image**. The image is Rendered and displayed in a full Screen version of the Image Editor (Figure 16.97). Cancel this Editor (click the X- upper RH of Screen).

In the **UV Editor** click on the **Browse Image to be linked** button in the Header and select **Render Result** to display the rendered image of the Monkey (scroll out) (Figure 16.98).

Figure 16.98

Browse Image to be linked

Figure 16.99



To combine the Rendered Image with another file click **Use Nodes** in the Compositing Editor Header (Figure 16.98).

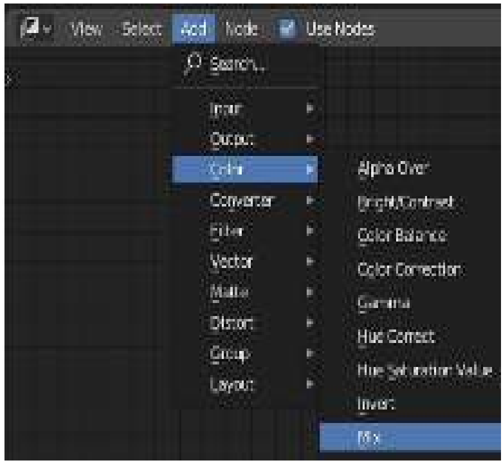
With the Mouse Cursor in the Compositor Editor press the T Key to display the Tool Panel at the LH side of the Editor containing the Annotation Tool and the Link (Noodle) Cut Tool.

Mouse over on the Annotation Tool, click and hold for options.

Clicking Use Nodes displays the Render Layers Node connected to the Composite Node. A view of the Rendered Monkey shows in the Render Layer Node (Figure16.99 previoust).

In the Header click Add and enter an Image Node and a Color Mix Node.

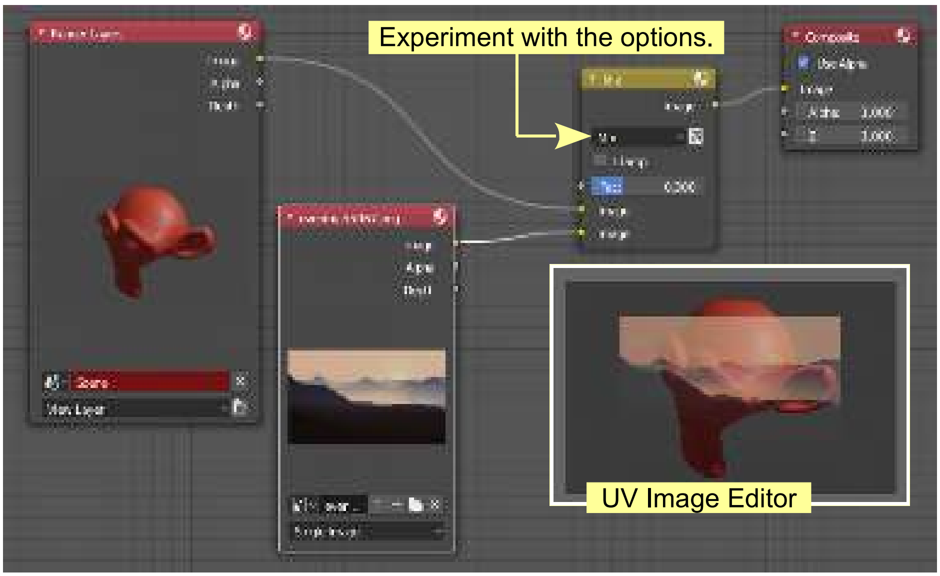
Figure 16.100



Arrange and connect the Nodes as shown in Figure 16.101.

In the **Image Node** click on Open, navigate in the File Browser that opens and select the downloaded image.

Figure 16.101



The selected image displays in the Image Node. In the **Mix Node** set the slider Fac: to approximately 0.300 and the Monkey Image in the Render layer is combined with the downloaded image and displayed in the UV Editor. Render and save the new Image.

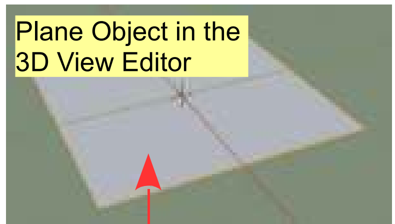
16.25 Color Ramp Shader

The Color Ramp is Material Node which implements a color gradient over the surface of a Mesh Object. The Node is configured in an arrangement which, in its simplest form, comprises a Color Ramp Node, a Diffuse BSDF Node and a Material Output Node.

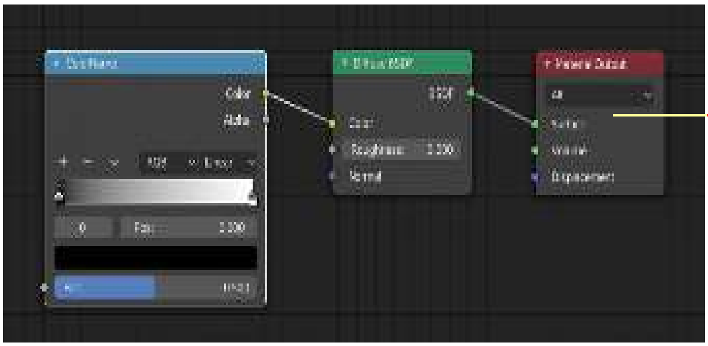
Material Nodes are introduced to the Shader Editor when a new Material is applied to an Object in the Properties Editor, Material buttons with Use Nodes active. By default, adding a new Material introduces a Principled BSDF Node connected to a Material Output Node.

Remember: Material Nodes produce color on the surface of an Object which is selected in the 3D Viewport Editor. To see Material Color the 3D Viewport Editor must be in LookDev or Rendered Viewport Shading Mode.

Figure 16.102



To show the Color Ramp system in its basic form the Principled BSDF Node is replaced with a Diffuse BSDF Node.



The arrangement shown in Figure 16.42 may be configured in the **Shader Editor** by deleting the default Principled BSDF Node then adding a Shader – **Diffuse BSDF** and a Converter – **ColorRamp** Node.

Figure 16.103

Alternatively, in the **Properties Editor, Materials buttons** with a New Material added and Use Nodes active, click on Surface and select Diffuse BSDF in the menu that displays then click on the button at the RHS of the Base Color bar and select ColorRamp under Converter.

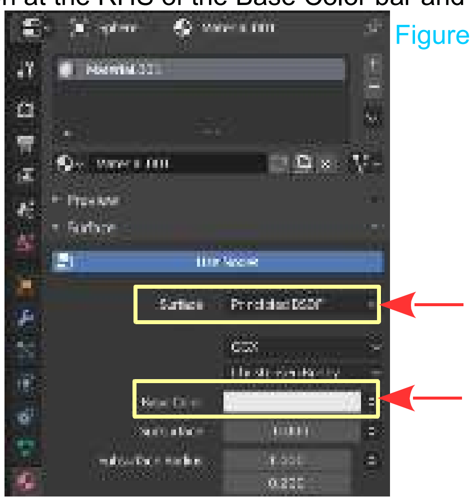
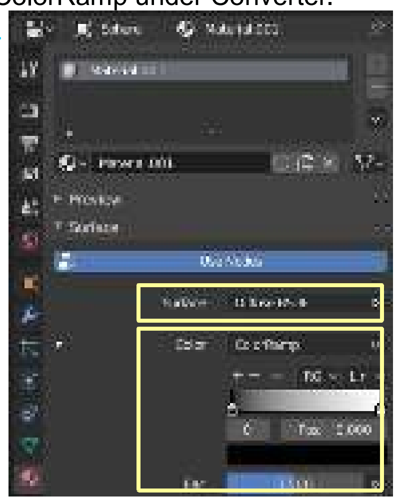


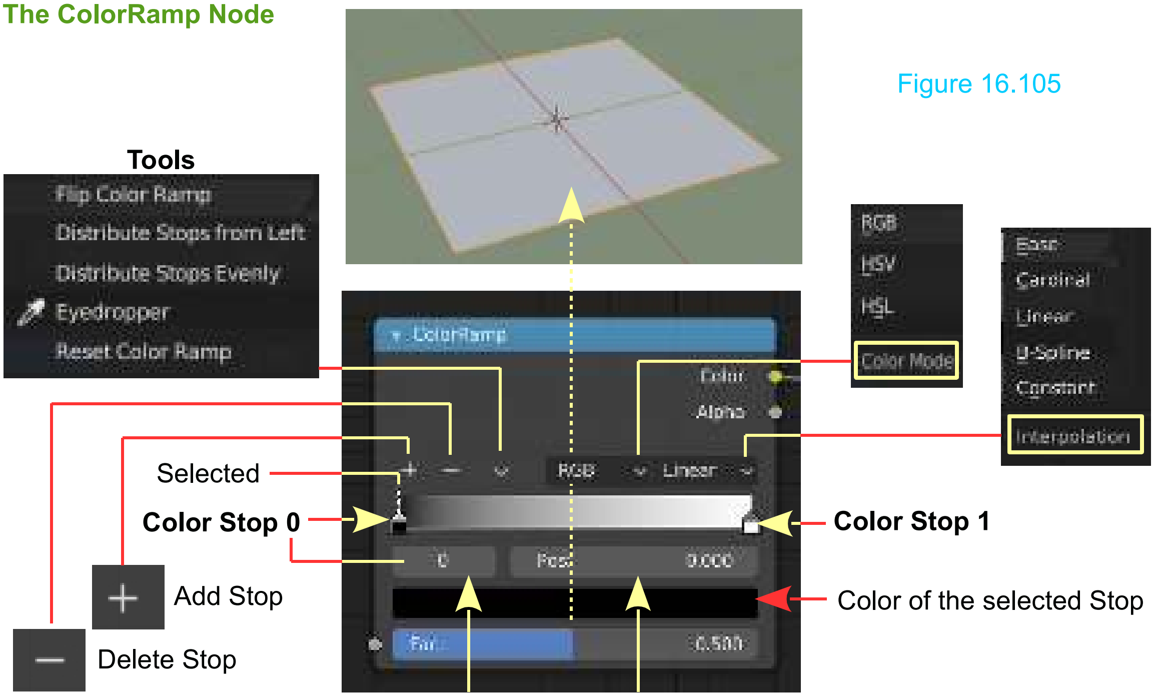
Figure 16.104



The Nodes are automatically configured in the Shader Editor and the ColorRamp Node is replicated in the Properties Editor.

The ColorRamp Node

Figure 16.105



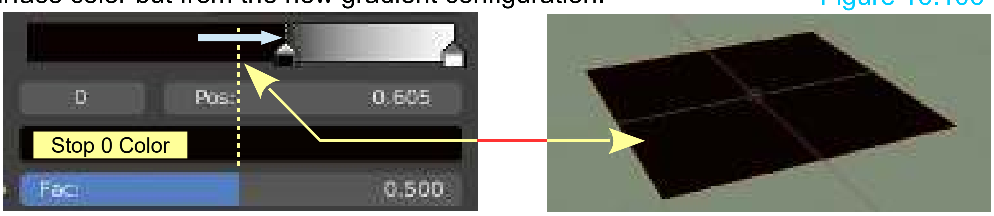
As seen in Figure 16.105 the Color Ramp Node packs a considerable number of controls. Although not evident in the default configuration the Node will generate a graduated Color Shading across the surface of the selected Object to which the Node is applied. You can see the shading in the Color Ramp bar in the center of the Node between Color Stop 0 (Black) and Color Stop 1 (White).

Note: The Node itself does not create the color gradient shown in the Color Ramp bar. Additional Nodes have to be connected to Map the gradient to the surface.

As it stands the color of the Object's surface is being set by the Factor Slider. With the Slider mid way between Stop 0 and Stop 1 (Fac: 0.500) the surface color is the gray color half way along the Color Ramp Bar. Adjusting the Slider alters the color between Black and White.

Clicking a Stop to select (Selected Stop indicated by a broken white line) holding and dragging to reposition in the Color Ramp bar changes the color gradient. The Factor Slider continues to set the surface color but from the new gradient configuration.

Figure 16.106



Adding Stops and Setting Stop Colors

Click the Add Stop button to Add a Stop. The new Stop is inserted mid way between the two existing Stops. If there are multiple Stops, selecting a Stop (click LMB) and adding a new Stop positions the new Stop mid way between the selected stop and the Stop to the left. As new stops are added the Stop Numbers are rearranged accordingly (LH Stop: 0 followed by 1, 2, 3 etc).

The position of a selected Stop is shown in the **Pos: bar**. You may edit the Stop position by retyping a new value.

To edit the Color Gradient, select a Stop. The color in the Gradient at the Stop position is shown in the Color Bar. Click on the Bar and select a new color in the Color Picker circle that displays.

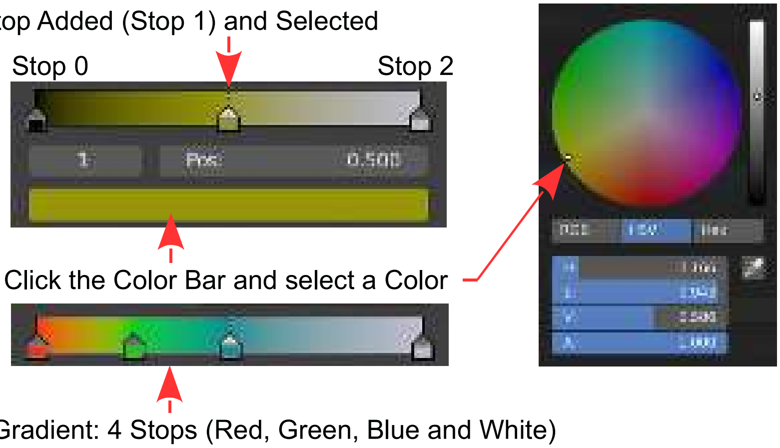
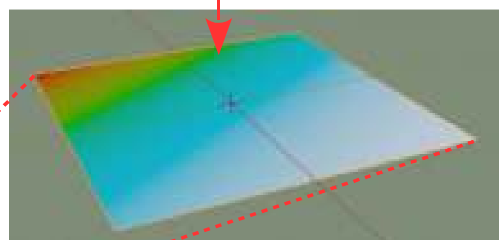


Figure 16.107

Applying the Gradient

Material Preview or Rendered Viewport Shading Mode



To apply the Color Gradient to the selected Object in the 3D Viewport Editor add an **Input – Texture Coordinate** Node and a **Vector – Mapping Node** to the Node Arrangement in the Shader Editor and connect as shown in Figure 16.108.

The way the Color Gradient displays on the Object depends on the values set in the Mapping Node.

Figure 16.108

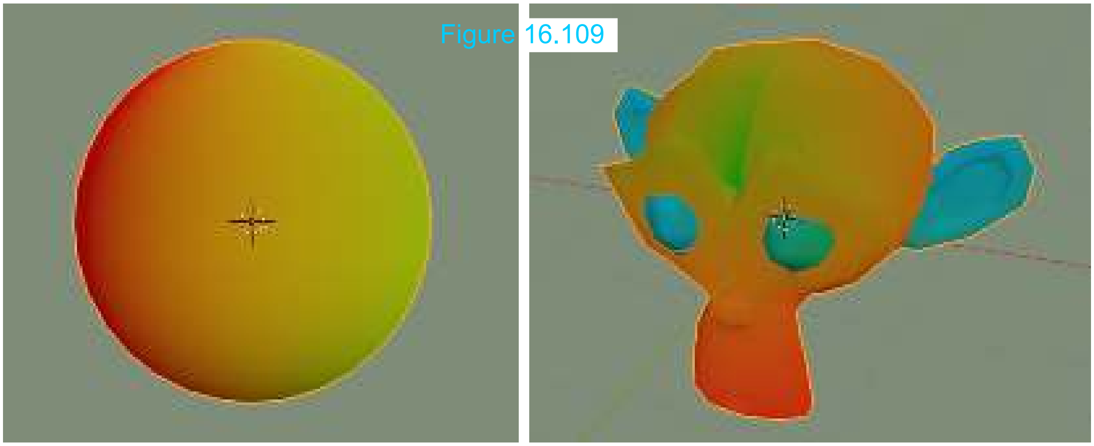


Figure 16.109

The identical Color Gradient applied to a UV Sphere and a Monkey Object

Note: You will have to experiment with the settings in the Mapping Node and Rotate the 3D Viewport Editor View.

Dont forget to be in Material Preview or Rendered Viewport Shading Mode.

16.26 Texture Displacement

In **Chapter 9 – 9.6 Displace Modifier**, a simple demonstration showed how to displace a Vertex Group, using the Displace Modifier with one of Blenders **Procedural Textures** (In Built Texture). Vertices were displaced according to the light and dark components of the Texture.

Image Textures may also be used, in which case, displacement is determined by the color shades in the image. The Vertex displacement may be applied to the entire Mesh surface not only a Vertex Group. Textures have been defined in 16.1.

Prerequisites: **1.** You must have an Image saved on your PC to be used as a Texture. To demonstrate Texture Displacement the image shown in Figure 16.99 will be used.

2. Have the surface Mesh subdivided creating plenty of Vertices.

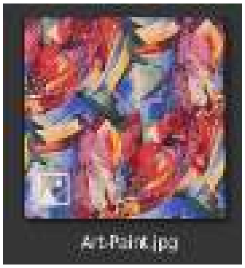


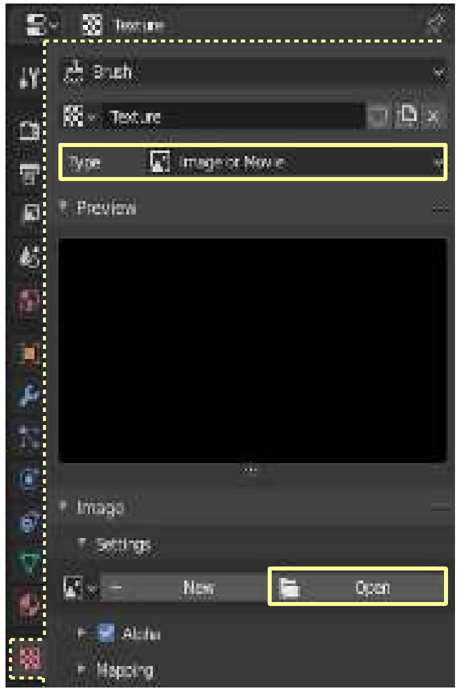
Figure 16.110

Note: Images may be used to simply color a surface, in which case, the image is displayed on the surface of the mesh using the Material buttons in the Properties Editor.

Remember: To see color, be in Material Preview or Rendered Viewport shading Mode.

Coloring using Texture

Figure 16.111



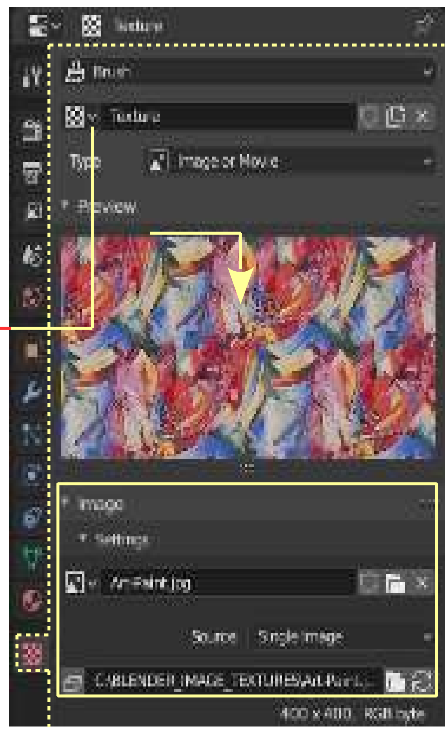
With the Object in the 3D Viewport Editor selected, open the Material buttons in the Properties Editor with **Use Nodes** active. Click on the button at the end of the **Base Color** bar and select **Image Texture** from the menu. The Base Color will show **Image Texture** in what was the color bar. Click on **Open** and navigate in the File Browser to find your image file. Select a file and click **Open Image** in the upper RH corner of the File Browser. In Material Preview or rendered Viewport Shading Mode the Texture Image is mapped to the surface of the Object.

Displacement using Texture

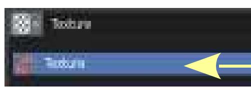
The displacement is performed by entering a Texture in the **Displace Modifier** (Ref: Chapter 9 – 9.6). To enter a Texture in the Modifier the Texture must first be entered in the **Texture Cache**.

In the **Properties Editor, Texture buttons** click **New**. The buttons display with **Type Image or Movie** (Figure 16.111). In the Image Tab, Settings, click **Open** (the File Browser opens). Navigate to your Texture Image and open it. This enters the Texture in the Texture Cache.

Figure 16.112



Note: To use a texture for surface displacement it is not necessary to have it entered as a Material. The surface deformation will still occur in accordance with the color shading of the image but the colors do not show on the deformed surface. If you wish to display the colors enter the Texture Image in the Material buttons (Figure 16.104).



Texture Cache

With the Texture Image entered in the texture Cache have the Object surface selected in the 3D Viewport Editor and add a Displace Modifier. In the Displace Modifier click on the Browse texture to be Linked button to display the Texture Cache and select the Texture you previously entered (Figure 16.110).

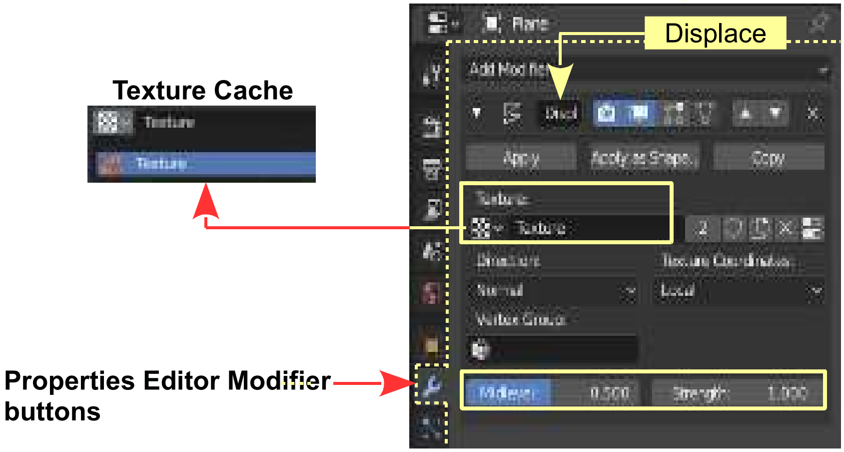


Figure 16.113

The Objects Mesh surface is deformed (Figure 16.114). The amount of deformation is controlled using the **Midlevel** and **Strength** sliders in the Modifier panel.

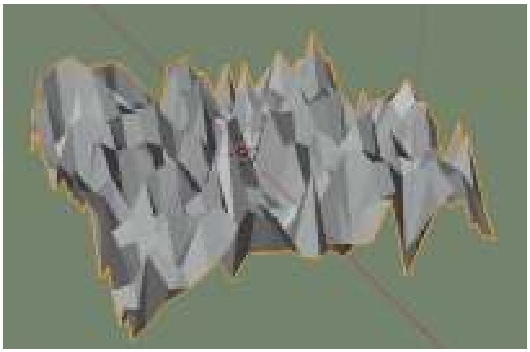


Figure 16.114

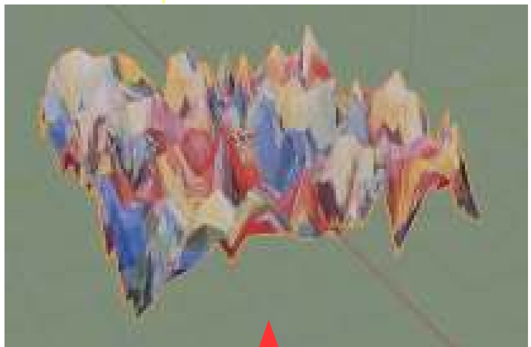


Figure 16.115

If you wish to see color on the deformed Mesh enter the Image as a **Color Image Texture** in the Material buttons (see **Coloring using Textures** above).

17

Rendering

17.1 Rendering
17.2 Properties Editor Render Buttons
17.3 Properties EditorOutput Buttons
17.4 The Dimensions Tab
17.5 The Output Tab
17.6 Rendering a JPEG Image
17.7 Rendering a Movie File
17.8 Video Playback
17.9 Video Codecs
17.10 Making a Movie

Rendering is the process of converting the Blender file information into an Image file or a Video Movie file. In practice this entails taking the data producing what you see in **Camera View** in Blender and converting it into image or Video **file format**. The conversion may then be viewed as a digital still image or in the case of a video file, played on a variety of media devices depending on the format chosen. Controls and settings for Rendering are located in the **Properties Editor**

Note: There are three separate rendering systems in Blender. One is the Blender **Eevee** system, the second is the **Cycles** system and the third is **Workbench**.

This chapter explains the basic render procedure using the default **Eevee** system limiting the discussion to producing a still image file or video file.

Eevee is a fully-featured PBR (physically based-rendering) engine for real-time visualization. with advanced features such as volumetrics, screen-space reflections and refractions, subsurface scattering, soft and contact shadows, post-processing effects such as ambient occlusion, depth of field, camera motion blur and bloom, to name a few (definition from the Blender Wiki).

As you work with **Eevee** engaged, what you see in **Camera View** with **Rendered Viewport Shading Mode** active, is what you get when the Blender file is converted to an image file.

17.1 Rendering

Rendering, in the practical sense, converts the data producing what is seen in **Camera View** in the 3D Viewport Editor into a still image or in the case of an animation into a video clip.

To Render a still image press the **F12** button on the Keyboard. An image is Rendered and displayed in a full Screen version of the **Image Editor**. Press **Esc** to cancel.

To Render an animation press **Ctrl + F12.**

These Render options are also located in the Render button in the Screen Header.

With the **Eevee** Render Engine active (default) it is not necessary to Render to see what you get in an image . With Eevee engaged and the 3D Viewport Editor in **Rendered Viewport Shading Mode** you see the equivalent of a Render in the 3D Viewport Editor. However, at some stage, you will Render a Scene and save it as a still image or Render an animation to a video sequence and then produce a Video Clip.

Note: Rendering a still image does not save a file to the computer. With the default settings in the Properties Editor, Render buttons, Rendering a still image merely displays the Render in the Image Editor. Rendering an animation, however, saves an image for each Frame in the animation and by default, saves to the /tmp\ directory as seen in the Render buttons, Output Tab. On a Windows 10 Computer this means the files are saved in Local Disk (C:)\tmp.

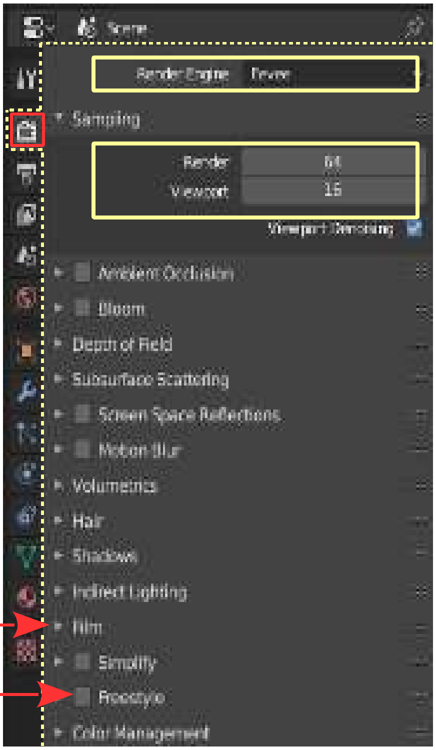
17.2 The Properties Editor Render Buttons

Figure 17.1

The detailed output from the Render process is controlled in the **Properties Editor, Render buttons**.

The Render controls are shown here to make you aware of their existence. As you see there are numerous categories arranged in Tabs. Opening a Tab displays the controls for that particular subject which in some cases requires activation by checking the button preceding the subject name.

Properties Editor, Render buttons



Click to open a Tab

Check (tick) to activate

When Rendering, the computer is converting the data producing the Screen display into a format for an Image display. In doing this, it processes in a series of passes, which in each pass improves on the quality of the previous pass. How many passes performed is referred to as the number of **Samples**. As you see in Figure 17.1 the default number of Samples is; Viewport 16 (what you see in the Viewport) and Render 64 (what you get when you press F12).

17.3 The Properties Editor Output Buttons

Properties Editor, Output buttons

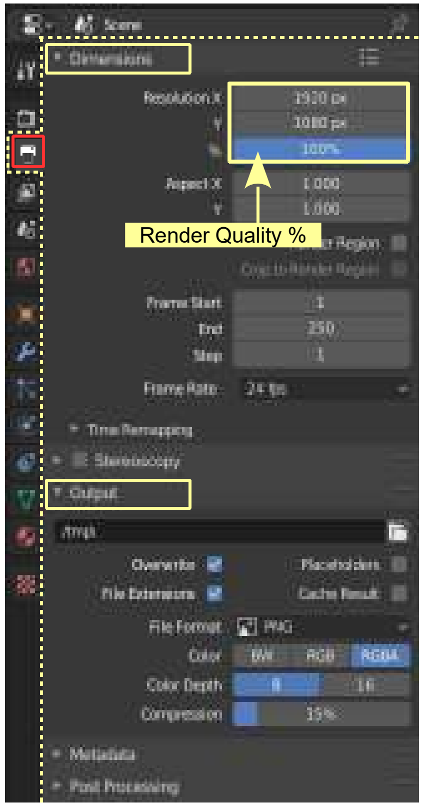


Figure 17.2

In accepting the default number of Render Samples and Render Settings, to produce an image or video, all you have to do in practice is specify the Resolution and where you want the file saved. This is done in the **Properties Editor, Output buttons** (Figure 17.2)

In the Output buttons the **Dimensions Tab**, and **Output Tab** are expanded.

You may consider the expanded tabs as the basic controls for setting the rendering process.

17.4 The Dimensions Tab

The **Dimensions Tab** (Figure 17.2) is where you tell Blender how big to make your image, the shape of the image, the quality of the image (Resolution) the shape of the pixels (Aspect Ratio) and in the case of an animation where to start and stop rendering and how fast you want it to play back when finished (Frame Rate).

Resolution

X : The number of pixels wide in the display. **Y:** The number of pixels high in the display.

Pixels are the tiny little rectangles which display on the computer or television screen.

> **Note:** The default **Resolution** 1920 x 1080 equates to the HDTV 1080p **Preset.**

The percentage slider sets the quality of the render. The default is 100% which scales the resolution. If the value were 50% although the resolution is set at 1920 x 1080 the render would be a preview at 960 x 540. Since rendering takes time this is a way of seeing your image or movie as a preview prior to a final render and therefore saving time. For the final render you set the slider to 100%.

Aspect (Aspect Ratio)

The aspect ratio refers to the shape of the pixels. The default ratio X:1.000, Y:1.000 (1:1) is for computer monitors which have square pixels. TV screens have rectangular pixels so you have to set a ratio for the appropriate format i.e. HDV NTSC 1080p for America the ratio is 4:3 and HDV PAL 1080p for Europe is also 4:3 but TV PAL 16.9 the ratio is 16:11.

Aspect ratios are very confusing. Figures 17.3 and 17.4 on the following page are offered as a guide.

Frame Start – End – Stop (Frame Range)

This is fairly self explanatory and shows the start frame (Frame Start) and end frame of the animation and the **Steps** which means which frames to render. **Frame Steps: 1** means render every frame, **Frame Steps: 2** would mean render every other frame **Frame Steps: 3** would mean render every third frame etc.

Note: Pressing **F12** with an animation paused renders an image of the single frame in the animation where it paused.

Frame Size	Aspect Ratio	Description (note these are only the most common formats) Figure 17.3
1920x1080	16x9	1080p/i
1440x1080	16x9	1080i **(Most HDV use this format)**
1280x720	16x9	720p
852x480	16x9	480p
720x480	4:3	DV NTSC (when the pixels are square it is actually 3:2)
720x480	16:9*	DV NTSC / Anamorphic* / Wide Screen (non square pixles)
720x576	5:4	DV PAL
640x480	4:3	a ration suitable for square size pixle multimeida video.
640x360	16:9	a ration suitable for square size pixle multimeida thats widescreen.
480x360	4:3	Multimedia large (480x360 : 75%(640x480))
480x270	16:9	Multimedia Large (similar to Apple's large move trailer standard 480x272) (480x270 : 75%(640x360))
320x240	4:3	Multimedia Large
320x180	16:9	Multimedia Large / Wide Screen
240x180	4:3	Multimedia Small
160x120	4:3	Thumbnail
1600x1200	4:3	Computer Display
1280x1024	4:3	Computer Display
1152x870	4:3	Computer Display
1024x768	4:3	Computer Display
800x600	4:3	Computer Display

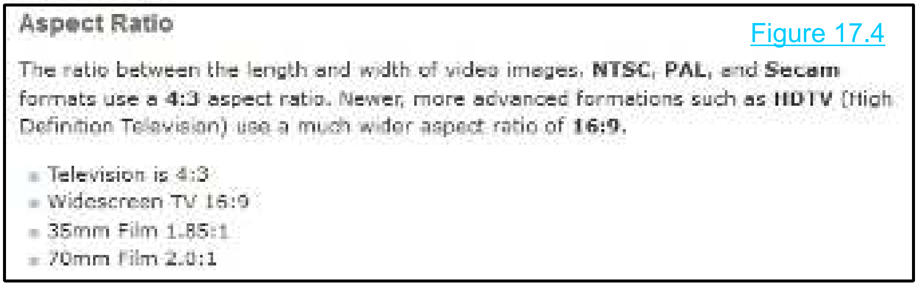


Figure 17.4

Aspect Ratio

The ratio between the length and width of video images. **NTSC**, **PAL**, and **Secam** formats use a **4:3** aspect ratio. Newer, more advanced formations such as **HDTV** (High Definition Television) use a much wider aspect ratio of **16:9**.

- Television is 4:3
- Widescreen TV 16:9
- 35mm Film 1.85:1
- 70mm Film 2.0:1

Frame Rate The playback speed of the animation expressed in Frames per second. The selection menu provides options for a variety of formats. 24 Frames per second is the default setting (25 FPS for PAL TV European format and 30 FPS for NTSC TV US format – These frame rates are approximate and vary with the actual **Render Preset** selected).

Border

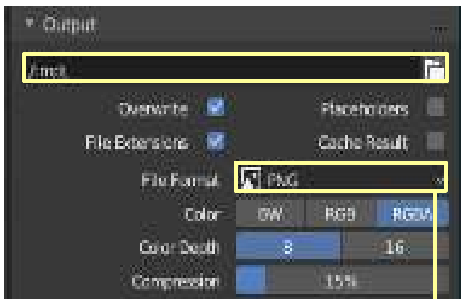
Check (Tick) Border. In Camera View, press Shift + B Key, drag the mouse to define a portion of the view to render instead of the whole Camera View.

Crop

Enabling **Crop** will crop the rendered image instead of rendering a black region around it.

17.5 The Output Tab

Figure 17.5



In the **Output tab** (Figure 17.5) you set options to tell Blender where to save your render and the file format you require.

By default Blender will save your render to the **temporary** folder on your hard drive as seen by the **/tmp** notation in the output file address bar. On this computer this is C:\tmp\. You can choose a different location by clicking on the folder icon at the end of the bar and navigating in the file browser that opens.

Figure 17.6

Blender will save your render in a variety of file formats. The default format is **PNG** (Portable Network Graphics). Where you see this in the Output Tab is a selection menu for choosing alternative formats (Figure 17.6). In the menu you will see that the options are in two categories: **Image** and **Movie**. Image types such as PNG or JPEG produce a render of a still image in that particular file type. Selecting one of the Movie options produces a render of an animation in a compressed movie file such as AVI Raw or FFmpeg.

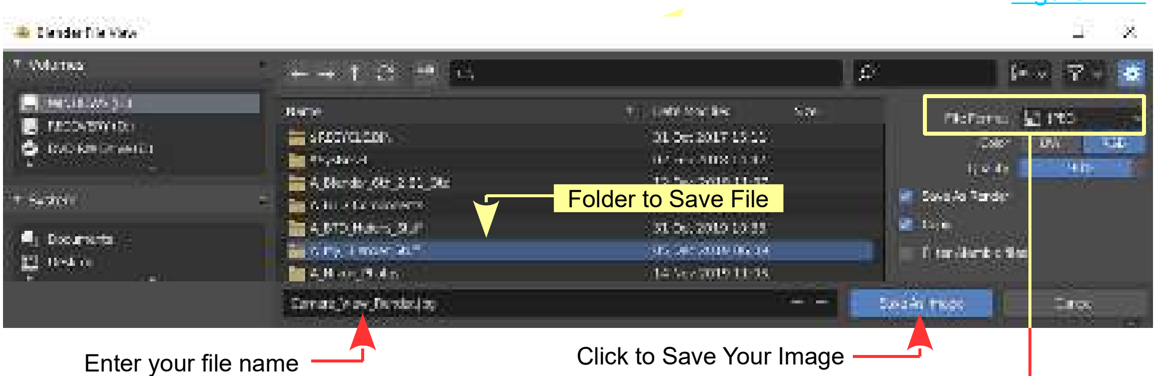
> **Note:** With an Image file selected a render of an animation will consist of a series of images of each frame of the animation. Although this takes up a lot of room in a folder it is an acceptable method of producing a video file.
>
> **Note:** The default **Image** type PNG with the RGB color scheme and **Compression** ratio of 15%. Some formats can compress images to use less disk space, for instance; Lossless PNG or JPEG.

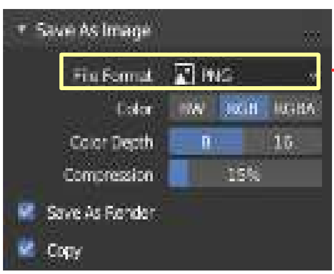
17.6 Rendering a JPEG Image

1. When you have created a scene in the 3D Viewport Editor and decide that you wish to save an image of what you see in the **Camera View** go to the **Properties Editor, Render buttons**. For the time being leave all the default settings just as they are. In the **Output Buttons, Output Tab,** click on the selection menu where you see **PNG** and change to **JPEG**.

With your mouse cursor back in the 3D Viewport Editor, press F12 on the keyboard to render the camera view. The image displays in the Image Editor. In the Header click Image and select Save As (Shift + S Key) to save the Rendered image. If you have opened a previously saved image you will press Save (Alt + S Key). The File View displays (Figure 17.7) which allows you to name your image file and navigate to a folder on your hard drive where you wish to save the JPEG image.

Figure 17.7





Note: If you have forgotten to change the file format from PNG to JPEG when you saved you can change it in the Panel at the upper LRH side of the File View window.

In Figure 17.7 the image file has been named **Camera_View_Rendre.jpg** and is saved to **A_My_Blender_Stuff** folder on the hard drive. With the information entered as shown, click **Save As Image** in the lower RH corner of the File View window. **Note:** If you have an animation sequence paused you can render and save an image of the animation frame.

17.7 Rendering a Movie File

The title, **Rendering a Movie File** should possibly be named, **Rendering a Video Clip**. Movies are made by combining a series of video clips (short sections of video). Video clips are made from animation frames compiled into a sequence. Before you can render a video file you must have an animation sequence.

To demonstrate the process an animation will be created and rendered to video . Animation is covered in the next chapter so assuming you are working your way through the book chapter by chapter you will not have covered the topic at this stage. To create an animation work through the following instructions.

In the **3D Viewport Editor** go into **Camera View** (Num Pad 0) and Translate the default Cube back along the X Axis outside the Camera View (Figure 17.8). Press the **I Key** and in the drop down menu, select **Location**. In the **Timeline Editor** at the bottom of the screen click RMB on the vertical blue line, hold and drag the line to frame 10. In the 3D View Editor, Translate the Cube along the X Axis to outside Camera View on the opposite side. Press **I Key** again and select **Location**.

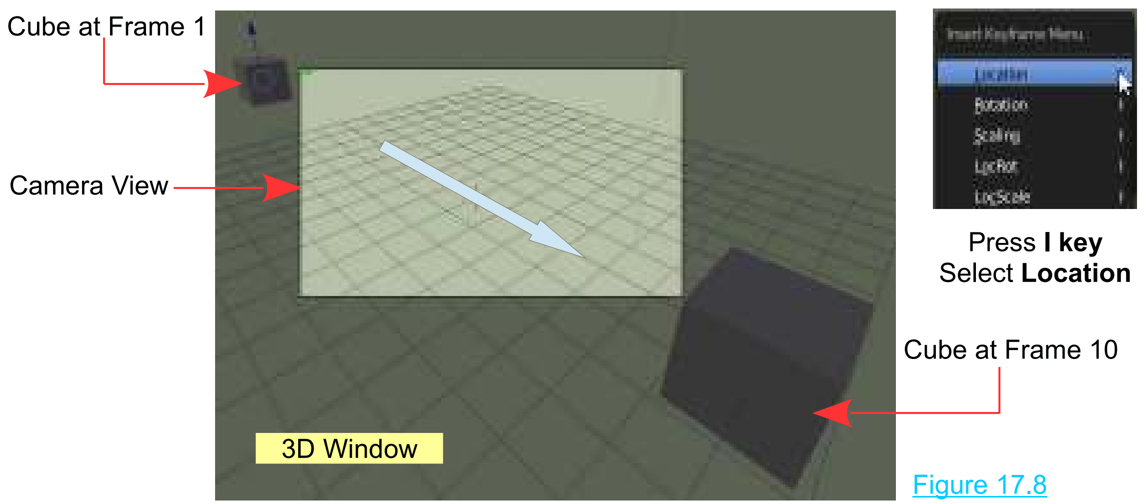


Figure 17.8

In the **Timeline Editor** Header change the **End: 250** value to **End: 10** (Figure 17.9).

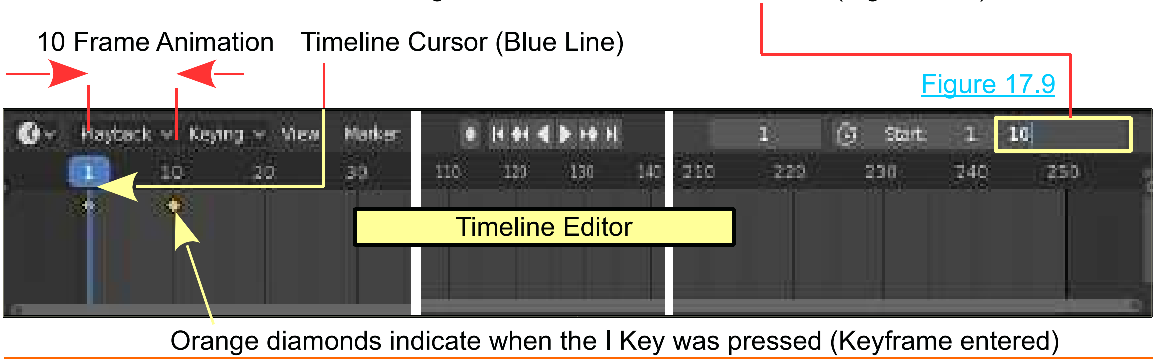


Figure 17.9

You have made an animation consisting of 10 frames. In the Timeline Editor click on the reverse arrows to set the animation at frame 1 (Figure 17.10) . Click the start button to play the animation in the 3D Viewport Editor. The Cube zips across the Camera View and repeats the 10 frame animation over and over. Press **Esc** to quit.

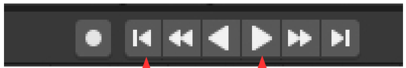


Figure 17.10

Reverse Arrows - Go to Start Frame (1)

Start Play

OK! Now for the render.

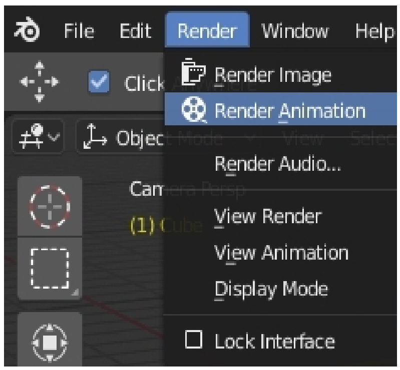
In this demonstration use the default settings in the **Properties Editor, Output buttons.** The **Output Tab** is set to render a **PNG** file format and save it to the **/tmp** folder on the hard drive (Figure 17.11). If you haven't been messing with your hard drive and re-partitioning the /tmp\ folder should be in **C:\tmp**.

Figure 17.11

tmp stands for temporary. Programs use this location for storing information while they work therefore there could be files in the folder.

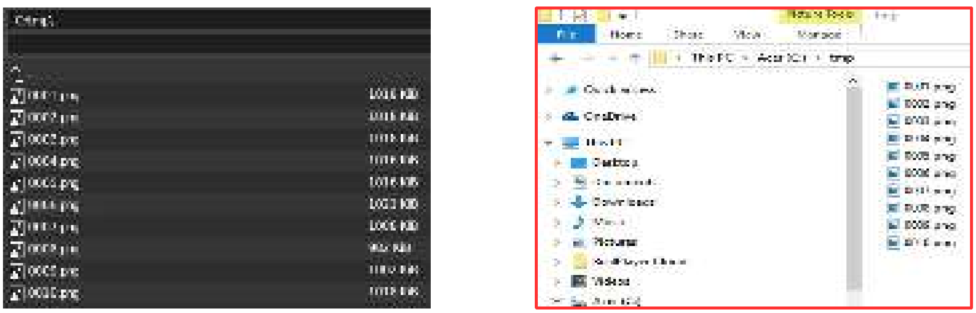
Before you do any rendering to the **/tmp** folder give it a clean out so you have a clean slate for this demo.

Figure 17.12



To Render the animation click **Render** in the **Screen Header** and select **Render Animation (Ctrl _ F12)** (Figure 17.12).

Blender will start making an image for each frame of the animation and save it to the **/tmp** folder. The reason for Rendering an image for each frame is that the default output file type is **PNG** which is an image file. The same thing would happen if you had JPEG selected. The Render is performed in the Image Editor where progress displays at the top of the Screen. When the render is finished Close the Image Editor. If you look in the /tmp\ folder when the render is finished you will see 10 image files (Figure 17.13).



Blender File Browser Window Figure 17.13 Windows 10 File Explorer

17.8 Video Playback

To playback your rendered animation from within Blender you go to the **Screen Header** and click on **Render** and select **View Animation**.

Playing the animation at this stage is simply cycling through the sequence of image files that has been created. Ten simple image files constitute a very very basic animation. Animations can run to thousands of image files which would accumulate and create a massive storage problem on your hard drive. To save space you render the animation sequence to a **Movie File**.

As an example take the same 10 Frame animation previously created and in the **Properties Editor, Render buttons, Output tab**, change the default **PNG** to one of the other **Movie** options, for example **AVI Raw**, which is a video file format (Figure 17.14). Video file formats compress the data from the rendered animation into a single file instead of the series of image files.

Figure 17.14

Before you Render with the video file format clean out the **tmp** folder again.

OK! With a clean slate go ahead and select **Render Animation** to start Rendering. When Blender is finished Rendering press **Esc** to exit the Image Editor.

Go look in your **tmp** folder and you will find a single video file (Figure 17.15). Press the **Play** button to replay the rendered animation in the inbuilt player. Since this is a video file you could also play it in some external application such as **VLC Media Player**. If you try this with the 10 frame animation pay attention since 10 frames plays pretty quickly. An external player only plays the file once and at 24 frames per second this is less than half a second of video.

Windows 10 File Explorer Figure 17.15

17.9 Video Codecs

In the preceding example, changing the default **PNG** file format to **AVI Raw**, elected to use the **AVI Raw Video Codec** which tells the computer how you want your animation data encoded. There are many many video codecs to chose from and simply selecting a codec type in Blender doesn't necessarily mean that you will get the result that you want. You must have the **Codec** installed on your computer.

A Codec is a little routine that compresses the video so that it will fit on a DVD, or be able to be streamed over the internet, or over cable, or just be a reasonable file size.

Simply put, using a codec, you encode the Blender animation data to a video file which suits a particular output media such as PAL TV or NTSC TV. When you have used the encoded data to create a video CD or DVD, the CD or DVD is played in a device (CD / DVD Player) which decodes the data for display i.e. Television Screen.

As previously stated you must have the codec installed on your computer. Codec Packs are available for download from the internet. Two examples are:

K-Lite Codec Pack 12.4.7

media.player.codec.pack.v4.4.2.setup.exe

17.10 Making a Movie

In the preceding information the procedure for rendering an image or a animation sequence has been briefly explained. In rendering the animation you first created a series of image files and then repeated the process creating a video file. The video file does not constitute a movie. In this case the video was a mere 10 frames, a Video Clip, but even if it were a thousand frames it would not be a movie. It is merely a render of one animation sequence from one Scene into a Video File. Movies are made by combining many video files and then rendering the combination to a Movie File. At the same time as this combination is compiled sound effects are added and synchronized with the video.

This combining, synchronizing and editing takes place in a **Video Sequence Editor** (VSE). Blender has its own VSE which is discussed in Chapter 26.

A Video Clip (movie file) will take some time to Render (compile) depending on the length of the animation. Each Frame of the animation has to be rendered and saved. Depending on the complexity of the Scene, a Frame can take from a few seconds to several minutes to render. To begin, it is best to keep everything very basic and simple. If you get to the stage where you have created a wonderful movie, you can send the animation files to a **Render Farm** on the Internet to have them rendered—it saves you time but it costs you money.

18

Animation

18.1 The Animation Screen
18.2 Movement in the 3D View Editor
18.3 Planning the Animation
18.4 Keyframes Time and Interpolation
18.5 Animation Speed and Length
18.6 Inserting Keyframes
18.7 Playing the Animation
18.8 Automatic Keyframing
18.9 Controlling the Animation
18.10 The Graph Editor
18.11 Editing the Graph
18.12 Other Types of Curves
18.13 The Curve Properties Panel
18.14 Animating Rotation
18.15 Rotation Using F-Curves
18.16 Animating Other Features
18.17 Keying Sets
18.18 Animation Follow Path
18.19 Displacement Sound Animation
18.20 Sound Effect and Cast Modifier

Animation is the illusion of motion, of making objects depicted in a still image appear to move. In its simplest form stick figures drawn on separate pages appear to move when the pages are viewed in quick succession. Animation has advanced from that simple technique to sophisticated full length feature films with sound and voice which are experienced today. In the past Movies were produced by laboriously drawing many images, posing figures, each slightly different to the next which were photographed and transcribed to film. Each image was then said to be a Frame in an animation sequence. Today the process is accomplished by Computer Graphics which essentially mimics that same process.

In Blender animation is accomplished by creating data which displays on the computer Screen. The display is programmed to change over a period of time (**The Timeline**) and then captured by a camera at intervals producing **Frames** of the animation. Each Frame is **Rendered**, which means the Blender data is correlated and turned into a series of digital images. The images are compiled into a video clip or sequence depicting an action. Finally a series of video clips are assembled, edited, combined with effects such as audio and converted to a movie file.

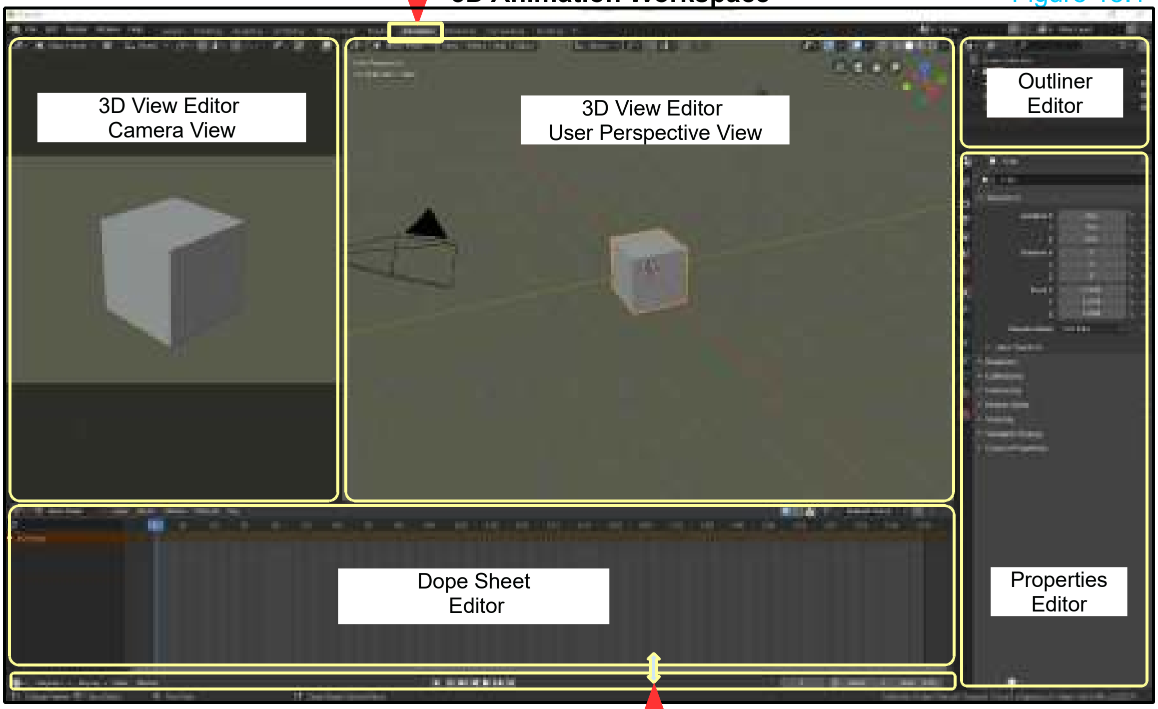
This chapter will explore some of the techniques used for creating animation effects.

18.1 The Animation Screen

Animation may be performed in the default Blender Screen, in the **3D Viewport Editor**, in conjunction with the **Timeline Editor.** Alternatively Blender has a dedicated **Animation Workspace** (Screen Arrangement)(Figure 18.1).

The **Workspace** is accessed in the Blender Screen Header.

3D Animation Workspace Figure 18.1



Timeline Editor (Drag border up to view)

The **3D Animation Workspace** comprises a **3D Viewport Editor** in Camera View (upper LHS), a second **3D Viewport Editor** in User Perspective View (center), the **Outliner Editor** and **Properties Editor** at the RH side of the Screen and the **Dope Sheet and Timeline Editors** across the bottom. To see the **Timeline Editor** drag the border up.

To demonstrate the very basics of the animation process the default Cube Object will be animated to move in the Scene, and change shape at the same time. Simple motion and deformation of an Object are only two of many features which may be animated.

The objective in creating an animation is to capture what you see on the Screen in the **Camera View**. This will be what is included in the final render. You may set up an animations sequence in the Blender Scene then position the Camera or position multiple Cameras to capture parts of the sequence. What is captured will be rendered to a series of still images (Frames) producing a video clip. The clip will be finally compiled (spliced together) with other clips to make a movie file.

18.2 Movement in the 3D View Editor

Moving or Translating Objects in the 3D View Editor may be performed by selecting the Object, pressing the **G Key** and moving the Mouse or by using the **Manipulation Widget**. The two methods move the Object in the Scene in different ways.

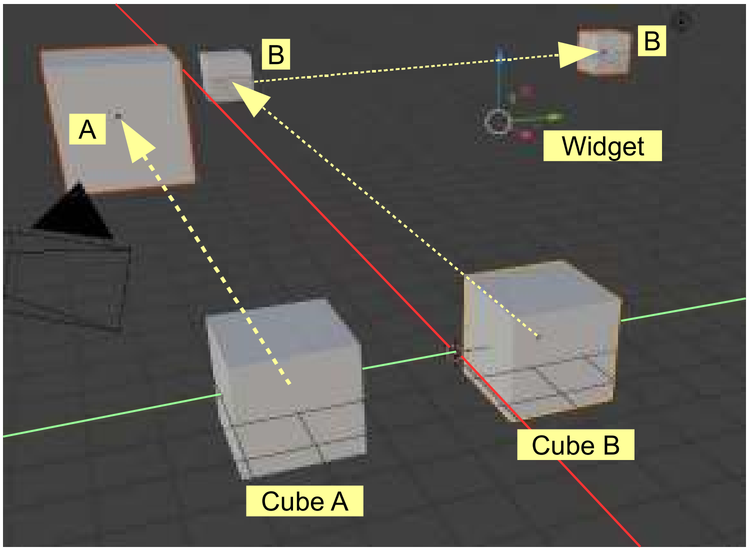


Figure 18.2

What you see in the 3D View Editor when you move Objects depends on the method of Translation. In Figure 18.2 **Cube A** is Translated by pressing the G Key (Grab) and moved up and to the left. **Cube B** is translated using the **Move Tool** which activates the Manipulation **Widget**.

Note: The Widget in the diagram is positioned at the center of geometry of the three B Cube Objects . This is for diagram construction only.

When **Cube A** is Translated by using the **G Key** the movement is confined to the plane of the computer Screen.

When **Cube B** is Translated by using the Move Tool Widget the movement is confined to either the X, Y or Z Axis of the 3D World (the Scene).

Cube B has been moved back along the X Axis then to the right along the Y Axis. In **User Perspective View** you see its size diminish as it recedes into the distance. In fact all views of the Cube have the same physical size as seen in Top Orthographic View (Figure 18.3).

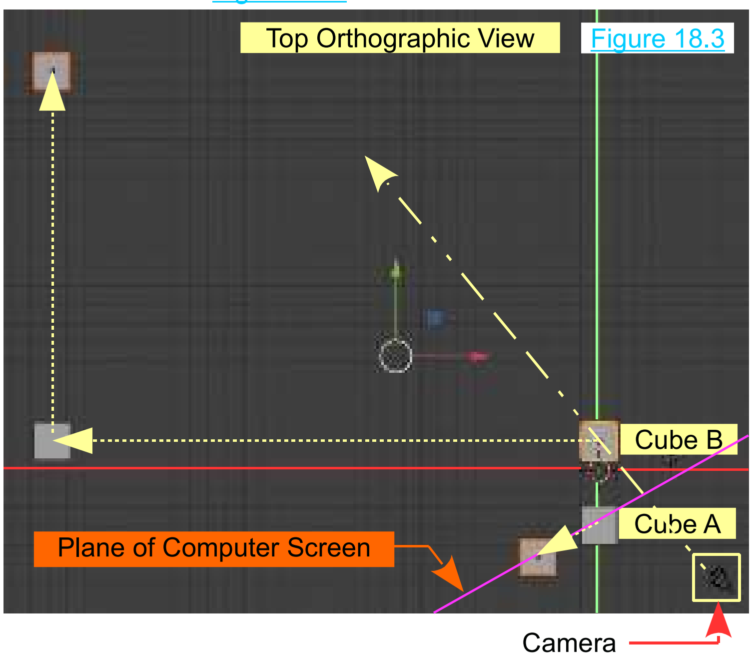


Figure 18.3

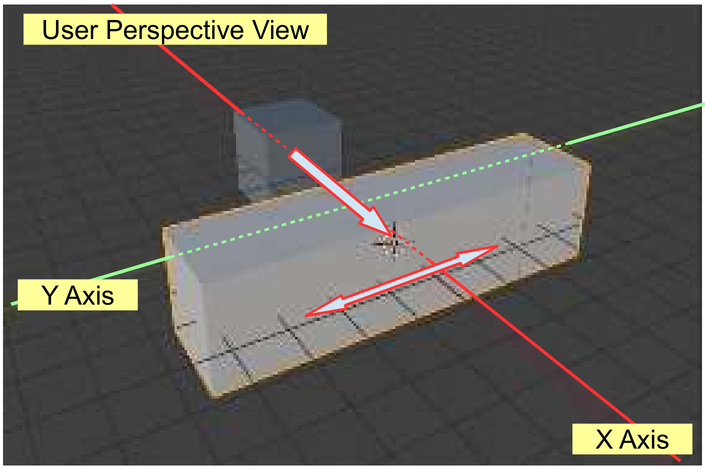
Understanding this concept of Translation on the Computer Screen and in the 3D World will assist when animating Objects to move.

18.3 Planning the Animation

Planing the animation is an important part of the process. Without having even a rudimentary idea of what you want to achieve can lead to disaster when the Scene becomes a little complicated.

In demonstrating the concept of animation, with a view to illustration, begin with a very simple sequence. The default Cube Object in the default 3D Viewport Editor will be relocated (Translated) then animated to move forward along the X Axis of the 3D World and at the same time Scaled along the Y Axis.

Figure 18.4

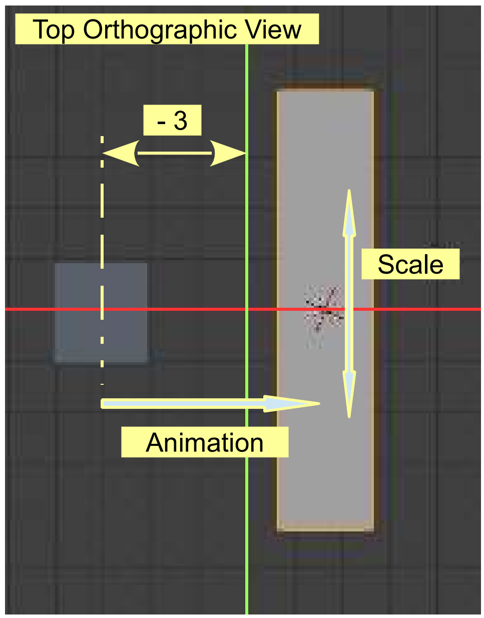


Figures 18.4 and 18.5 show the default Cube Object positioned approximatly three Blender units on the X Axis towards the back of the Scene in the 3D Viewport Editor (minus 3 Units).

The Cube will be animated to move forward along the X Axis.

At the same time the Cube will be Scaled on the Y Axis.

Figure 18.5



Note: In following the demonstration the position and the scale of the Cube are arbitrary but to explain features to follow it will help if they are copied (approximately).

Translating and Scaling will generate Curves in the **Graph Editor** which may be edited to affect the animation.

18.4 Keyframes Time and Interpolation

The first step in an animation is to decide what you want your actor to do in a given time. In this demonstration, the actor will be the Cube Object. How long it takes the actor to do something will depend on how many Frames per second the animation is run and this is determined by which format your final render will be.

The **Render Format** determines how many Frames per second the animation should run (For example when playing in a television format, **NTSC** for the US at 30 fps, **PAL** for Australia at 25 fps). When considering the animation, make the motion occur in an appropriate time. Look at the frames per second and relate it to time. If you want a movement to take 3 seconds and you are running at 25 frames per second, then the animation has to occur in 75 Frames (3 x 25 = 75).

In Blender you do not have to create every single Frame of the animation. You set up single Frames (**Keyframes**) at specific points and the program works out all the intermediate Frames.

Think of a 10-second animation that, when running at 25 Frames per second, would consist of 250 Frames. If you want your actor to go from point A to point B and then to point C in the Scene within the 250-Frame animation, you first insert a **Keyframe** at Frame 1 with the actor at position A. This is giving Blender data that says, at the Frame 1, locate the actor at location A. Then at another Frame, mid way in the animation, insert a second **Keyframe** with the actor at location B. Finally insert a third **Keyframe** at frame 250 with the actor at location C. These are the **Keyframes** for the animation. Blender will work out all the in-between Frames. The Keyframes can also include the data for other features such as scale, rotation and color.

Determining the in-between data is called **Interpolation.** There are different methods of interpolation. By default, Blender uses **Bezier Interpolation**, which for motion gives a nice acceleration and deceleration between **Keyframes**. When an object moves from point A to point B in a given time, it is said to move at a certain velocity (speed). In theory, the speed could be represented as a straight line graph, but in practice an Object at rest (motionless) has to go from being motionless to moving at a certain velocity. The rate at which it attains the velocity is called acceleration. Blender's **Bezier Interpolation** draws curves at the beginning and end of the straight line graph (acceleration and deceleration). You have the options to choose **Constant** or **Linear** type interpolation if appropriate. Selection of interpolation types will be discussed later in the chapter.

Using the term **Bezier** to describe interpolation is in fact an anomaly. Bezier actually describes a type of line (the line on a graph described in the previous paragraph). A Bezier line or curve in Blender is a line that has control points that allow the shape of the line to be altered or edited (see Editing Using Curves Chapter 10). In Blender, the control points are located at the position of the **Keyframes**. Interpolation is performed according to a mathematical formula that determines the shape of the line. When the data for the Frames in the animation is drawn as a line on a graph, the line conforms to that mathematical formula.

For the moment, accept the default Bezier-Type interpolation to demonstrate the insertion of Keyframes and the creation of a simple animation.

18.5 Animation Speed and Length

Set the animation to run at 24 frames per second, which would be suitable for PAL format. Go to the **Properties Editor, Output button, Dimensions tab – Frame Rate** (Figure 18.6).

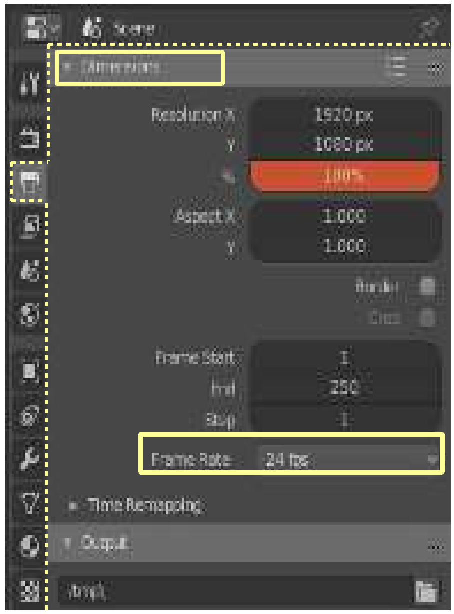


Figure 18.6

Note that in the **Timeline Editor** the Frame range settings are, **Start: 1** and **End: 250** (Figure 18.7); this says the animation will begin at Frame 1 and end at Frame 250. Running at the rate of 24 Frames per second will give an animation time of approximately 10 seconds. If you think about it, 10 seconds is quite a long time for a single action to take place in a video clip. Also in the Timeline Editor, make note of the lighter grayed area beginning at Frame 1 and ending at Frame 250. Changing the **Start Frame** and **End Frame** values in the header panel will move the end positions of the lighter grayed area. Note the vertical blue line at Frame 1. This is the **Timeline Cursor**.

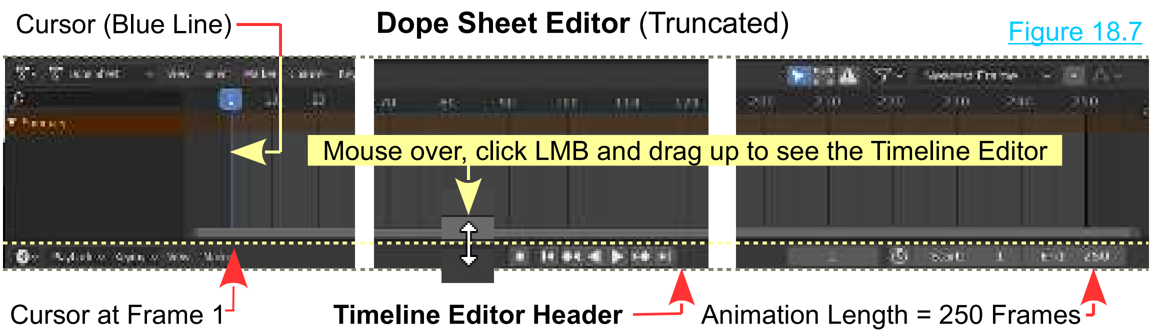


Figure 18.7

Note: The the Scale and Cursor are replicated in the Dope Sheet and Timeline.

To make the process relatively simple and suitable for a demonstration, the actor (the Cube) will be made to move in a straight line along the X Axis and at the same time increase in size on the Y Axis. Make sure the Cube is selected in the 3D Viewport Editor. Initially only two **Keyframes** will be inserted.

In the default Scene, the actor (the selected Object – the Cube) is located at Frame 1 in the animation. In the upper LH corner of the 3D Editor, you will see **(1) Cube** in white lettering. This indicates that you have the Cube selected. If you had ten objects in the Scene, all of which were actors with perhaps some hidden, it's nice to know which one is selected.

Observe the **Timeline Editor** at the bottom of the Screen. By default, in the Animation Workspace, only the Header is displayed. In the Header the buttons labelled **Start: 1, End: 250**, and **1** show the start Frame and end Frame that was set by default for the animation and the current Frame of the animation (Frame 1).

By dragging the upper edge of the Timeline Editor up you will see a scale showing the Frame numbers of the animation and in the Editor itself you see the number of Frames set for the animation represented by the light gray area. The default is 250 Frames. This corresponds to what is seen in the Dope Sheet Editor.

Clicking LMB on the scale repositions the Cursor (blue button with blue line). With the mouse cursor in the **Timeline Editor** pressing **Num Pad + or –** zooms the scale. Scrolling the Mouse Wheel zooms the scale.

At Frame 1 is the **Timeline Cursor** (blue button with vertical blue) line . Click on the cursor (blue button) with the LMB, hold and drag it across to Frame 25 (Figure 18.8). Note the number in the blue button changes and also next to **Cube** at the upper LH side of the 3D View Editor and in the Header bar of the **Timeline Editor**. Other ways to change the Frame are to click on the little arrows on either end of the **Frame Number** in the Timeline Editor Header, or click LMB on the button, hold and drag to change the Frame number or click on the **button**, hit delete, and retype the required frame number. *There is always more than one way to skin a cat.*

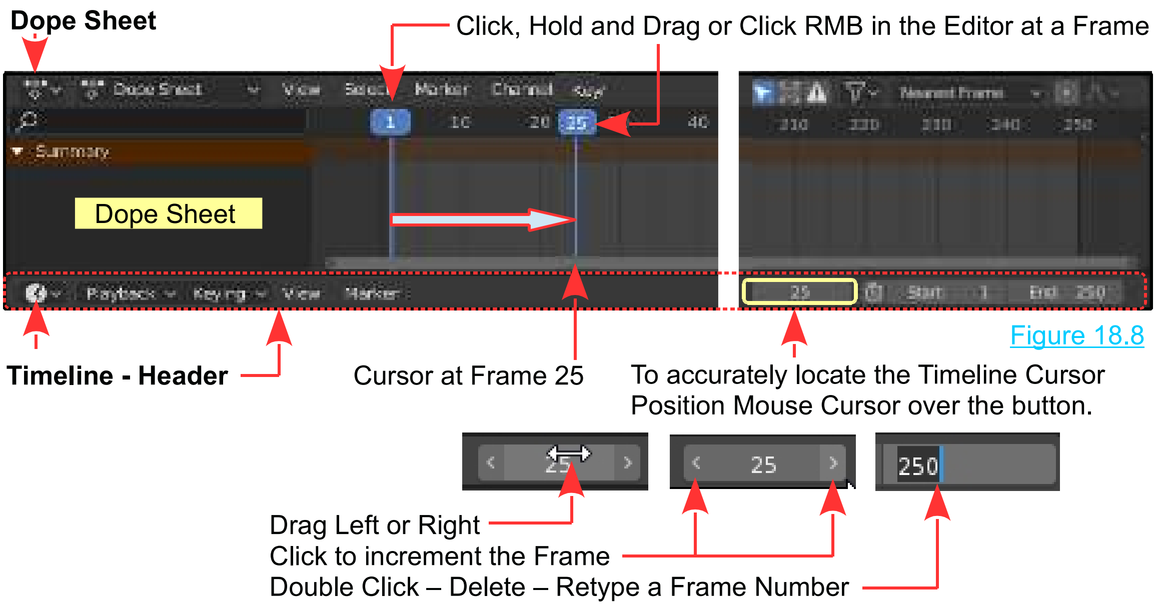


Figure 18.8

18.6 Inserting Keyframes

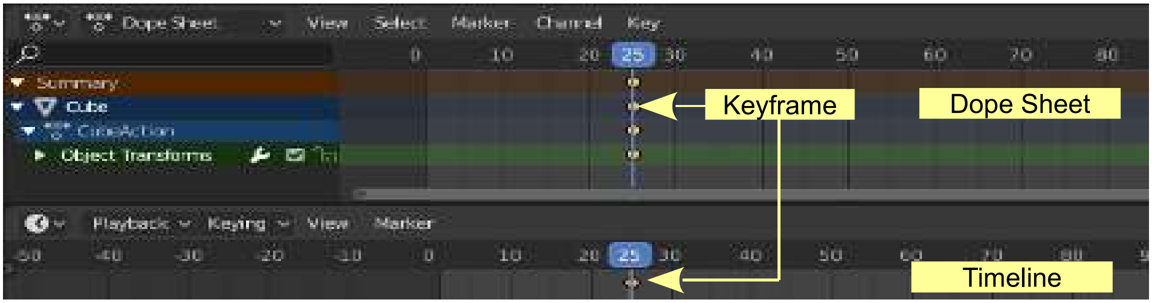
Keyframes are inserted in the animation at specific Frames. For example, with the Cube Object located at minus three (-3) units on the X Axis, position the **Timeline Cursor** at Frame 25.

Place the **Mouse Cursor** in the **3D Viewport Editor** and press the **I key** to insert a **Keyframe**. In the selection list that displays, select (click) **LocRotScale**, which covers moving, rotating and changing the size of the Object (Figure 18.9). You will see orange dots appear at Frame 25, in the Dope Sheet Editor and orange diamonds in the Timeline Editor.

Figure 18.9

Keyframe inserted in the animation at Frame 25.

Figure 18.10



At this point, only one set of Keyframes have been inserted and the Cube remains stationary at minus three units on the X Axis of the Scene.

If you click LMB on the **Dope Sheet Editor Cursor** (blue button) ,hold and drag the mouse from Frame 25 along the timeline the Cube (actor) remains stationary. Clicking LMB and dragging the blue line in the Editor is called **scrubbing the animation**, which is actually manually playing the animation. You can play the animation by clicking the **Play button** in the **Timeline Editor Header**.

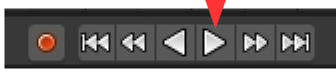
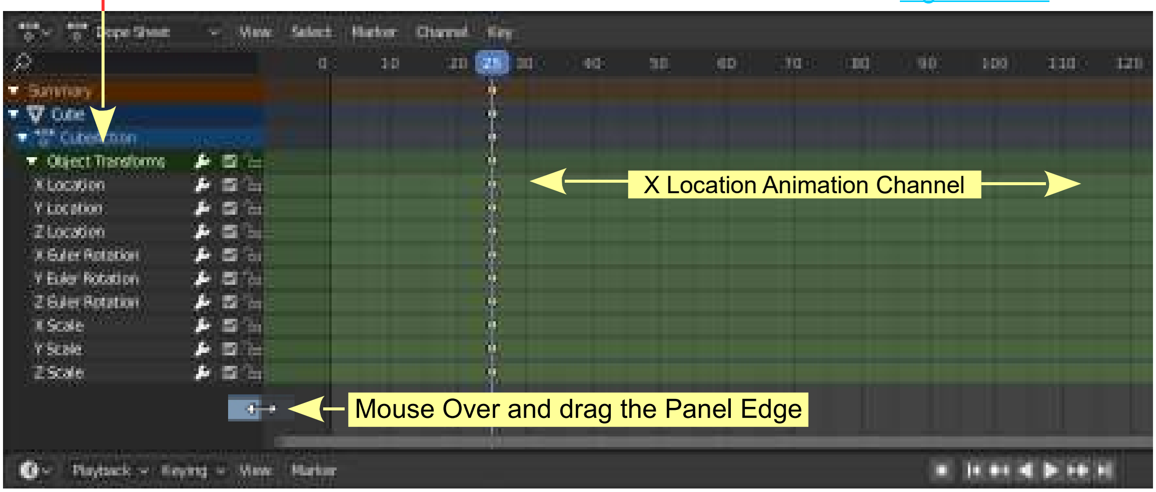


Figure 18.11

Since you haven't told the actor (the Cube) to do anything, nothing happens.

In the **Dope Sheet Editor,** Keyframes (orange dots) are located on a colored strip representing an **Animation Channel**. Click on the **Object Transforms** to see the full display.

Figure 18.12



The animation channels give a visual reference to the **Keyframes**.

Note: With the Timeline Editor Cursor positioned at a Keyframe the notation in the 3D Viewport Editor indicating the selected Object changes color.

Note: Going from Frame 1 to Frame 25 at 24 Frames per Second equals approximatly 1 second.

Continue creating the animation by moving the Cursor to Frame 75 (click on Frame 75).

In the 3D Viewport Editor, grab and move the Cube 6 Blender units on the X Axis (-3 to +3) and scale it up four (4) times on the Y Axis (Figure 18.13). With the Mouse Cursor in the 3D View Editor, press the **I key** and select **LocRotScale** to insert a second Keyframe. You will see another set of orange diamonds in the Timeleine at Frame 75 (Figure 18.15).

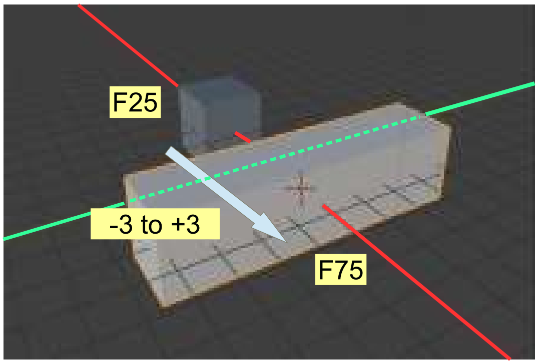


Figure 18.13

To accurately locate and scale the Cube, with the 3D Mouse Cursor in the 3D View Editor, press the **N Key** and enter values in the **Object Properties** panel (Figure 18.14).

Values shown are for Loc Scale at Frame75.

N Key to hide the panel.

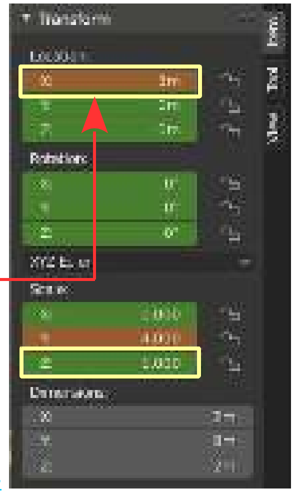
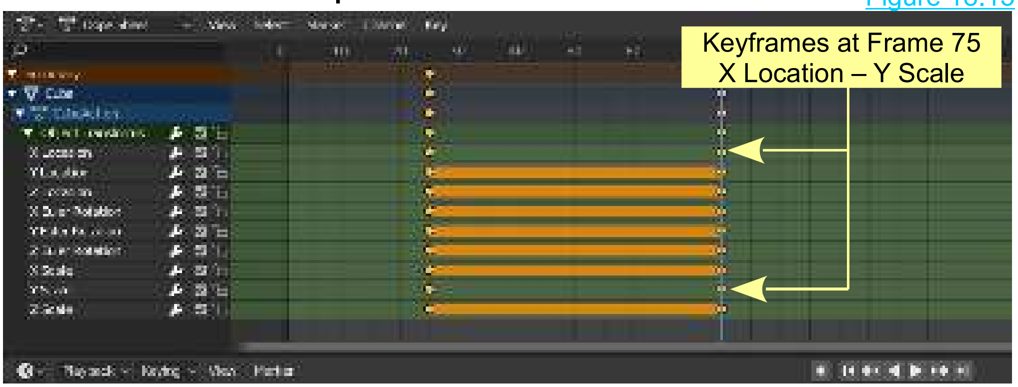


Figure 18.14

Dope Sheet/Timeline Editor

Figure 18.15



Note: Only **X Location** and **Y Scale** Channels have data recorded. The orange Channels indicate that there is no change in state between the Keyframes in these Channels.

When you scrub the animation between Frames 25 and 75, you will see the Cube move and change in size—you are manually playing the animation. Note that the action only takes place between frames 25 and 75, which is the location of the Keyframes; no action takes place on either side of the Keyframes.

> **Note:** In moving the Cube from minus three to plus three on the X Axis the Cube will have disappeared from Camera View. This will require addressing since Camera View is what Renders as the final animation.

18.7 Playing the Animation

To actually play a preview of the animation, move the Cursor in the Timeline to frame 1 then press the **Spacebar** with the Cursor in the 3D Viewport Editor. Say “one thousand” to yourself slowly (counting one second, while the Cursor in the **Timeline** moves across to frame 25). You will see the Cube remain stationary until the Cursor reaches frame 25 then the Cube will move and increase in size. At frame 75, it stops moving and changing size. The Cursor in the Timeline continues on to frame 250 then jumps back to frame 1 and the preview of the animation plays again. Press **Esc** or press the Spacebar a second time to stop playing.

Another way to play the animation is to press the **Play** button in the **Timeline Editor Header** (Figure 18.16). This button is much like the play button on any video or audio player.

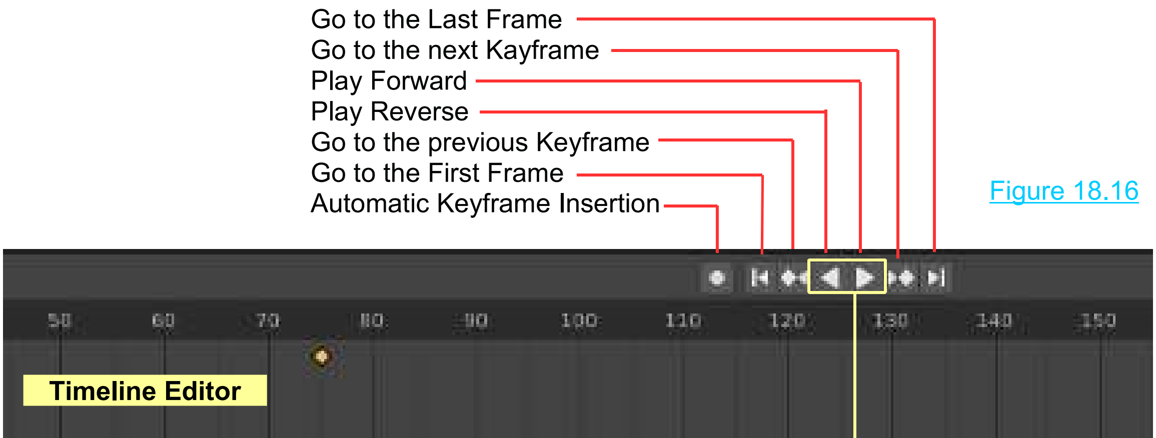
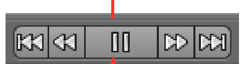


Figure 18.16

When pressing Play, Reverse or Forward the button changes to the **Pause Button**.



More Keyframes may be added to the animation to translate (move), scale and rotate the actor in the Scene. For the most part, location and size Keys work flawlessly but care needs to be taken with Rotation Keys . If you try to rotate an Object too far in one set of Keys, the Object may not rotate in the direction you want it to and it may rotate oddly. Try small angular movements between Keys while rotating. There are better ways to control this and tools to simplify the process, (see 18.14). Be aware that the movement of the actor may not be exactly as planned. Blender automatically defaults to trying to create a smooth flow through the animation.

18.8 Automatic Keyframing

Keyframes have been inserted in the animation by placing the Mouse Cursor in the 3D Viewport Editor, moving to a Frame in the Timeline, changing the status of the Object and then pressing the **I Key** and selecting one of the Keyframe options.

Blender has an **Automatic Keyframe** insertion function which is activated by pressing the white button in the **Timeline Editor Header** (highlights blue when active)(Figure 18.17).

Figure 18.17

With auto on, whenever you Move, Scale, or Rotate the actor Object in the 3D Viewport Editor, a Keyframe will be inserted at whatever Frame has been selected in the Timeline.

For example; With the Cube Object in the default Scene in the 3D Viewport Editor it is located at the intersection of the X Axis and Y Axis. The Cursor in the Timeline Editor is located at Frame 1. With Auto on, Translating the Cube along the X Axis inserts a Keyframe at Frame 1 recording that this is the state of the Cube at Frame 1.

If the Timeline Cursor had been positioned at Frame 25 then the Cube Translated, a Keyframe will have been inserted at Frame 25. This will be the First frame in the animation. If the Timeline Cursor is moved back to Frame 1 the Cube remains in its position for frame 25.

The procedure for Automatic Keyframing is, position the Timeline Cursor, Translate, Rotate or Scale the selected Object to insert Keyframes.

Remember to turn this off after you're finished using it (press the button a second time)**.**

18.9 Controlling the Animations

When an animation has been created it may be controlled (modified) in the **Dope Sheet/Timeline Editor** and by using the **Graph Editor**. Modifying the animation means adjusting how motion is performed, such as the speed and when the motion occurs in the animation. Adjustment also entails what type of motion is performed, when movement takes place and how fast the motion is may be adjusted by repositioning Keyframes in the Dope Sheet/Timeline Editor. Different types of motion adhere to mathematical formula and, therefore, are represented by graphs. The shape of the graph line represents the motion, therefore, altering the shape of the graph line changes the motion.

To modify and control the animation, in the **Animation Workspace**, change the 3D Viewport Editor with Camera View to the **Graph Editor** and align the **Dope Sheet Timeline** (Frames) (Figure 18.18 over)

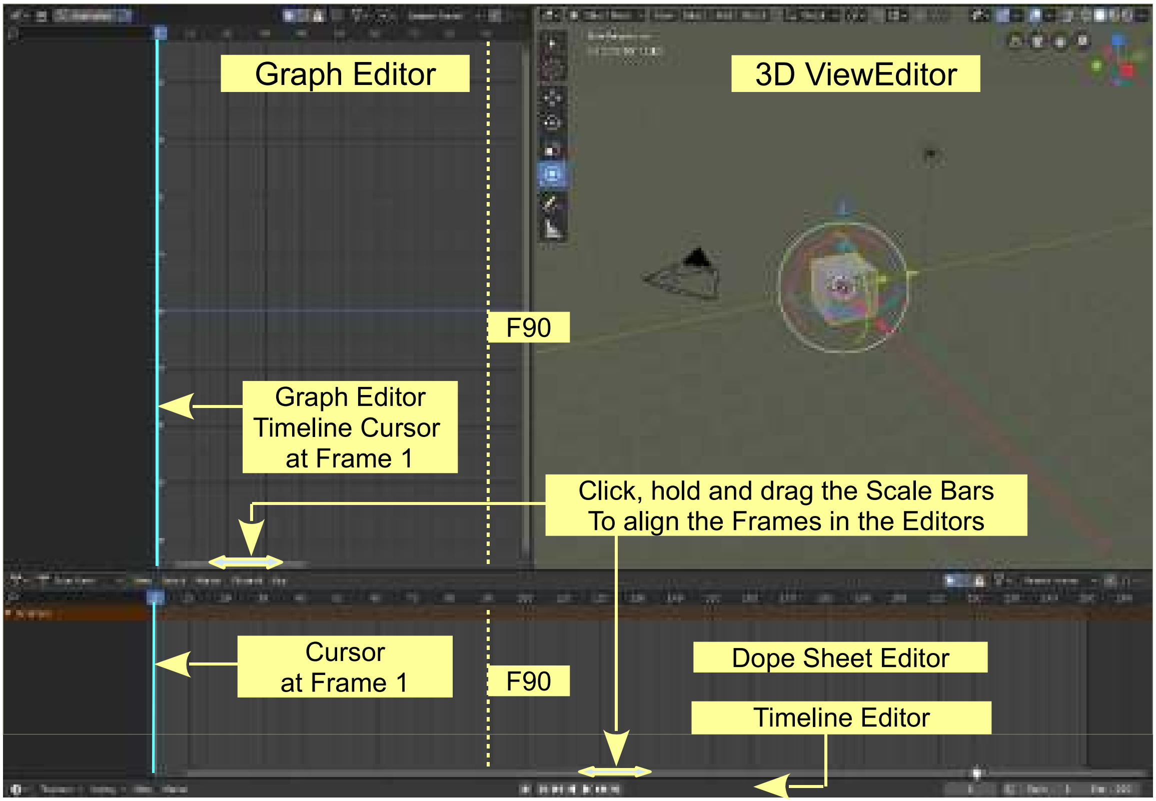


Figure 18.18

To align the **Timelines** click and drag the **Frame Scale Bars** and **Pan the Graph Editor panel**.

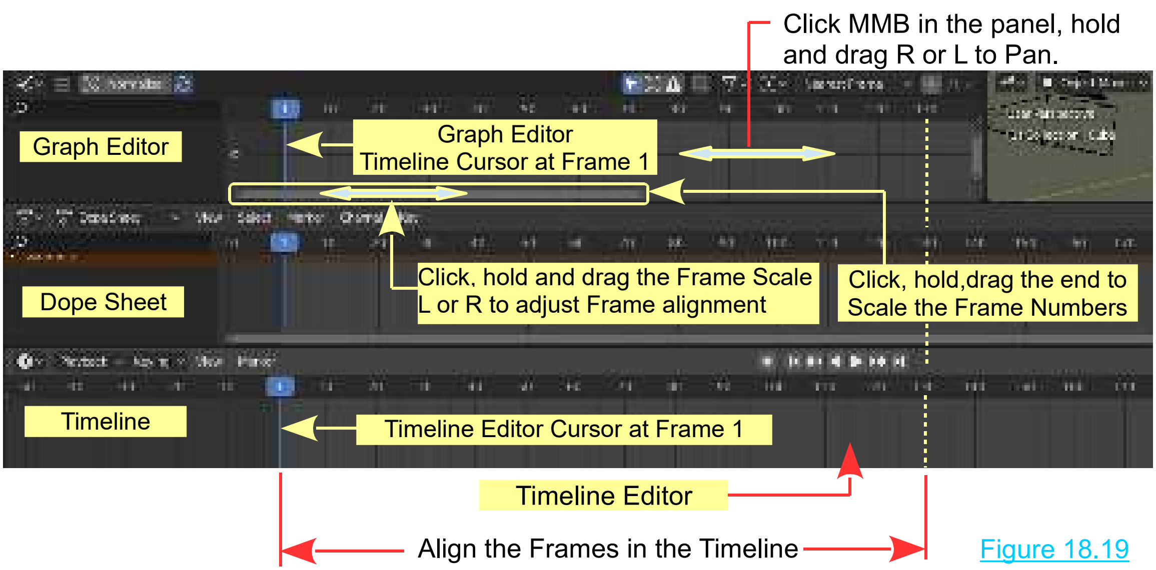


Figure 18.19

18.10 The Graph Editor

The **Graph Editor** shows a graphical display of the animation. The graphs can be edited to refine and control the animation actions. By adjusting the position and scaling panels you can align the Graph Editor with the Dope Sheet/Timeline Editor (Figure 18.20).

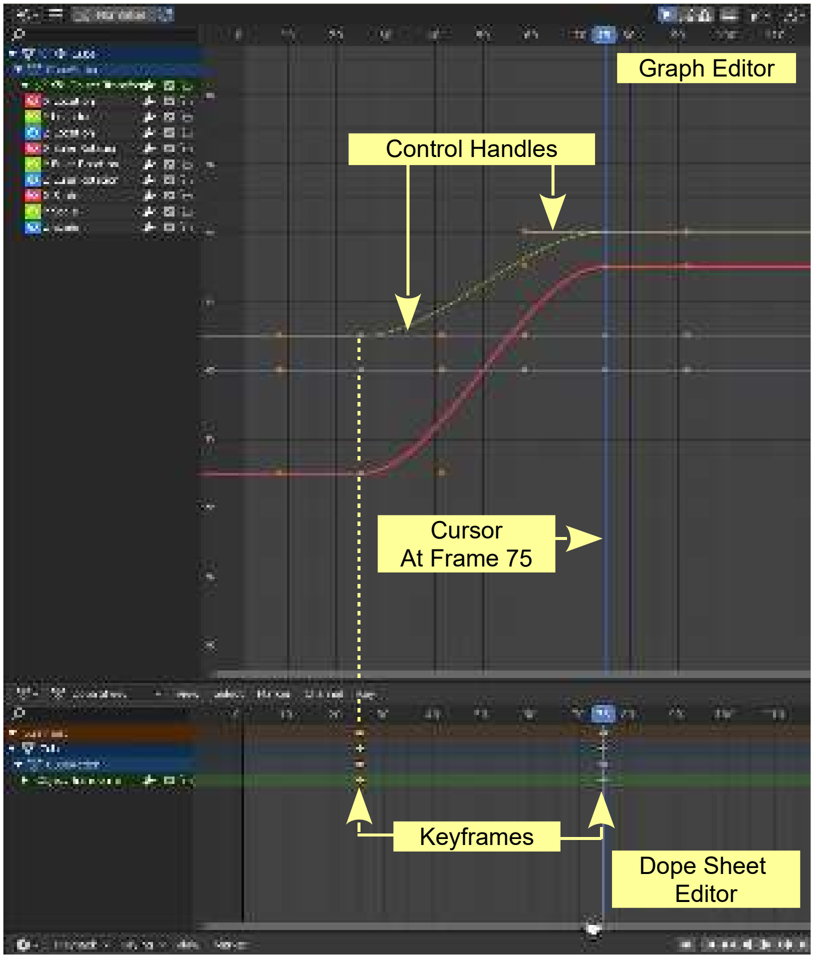
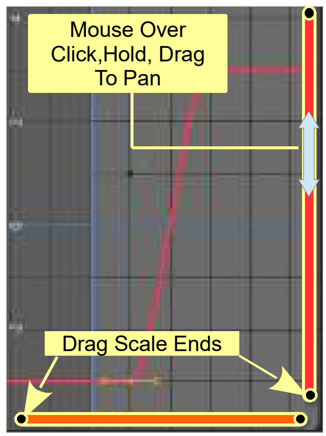


Figure 18.20

Zoom the horizontal and vertical scales by clicking, holding and dragging the buttons at the Scale Ends end of the Scale Bars.



In Figure 18.20 the Keyframes in the Dope Sheet/Timeline Editor have been aligned (approximately) with the Graph Control Handles in the Graph Editor to demonstrate the correlation between the two Editors.

The graph lines in the diagram represent the Keyframes which were inserted when Translating and Scaling the Cube Object (18.3 - Figure 18.4)

Examine the Graph Editor in more detail (Figure 18.21 over).

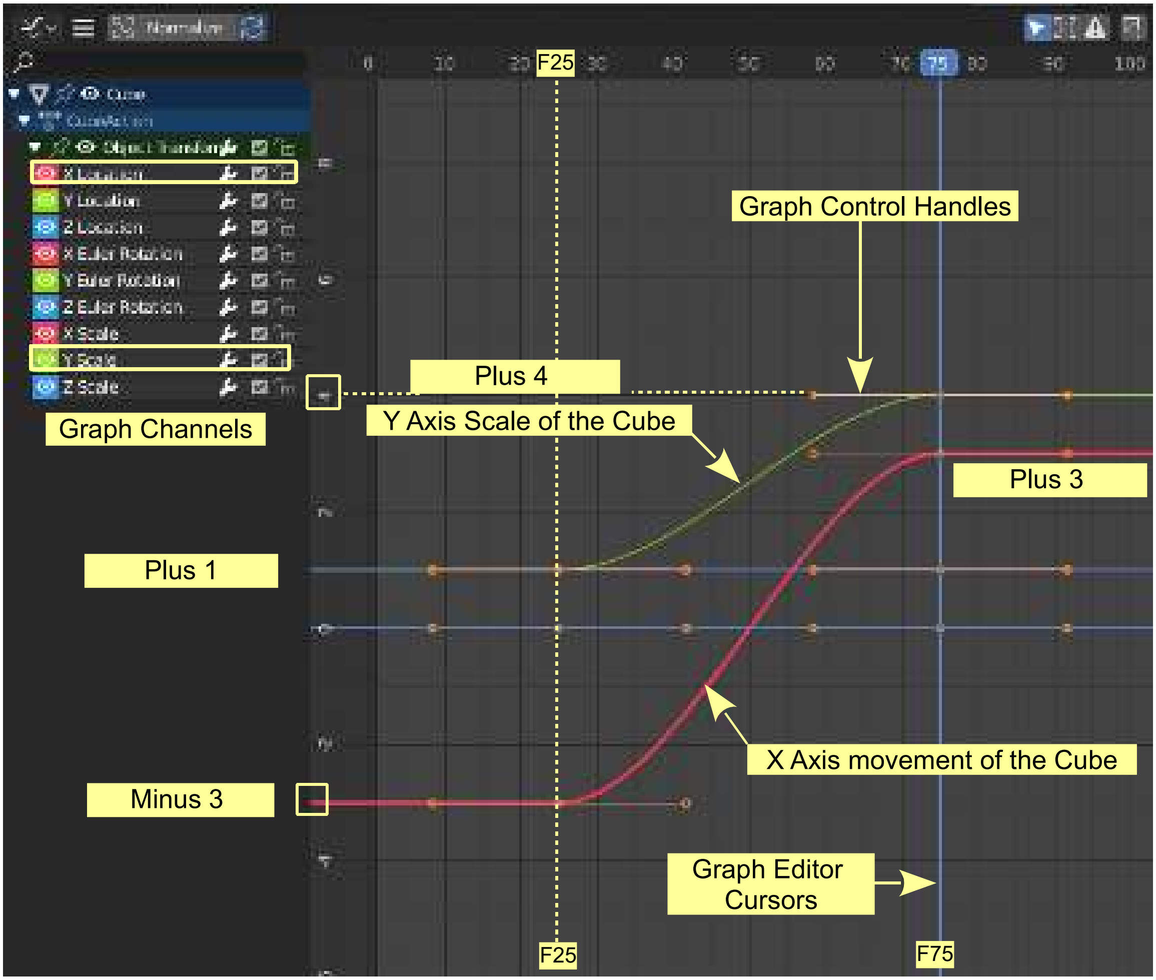


Figure 18.21

In the Graph Editor the red line represents the movement of the Cube Object on the X Axis of the 3D World. The movements initial position of minus three units changes to plus three units between Frame 25 and 75 (the position of the Keyframes). The green line represents the change in Scale of the Cube on the Y Axis (default Cube Scale = 1. Scale value entered = 4). The two horizontal blue lines represent the Z Axis Location and Scale which, being horizontal, means no change. You see Frame numbers in the scale at the top of the Editor and Blender units in the vertical scale. Note: The vertical alignment of graph lines with the scale is approximate.

The Graph Channels in the panel at the LH side of the Editor list the actions that have been entered in the animation by inserting Keyframes. When entering Keyframes, type **LocRotScale** was selected, therefore, the Graph Channels list Location, Rotation and Scale actions. In the Cube animation only the X Location and Y Scale Channels are of significance. The remaining Channels are shown since LocRotScale was the Keyframe Type selected.

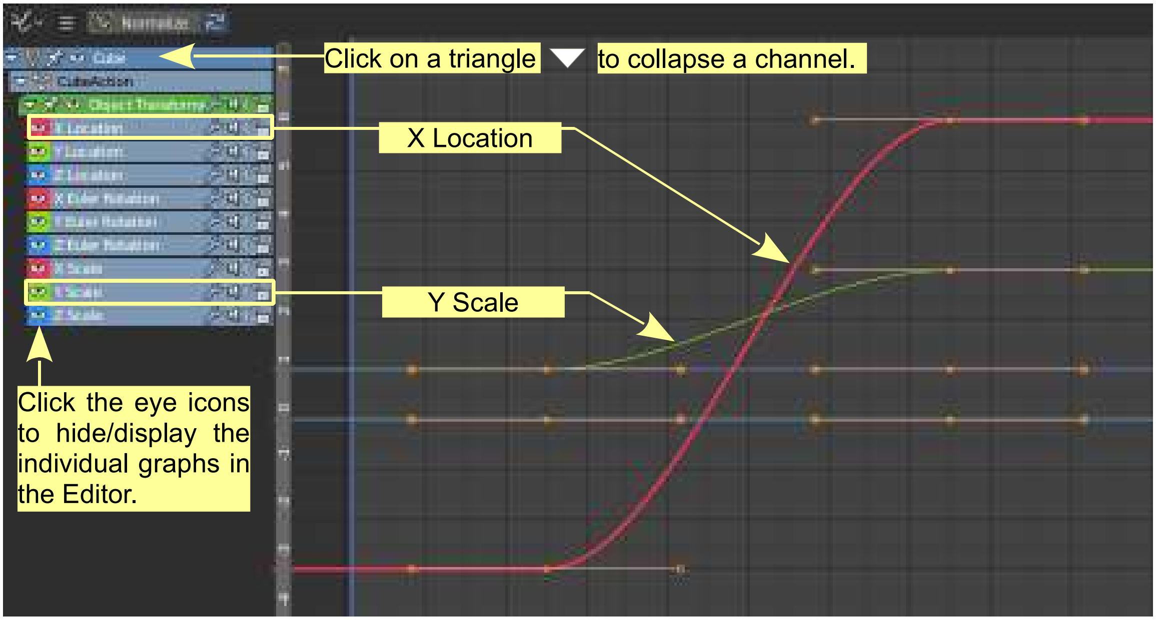


Figure 18.22

Graph Editor Cursors is the Vertical blue line – LMB click on the blue button, hold and drag in the Frame Header to position.

Scaling the Graph Editor may be done by clicking on the Scale Bar, holding and dragging the Mouse. Click and hold a dot at either end of a scale to shrink or extend the scale.

Scaling the Frame Bar may be done in a similar manner.

The Dope Sheet Channels, Cube, CubeAction and Object Transforms may be expanded or collapsed by clicking the white triangle preceding each name. (Figure 18.22).

Hiding Graphs: Clicking the eye icons preceding each Graph Channel toggles hide and display of the graph lines in the Editor.

Collapsing Channels in the Dope Sheet and hiding graph lines in the Editor can be very useful in a complicated animation. In the demonstration only the X Axis Translation and Y Axis Scale have been animated. There are many more features of the Cube alone which may be animated, therefore, you can imagine the Graph Editor could become congested with information.

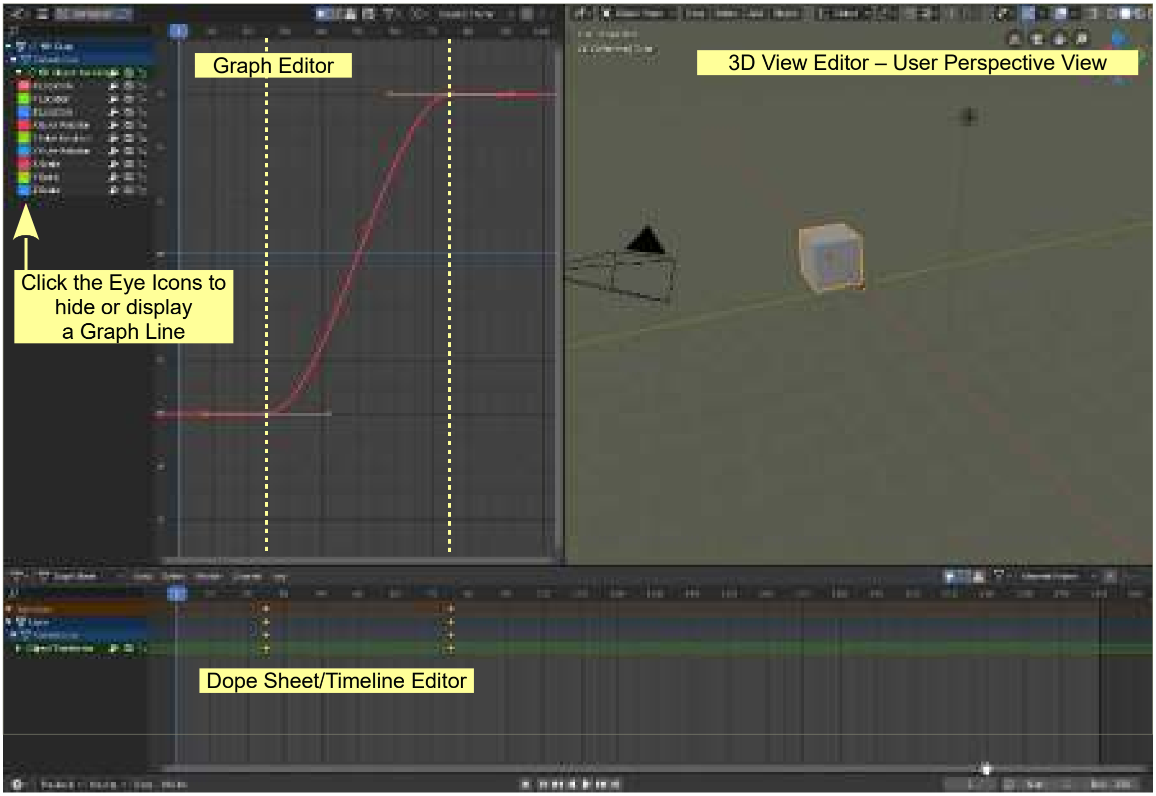
Positioning the Graphs relative to the Timeline in the Graph Editor may be accomplished by selecting Control Handles on a Graph Line, pressing the G Key and dragging the Mouse. This action moves the selection, moving the Graph Line. The movement is relative to the Timeline. Graph Lines that are not selected remain stationary, therefore, the movement of the selected line alters the action of the Object in the 3D View Editor relative to other actions.

18.11 Editing the Graph

Editing (changing the shape of the curve) in the Graph Editor will affect the animation that takes place in the 3D Viewport Editor. The curves (graph lines) are Bezier Curves as described in Chapter 10.

To understand how the animation is edited in the Graph Editor, arrange the **3D Animation Workspace** as shown in Figure 18.23. The default 3D Viewport Editor camera view has been changed to the Graph Editor and aligned with the Dope Sheet/Timeline Editor at the bottom of the Screen. The display of all but the X Axis Location Curve have been cancelled.

Figure 18.23



Note: The Curve Control Handles in the Graph Editor are aligned with the Keyframes in the Dope Sheet Timeline. The Timeline Cursors are also aligned (at frame 1).

To recap on the animation, press the Play button in the Timeline Editor. The blue line Cursors in the Timeline and in the Graph Editor move. Initially the Cube in the 3D View Editor remains stationary. When the Cursors reach Frame 25 (position of the first Keyframe) the Cube begins to move along the X Axis of the Scene. The movement of the Cube continues until it reaches Frame 75 (position of the last Keyframe). As the Cube moves between Frame 25 and 75 it scales on the Y Axis. At Frame 75 the Cube ceases to move and change shape.

Selecting the Curve in the Graph Editor

The X Location Curve in the Graph Editor is a Bezier Curve representing the X Axis movement of the Cube, therefore, the Control Handles can be selected and manipulated. The following commands execute selection procedures when the Mouse Cursor is in the Graph Editor panel:

Press **Alt + A Key** deselects the Control Handles. Press the **A Key** reselects the Control Handles.

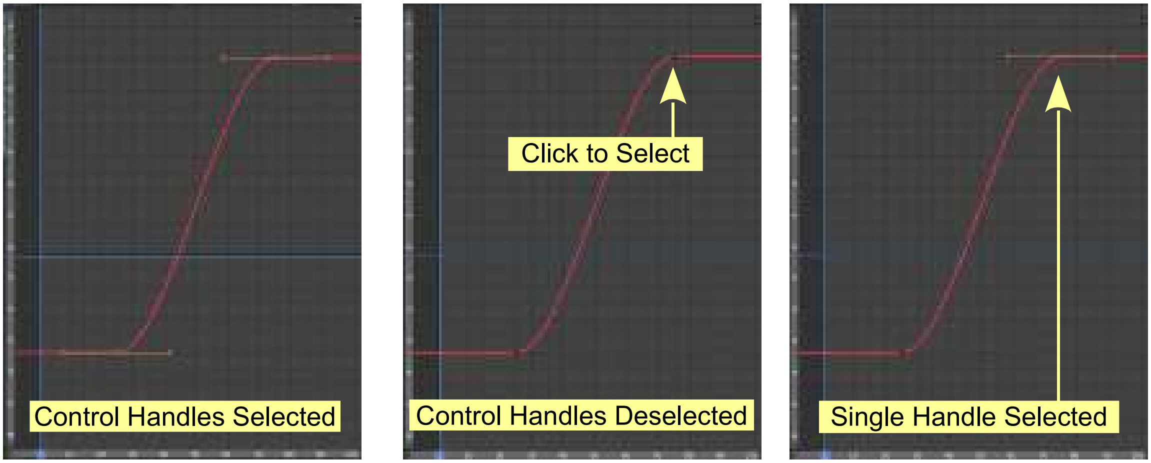


Figure 18.24

With Control Handles deselected (click LMB in an empty space), click LMB on a Control Handle (black dot) to select. With a Control Handle selected it may be Translated, Rotated and Scaled by:

- **G** Key (Grab), move the Mouse, LMB click to locate.
- **R** Key (Rotate) move the Mouse, LMB click to set.
- **S** Key (Scale) move the Mouse, LMB click to set.

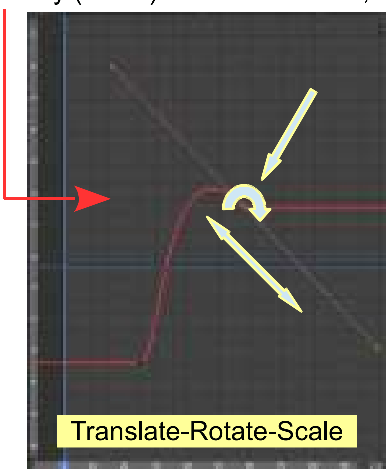
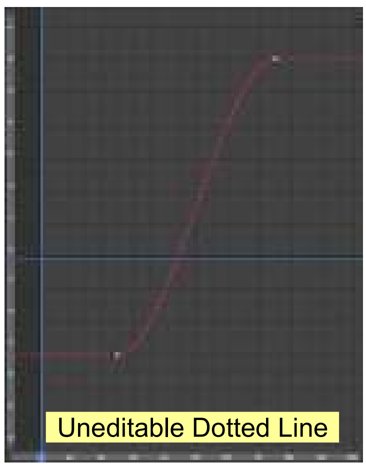


Figure 18.25



Each of the above actions reshapes the Curve affecting the X Axis movement of the Cube in the animation. With all Control handles selected or deselected, pressing the Tab Key leaves the Curve displayed as a broken line which is uneditable.

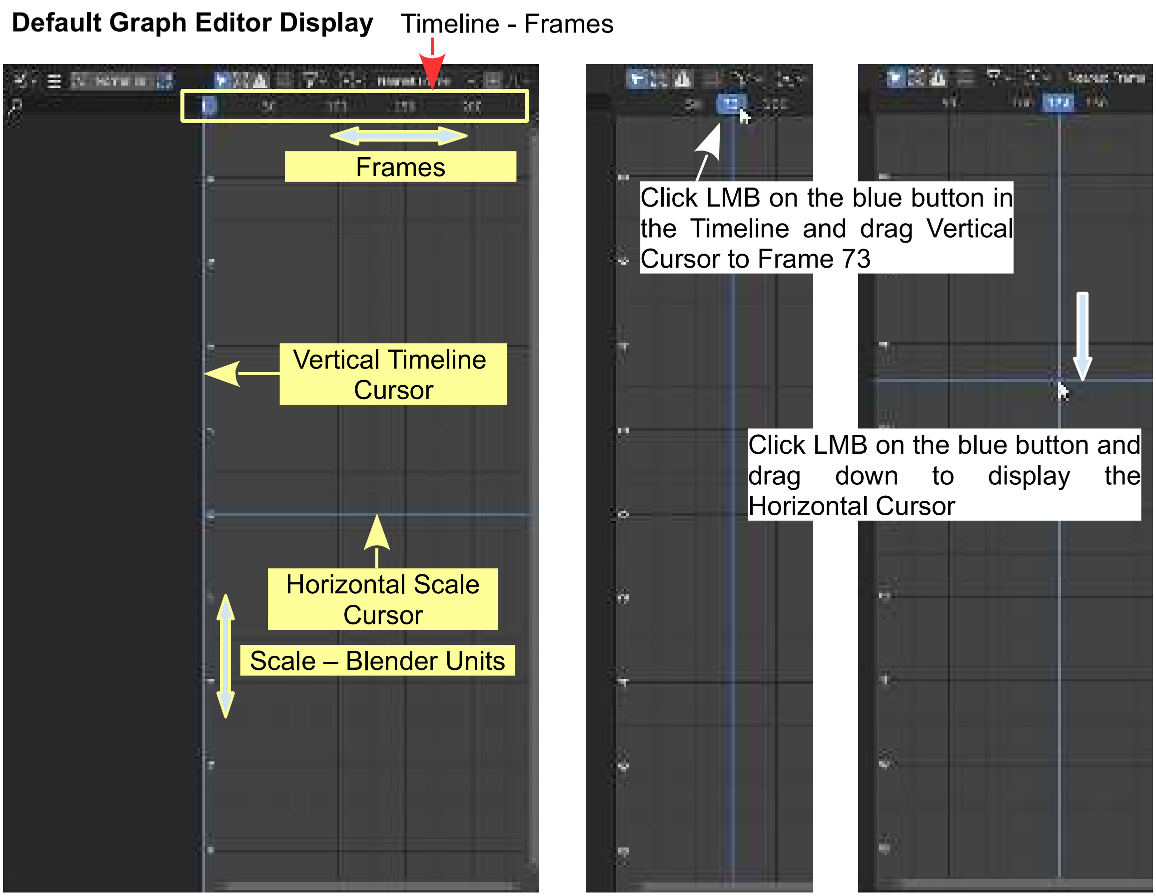
The Graph Editor Cursor

Before proceeding, how to control the Graph Editor Cursor should be explained.

With the default Cube Object in the 3D Viewport Editor, before any animation has taken place the Graph Editor displays as shown in Figure 18.25. There is a vertical blue line Cursor at Frame 1 in the Timeline and a horizontal blue line Cursor at position 0 (zero) in the vertical Scale.

When you click LMB on a Frame in the horizontal Timeline or click, hold and drag the blue Cursor button in the Timeline, moving the vertical Cursor, the horizontal blue line Cursor disappears from view. Moving the vertical Cursor back to Frame 1 does not reinstate the horizontal Cursor.

To display the horizontal Cursor, click on the blue button in the Timeline, hold and drag down. By holding LMB and dragging both vertical and horizontal Cursors are positioned in the Graph Editor.



The significance of positioning the Cursors will follow. Figure 18.25

Editing the Curve in the Graph Editor

To edit the X Axis movement of the Cube, select the top Control Handle, press the G Key and move the handle down approximately three units and left towards the Cursor aligning with Frame 50. Click LMB to set in position (Figure 18.26).

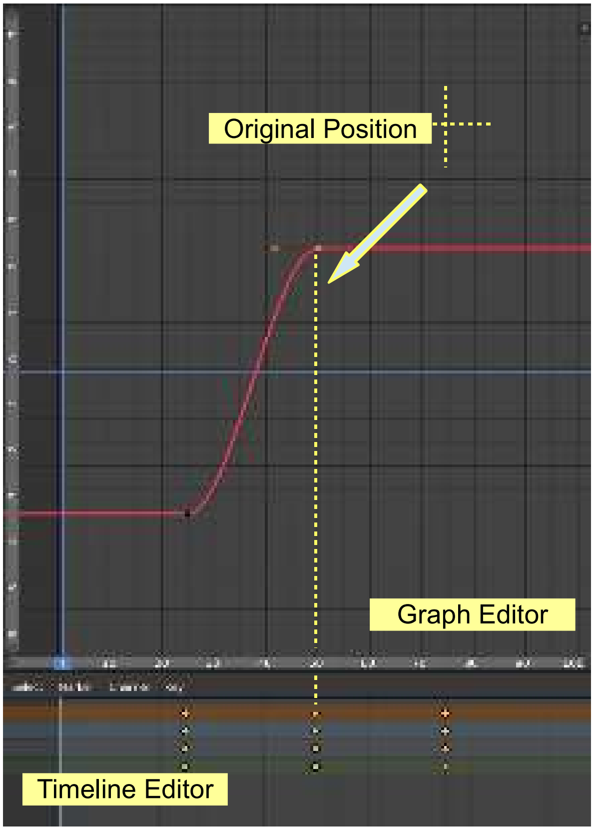


Figure 18.26

Note: When the Control Handle is moved you will see a set of Keyframes move to the Frame where you position the handle (Frame 50). This set of Keyframes is for the X Axis movement of the Cube. The Keyframes remaining at Frame 75 are for the Y Axis scale of the Cube.

Playing the animation at this point will see the Cube start to move on the X Axis at Frame 25 then stop at Frame 50. The Cube will scale on the Y Axis between Frame 25 and frame 75. Before frame 25 and after frame 75 no change in state occurs.

By scaling and rotating the top Control Handle you further edit the Curve (Figure 18.27.

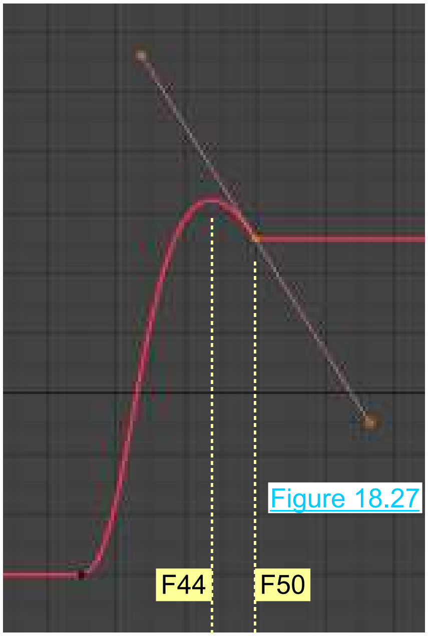


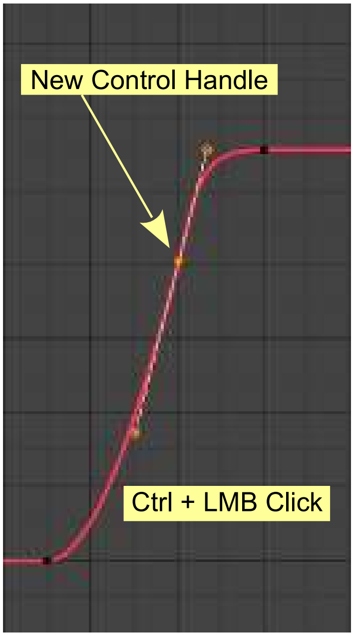
Figure 18.27

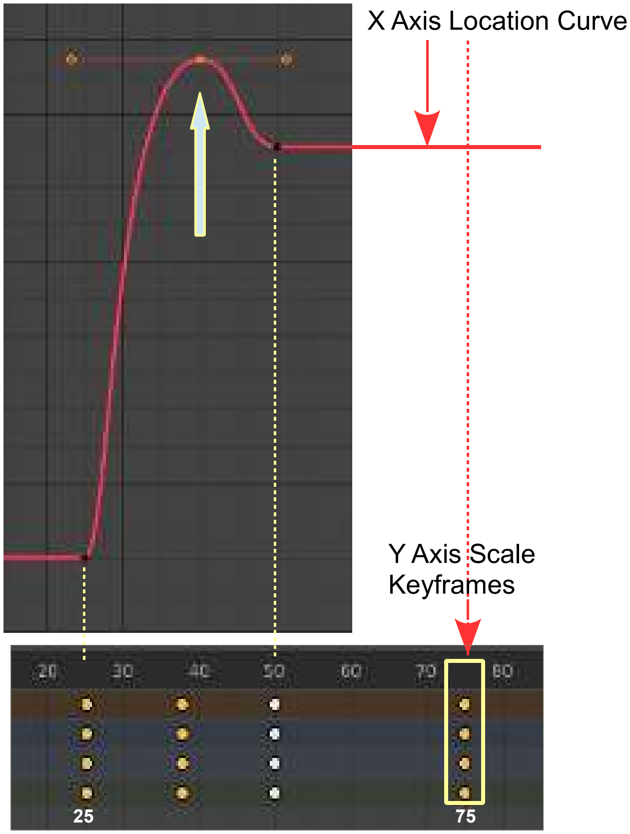
With the handle shaping the Curve as shown in Figure 18.27, when the animation is played the Cube moves forward on the X Axis between Frame 25 and Frame 44 then reverses direction until frame 50. **Note:** With this method no additional Keyframes are added to the Timeline.

Alternatively, instead of rotating the top Control handle, press **Ctrl** and **RMB Click on the Curve** to add a new Control Handle (Figure 18.28). New Keyframes are inserted in the Timeline. With the handle selected press G Key and Translate it up and Scale approximating the Curve previously created.

Using this alternative method gives more control in editing since it provides an additional Control Handle and Keyframes.

Figure 18.28





Note: The Keyframes in the Timeline.

Yellow Keyframes are selected.

White Keyframes are deselected.

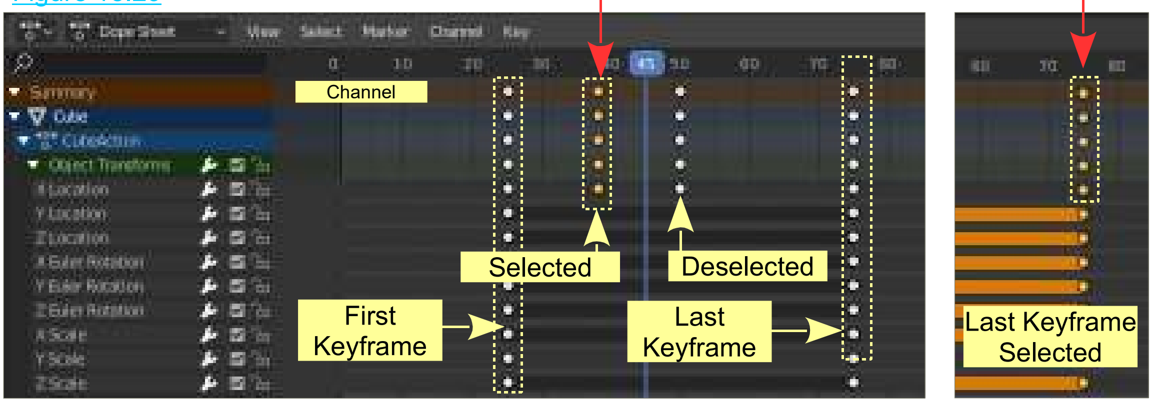
Keyframes in the Dope Sheet Timeline

Editing the Curve in the Dope Sheet Timeline

Curves and, therefore, the animation may be edited, by repositioning Keyframes in the Timeline of the Dope Sheet Editor. The first operation is to select individual Keyframes.

Figure 18.29

Click **LMB** on either of the first four channels to select Keyframes



Selecting Keyframes in the Dope Sheet Editor follows the basic rules for all Editors. **LMB** Click to select. Press **Alt + A Key** to deselect. Press **A Key** to select all.

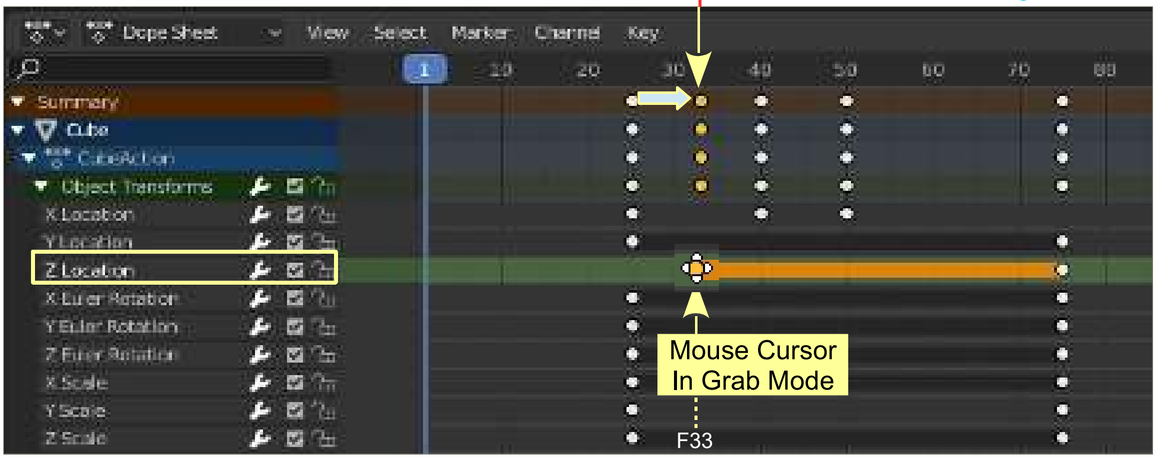
With a Keyframe selected press **Delete** or the **X Key** to delete the Keyframe.

With a Keyframe selected press the **G Key**, hold **LMB** and drag to reposition the Keyframe.

With the **Object Transforms** expanded, click **LMB** on a Channel to select it (Z Location). Click LMB on a Keyframe in the Channel, Press **G Key**, hold **LMB** and reposition.

First Z Location Keyframe Repositioned

Figure 18.30



Note: Repositioning the Z Location Keyframe as shown has no effect on the Cube in the 3D View Editor. When inserting the LocRotScale Keyframe no change was made to the Z Location in the 3D View Editor, therefore, the Z Location Graph is a horizontal straight line.

Control Handle

Figure 18.31

Repositioning the Keyframe in the Dope Sheet has repositioned the Control handle in the Graph Editor which, if there were a change in elevation on the Z Axis in the scene for the Cube, it would commence at this point.

To understand the correlation between the Graph Editor and the Dope Sheet align the two Editors one above the other (Figure 18.32 opposit).

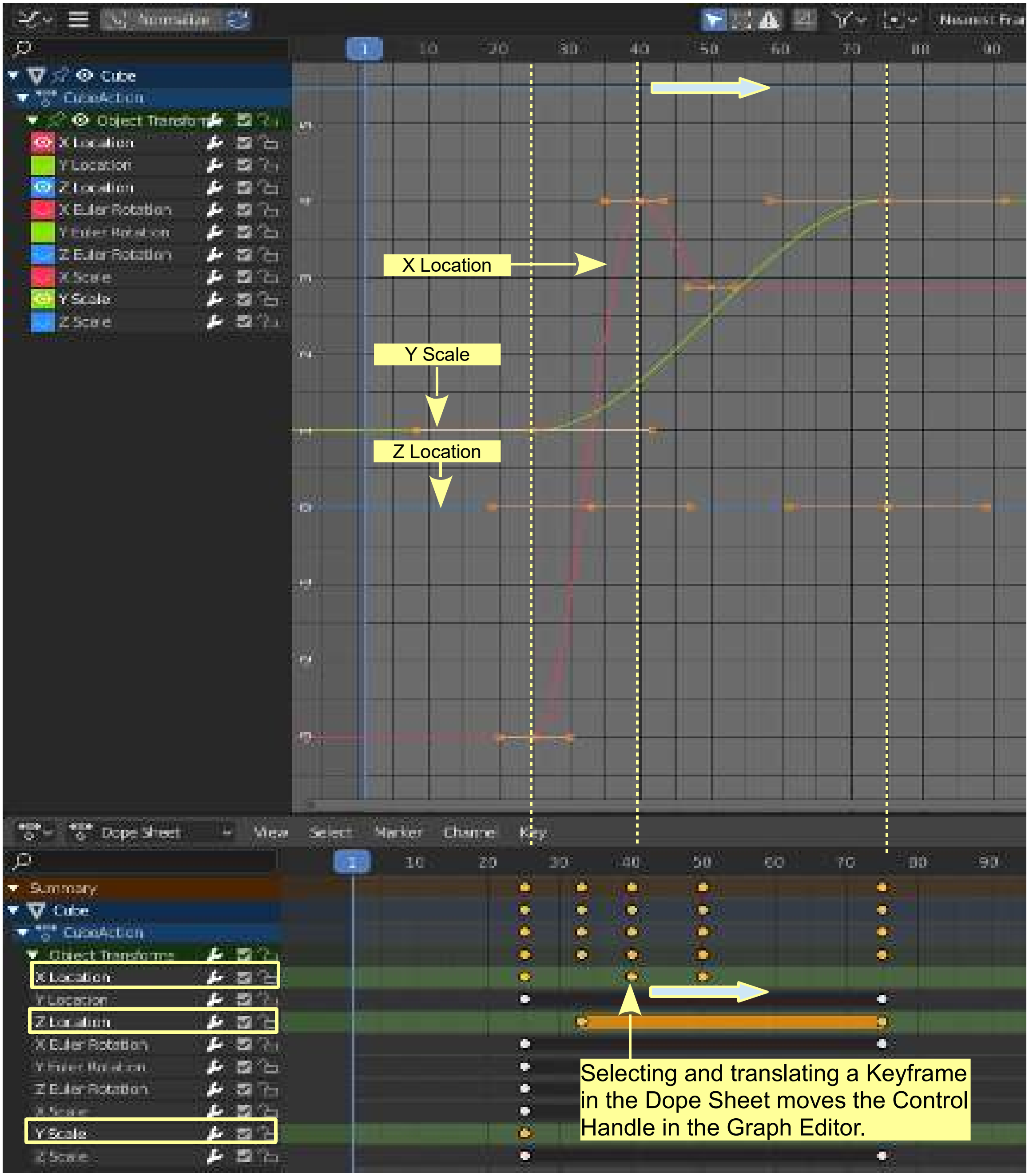


Figure 18.32

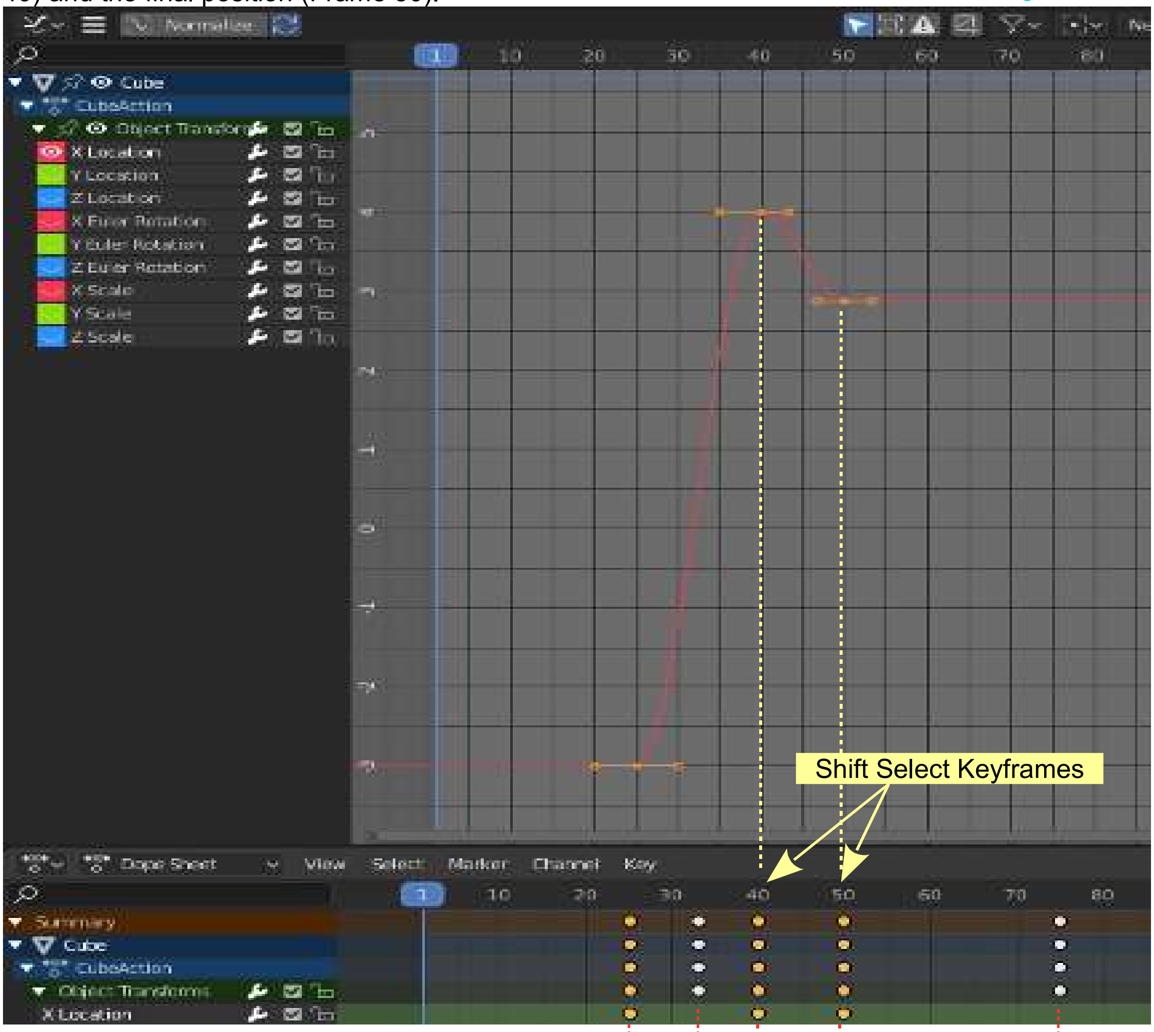
Translating a Keyframe in the Dope Sheet moves the Control Handle in the Graph Editor. Where the Keyframe/Control Handle is positioned determines where the action in the animation occurs. In Figure 18.32 the apex of the X Location Curve is the point where the forward movement of the Cube in the 3D Viewport Editor is reversed.

Scaling in the Dope Sheet

Besides moving Keyframes adjustment to when an action takes place in the animation may also be adjusted by Scaling on the Timeline in the Dope Sheet.

Note: Scaling is relative to the Dope Sheet Editor Cursor. To demonstrate consider the movement of the Cube on the X Axis between the apex of the Curve in the Graph Editor (Frame 40) and the final position (Frame 50).

Figure 18.33



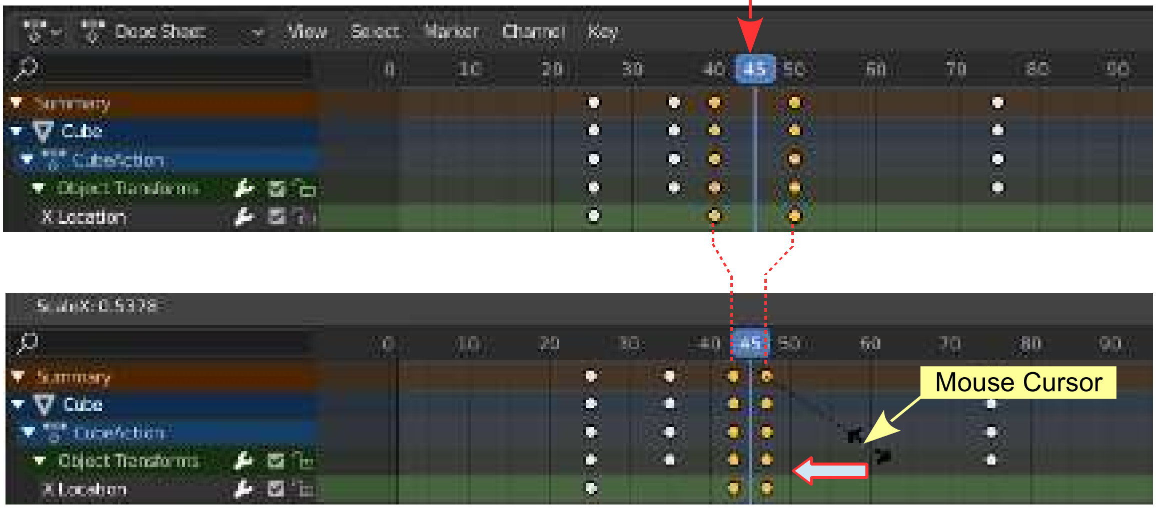
With Keyframes selected place the Mouse Cursor in the Dope Sheet and press the S Key (Scale). Move the Mouse towards the **Dope Sheet Cursor**.

Figure 18.34

The selected Keyframes are Scaled relative to the Dope Sheet Cursor (blue line). You will see the shape of the Curve in the Graph Editor modified accordingly.

Repeat the procedure, this time, positioning the Dope Sheet Cursor between the selected Keyframes. The Scaling is relative to the Cursor.

Figure 18.35



Moving Keyframes and manipulating Control Handles edits the animation Curve. The Curve has been a Bezier Type but there are alternative types to be considered which means alternative types of Interpolation between Keyframes resulting in different types of motion for the selected Object.

18.12 Other Types of Curves

By default, Blender displays **Bezier Type Curves** in the Graph Editor which means that **Bezier Type Interpolation** is used between **Keyframes**.

When considering Bezier Type Interpolation (the Curve shape) the curves at either end of the graph line represent the acceleration of the Object.

Other Types of Interpolation (Curves) are accessed in the Graph Editor or the Dope Sheet Editor. In the Dope Sheet Header click **Key** and select **Interpolation Mode** or with the Mouse Cursor in either Editor press the T Key. Either method opens the Set Keyframe Interpolation menu.

At this point only be concerned with the Constant, Linear and Bezier options.

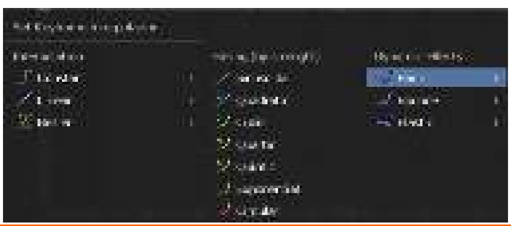
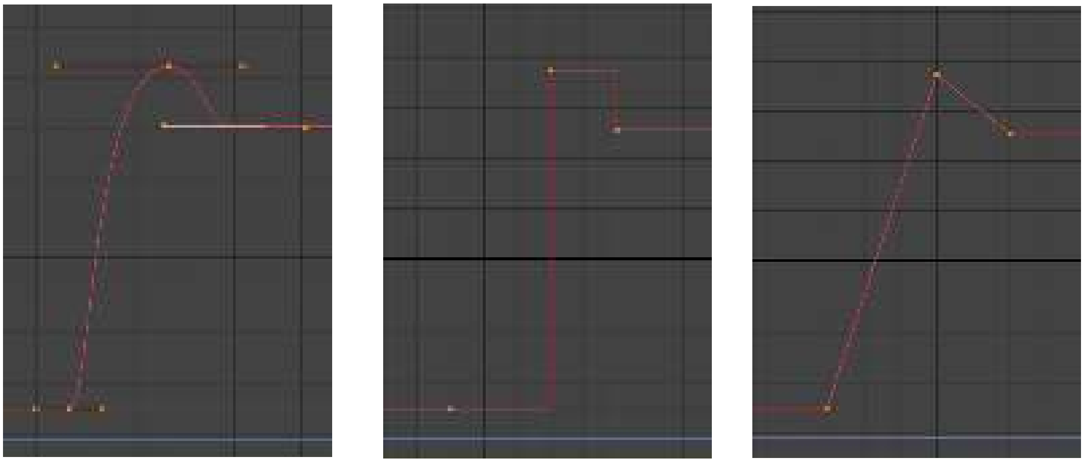


Figure 18.36

With a Curve selected in the Graph Editor (the default is Type Bezier) select **Constant** or **Linear**.

Figure 18.37



Bezier Constant Linear

Each Type of Interpolation (Curve) produces a different motion in the animation. **Constant Interpolation** results in a dramatic quick change from one state to the other at a given Frame while **Linear Interpolation** produces a change following a straight line graph between points . The choice of these types of graphs and motions depends on how you want your actor to behave in the animation. Both of the alternatives to Bezier give the option to grab and move points and to add additional points on the graph, but Bezier is by far the most flexible of the three.

Extrapolation

Blender interpolates to add frames between the Keyframes according to which of the previous Curve options were selected. Blender can also figure out what to do with the frames of the animation before the first Keyframe and after the last Keyframe, which is called **Extrapolation**.

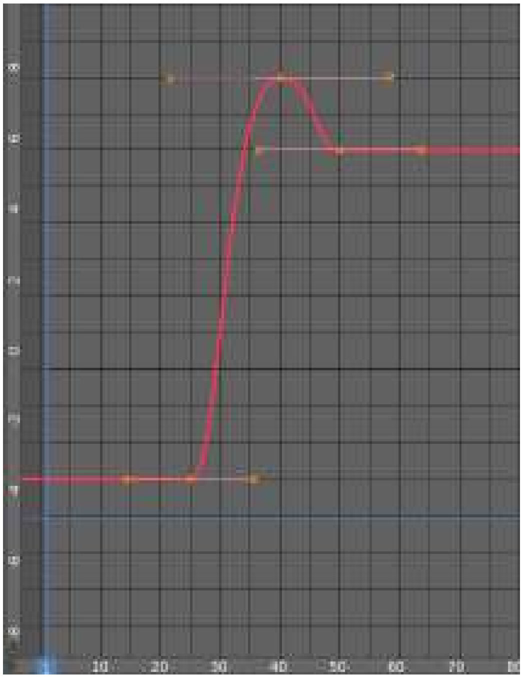
With the Mouse Cursor in the Graph Editor press **Shift + E Key** to display the **Set Keyframe Extrapolation** menu.

Figure 18.38

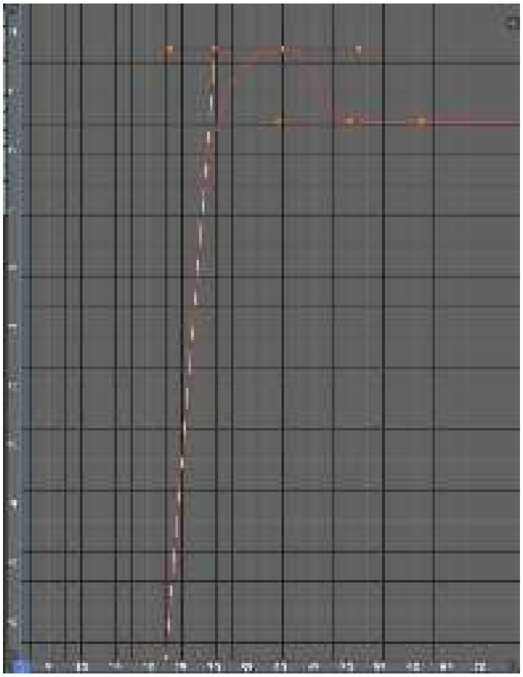
Constant Extrapolation: Blender has inserted frames that comply with a Bezier curve. On either side of the Keyframes, you can see horizontal lines that indicate there is no further change in status. This is constant extrapolation.

Linear Extrapolation: Blender plots a straight line curve leaving and entering the curve. The action of the actor before and after first and last Keyframes follows these straight line curves.

Cyclic Extrapolation: Blender copies the graph between the first and the last Keyframes and duplicates it to infinity on either side of the graph. You **Make** the Extrapolation Cyclic or you **Clear** the Cyclic Extrapolation.

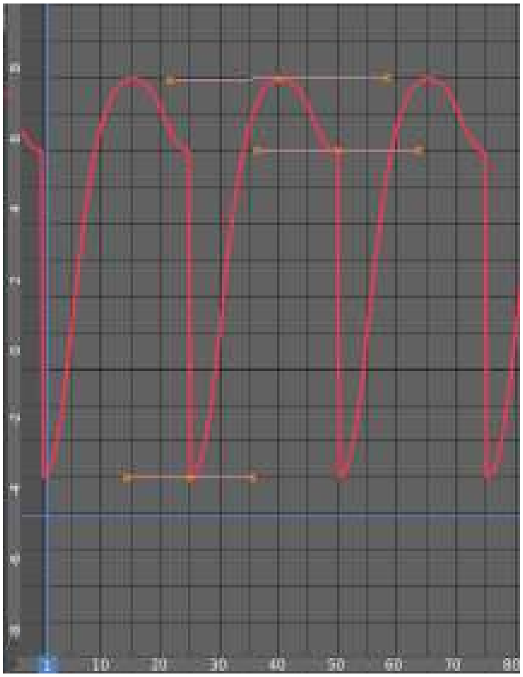


Constant Extrapolation



Linear Extrapolation

Figure 18.39

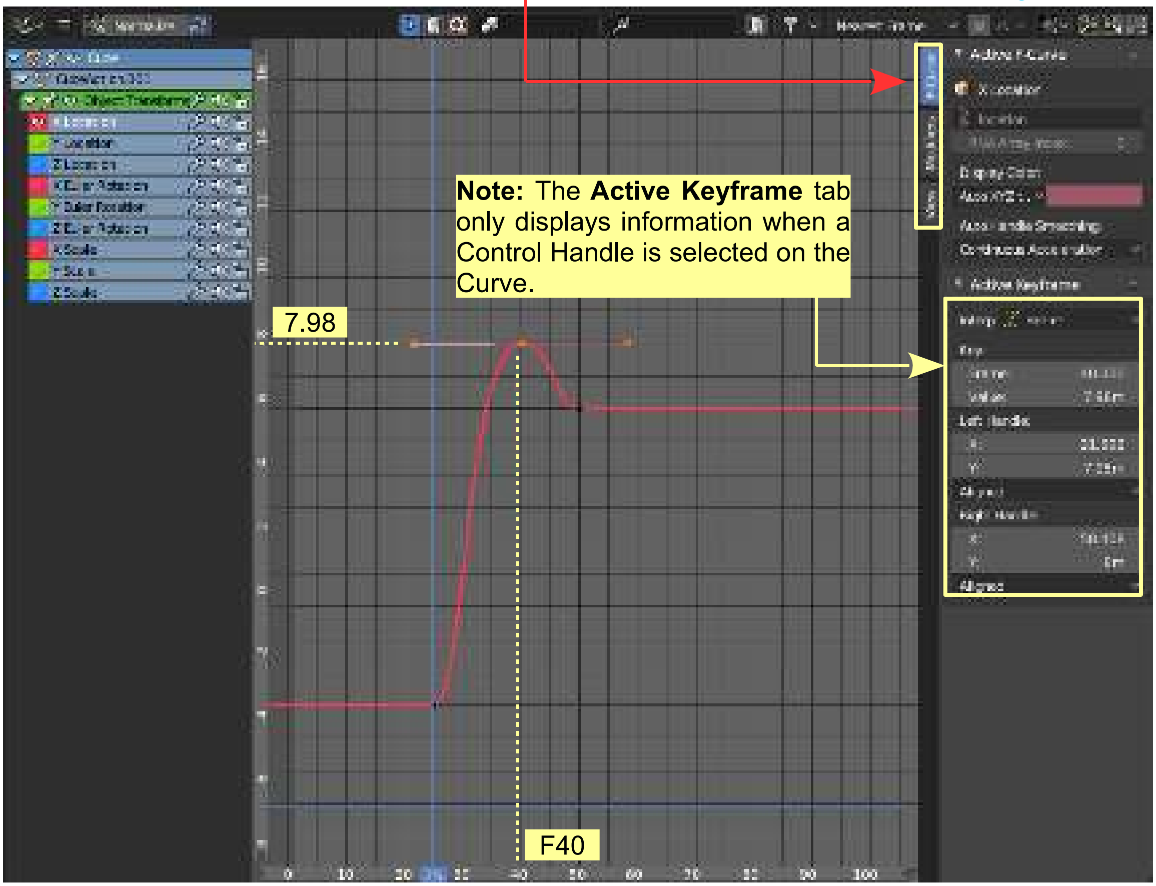


Cyclic Extrapolation

18.13 The Curve Properties Panel

The **Curve Properties panel** (Figures 18.40, 18.41) provides data and gives control to certain functions in the Graph panel. With the **Mouse Cursor** in the **Graph Editor**, press the **N key** to display the **Curve Properties panel** at the RHS of the Editor. The panel is divided into three Tabs; **F-Curve**, **Modifiers** and **View** Properties.

Figure 18.40



This introduction to the Curve Properties panel is presented to make you aware of its existence. Experiment with the values, especially the **Modifiers.** For example: With only the X Location Curve displayed in the Graph Editor click on the **Modifiers Tab** and then click Add Modifier. Select the **Noise Modifier** which adds a jittered effect to the Curve. Playing the animation sees the Cube shake as it moves in the 3D Viewport Editor. For a more dramatic shake increase the **Amplitude** of the **Noise.**

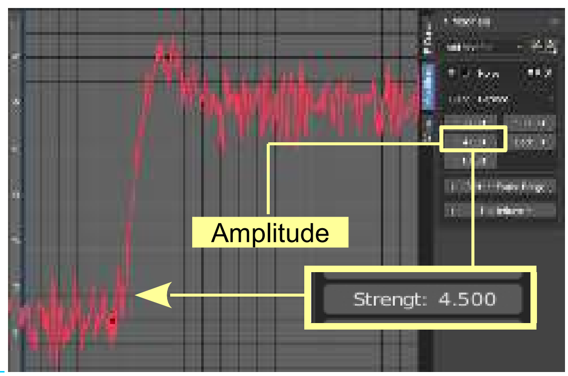
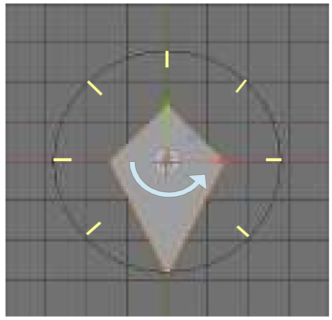


Figure 18.41

18.14 Animating Rotation

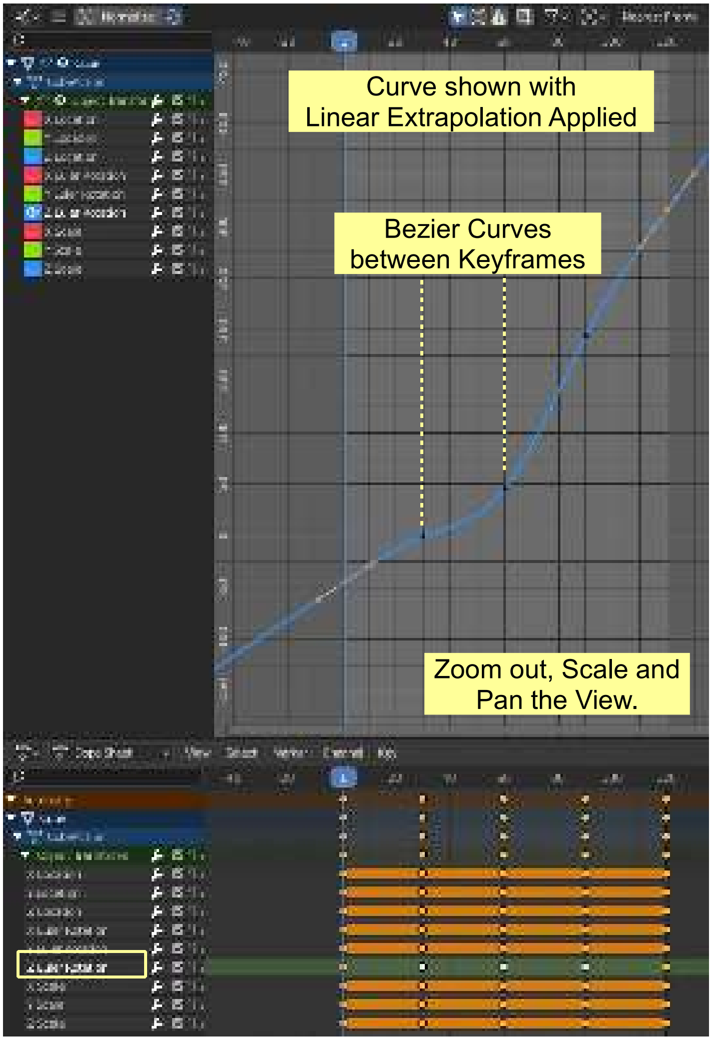
Figure 18.42



Animating Rotation deserves special consideration when attempting to create a continuous smooth Rotation. As an example use the default Cube Object in **Top Orthographic View** with one corner move to form a pointer (Figure 18.42).

Have the 3D Animation Workspace arranged as shown in 18.11 - Figure 18.23 and **turn on Automatic Keyframing**.

Figure 18.43



With the Cube selected in the 3D Viewport Editor, and the Timeline Cursor in the Dope Sheet Editor at Frame 1, Rotate the Cube slightly using the Mouse, and before releasing the Mouse button return it to the start position. This creates Keyframes at Frame 1. Move the Dope Sheet Timeline Cursor to Frame 30 and Rotate the Cube 45° (Approx.). Move the Timeline Cursor to Frame 60. Rotate the Cube 45°. Repeat for Frames 90 and 120 making one complete revolution.

Observe the Graph Editor and Dope Sheet Timeline Editor. The rotation has been about the Z Axis, therefore, the Curve in the Graph Editor is in the Z Euler Ruler Rotation Channel.

The Curve drawn in the Graph is a Bezier Curve with Control Handles at the Keyframes. When playing the animation you will observe the rotation hesitates at each Keyframe, as the motion decelerates and accelerates. To correct, press **Shift + E Key** and select **Linear Extrapolation**. This produces a smoother Curve in the Graph Editor resulting in a smoother rotation, however, the rotation is not constant since it takes place between Frame 1 and Frame 120. The rotation stops after one revolution at Frame 120 while the animation plays on to the default 250 Frames. To create a continuous rotation, change the **End Frame** value in the Timeline Editor Header to 120. The rotation is continuous but the speed of rotation varies.

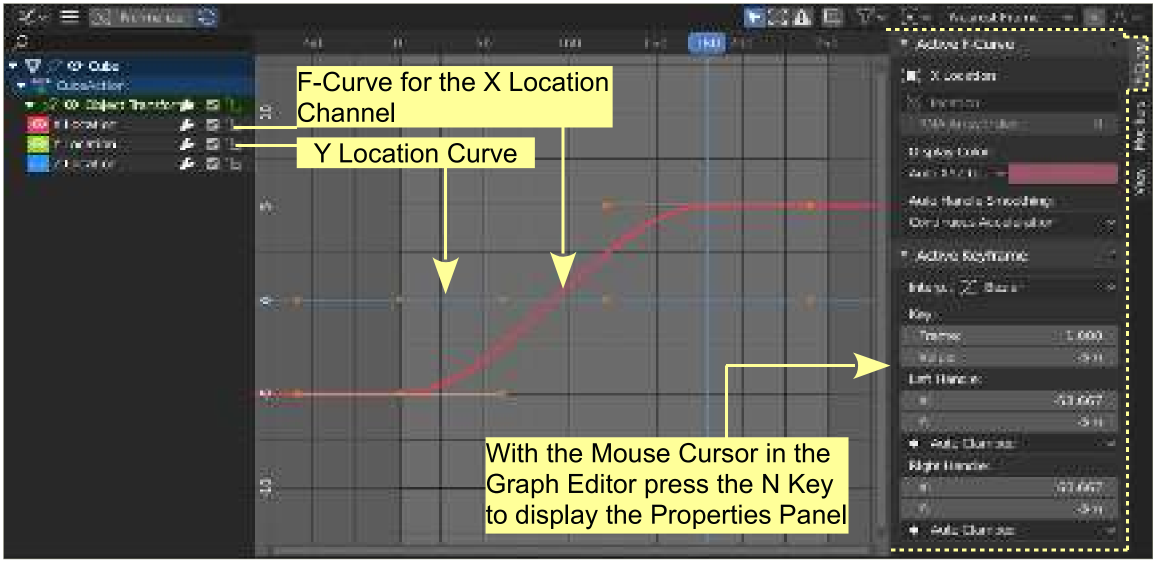
18.15 Rotation Using F-Curves

The Blender Manual states, “After animating some property in Blender using Keyframes you can edit their corresponding curves. When something is “animated”, it changes over time. This curve is shown as something called an **F-Curve**. Basically what an F-Curve does is an interpolation between two animated properties. In Blender, animating an object means changing one of its properties, such as the object’s location, or its scale.

As demonstrated, when an Object is animated a Curve is created in the graph Editor. It, therefore, follows that this is an **F-Curve**. When considering the default Cube Object in the 3D View Editor, before it is animated there is no Curve in the Graph Editor. The Cube may be made to Rotate by animating to create a **Location Curve** then editing the Curve using Modifiers.

Animate the Cube to move from minus 5 units on the X Axis to plus 5 units on the X Axis between Frame 1 and frame 180. An **F-Curve** is drawn in the Graph Editor.

Figure 18.44



With the Curve drawn, playing the animation shows the Cube move from minus 5 to plus 5 along the X Axis in the 3D View Editor. As well as the X Location Curve a Y Location Curve has also been created (straight line).

Both Curves may be modified to produce a Rotation of the Cube.

In the **Properties Panel** click on the **Modifiers Tab**, click **Add Modifier** and select **Built in Function** (Figure 18.45). The default Built in Function is **Sine** which immediately changes the Bezier Curve in the Graph Editor to a Sine Curve or rather a Sinusoidal Curve since it repeats to infinity (Figure 18.46 opposit).

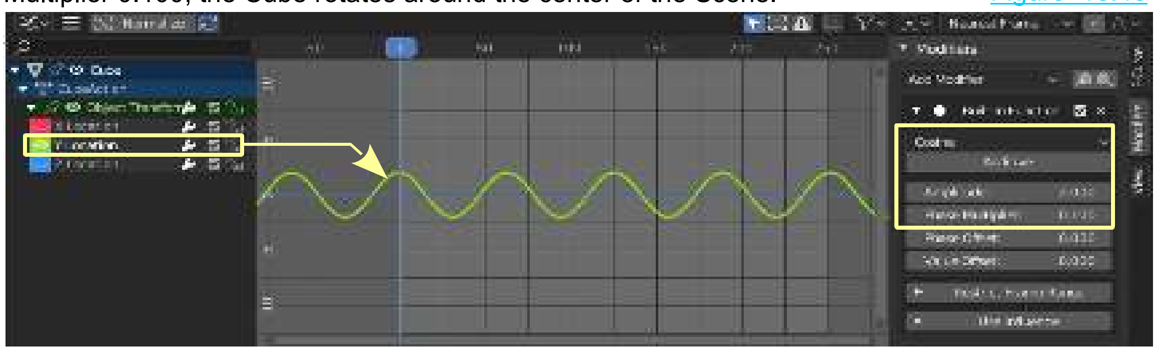
Figure 18.45

Figure 18.46

Playing the animation shows the Cube in the 3D Viewport Editor oscillate on the X Axis. The degree of oscillation is governed by the Amplitude value in the Modifier. The movement of the Cube is best seen in Top Orthographic View.

In the Modifier panel, increase the Amplitude to 2.000 and reduce the Phase Modifier to 0.100. This reduces the oscillation of the Cube to a nice smooth motion Figure 18.47

The Curve under consideration at this point has been the Curve representing the **X Axis** motion of the Cube (see the **X Location Channel** in the Graph Editor). As previously stated a **Y Axis** motion Curve is also drawn (straight line) as seen by selecting the **Y Location Channel**. By applying a Built in Function Modifier and making it **Type Cosine** with Amplitude 2.00 and Phase Multiplier 0.100, the Cube rotates around the center of the Scene. Figure 18.48

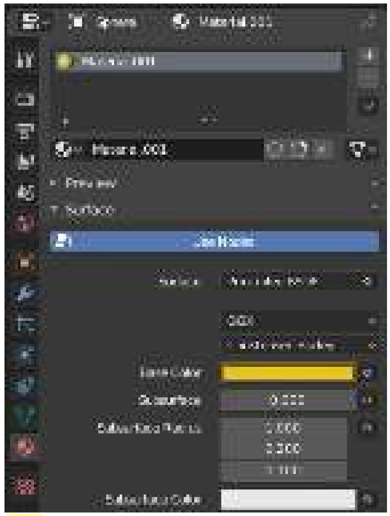


18.16 Animating Other Features

There are many features in Blender which may be animated. For example:

Material (color) Animation

Figure 18.49



As an example of animating color change perform the following using the Animation Workspace;

Add a UV Sphere in the 3D Viewport Editor and set the surface to Smooth Shading. In the Properties Editor, Material buttons, add a Material and leave Use Nodes active.

Change the 3D Viewport Editor to rendered Viewport Shading.

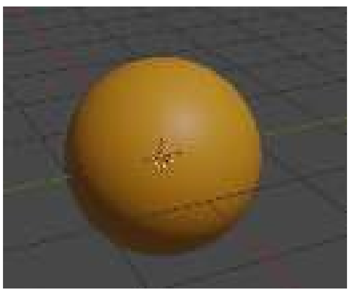
In the Material buttons, click on the base Color bar and select a color. **RMB click the color bar** and select **Insert Keyframe** from the menu.

Figure 18.50

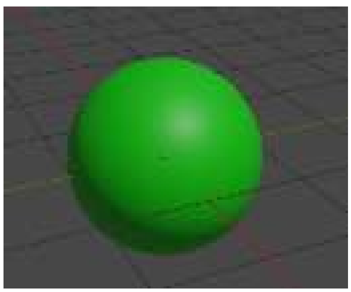
This enters a Keyframe in the Dope Sheet Timeline at the location of the Cursor (the default is frame 1).

Relocate the Timeline Cursor to another Frame (Frame 50). Select a different color. RMB click the color bar and select Insert Keyframe. A Keyframe is entered at frame 50.

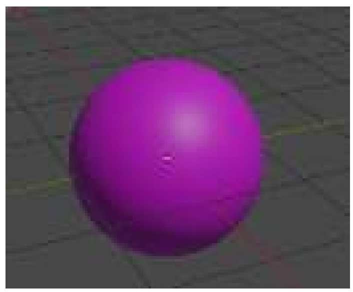
Repeat for Frame 100 then play the animation to see the color change in the 3D Viewport Editor.



Frame 1

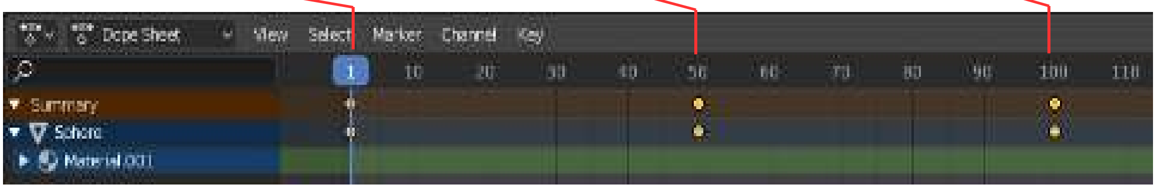


Frame 50



Frame 100

Figure 18.51



Timeline Cursor at Frame 1 (blue line)

Spotlight Size Animation

The size of a Spotlight beam may be animated to change.

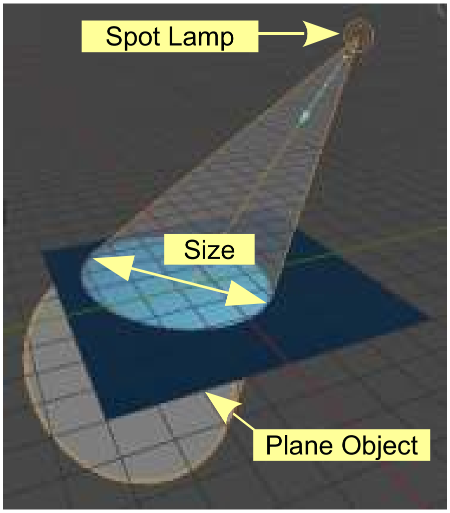
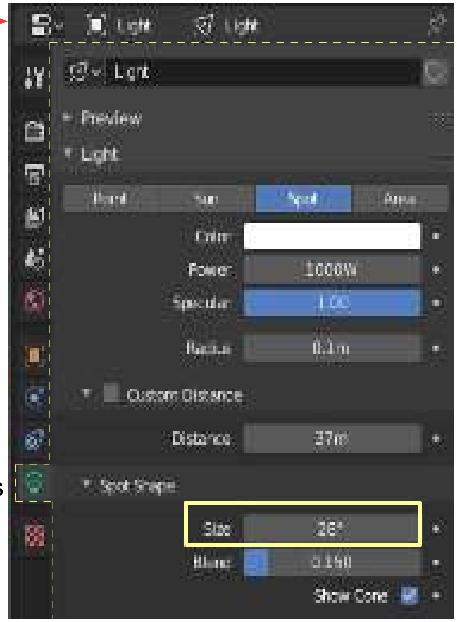


Figure 18.52

Properties Editor



Data Buttons

Using the 3D Animation Workspace be at Frame 1 in the Timeline . With the Spot Lamp selected in the 3D Viewport Editor, in the Properties Editor, Data buttons, Spot Shape tab, **RMB click** on Size and select **Insert Keyframe**. Change to Frame 50. Change the Size and insert a second Keyframe. Repeat at frame 100 and play the animation.

18.17 Keying Sets

In a basic capacity **Keying Sets** provide the means of assigning multiple **Animation** properties to an Object, then creating all the Keyframes in a single go.

To demonstrate have the default **Layout Workspace** with the **Timeline Editor** sized vertically, divided in two and having one half changed to the **Dope Sheet Editor**. The upper part of the Screen is the 3D Viewport Editor containing the default Cube. The Timeline and Dope Sheet Cursors will be located at Frame 1.

Keyframes will be created for the Location and Material color. Have the 3D Viewport Editor in **Material Preview Viewport Shading Mode**.

In the 3D View Editor move the Cube back along the X Axis. Note: The default Cube has the default gray Material applied.

With the Mouse Cursor in the 3D View Editor, press the **N Key** to display the **Object Properties Panel**.

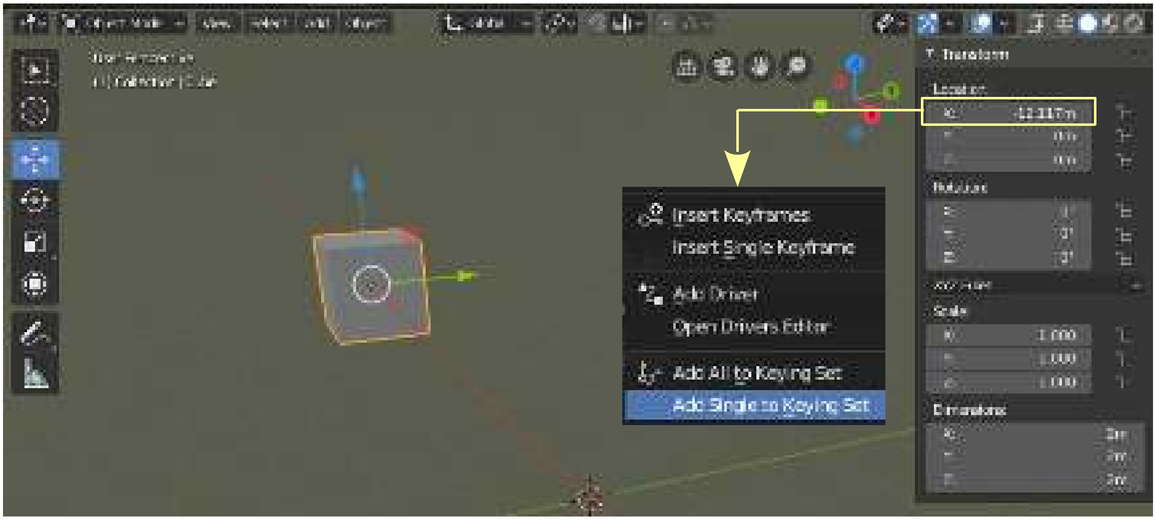


Figure 18.53

Under **Location** in the panel, RMB click on **X Location** and select Add **Single to Keyeing Set.** This is saying you wish to add a single Keyframe to the Keying Set. It does not enter a Keyframe in either Timeline Editor.

RMB click on **Y Location** and repeat the above which adds a second Keyframe request to the set. Again, Keyframes are not entered in the Timelines.

Now request a Keyframe for the Material color. In the **Properties Editor, Material buttons**, RMB click on the **Base Color** bar and select **Add to Keying Set.**

Keyframes have been requested for the X and Y Location and the Material Color of the Cube. The Timeline and Dope Sheet editor Cursors are at Frame 1. The Keyframes are, therefore, requested for Frame 1.

In the **Timeline Editor Header** click on the **Keying** button. In the menu that displays, adjacent to **Button Keying Set** click on the Key button **with the plus sign above the key icon**. This inserts the requested Keyframes in the Timelines at Frame 1. A message displays in the Header at the bottom of the Screen.

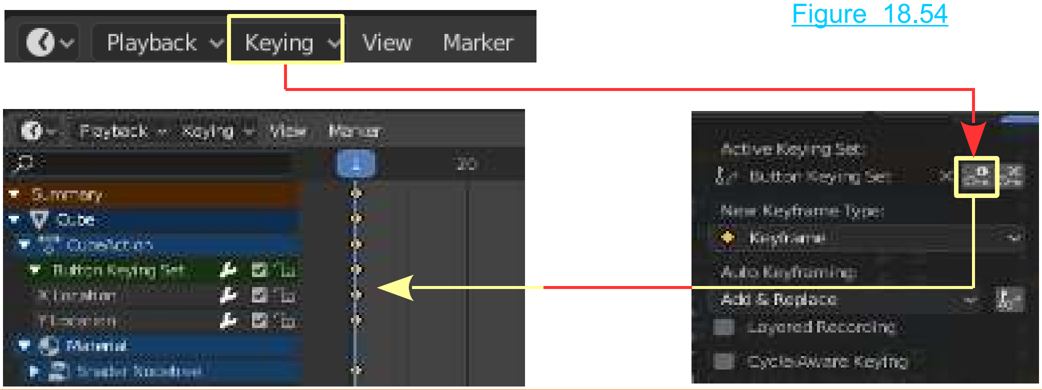


Figure 18.54

Move the Timeline Cursors to Frame 50. In the 3D Viewport Editor relocate the Cube on the XY Plane. In the Object Properties Panel, RMB click on the X and Y Location channels and request Keyframes. Change the Material base Color and request a Keyframe.

Repeat the Keying procedure, entering Keyframes in the Timelines.

Move the Timeline Cursors to a different Frame and repeat the requesting and adding Keyframes.

Scrubbing the Cursors in the Timelines shows the Cube moving and changing color.

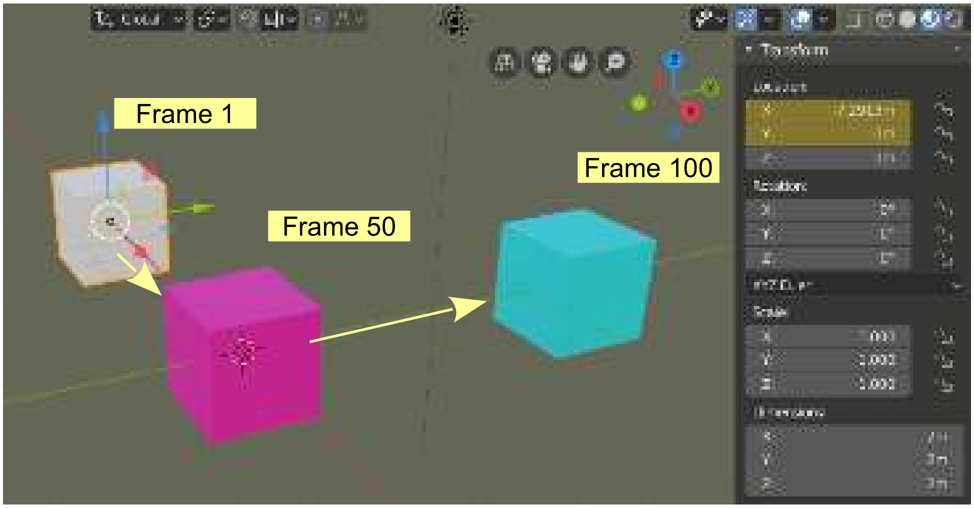


Figure 18.55

18.18 Animation Follow Path

As previously demonstrated, animating an Object to move is achieved by entering Keyframes in the Timeline with the Object located at positions in the 3D Viewport Editor. With the animation created it may be edited by modifying the Curve in the Graph Editor or relocating Keyframes in the Dope Sheet Editor Timeline.

On occasion you may wish to animate an Object to follow a pre-constructed Path. Once the Object is made to follow the Path, you reshape the Path to alter the movement of the Object in the 3D Viewport Editor.

To demonstrate the procedure for animation following a Path, open the **Animation Workspace** and change the left hand 3D Viewport Editor Camera View to the **Graph Editor**. Have the right hand 3D Viewport Editor in top Orthographic View with default Cube Object **at the center of the Scene**.

Deselect the Cube and add a **Curve Type: Bezier** to the Scene. You may use any Curve Type but the Bezier Curve has a nice profile when entered. Scale the bezier Curve up six times (Figure 18.56).

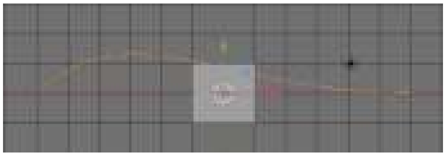


Figure 18.56

Deselect the Curve and **select the Cube**.

In the **Properties Editor, Constraints buttons**, click **Add Object Constraint** and select **Follow Path** in the Relationship category. The **Follow Path Tab** displays (Figure 18.57).

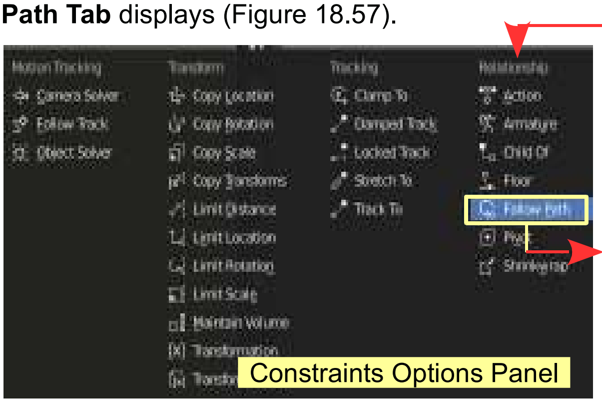
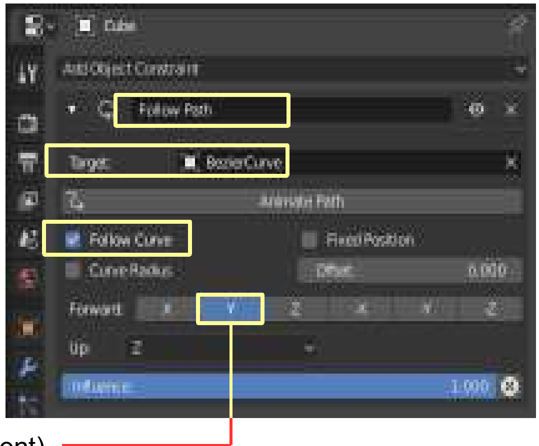


Figure 18.57



In the Follow Path Constraint click in the bar where you see the **Target** icon and select **Bezier Curve** from the panel that displays. Also, check (tick) **Follow Curve**. **Note: Forward Y** is selected (the Object's Axis which points in the direction of movement).

Entering the Target locates the Cube in the 3D Viewport Editor at the LH end of the Curve Path. Checking **Follow Curve** aligns the Cube,s Axis to the Path (Figure 18.58).

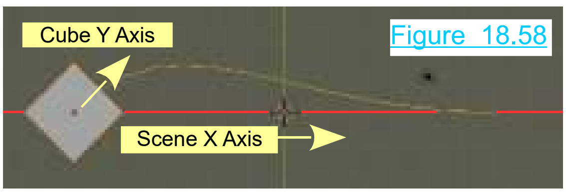


Figure 18.58

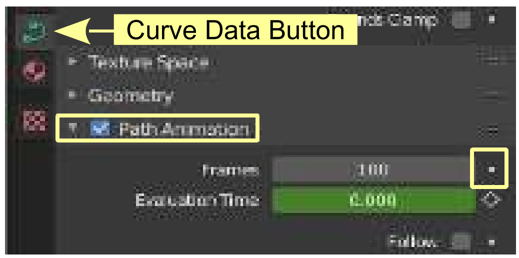


Figure 18.59

Properties Editor, Object buttons, Viewport Display Tab

With the Cube aligned deselect the Cube and select the Curve Path.

Go to the Properties Editor, **Data buttons** (for the Curve Path) and see the **Path Animation Tab** at the bottom of the panel. Ensure that **Path Animation** is checked (Figure 18.59).

Select the Cube and go back to the Follow Path Constraint. In the Constraint panel click **Animate Path.** Press Play in the Timeline Editor Header to see the Cube traverse the length of the Path.

Note: At this point Keyframes have not been entered in the Timeline Editor.

You may select the Curve Path, Tab into Edit Mode and modify the shape of the Curve. If you Extrude the Path from either end, the Cube always locates at the start of the Path at Frame 1 in the Animation. In Edit Mode the Curve Path displays with chevrons along its length indicating the direction of travel.

How quickly the Cube appears to traverse the length of the Curve Path in the 3D View Editor depends on the physical length of the Curve and the Frame Rate of the Animation (see the Properties Editor, Output buttons, Frame Rate).

Altering the Frame Rate will change the speed of movement along the Path but the Frame Rate is set for the output required in the video format being produced. **Do not change this**. There are two alternatives; Modifying Evaluation Time and Keyframing.

Evaluation Time

Evaluation Time settings are found in the Properties Editor, Data buttons, Path Animation Tab. The setting is defined by Blender as;

In a practical sense you could consider the Evaluation Time as a percentage. At 0.000 % the Object is at the start of the Path, at 100.000 % it is at the end of the Path.

3D View Editor

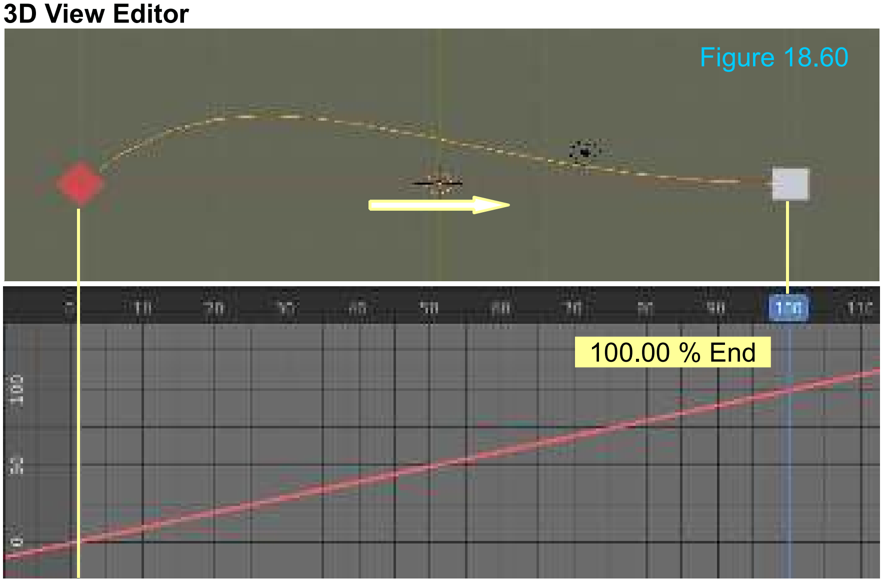


Figure 18.60

Graph Editor

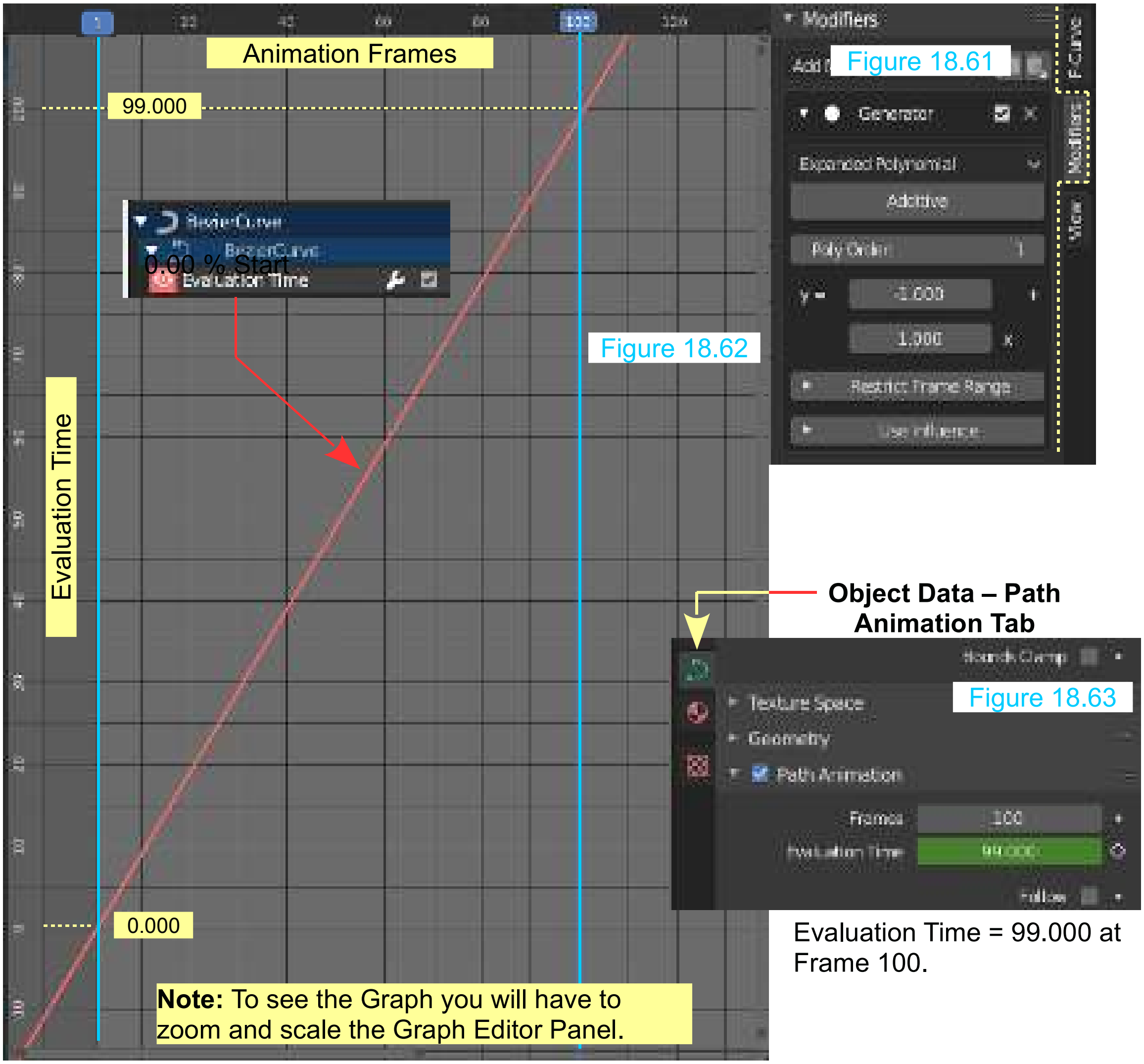


Figure 18.60 shows a Cube Object scaled down 0.5 and a Bezier Curve Path scaled up 10 times. The Cube has a Follow Path Constraint applied with Target: BezierCurve. With the Bezier Curve Path selected, the Properties Editor, Object Data button, Path Animation Tab (Figure 18.63) shows the value; Frames 100. This is the default value which means the Cube will traverse the Path in 100 Frames of the animation. With the Graph Editor Cursor at Frame 1 the Evaluation Time is 0.000. With Cursor at frame 100 the Evaluation Time is 99.000 (Frame 100 – Frame 1 = 99). The default Frame Rate is 24 Frames per second, therefore, actual time to traverse the Path will be approximately 4 seconds.

The Graph Editor (Figure 18.62) shows the Evaluation Time Graph (red line) indicating these values. The Bezier Curve Path must be selected in the 3D Viewport Editor to see the Graph.

With the Mouse Cursor in the Graph Editor, press the N key to display the Properties Panel (Figure 18.61) and select the Modifiers Tab at the RHS of the panel. Note the two values;

y= -1.000 and 1.000 x

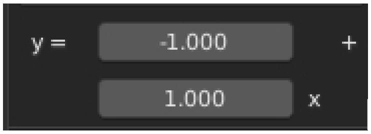


Figure 18.64

Increasing or decreasing **y = -1.000** shifts the Graph Line to the right and left (the slope of the graph remains the same). Altering the **1.000 x** value changes the slope of the Graph.

Altering either value alters the position of the Cube on the Curve Path at a particular Frame thus affecting the speed of traversing.

Keyframing

Up to this point **Keyframes** have not been entered in the **Timeline.** The Graph Editor only displays the Evaluation Time (when the Curve Path is selected in the 3D Viewport Editor). Entering Keyframes in the Dope Sheet Timeline allows you to manipulate where the Cube is located along the Curve Path at a particular Frame in the animation. This also affects the speed of traversing the Path.

With the Cube path arrangement set up as shown in Figure 18.60 and with the Timeline Cursor at Frame 1, add a **Follow Path Constraint** to the Cube with **Target: BezierCurve**.

Do NOT Animate the Path.

Select the Bezier Curve Path and in the Properties Editor, Object data buttons, Path Animation Tab, click the button at the end of the Frames bar. **Keyframes** are entered in the Timeline.

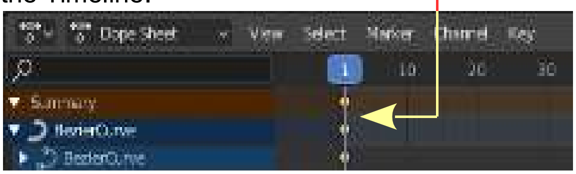
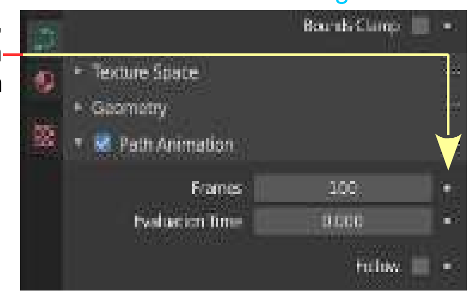


Figure 18.65



In the Path Animation Tab the Frames bar turns yellow and the button becomes a diamond shape indicating Keyframes have been added (Figure 18.66).

Figure 18.66

Move the Timeline Cursor to Frame 100, the end of the Path as indicated by Frames: 100.

Note: Frame 100 is the default value. You may reset this, bearing in mind, the default TOTAL animation length set in the Timeline is 250 Frames (Start: 1, End: 250).

Change the Evaluation Time to 100 (or to the value you have set).

Press the diamond button to enter Keyframes at Frame 100 in the Timeline (Figure 18.66 – 67).

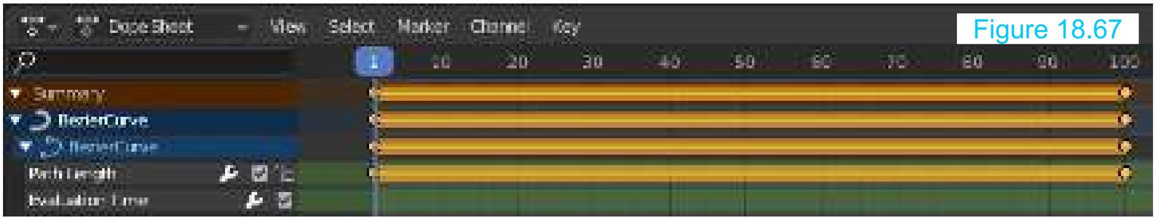


Figure 18.67

To have the Cube traverse the Path select the Cube and in the **Follow Path Constraint** click **Animate Path**.

Pressing the Play button in the Timeline shows the Cube following the Path between Frame 1 and Frame 100. At Frame 100 the Cube stops while the Animation continues on to Frame 250 then repeats.

At this point , with the Curve Path selected in the 3D View Editor, the Graph Editor shows two Graph lines; the Evaluation Time (green) and Path Length (red) (Figure 18.69). You will have to zoom and scale the graph Editor to bring the graphs into view.n

The red Path Length displays as a straight horizontal line since the motion of the Cube along the Path is constant.

With the Mouse Cursor in the Graph Editor press the N key to open the Properties panel (Figure 18.68) and note, under **Active Keyframes** that the **Interpolation Type** is **Linear**.

Figure 18.68

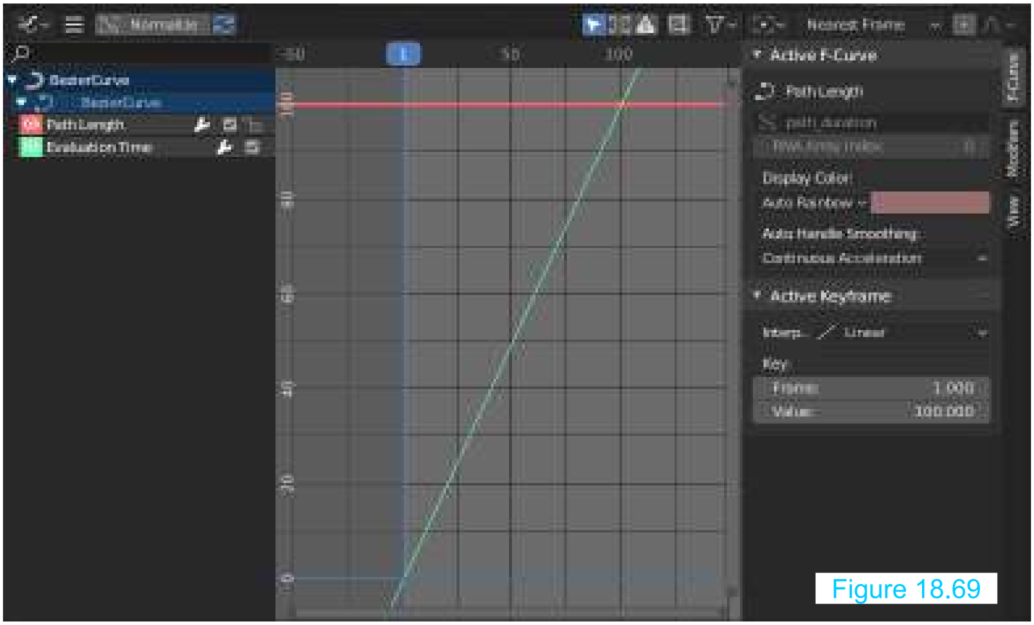


Figure 18.69

Change the Interpolation to Type: Bezier. Press Ctrl and RMB click on the Path Length Graph (red line) to add a control handle then drag down (Figure 18.70).

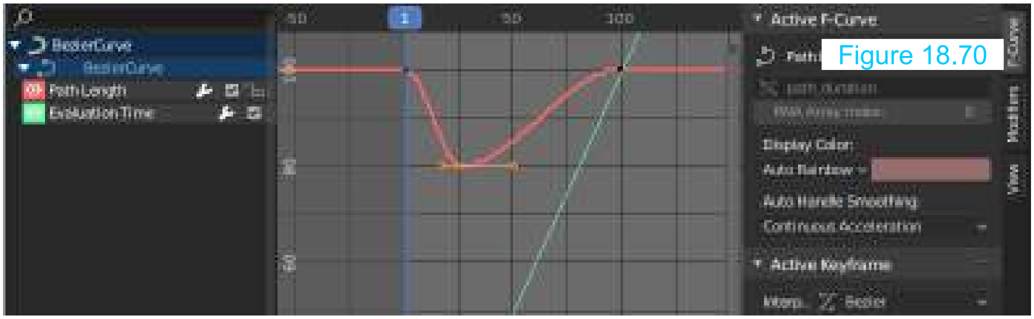


Figure 18.70

Playing the animation show a subtle variation in speed as the Cube moves along the Path, most noticeably, a deceleration as it approaches the end. Adding another control handle and arranging as shown in Figure 18.71 produces a distinct pause in motion.

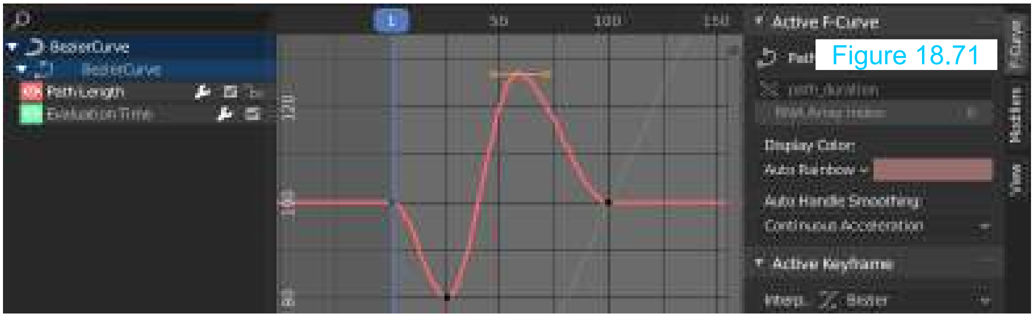


Figure 18.71

If control handles are positioned as shown in Figure 18.72 the Cube will move along the Path until it reaches Frame 85 in the animation then stop. You will observe that this is the point where the **Path Length Graph** intersects the **Evaluation Time Graph** which has become the end of the animation.

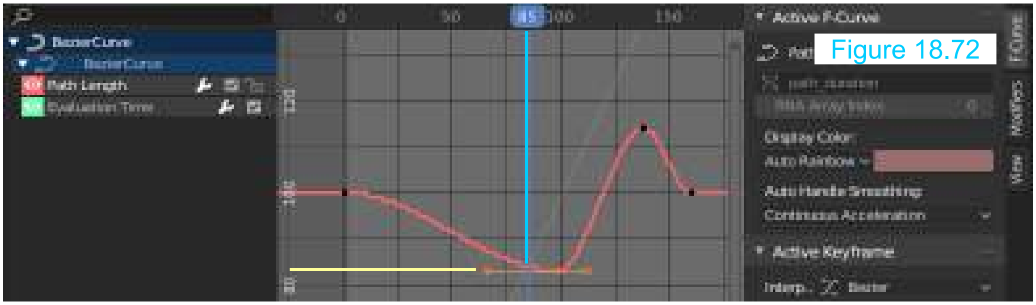


Figure 18.72

Observe that in the Properties Editor Object data buttons for the path Frames = Evaluation Time (Figure 18.73).

The foregoing has been an **introduction only** to Path Animation. With the examples shown you will be more easily placed to research and experiment to discover what can be achieved.


Figure 18.73

18.19 Displacement Sound Animations

A sound file (Music) can be used to affect the movement of vertices producing an interesting display effect.

For a demonstration have an image file (texture) such as that shown in Figure 18.62 and a sound file (music) saved on your hard drive. The Image Texture used in this demonstration is named Art-Fibers.jpg while the sound file is named Flex_Vector_-_Born_Ready.mp3.

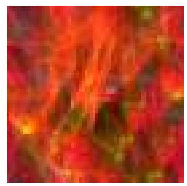
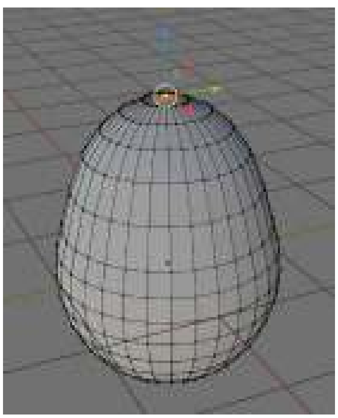


Figure 18.62

Flex_Vector is a Hip Hop file with a distinct base beat. You may use any sound file (MP3).



To demonstrate, set up a Sphere object (egg shaped – any shape with a reasonable number of Vertices) (Figure 18.63).

Figure 18.63

3D View Editor Header

Proportional Editing

Spherical Falloff

UV Sphere with a single Vertex selected and translated up on the Z Axis. **Proportional Editing** has been activated with **Spherical Falloff**.

With the Egg selected in the 3D View Editor, in **Object Mode** go to the **Properties Editor, Material buttons** and **Add a Material**. **Have Use Nodes active**.

Click the button at the RHS of the Base Color bar and select Image Texture. Navigate to the Texture Image file and click Open Image.

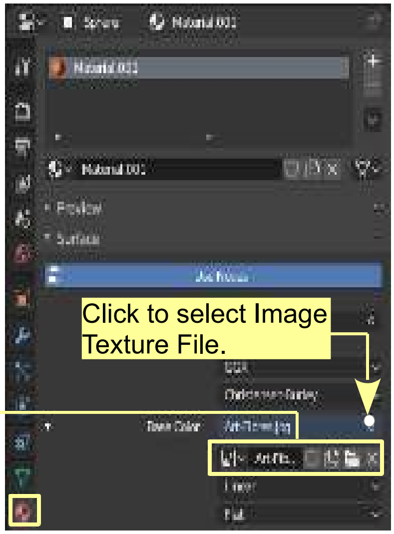
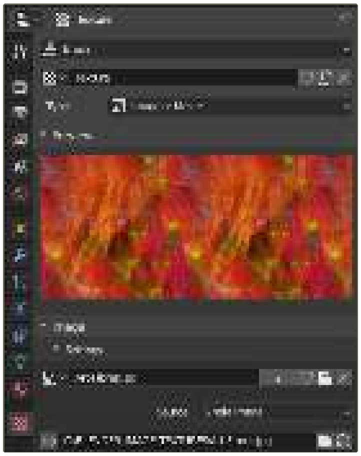
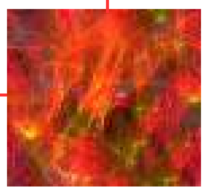


Figure 18.64

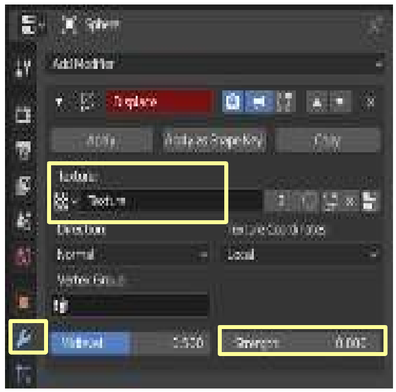
Change the 3D View Editor to Rendered Viewport Shading to see the Image applied as a Material to the Egg.

With the Egg selected in the 3D View Editor go to the Properties Editor, Texture buttons and Add a Texture, selecting the same Image as before.





The Texture will be named **Texture**.



Modifier Buttons

In the Properties Editor, Modifier buttons Add a **Displace** Modifier to the Egg selecting the Texture named **Texture**.

With the Strength value in the Modifier: 1.000 the Egg in the 3D Viewport Editor is deformed by the Texture. Set the Strength value to 0.000.

Figure 18.65

Divide the 3D Viewport Editor horizontally and make the lower part the **Video Sequence Editor.** The Timeline Editor remains at the bottom of the Screen.

With the Egg selected and the Timeline Editor Cursor at Frame 1 in the Timeline, in the Displace Modifier panel RMB click on the Strength value and select Insert Keyframe.

The Strength value slider turns yellow and a Keyframe is entered in the Timeline at frame 1.

In the Video sequence Editor Header click Add – Sound and navigate to the sound file then click Add Sound at the upper RHS, The file is entered in Channel 1 in the Video Sequence Editor.

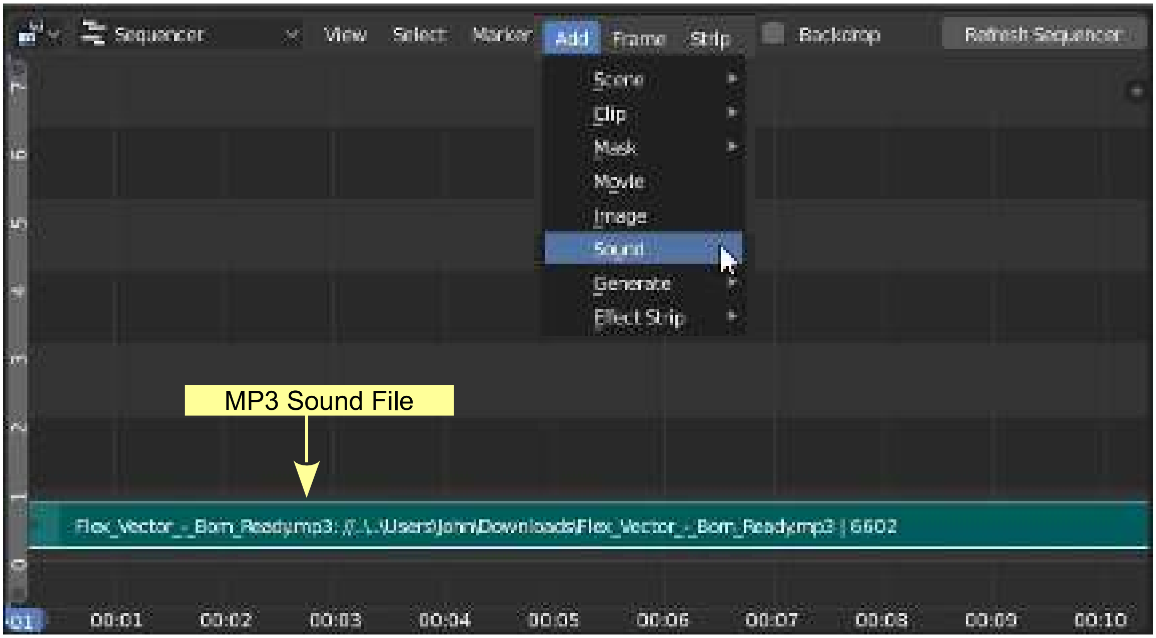


Figure 18.66

Change the Video Sequence Editor to the **Graph Editor** and in the Header click **Key** and select **Bake Sound to F-Curve**. Navigate to and select the Sound File then click **Bake Sound to F-Curve** in upper RHS of the panel. **Note:** A Keyframe must be entered before this instruction.

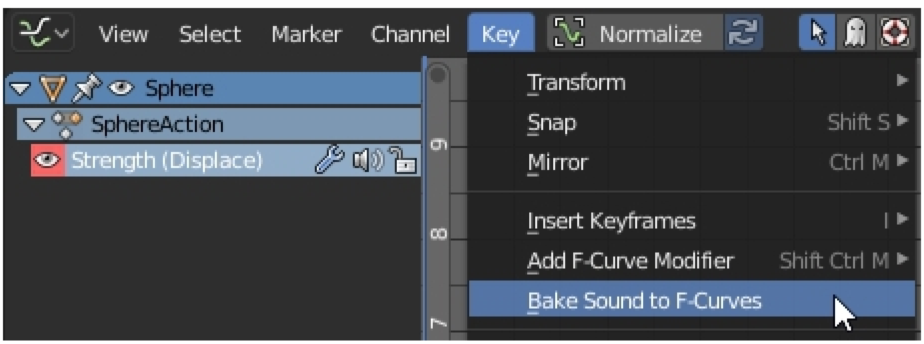


Figure 18.67

A Sound Curve is drawn in the Graph Editor.

Figure 18.68

Playing the animation sees the Egg pulsate in the 3D Viewport Editor to the beat of the Sound (have the speakers turned on).

This result may be what is required but if not you can modify the Curve in the Graph Editor. With the Mouse Cursor in the Graph Editor press the N Key to display a Properties Panel and select the Modifiers tab.

Click Add Modifier and select Envelope. Click Add Point to add control points. Adjusting the Control Point values alters the Sound Curve in the Graph Editor which alters the the way in which the sound affects the animation.

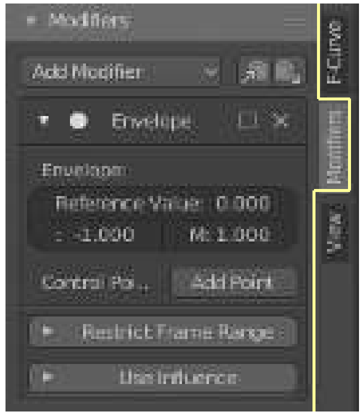
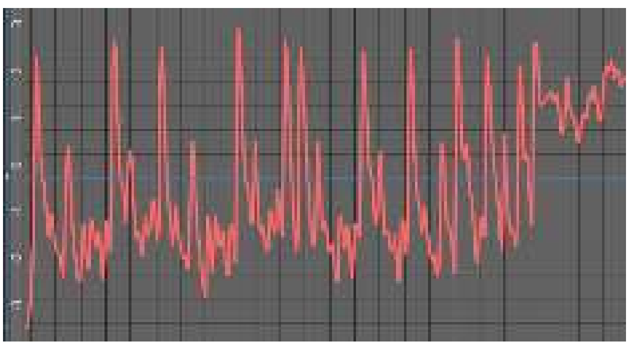


Figure 18.69



18.20 Sound Effect and Cast Modifier

Displacement Sound Animation in the previous section used a sound file to affect the **Strength value** of a **Displacement modifier.** A sound file was then **Baked** to an **F-Curve** and modified. This was to control the displacement of the Object's surface.

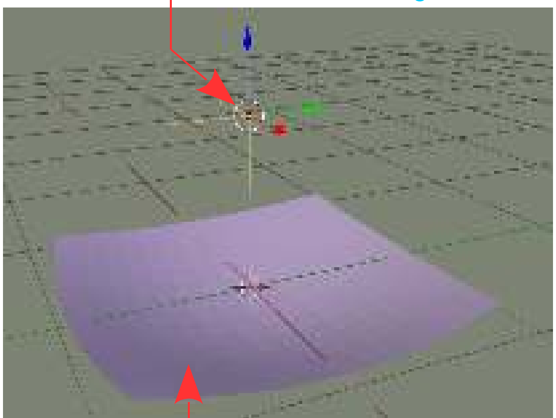
You may combine a sound file **F-Curve** and a **Cast modifier** with an **Empty** control object to influence an animation of the Object's surface deformation.

To demonstrate set up a Plane object with a **Cast Modifier** and an **Empty** object (Figure 18.70).

Set up the 3D View Editor

Empty Control Object

Figure 18.70



Plane Object – Subdivided x 12

Properties Editor

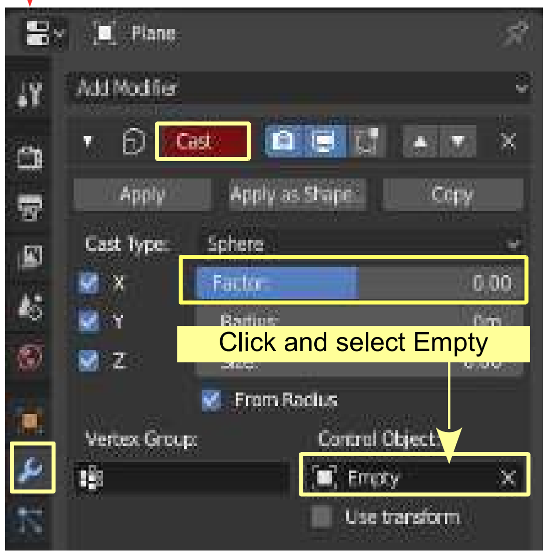
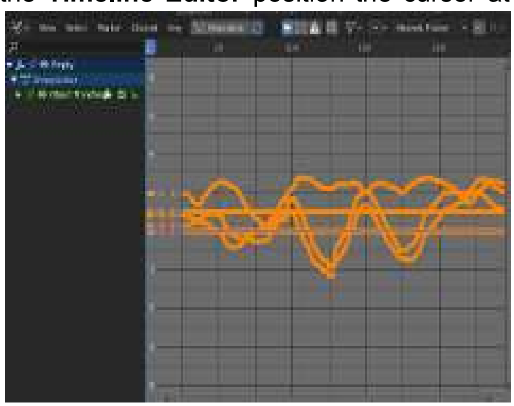


Figure 18.71

Add a Sound File to the **Video Sequence Editor.**

Create an F-Curve for the **Factor value** of the Cast modifier by selecting the Plane, then setting the **Factor value** in the **Cast modifier to 0.000.** In the **Timeline Editor** position the cursor at Frame 1. Right click on the **Factor value slider** in the Cast Modifier and select **Insert Keyframe**.

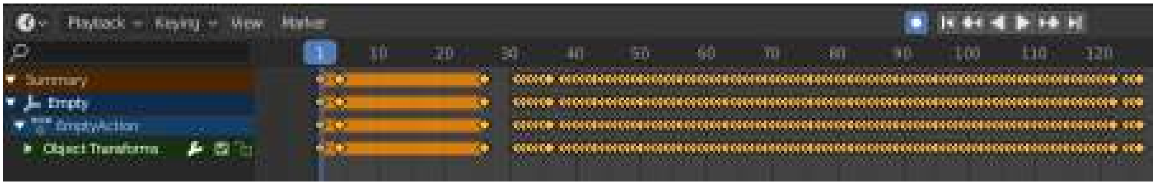


Declare the sound file to affect the Factor value by dividing the 3D Viewport Editor in two and changing one half to the **Graph Editor.** In the Header click on **Key** and select **Bake Sound to F Curves**. Navigate to the sound file, select the file and click Bake Sound to F-Curves in upper RH corner of the Editor**.** The bake can take a while. The sound file **F-Curve** is inserted in the **Graph Editor.**

Figure 18.72

Automatically Insert Keyframes

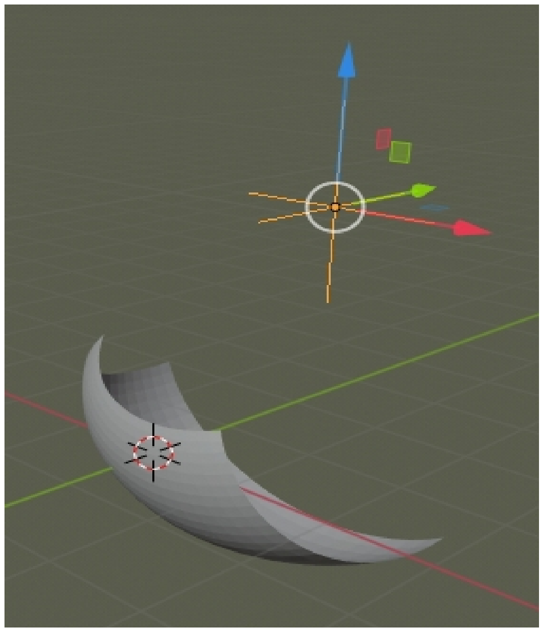
Turn on **Auto Keyframing** in the **Timeline Editor Header**. With the **Empty Object** selected in the 3D Viewport Editor play the animation and at the same time press **G Key** in the **3D Viewport Editor** and move the Empty object about. Keyframes are added to the Timeline. Stop the animation, reinstate the sound file in the Video Sequence Editor and replay to see the effect.



Keyframes Added in the Timeline Window Figure 18.73

Figure 18.74

Sound file in the Video Sequence Editor



When the Animation is played the Mesh Deforms to the beat in the 3D Viewport Editor.

Figure 18.75

19

Constraints

19.1 Introduction to Constraints
19.2 Track to Constraint
19.3 Constraint Stack
19.4 Transform Constraint List
19.5 The Transform Constraint
19.6 Tracking Constraint
19.7 Relationship Constraint
19.8 The Action Constraint
19.9 The Shrinkwrap Constraint
19.10 Extrusion Follow Path

Constraints control an Object's properties such as its Location, Rotation and Scale by Targeting the Object to a secondary Object or connecting Objects in a Scene together, such that they act as a single entity while maintaining individual characteristics. Another way to define Constraints is to say they define relationships between Objects.

For example, the **Track To Constraint** applied to a **Camera** Object, with a **Target** set as another Object in the Scene, causes the Camera to always point to the second Object no matter where it moves.

Another example is a **Child Of Constraint** which when applied to one Object (the child) with a **Target** set as a second Object (the parent) causes the child to follow the parent. Using a Child Of Constraint creates what is termed a **Child / Parent Relationship.** This has a particular application in animating characters.

Constraints are applied to Objects in the **Properties Editor, Constraints buttons**, clicking on **Add Object Constraint** then selecting a Constraint from the menu that displays.

Constraints in Blender are listed in four categories as shown in Figure 19.2 on the following page.

In this chapter, Constraints are briefly defined and several examples provided which will allow you to understand their application.

19.1 Introduction to Constraints

Constraints are are accessed in the **Properties Editor, Constraints buttons** (Figure 19.1).

Clicking **Add Object Constraint** displays the Constraint selection menu listing Constraints in four categories (Figure 19.2).

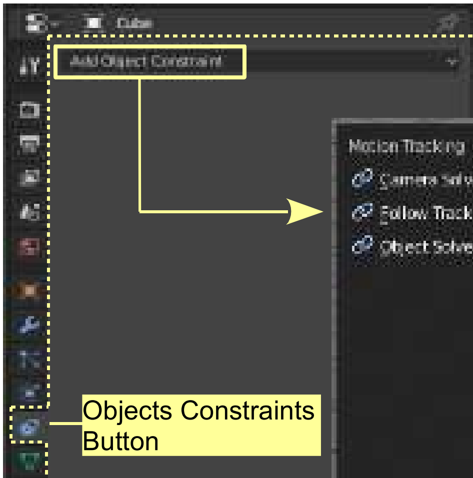
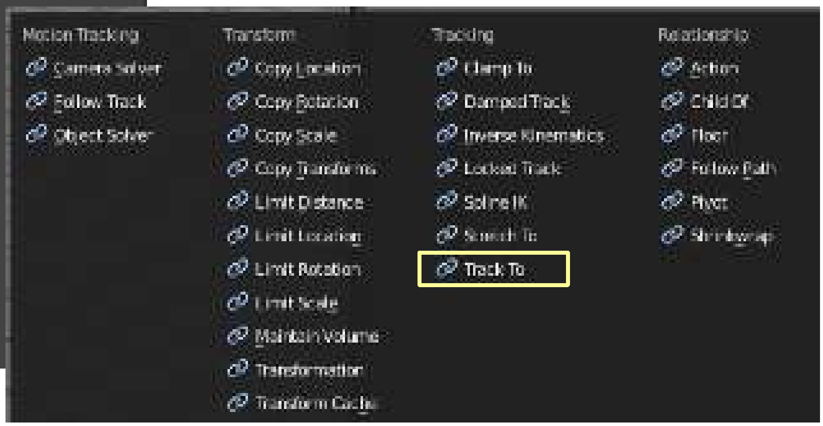


Figure 19.1

Note: Not all constraints work with all Objects.

Figure 19.2



19.2 Track to Constraint

The Track To Constraint provides an introduction demonstrating what a Constraint is, in practical terms and how Constraints are used.

In the default Blender Scene a Camera Object is directed towards the Cube Object such that it captures the Cube in Camera View (Num Pad 0). When the Cube is animated to move across the Screen the Cube can move in and out of Camera View. If you want the Cube to remain in view no matter where the Cube is in the Scene, you track the Camera to the Cube by employing the **Track To Constraint** (add the Constraint to the Camera).

Note: The default camera has been rotated and locked in position to point towards the center of the Scene (default position of the Cube). The rotation of the default Camera has to be unlocked to use the Track To Constraint. This only applies to the default Camera. A new camera entered in the Scene is not locked.

To unlock the default Camera have it selected then press **Alt + R Key**. The rotation is cleared and the Camera points down in the Scene. **Note:** The **<u>Clear Rotation Panel</u>** displays in the lower LH corner of the Editor.

Figure 19.3

If **Delta Transform Rotation** values have been entered in the **Properties Editor, Object buttons, Delta Transform Tab**, check **Clear Delta** in the Clear Rotation Panel.

With the Camera selected click **Add Object Constraint** (Figure 19.1) and select **Track To** in the menu (Figure 19.2).

Figure 19.4

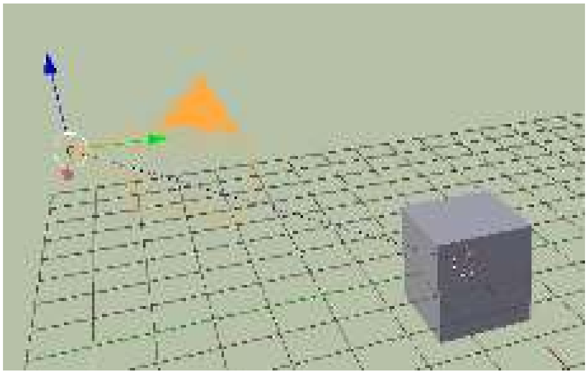
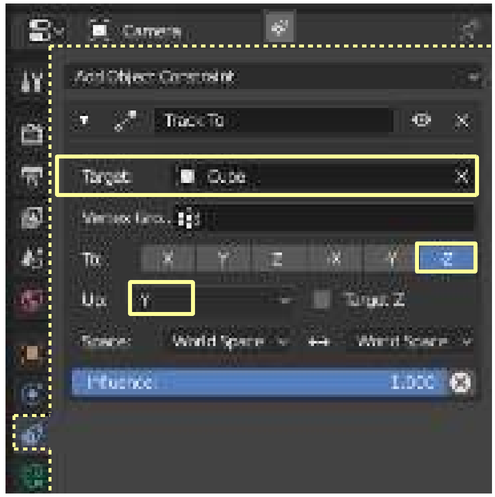


Figure 19.5



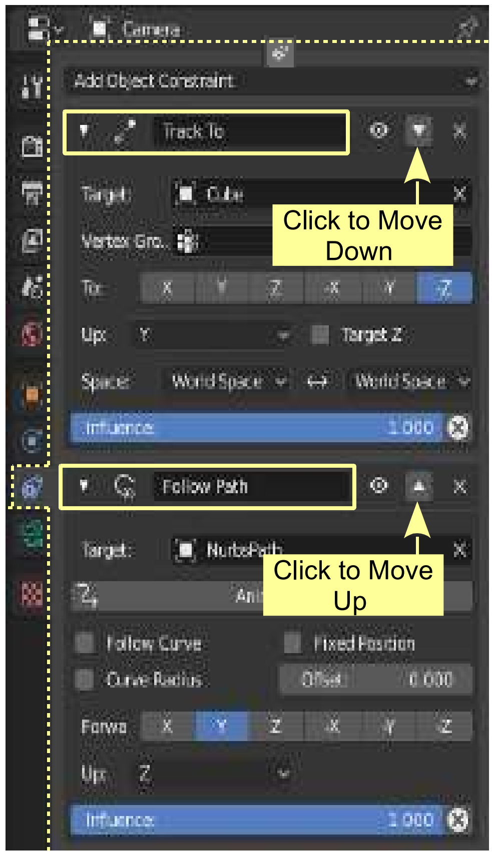
In the Track To Constraint panel click on Target and select the **Target Object** (Cube) in the menu (Figure 19.5).

Note: On entering the Target (Cube) the Camera swings around pointing away from the Cube. There is a broken line connecting the Camera to the Cube indicating that a Constraint is applied, but you have to adjust **To** and **Up** directions in the Constraint Panel. Set **To** as **-Z** and **Up** as **Y** (Figure 19.5). With the Cube animated to move in the Scene the Camera always points to the Cube.

Constraints are associated with an Object by selecting the Object in the 3D Viewport Editor then clicking on **Add Object Constraint** in the **Properties Editor, Object Constraints buttons and** selecting the Constraint from the menu that displays (Figure 19.2).

19.3 Constraint Stack

Figure 19.6



It should be noted that, in some cases, it is appropriate to apply more than one Constraint to an Object. When this is done, the Constraints are placed in a stack in order of priority. The priority can be changed by moving a constraint up or down in the stack (Figure 19.6).

In Figure 19.6 a Follow Path and a Track To Constraint are applied to the same Object. The **Track To** takes precedence over the **Follow Path**. To reverse the precedence click either of the up or down arrows.

When using Constraints, in many cases, there are control values to be inserted in the Constraint Panel to regulate the functions. The following pages in this chapter contain a brief description of Constraint functions. Most Constraints are self explanatory, therefore a detailed explanation will only be given for a few common Constraints, or where it is not self evident.

19.4 Transform Constraints List

- **Copy Location.** Forces the Object with the constraint added to take up the location of the Target Object.
- **Copy Rotation.** Forces the Object with the constraint added to copy the rotation of the Target Object. When the target rotates, the Object rotates.
- **Copy Scale.** Forces the Object with the constraint added to copy the scale of the Target Object
- **Copy Transforms.** Similar to the copy location constraint.
- **Limit Distance.** Constrains the Object to remain within a set distance from the Target Object. The distance is a spherical field surrounding the target and the Object is constrained within or outside the spherical field.
- **Limit Location.** Constrains the Object's location between a minimum and maximum distance on a specific axis. The distance is relative to either the world center or a parented Object.
- **Limit Rotation.** Constrains an Object’s rotation about a specific axis between limits.
- **Limit Scale.** Constrains the scale of an Object between limits on a specified axis.
- **Maintain Volume.** Constrains the dimensions of a side on a specified axis.
- **Transformation.** See Section 19.5.
- **Transform Cache.**

19.5 The Transformation Constraint

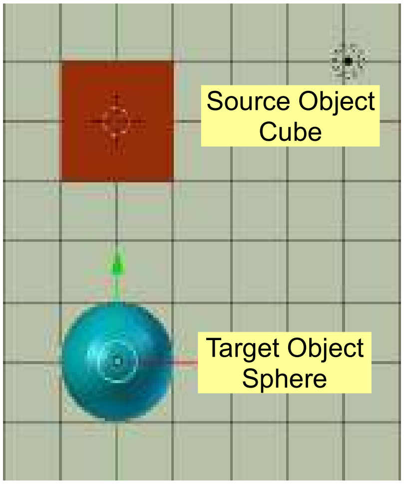
The Transformation Constraint allows you to control the Location, Rotation or Scale of one Object or part of an Object by adjusting the Location, Rotation, or Scale of another Object. The Location, Rotation or Scale values in either case can be set to operate within a specific range.

The Object to be controlled is termed the **Source** and has the Constraint applied to it, while the other Object (the controlling Object) is termed the **Target object**.

To demonstrate have a Cube Object and a UV Sphere in the 3D Viewport Editor in Top Orthographic View (Figure 19.7)

The Cube will be the Source Object controlled by the Target Sphere.

To apply the **Constraint**, select the Source (Cube), click **Add Object Constraint** in the **Properties Editor, Constraints buttons** and select **Transformation** under the **Transform** heading. **Select Target: Sphere**.



Top Orthographic View

Properties Editor

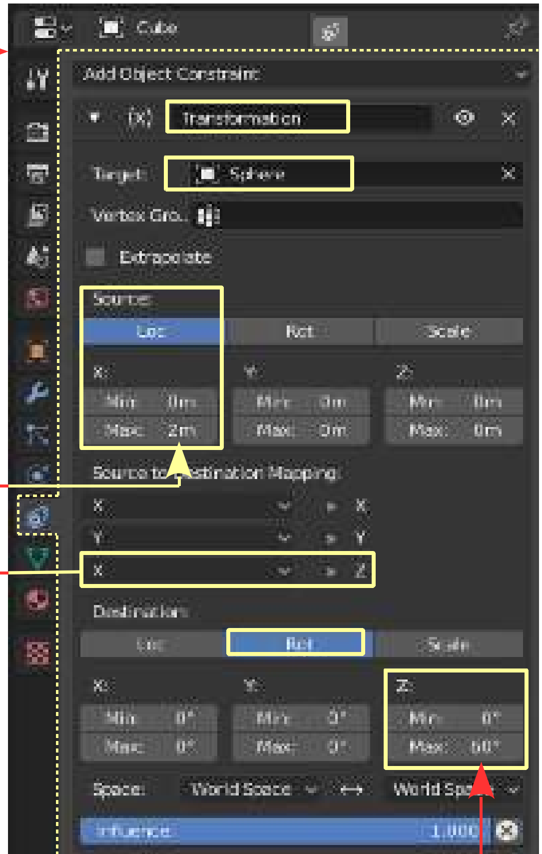
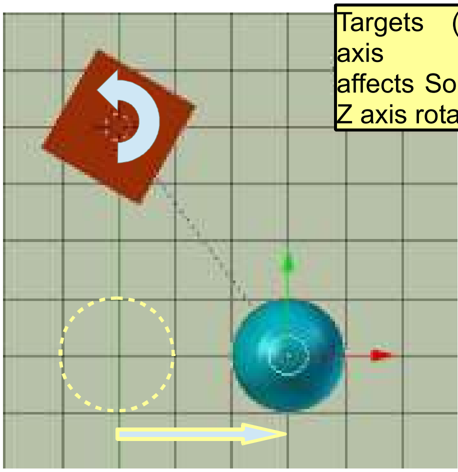


Figure 19.7

See **Max:2** below



Spheres Z Axis Rotation limited to 0 min – 60 max

Max. 2.0 - Cube rotates up to Max. 60° when the Sphere moves 2 Units on the X Axis. No further rotation takes place when the Sphere is Translated more than 2 Units.

19.6 Tracking Constraints

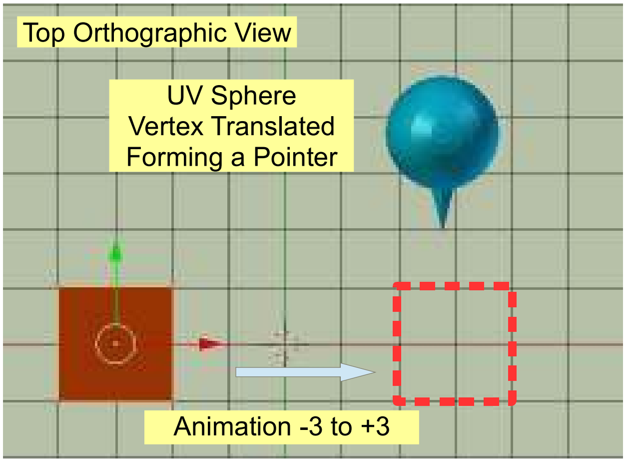
- **Clamp To:** Clamps or locks the position of the Object to a target curve
- **Damped Track:** Constrains one local axis of the Object to always point towards the target Object .
- **Locked Track:** Similar to a Damped Track Constraint with more axis control.
- **Inverse Kinematics:** Can only be applied to Bones (see Chapter 20 Armatures).
- **Spline IK:** Can only be applied to Bones (see Chapter 20 Armatures).
- **Stretch To:** Stretches the Object towards the Target Object or compresses the Object away from the Target Object.
- **Track To:** As seen in the introduction to Constraints the Track To Constraint causes the Object to always point towards the Target Object no matter where either the Object or the Target is positioned (Figure 19.4).

19.7 Relationship Constraints

- **Action:** See Section 19.8.
- **Child Of:** Chapter 20 – 20.3.
- **Floor:** Allows the Target Object to obstruct the movement of the Object. For example, a Sphere animated to descend in a Scene will not pass through a Plane that has been set as a Target Object.
- **Follow Path:** Causes the Object to be animated to follow a Curve Path nominated as the Target. This Constraint also has the feature to follow the Curve, which means that the Object will rotate and bank as it follows the Curve. This constraint can also be employed to duplicate Objects along a Curve Path. (See Chapter 18 – 18.18).
- **Pivot:** Causes the Object to leapfrog to the opposite side of the Target Object along an axis between the Object and the Target Center. The location can be offset on either side of the axis by inserting offset values.
- **Shrinkwrap:** Locks an Object to the surface of another mesh Object that is set as the Target.

19.8 The Action Constraint

Figure 19.8



The **Action Constraint** allows you to control the action of one Object by manipulating the action of another. Consider an action to mean a Translation, Rotation, or Scale of an Object. To demonstrate, the Rotation of a Sphere Object will control the Translation of a Cube.

The location of the UV Sphere in the Scene is not important.

Animate the Cube to move from minus three Blender units to plus three units on the X Axis in 100 Frames (see Chapter 18 for Animation). Place the animation at Frame 1.

Select the **Cube** then in the **Properties Editor, Constraints buttons,** Add **Relationship Constraint** type **Action**. In the Constraint panel set the values as shown in Figure 19.9.

Note: The **Cube Action** value under **To Action** does not exist until the Cube is animated to move. Note: Pay particular attention to

The Z Rotation of the Target (UV Sphere) controls the Action of the Cube within the Animation (CubeAction).

The Z Rotation (Target Range) is limited to: 0 to 90°.

The Action Range is between Frame 1 and frame 100 of the animation. **Note:** When the Action Constraint is applied the Cube Animation changes to minus 6 to 0 in the 3D Viewport Editor? Figure 19.9

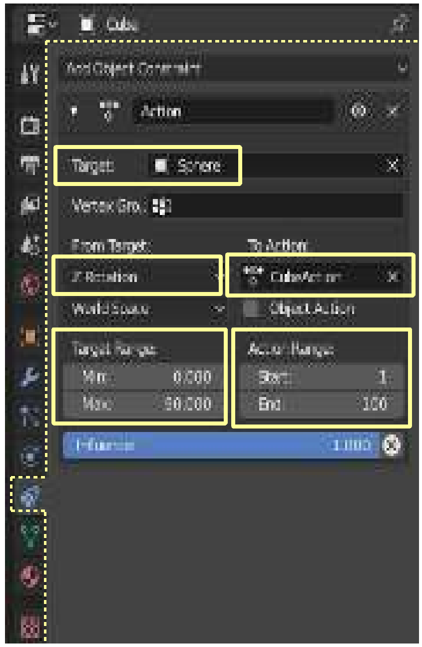
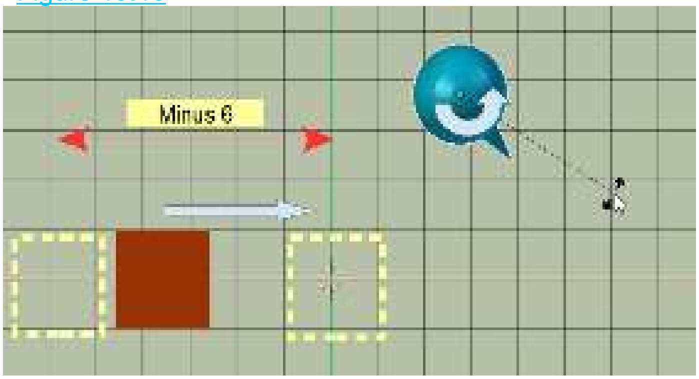


Figure 19.10



You may set an Animation to rotate the UV Sphere in which case when the Cube is Translated (Moved) the Sphere Rotates.

19.9 The Shrinkwrap Constraint

The **Shrinkwrap Constraint** could be more aptly named the **Mesh Surface Lock** since the constraint locks an Object to the surface of another mesh Object that is set as the Target. Do not confuse this constraint with the **Shrinkwrap Modifier**. To demonstrate how the constraint operates, follow this procedure:

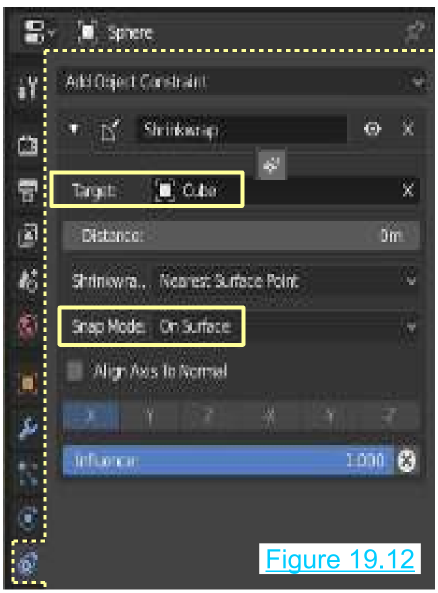
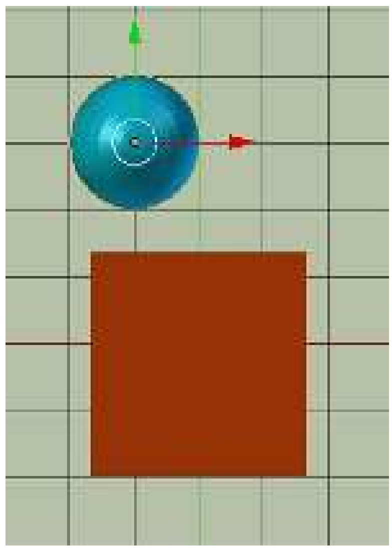


Figure 19.12

In the default Blender Scene in Top Orthographic view, add a **UV Sphere.** Scale the **Cube** up, and arrange the objects as shown in Figure 19.11. Select the Sphere and in the **Properties Editor, Constraints buttons**, add a **Shrinkwrap Constraint** (Figure 19.12).

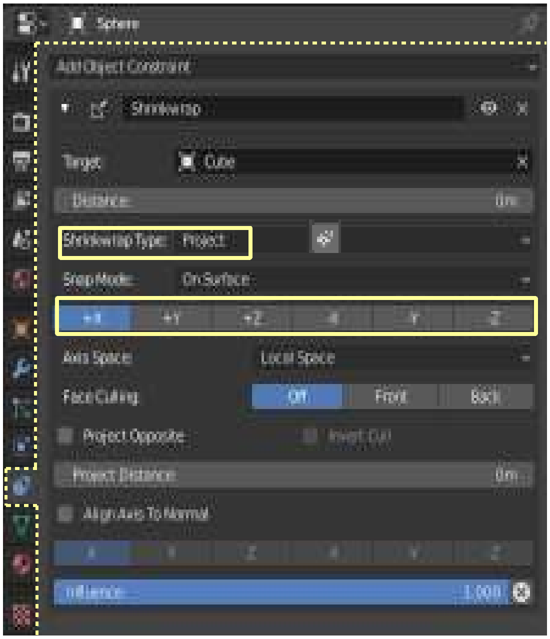
In the **Shrinkwrap Constraint panel**, click in the **Target selection bar** and select **Cube** as the Target (Figure 19.12).

Figure 19.11



Besides projecting to Nearest Surface or Nearest Vertex you may also use the Local Axis of an Object to project to a surface.

Figure 19.13



Note: The Manipulation Widget arrows represent direction.

With Shrinkwrap Type: Project selected, **Axis X, Axis Y, and Axis Z** buttons are present in the **Constraints panel** (Figure 19.13 - Note there are positive and negative values)**.**

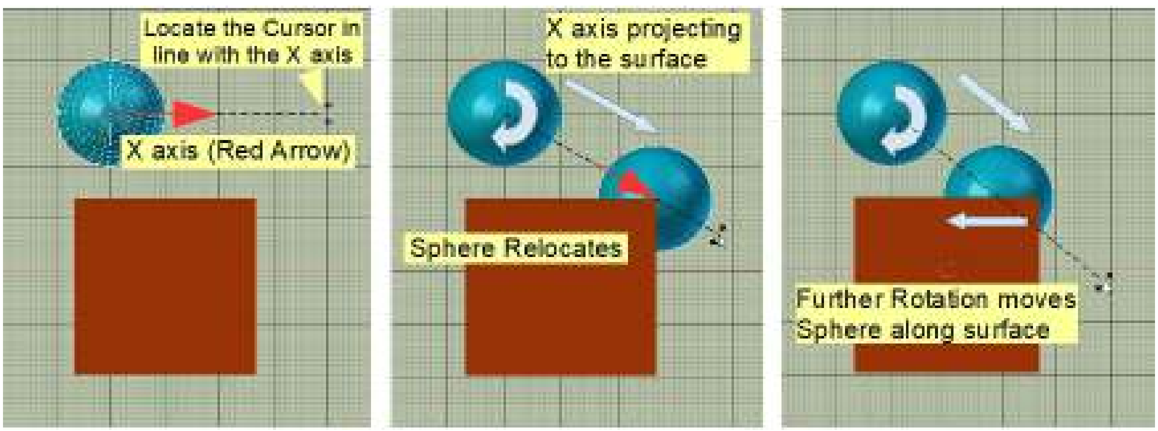
Check (highlight blue) the positive **Axis X button**.

This instructs Blender to project the selected Object which has the Constraint applied, to the surface of the Target Object when the X Axis points to the surface.

In order to project the X Axis of the Sphere towards the surface of the Cube, Rotate the Sphere.

Rotate the Sphere (slowly) until the X Axis points at the Cube. That is, rotate about the Z Axis. (Figure 19.14). As soon as the Axis points to the surface on the Cube, the Sphere is located on the surface. By slowly rotating the Sphere you will see it move along the surface as the direction of the Axis changes. In the **Object Constraints** panel, the **Distance** and **Influence** sliders affect how far the Sphere is located between its original position and the surface of the Cube. By checking **Axis X** and **Axis Y**, the projection line is at 45 degrees between the Axes.

Figure 19.14



19.10 Extrusion Follow Path

The **Follow Path Constraint** causes an Object to follow a **Path** set as the Target. The constraint incorporates a **Follow Curve** setting which make the Object rotate and bank as it follows the Path. This has been demonstrated in Chapter 18-18.18 Animation Follow Path.

The **Follow Path Constraint** may also be used to **Extrude** shapes.

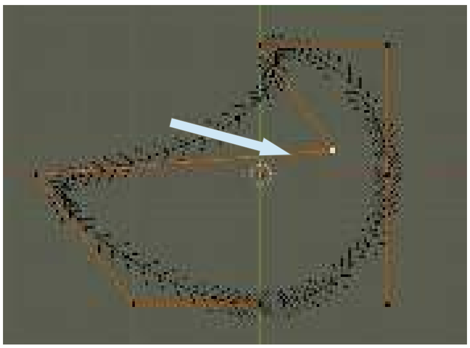
Review Chapter 10 and in particular 10.6 Modeling from a Curve where a Bezier Curve was manipulated to generate a Mesh Object (Figure 10.15). The Mesh Object created was a regular shape. The following procedure will demonstrate how irregular shapes may be created by extruding a profile along a Path.

The Profile

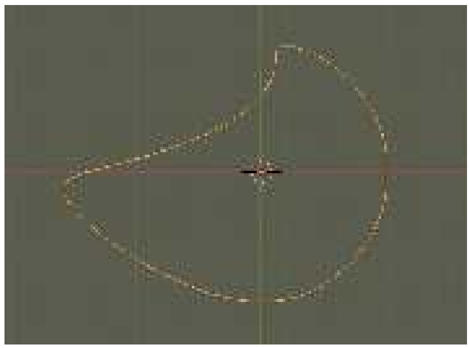
A Profile of the shape may be generated by using any Curved Path. Bezier or Nurbs Curves are particularly appropriate since they form a closed loop.

Start with a Nurbs Circle and create an interesting Profile (see Chapter 10 -10.8 and 10.9 Using Nurbs Curves).

Figure 19.15

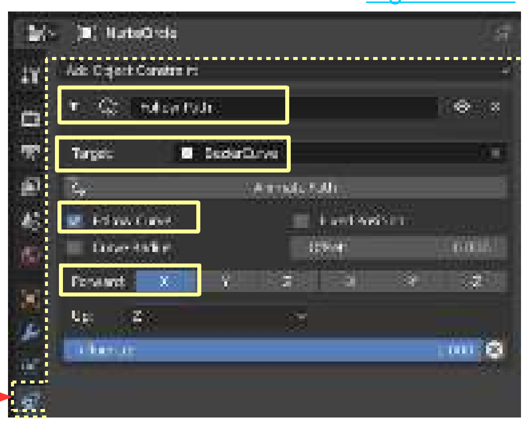


Nurbs Circle – Edit Mode
Top Orthographic View



Nurbs Circle – Object Mode
Top Orthographic View

Figure 19.16



Remember: Nurbs and Bezier Circle are entered in the 3D View Editor in **Top Orthographic View** flat on the XY Plane at the center of the Scene.

After shaping the Nurbs Circle deselect and add a **Bezier Curve** and scale the Curve up. The Curve is also entered flat on the XY Plane.

Have the Nurbs Circle Profile selected and add a **Follow Path Constraint**. Set **Target: BezierCurve** and check Follow Curve.

Change **Forward: Y to X.**

Object Constraint

With the settings in the Follow Path constraint as shown in Figure 19.16 the Profile is positioned at **the Start** of the Bezier Curve Path, standing on edge with its Z Axis pointing along the Path.

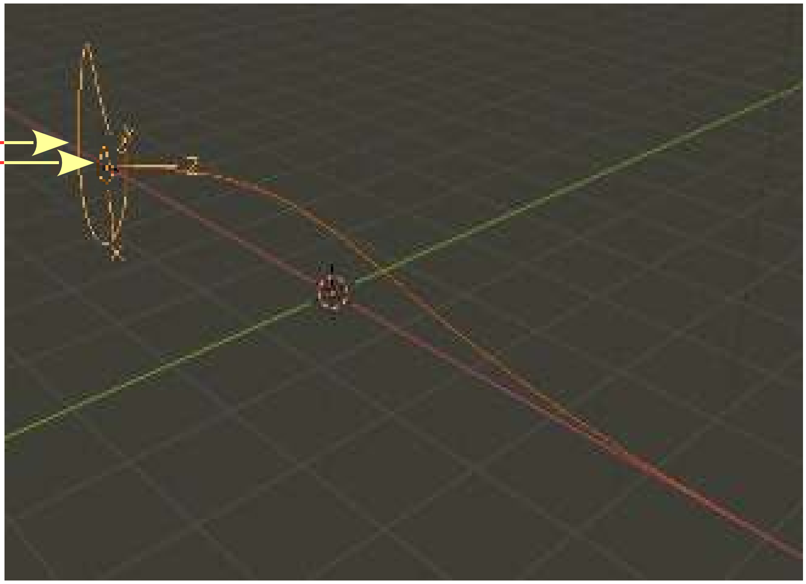


Figure 19.17

Scale the Profile way, way down. You can adjust the Scale after Extrusion to get an exact size.

Select the **Bezier Curve Path** and in the **Properties Editor, Object data buttons, Geometry, Bevel Tab**, enter **Object: Nurbs Circle**.

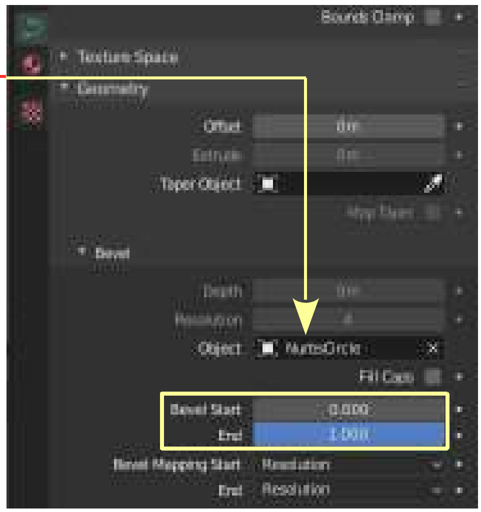


Figure 19.18

The Profile is Extruded along the Bezier Curve Path.

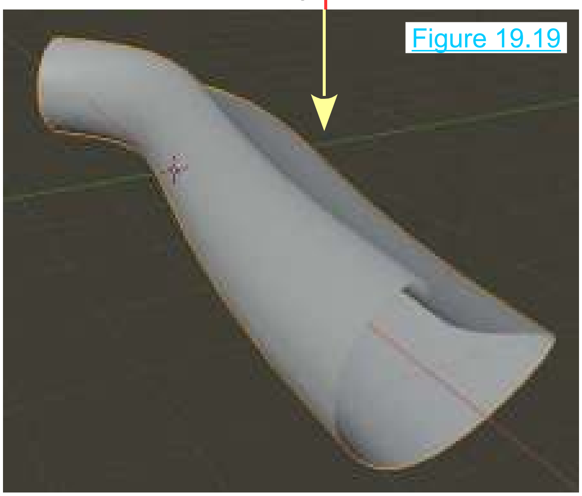


Figure 19.19

Adjusting Bevel Start and End moves the ends of the extrusion along the Bezier Curve. Checking Fill Caps fills in the ends of the extrusion.

Note: Entering, Nurbs Circle as the Taper Object under Geometry produces interesting results.

Note: With the **Bezier Curve Path** selected (**No** Taper Object entered in the Geometry Tab and **No** Object entered in the Bevel Tab);

Increasing the **Extrude value** under **Geometry**, extrudes the Bezier Curve on the Z Axis producing a flat curved shape.

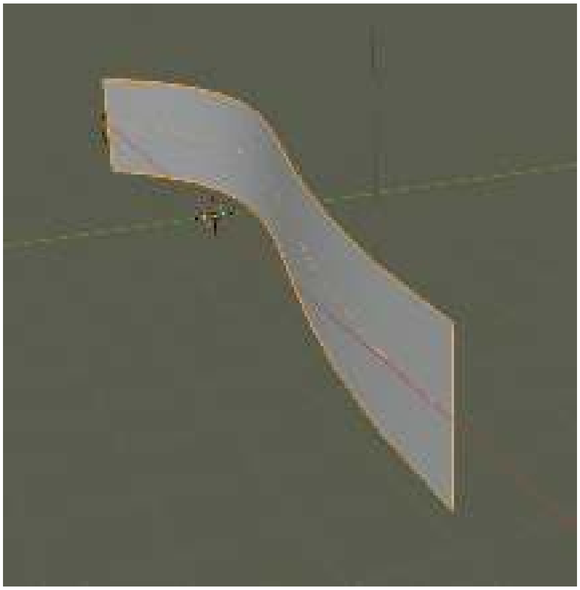


Figure 19.20

Increasing the **Depth value** in the **Bevel Tab** produces a curved circular tube.

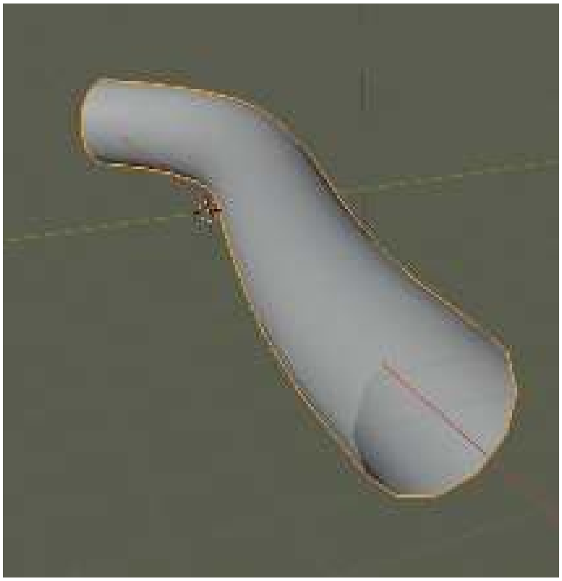


Figure 19.21

20

Armatures & Character Rigging

20.1 Single Bone Armature
20.2 Adding Armatures
20.3 Child Parent Relationship
20.4 Armature Display Types
20.5 Multi-bone Armatures
20.6 Multi-bone by Subdivision
20.7 Multi-bone by Extrusion
20.8 X-Axis Mirror Extrusion
20.9 Extruding Shoulder and Arms
20.10 Naming Bones
20.11 Deforming a Mesh
20.12 The Armature Modifier
20.13 Assigning Vertices-Vertex Groups
20.14 Assigning Vertices-Set Parent To
20.15 Vertex Groups-Weigh Paint
20.16 Inverse Kinematics Constraint
20.17 Spline IK Constraint
20.18 Forward
20.19 Character Rigging
20.20 Creating the Armature
20.21 Adding More Bones
20.22 Creating Arm Bones
20.23 Creating Leg Bones
20.24 Bone Naming
20.25 Assigning The Mesh
20.26 Vertex Groups
20.27 Posing the Character Model
20.28 Pre-Assembled Armatures

Armatures are used to control the movement of Objects or components of an Object, in animation. In intricate assemblies, components are linked or associated with Armatures, such that, when the Armature moves the components move. Armatures themselves are made up from parts called **Bones** and may consist of a single Bone or multiple Bones linked in **Child Parent Relationships**. This means that when one Bone moves other Bones move according to the hierarchy in the relationship. Armatures do not Render, therefore, Bones can be animated controlling the animation of the components of an assembly.

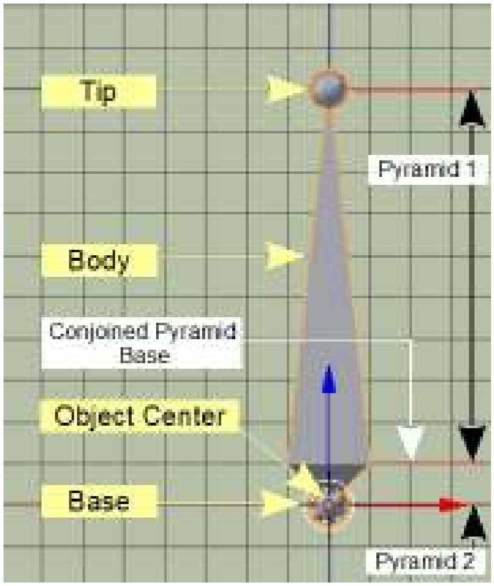
A particular application for Armatures is the control and animation of Character Models. Figure 20.1 shows an **Armature** (blue bones) inside a character model. Each bone is linked to part of the surface mesh. The bones are animated to move which causes the surface mesh to move, posing the character.

The complete assembly of model, mesh, armature and controls is called a **Rig**.

Figure 20.1

20.1 Single Bone Armature

Figure 20.2

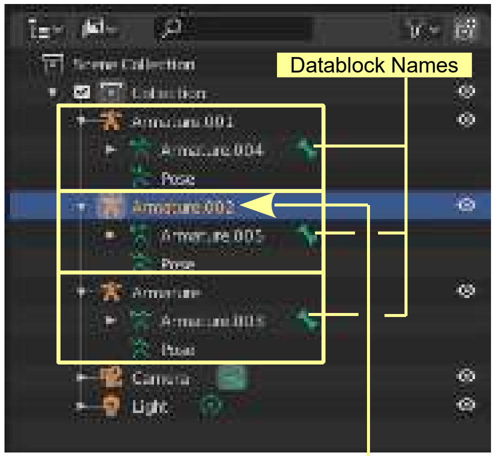


Armatures can, and usually do, comprise multiple Bones, but for an understanding of **Bone** manipulation start with the default single **Bone Armature** (Figure 20.2) which is displayed in type **Octahedral** (due to the object having eight surfaces): The Bone appears as two four-sided pyramids conjoined at the base with spheres at the apexes. For the purpose of the demonstration, the parts of the Armature will be named **Tip, Body**, and **Base**. **Note:** The red and blue arrows are the Manipulation Widget.

Although the armature is an Object in Blender, it is not a Mesh Object. Its shape cannot be edited other than scaling it larger or smaller. It can be rotated and translated. It has a center like any other Object, which by default is located at the apex of the lower (smaller) pyramid.

20.2 Adding Armatures

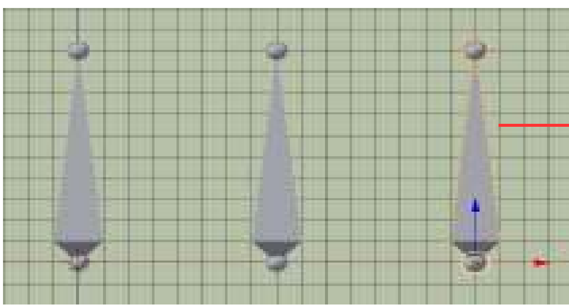
Figure 20.3



An Armature is added to the Scene from the **Add Menu** in the 3D Viewport Editor Header or by pressing **Shift + A Key.** It is located wherever you positioned the Editor Cursor (Reference Chapter 4 - 4.9), just like any other Object . You will see **Armature** listed in the **Outliner Editor** (Figure 20.3).

If you relocate the Cursor and repeat the process you add a second **Single Bone Armature**. Note: The new name, **Armature.001** in the **Outliner Editor** and the sub entries, **Armature.004** and **Pose** (Figure 20.3). If you select either Armature in the 3D Viewport Editor and press **Shift + D key** (Duplicate) and Translate (drag the mouse) you create a third single Bone Armature. The name in the **Outliner Editor** for this third Armature is **Armature.002**.

Note: All three Armatures are a single Bone and independent of each other.

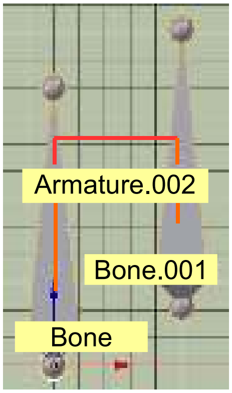


Armature Armature.001 Armature.002

Armature.002 is Selected (White Text)

Figure 20.4

Note: Datablock Names for each Armature may be independent of the Armature Name.



Select one of the three Armatures, say **Armature.002** and **Tab into Edit mode**. In Edit Mode only the Tip of the Armature is selected. Press **A Key** or **LMB click** on the body of the Armature to select the whole Armature.

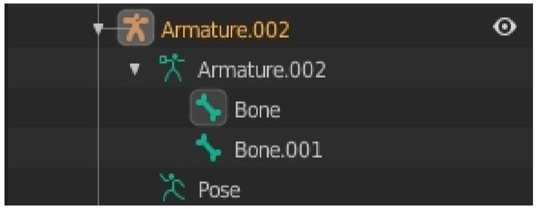


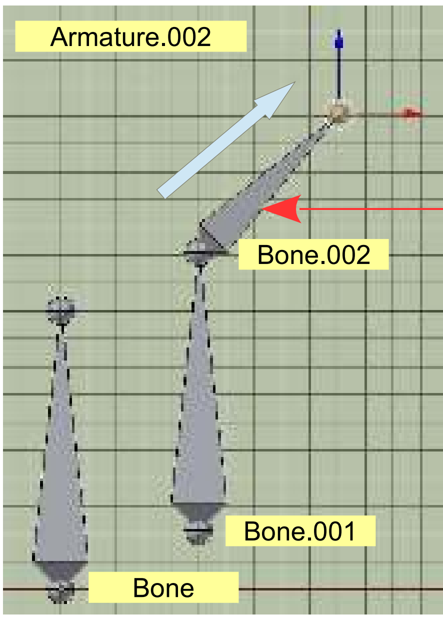
Figure 20.5

Figure 20.6

Note: You are in Edit Mode. Press **Shift + D key** (Duplicate) and drag the Mouse to reveal a new Bone. The point here is; **it is a new Bone which is part of Armature.002 , not a new Armature**. If you select the original Armature **Bone** and **Tab to Object Mode** both Bones will be selected (Figure 20.6). Translating the original will cause the new Bone to follow. There is no link shown between the two but they are connected. In the **Outliner Editor** you will see **Bone.001** entered under **Armature.002** (Figure 20.5).

In **Edit Mode** (Armature.002 selected), press **Alt + A Key** to deselect then **RMB click** on the Tip to select the Tip of Bone.001. Press **E key** (Extrude) and drag the mouse to extrude a new Bone from the tip of Bone.001. This is a new bone which again is part of the armature, not a new armature.

Note the entries in the **Outliner Editor**. You now have sub entry Bone.002 under Bone.001.

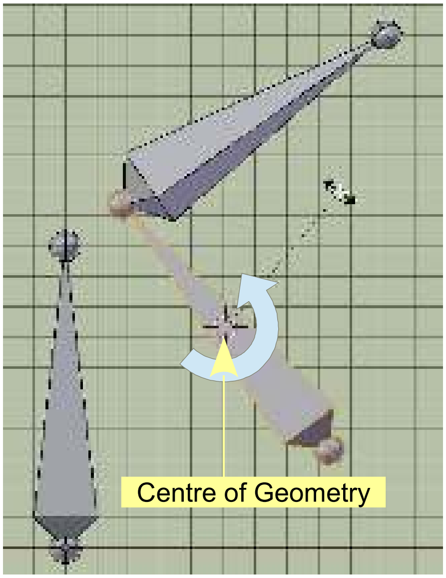


When you Extrude a new Bone from the Tip you may drag the Mouse in any direction.

Figure 20.7

With an Armature selected in the 3D Viewport Editor in **Object Mode**, if you go to the **Properties Editor, Data buttons**, **Display tab** and tick **Names** the individual bone names will display in the 3D Viewport.

Remember: You are still in Edit Mode with Armature.002 selected.



If you press the **Tab Key** and enter **Object Mode** you can deselect and select any of the three Armatures. Armature has one Bone, Armature.001 has one Bone and Armature.002 has three Bones.

Figure 20.8

Have Armature.002 selected. In **Object Mode** RMB clicking on any of its three Bones will select the entire Armature (all three Bones).

In Edit Mode you can select the individual Bones of the Armature and Translate, Rotate and Scale. The Rotation and Scale takes place about the center of geometry of the Bone selected (Figure 20.8).

In the 3D Viewport Editor Header select **Pose Mode** .

The selected Bone will have a blue outline.

Any Bone may be selected then Rotated, Translated or Scaled independently to enable posing for a still image or for animating.

The Tab Key will take you back to Edit Mode and all Bones are displayed in their original positions prior to posing. Observe that Bone.002 follows Bone.001 when it is rotated but Bone remains stationary.

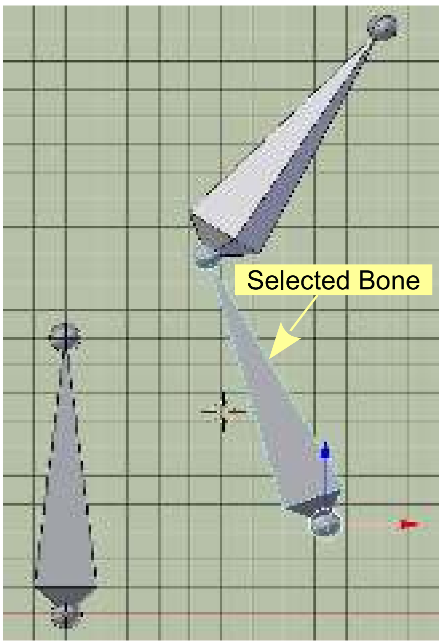


Figure 20.9

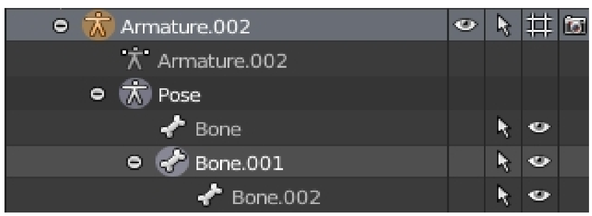


Figure 20.10

In the **Outliner Editor,** while in **Pose Mode** under **Pose** for **Armature.002** (the selected Armature) you see a hierarchical listing of the Bones that have been Posed (Figure 20.10).

Adding, Editing and Posing Armatures at this stage may be somewhat confusing but with practice it will begin to make sense. Working through examples will be invaluable. Before continuing review the hierarchy displayed in the Outliner Editor (Figure 20.11).

The Outliner Editor

The Outliner Editor provides a graphical display of the Armatures and Bones in a Scene. **In Edit Mode** you can select a Bone in an Armature by clicking on its name in the Outliner Editor.

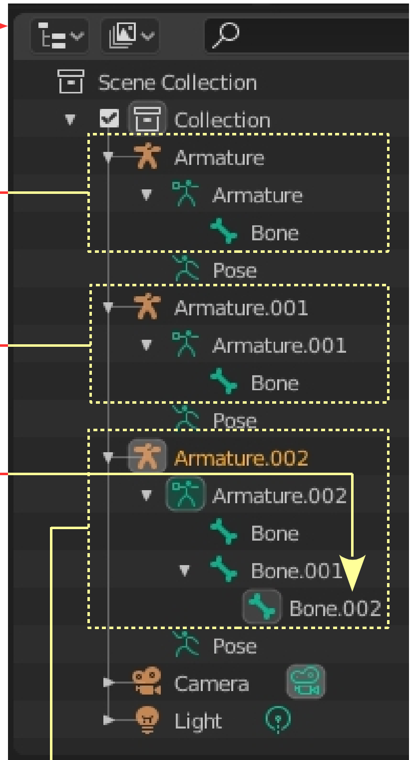
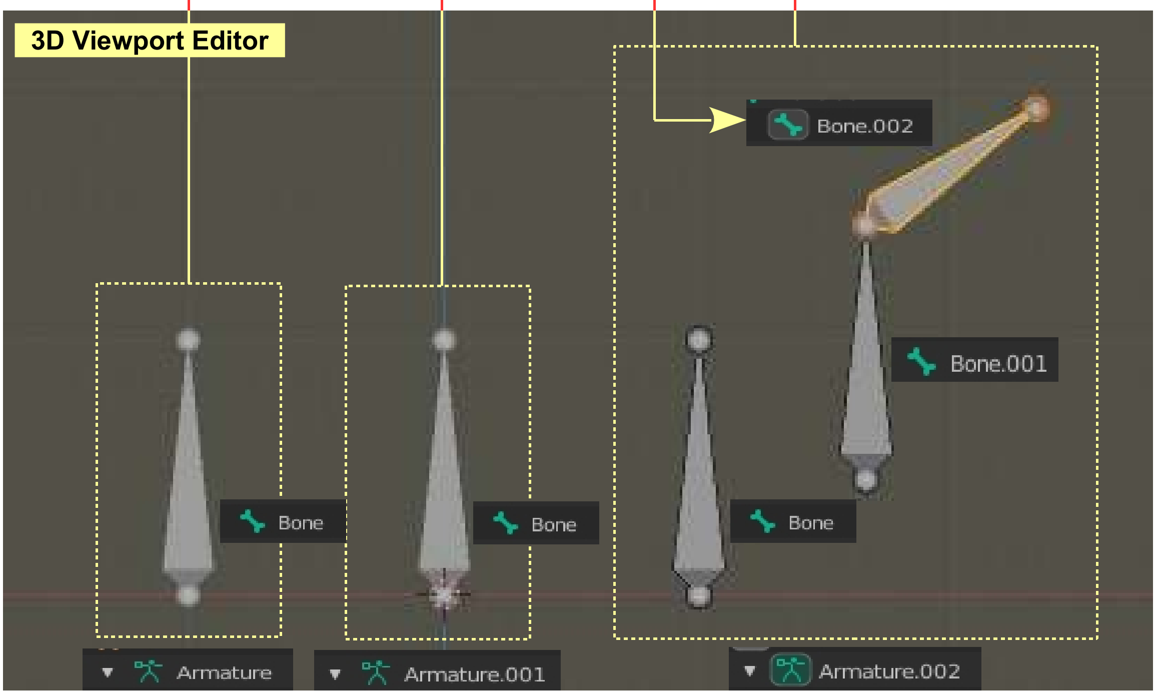


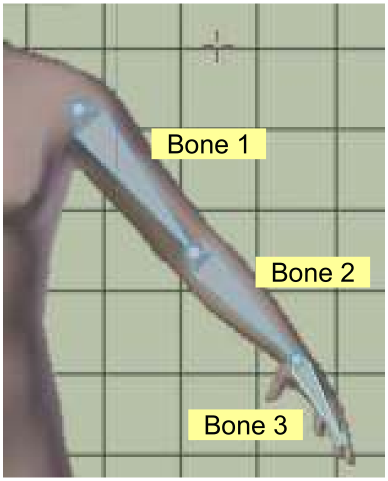
Figure 20.11

Click to select Bone.002 with the 3D Viewport Editor in Edit Mode.



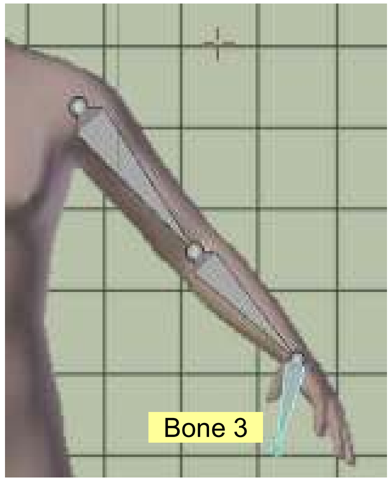
20.3 Child/Parent Relationship

The Bones in an Armature are connected in a **Child/Parent Relationship**. When a second Bone (Bone 2) is extruded from the tip of an Armature (Bone 1) it automatically becomes the Child of the first Bone. Extruding a third Bone (Bone 3) from the tip of the second Bone makes the third Bone the Child of the second Bone. Being a Child means that the Bone follows its parent.

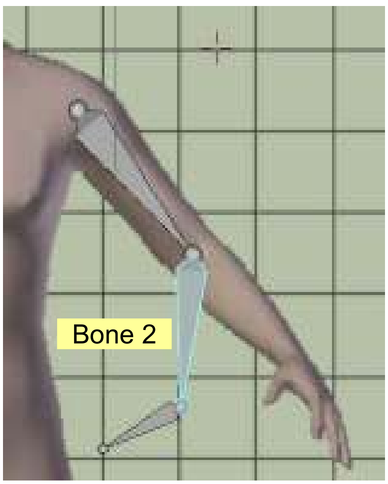


Bone 2 Extruded from Tip of Bone 1.
Bone 3 Extruded from Tip of Bone 2.

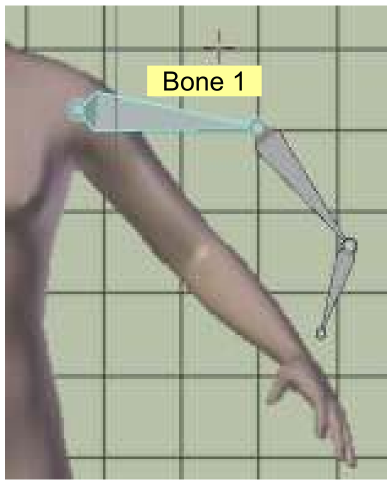
Figure 20.12
Pose Mode



Bone 3 Rotates independently
but is fixed to Bone 2.



Bone 2 Rotated Bone 3 Follows.
Bone 3 is the Child of Bone 2.



Bone 1 Rotated Bones 2 and 3 Follow.
Bone 2 is the Child of Bone 1.

Note: With the Bones linked to the mesh forming the arm, the Mesh will follow the Bones (Linking the Mesh to the Bone to follow).

20.4 Armature Display Types

The default Armature display type is **Octahedral.** There are four alternative display types (Figure 20.13).

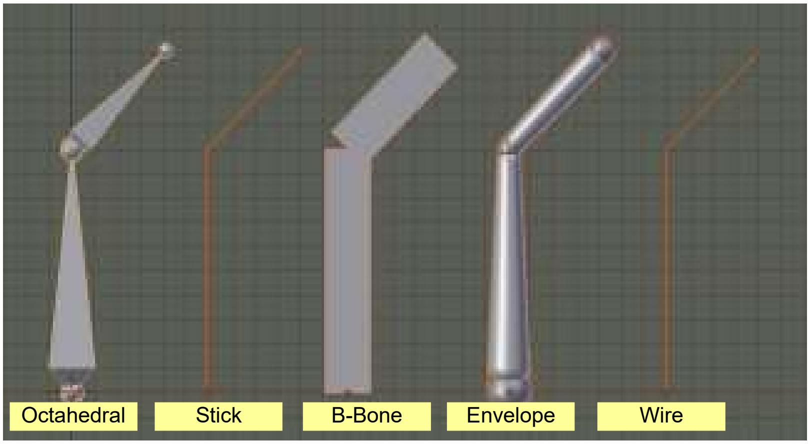


Figure 20.13

With the Armature Bone selected, see the **Properties Editor, Data buttons, Viewport Display tab** (Figure 20.13).

Which display type is used depends on what you will do with the Armature. The different uses will not be explained at this time but since the basic function of an Armature is to deform a mesh Object, you need to understand how this occurs.

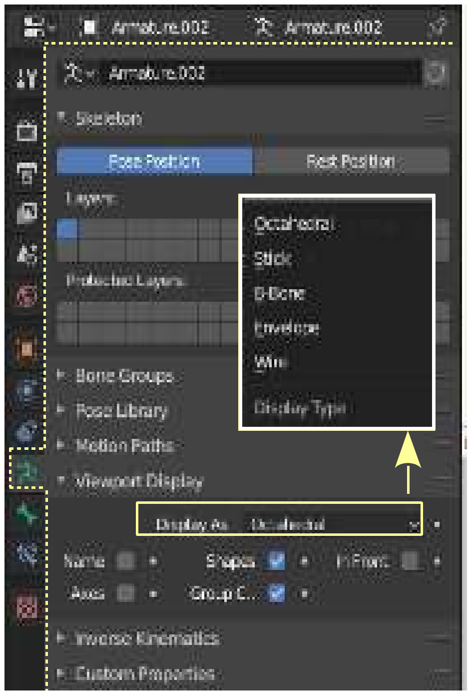


Figure 20.14

20.5 Multi-Bone Armatures

In adding Bones to an Armature, as you did with Armature.002 in Figure 20.7, you have created a Multi-Bone Armature.

Adding Bones to an Armature and creating an Armature Rig is primarily for posing or animating a Character Model. In Figure 20.1 (at the beginning of this chapter) you see an Armature Rig inside a Character Model. There are pre-assembled Rigs which may be used but you should understand how they are created. Understanding will allow you to create Rigs for any application. Rigs are employed for many characters such as strange creatures and weird robots, not only human figures. They are also used when animating machine parts.

A **Character Rig** or **Armature** is constructed using the Extrusion method (see Chapter 6 - 6.4). A Rig is constructed to fit a particular model and there are pre-assembled Rigs which can be modified to fit models.

You may construct your own model, create and import models from external applications or download and use pre-assembled models. The process for constructing an Armature Rig to fit any model is the same.

In Chapter 8–8.12 **Skin Modifier** instruction is provided showing how to extrude a model. The **Skin Modifier** has a function which automatically creates an Armature for the model.

In this demonstration showing how to create a Multi-bone Armature, a model of a human figure has been generated in the **Make Human** program.

http://www.makehuman.org/index.php Figure 20.15

Make Human is a **free Open Source** human character modeling program. You can import a model from the program into a Blender file. Importing Objects is discussed in Chapter 3-3.12.

Figure 20.16 shows the imported model with the Multi-Bone Armature fully constructed. The Armature is shown here so you can see what you are aiming for in the exercise. Figure 20.17 shows the Armature moved to one side as a reference for construction.

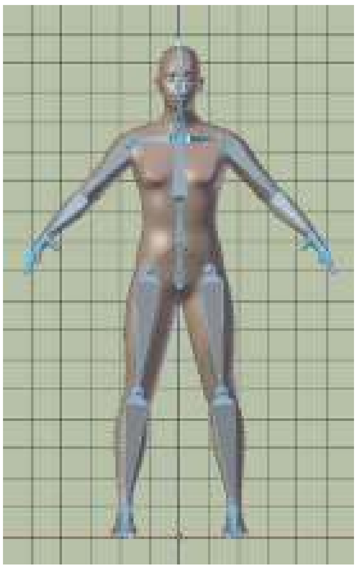


Figure 20.16

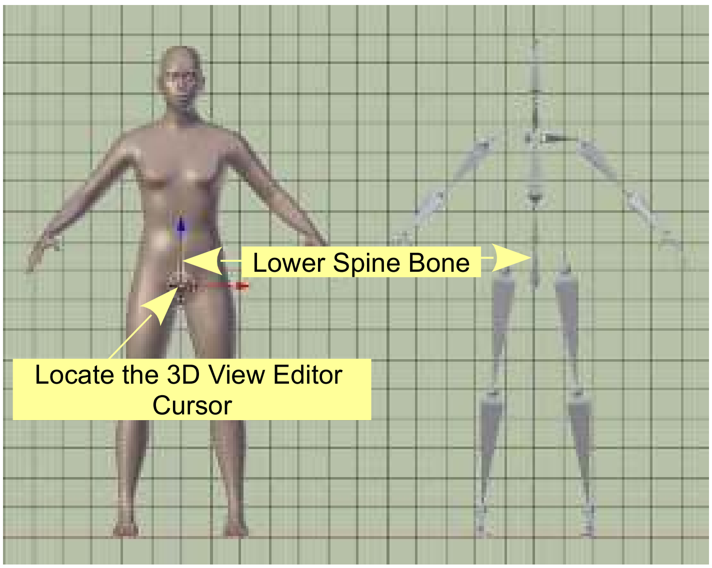


Figure 20.17

When constructing the Armature think of it as a human skeleton.

To start the construction the first Bone to be placed is the **Lower Spine Bone**. Locate the 3D Viewport Editor Cursor where you want to place the Base of the Bone. Press **Shift + A key** and select **Add – Armature**.

The single Bone Armature is entered in the Scene but it may be way too big or too small for the model. Scale to fit.

Figure 20.19

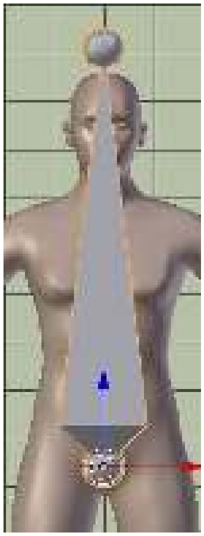


Figure 20.20

Note: When the Armature is scaled, depending on its location, it may disappear inside the model (Figure 20.19).

Figure 20.18

To see the Bone inside, check **In Front** in the **Display tab** in the **Properties Editor, Data buttons** (Figure 20.17). The bone must be selected in the 3D Viewport Editor.

With **In Front** checked you will see the Bone (Figure 20.20).

Figure 20.21

20.6 Multi-bone by Subdivision

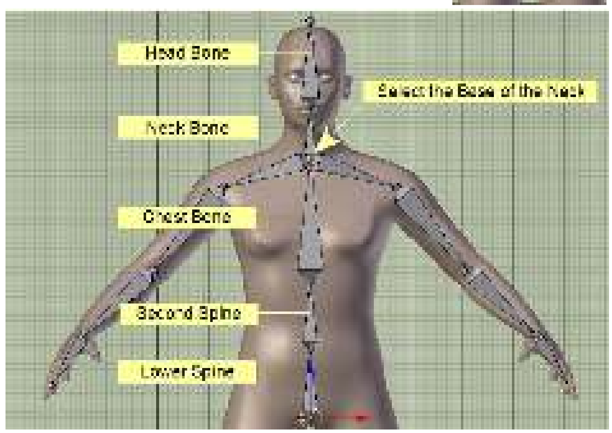
To create a **Multi-bone Armature** from a single Bone, have the bone selected in the 3D View Editor. Tab to Edit Mode. LMB click on the Body of the Bone then RMB click in the Screen and select **Subdivide**. In the **Subdivide Multi** panel that displays, increase the **Number of Cuts** to produce multiple Bones (Figure 20.21).

Remain in Edit Mode, deselect, then select individual Tips and Bases of the bones and Translate to fit the model. You may also select individual Bone bodies and Scale and Translate.

20.7 Multi-bone by Extrusion

Have the Lower Spine bone Armature positioned as shown in Figure 20.17. With the Armature selected press the **Tab Key** to enter Edit Mode. The Tip of the Bone will be selected.

Figure 20.22

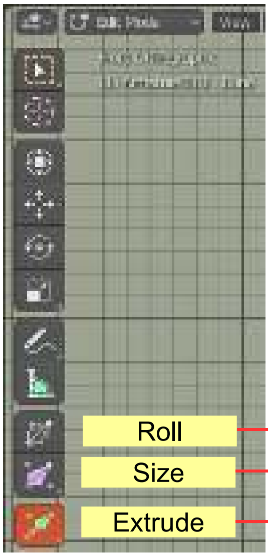


Press the **E Key + Z Key** (Extrude on Z axis) and drag the mouse up extruding a second Spine Bone. Repeat the process extruding a chest Bone, a neck Bone and a head Bone (Figure 20.22).

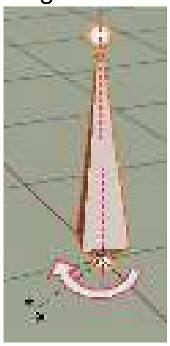
An alternative to pressing the E Key to Extrude a Bone is to click the **Extrude Tool** in the Tool Panel. There are three options; Roll,Size and Extrude. Size and Extrude have sub options.

Note: When an Armature has been added to the Scene and selected in the 3D Viewport Editor, the Edit Mode Tool Panel is an abbreviated version with three Armature Tools.

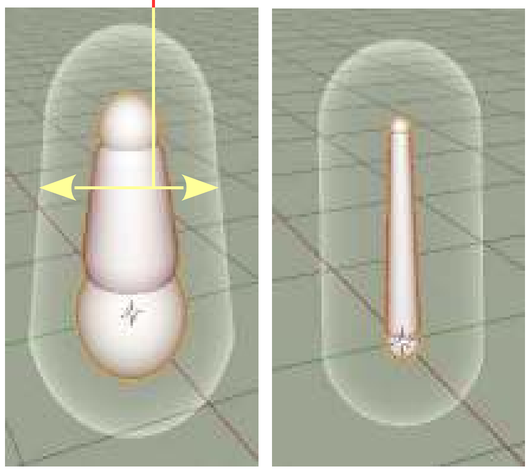
Figure 20.23



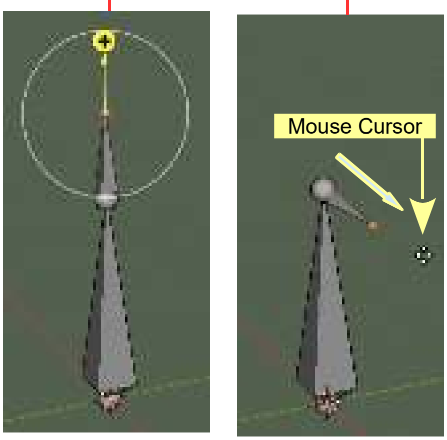
Roll: Click, hold and drag the Mouse to rotate the Bone about its longitudinal Axis.



Envelope display Mode
Bone Size difference
Bone Envelope size

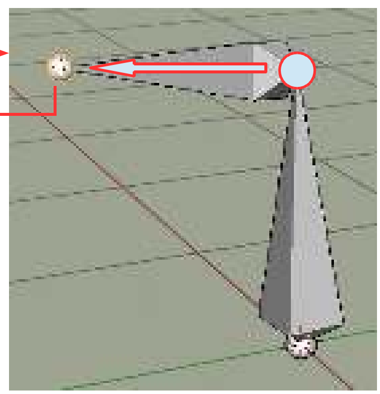


Click and hold LMB for options.



Extrude: Click on the cross, hold and drag to extrude in line with the Bone. Click, hold and drag in the circle and Extrude in any direction.

Extrude to Cursor



Click LMB in the 3D Viewport Editor. A Bone is extruded from the Tip or Base selected to the position of the Cursor.

See **Extrude** examples Figure 20.24 over.

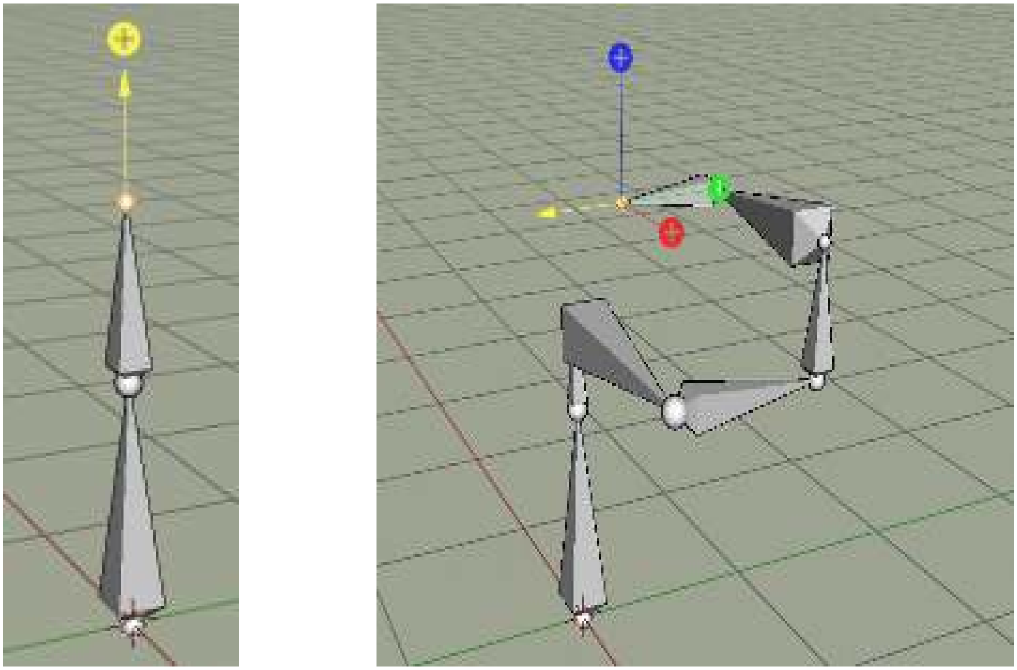


Figure 20.24

20.8 Axis Mirror Extrusion

For Extruding Bones simultaneously either side of an axis to produce arm or leg Bones the procedure is as follows:

Have the Bone Chain in Front Orthographic View. In Edit Mode, select the Base or Tip of intermediate Bones in a chain. Press the E Key (Extrude), click LMB, hold and drag the Mouse to Extrude a Bone (one side only).

With the Mouse Cursor in the **3D Viewport** press the **N Key** to display the **Properties Panel** (upper RHS), select the **Tool Tab** and check **X-Axis Mirror** (Figure 20.25).

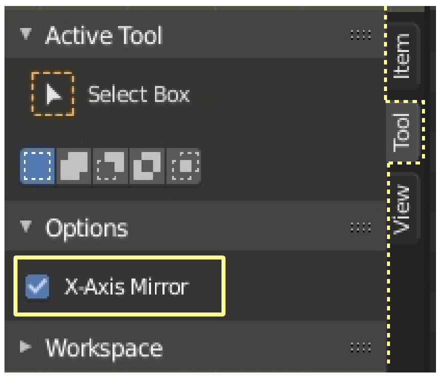


Figure 20.25

Figure 20.26

In the Extrude panel (lower Left of Screen) that displays when the single intermediate Bone is Extruded check **Forked** (Figure 20.26). The Extruded Bone is Mirrored (Figure 20.27).

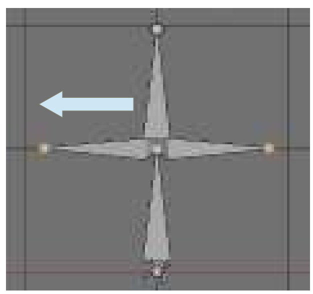


Figure 20.27

20.9 Extruding Shoulder and Arms

With the Base of the Neck selected, press **Shift + E key** and drag the mouse to Extrude Shoulder Bones. Use X Axis Mirror to duplicate on both sides of the model. Press Shift + E key again and extrude Arm Bones and finally a Hand Bone.

Continue the X-Axis Extrusion for the lower limbs starting by selecting the Base of the Lower Spine Bone.

Creating the Multi-Bone Armature this way in Front Orthographic View is fine for the front view but in Right or Left Orthographic Views you will find the Bones are way out of position. They have to be inside the mesh. You now have to select individual Bone Tips/Bases and manoeuvre them into their correct locations (Figure 20.28).

Right Orthographic View – Bones way out of position.

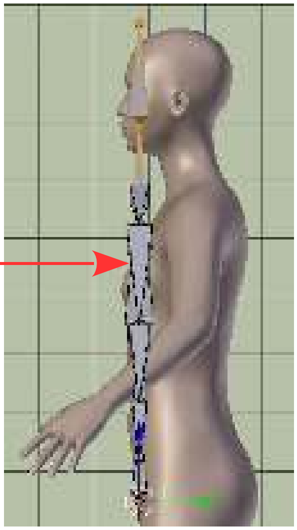
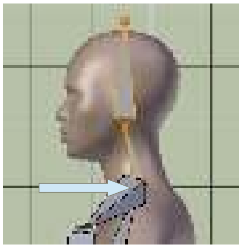


Figure 20.28

Head and Neck Bone correctly positioned



20.10 Naming Bones

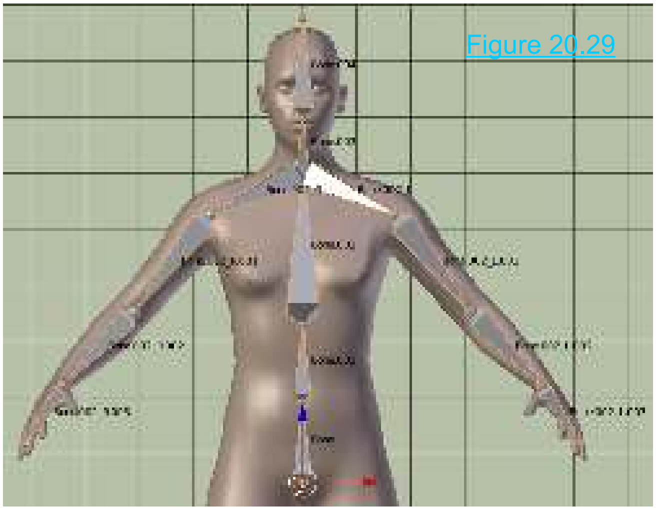


Figure 20.29

For a human figure there are many Bones included in an Armature. In Figure 20.22 a few of the Bones were labelled for the demonstration but Blender has an automatic Bone naming system for dealing with complex Armatures.

With an Armature selected in the 3D Viewport Editor in Object Mode go to the **Properties Editor, Object Data buttons** and in the **Viewport Display tab** check (tick) **Names**. Names are displayed in the 3D Viewport Editor (Figure 20.29).

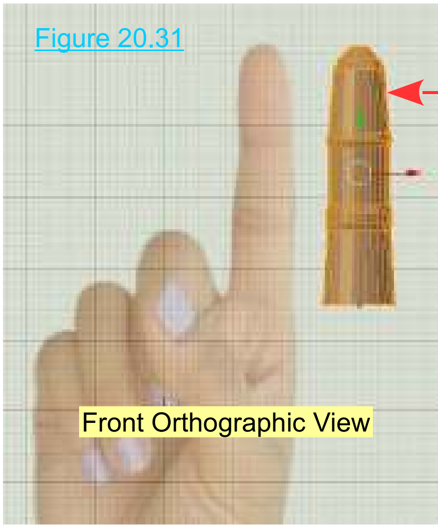
You will also see the names displayed in the Outliner Editor (Figure 20.30 over).

You may change the names to something meaningful for your application by double clicking on the name in the Outliner Editor, deleting and retyping a new name. The new name is automatically updated in the 3D Viewport Editor.

20.11 Deforming a Mesh

Figure 20.30

Figure 20.31



Finger Model
(Figure 20.32)

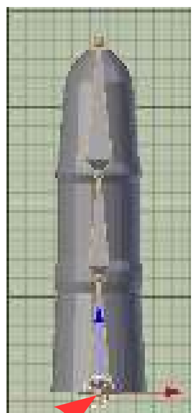
The basic procedure for deforming a Mesh Object with an Armature is to link or associate vertices on the mesh surface to Bones in the Armature. When the Bones are moved the Vertices in the mesh move.

Make Human models come with a considerable number of Vertices in the surface mesh. That's why they look so good. When deforming a mesh using an Armature you should consider the number of vertices that will be manipulated. A large number of vertices means the computer has to perform a large number of calculations when moving vertices about and that can slow things down considerably. That being the case, in demonstrating mesh deformation, a simple model will be used that has a minimal number of mesh vertices.

In Figures 20.31 - 32 a simple finger has been modeled by extruding a Circle. The finger is shown in Edit Mode in Figure 20.31 displaying its Vertices.

Arrange the finger model so that it is pointing up in **Front Orthographic** view with its center of rotation on the center of the Scene.

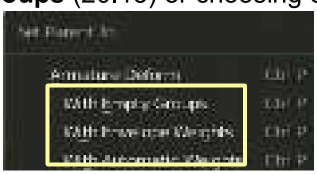
Figure 20.32



Center of Rotation

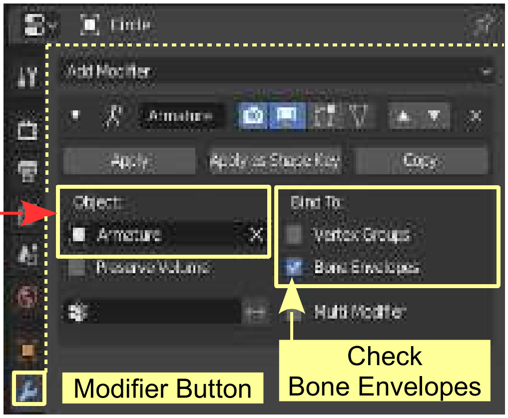
Construct a three Bone Armature as shown in Figure 20.32.

Place the Armature inside the model. With the Armature in place you Parent (associate) parts of the mesh with the Bones by using an **Armature Modifier** (20.12), creating **Vertex Groups** (20.13) or choosing options from the **Set Parent To** menu (20.14).



20.12 The Armature Modifier

Figure 20.33



In Object Mode select the Mesh Model then in the **Properties Editor, Modifier buttons**, add an **Armature Modifier** (Figure 20.33).

In the Modifier panel set **Object** as **Armature**.

In the modifier panel, uncheck **Vertex Groups** and check **Bone Envelope** under the **Bind To** heading. This is telling Blender to associate the Armature Bones with Vertices that are enclosed by the Bone Envelopes (Field of Influence Figure 20.33).

To see what this means have the Armature selected in the 3D Viewport Editor then in the **Properties Editor, Object Data buttons, Viewport Display tab** change **Octahedral** display to **Envelope** display (Figure 20.34). In the Viewport Display Tab check **In Front**.

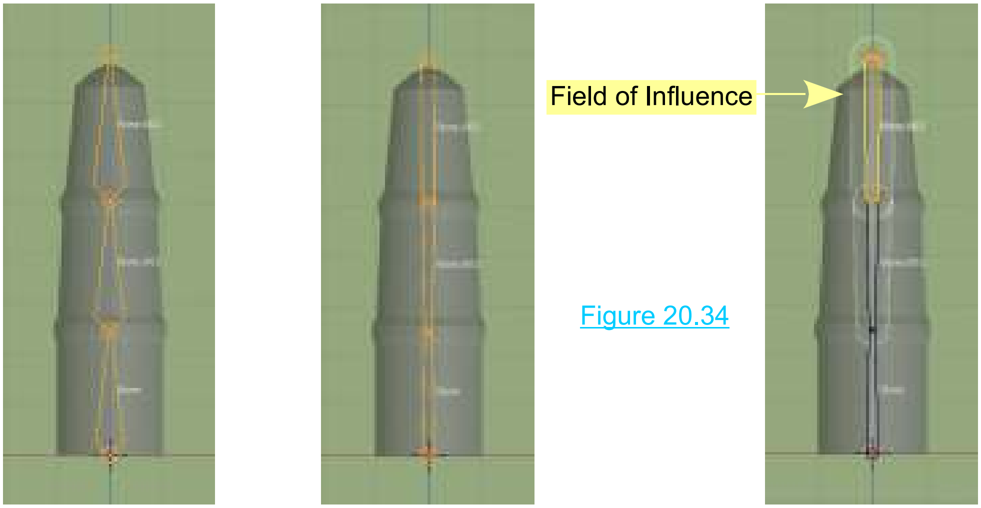


Figure 20.34

Octahedral
Object Mode

Envelope
Object Mode

Envelope
Edit Mode

Have the **Armature selected** in **Edit Mode**. In the diagram you see the upper finger Bone (Bone.002) selected in Edit Mode and with Envelope Display Mode you see the Field of Influence. This field provides a guide, approximating, which part of the Mesh will be influenced when the Armature is moved.

The dimensions of the envelope are adjusted in the Envelope Distance panel, in the Properties Editor, Bone Properties buttons, Deform Tab with the Armature in Edit Mode or Pose Mode (ensure **Deform** is checked in the Tab - Figure 20.35).

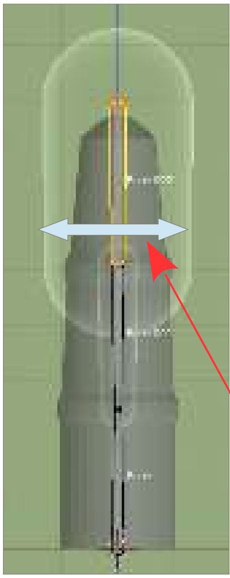
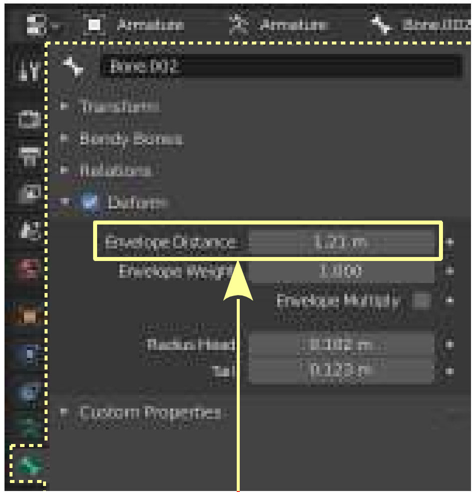


Figure 20.35



Deform Envelope **Distance** value Increased.

With the upper Armature Bone selected in Edit Mode change to Pose Mode in the 3D Viewport Editor Header. The Bone displays colored blue (Figure 20.36).

You may select any Bone and Rotate (R key drag mouse) to see the mesh deform (Figure 20.37).

Figure 20.36

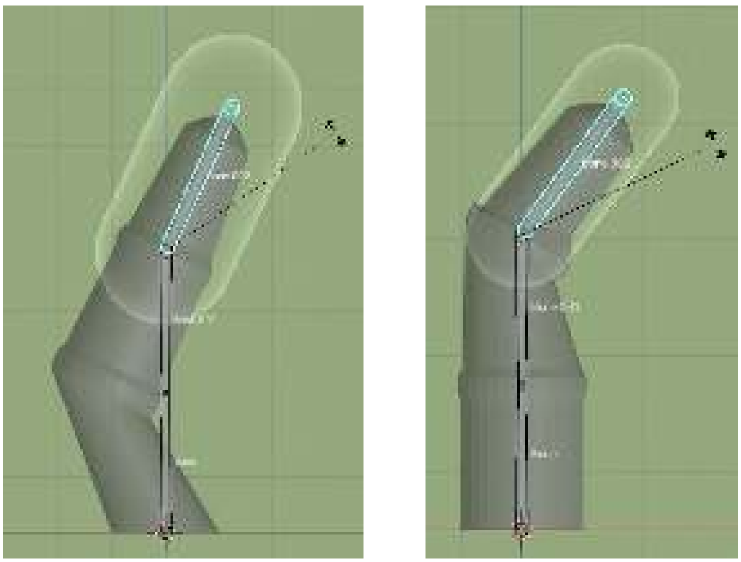


Figure 20.37

Note: The Bone Envelope Distance has an effect on how the Mesh deforms. This has to be adjusted for the each Bone section. Experiment with the Envelope Distance setting and subdivide the Mesh to achieve the desired deformation.

By selecting the Mesh Model in Edit Mode, in the Properties Editor, Object Data Properties you will see that a Vertex Group has been created for each Bone in the Armature. By setting the **Bind To:** value in the Armature Modifier to **Bone Envelope** (Figure 20.33) the Vertices in the Vertex Groups are controled by the Bone Envelopes.

20.13 Assigning Vertices – Vertex Groups

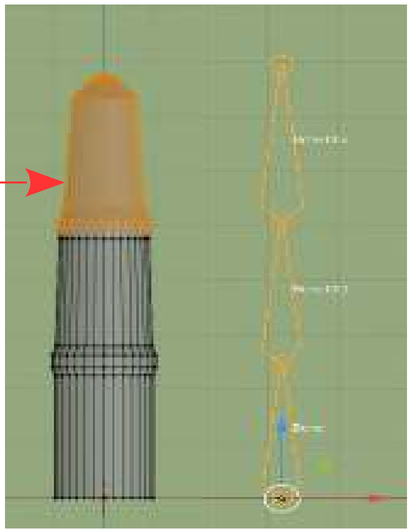
In the previous examples (20.12) **Mesh Vertices** were selected from within the **Field of Influence** of the Armature by the Armature Modifier. An alternative to this, is to manually nominate which vertices will be affected by the Armature.

Use the same Finger – Armature arrangement previously described. Select the **Armature** then in the **Properties Editor, Data buttons, Display Tab**, tick **Names** to show the Bones named **Bone** and **Bone.001** and **Bone.002**. Deselect the Armature.

Select the **Finger** (Mesh), and in **Edit Mode** deselect the Vertices. In the **Properties Editor, Object Data buttons**, **Vertex Groups Tab**, click the **Plus** sign to add a **Vertex Group**; a Vertex Group is added and named **Group**. By renaming **Group** to **Bone.002** (Figure 20.38), the **Vertex Group** will automatically be controlled by the Bone named **Bone.002.** Groups and Bones may be renamed to whatever you want, but for a Group to be controlled by a Bone, the names must be identical.

Vertices assigned to Vertex Group named Bone.002

Armature Bone.002 controls Mesh deformation



Armature shown moved to one side

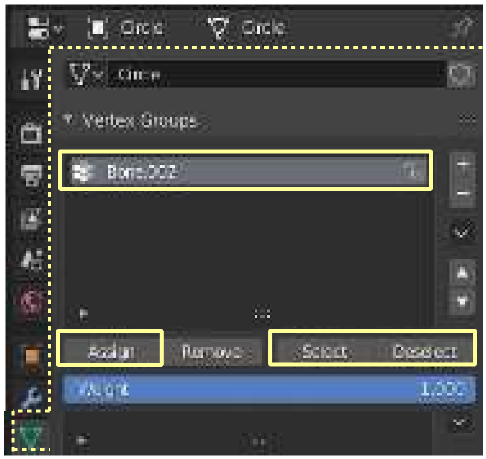


Figure 20.38

In the 3D Viewport Editor, select the Vertices in the upper part of the finger (press the B key – drag a rectangle). Make sure you have the **Select Only Visible button turned off** in the 3D Viewport Editor Header or you will only be selecting the front Vertices of the finger.

In the **Vertex Groups** tab, click **Assign** to assign the selected Vertices to the Group. Check out the assignment by alternately clicking on **Deselect** and **Select** (Figure 20.38). **Tab** into **Object mode** and deselect the finger. Select the **Armature** and change to **Pose Mode**. Select **Bone.002** and press the **R Key** to rotate. **Nothing happens because you haven't applied an Armature Modifier to the finger.**

Go back and select the finger and in the **Properties Editor, Modifier buttons**, click **Add Modifier** and select **Armature**. In the **Armature Object** panel, click and select **Armature**.

Deselect the finger and select the **Armature** in **Pose Mode**. Select **Bone.002** and rotate it—the upper part of the finger will now deform as the Bone is rotated (Figure 20.39).

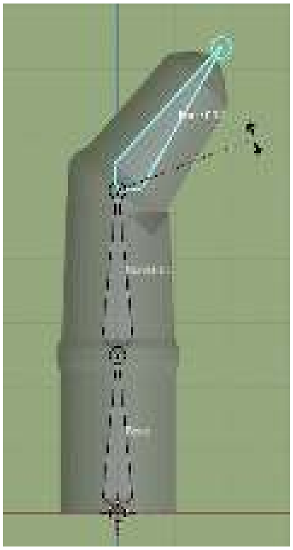


Figure 20.39

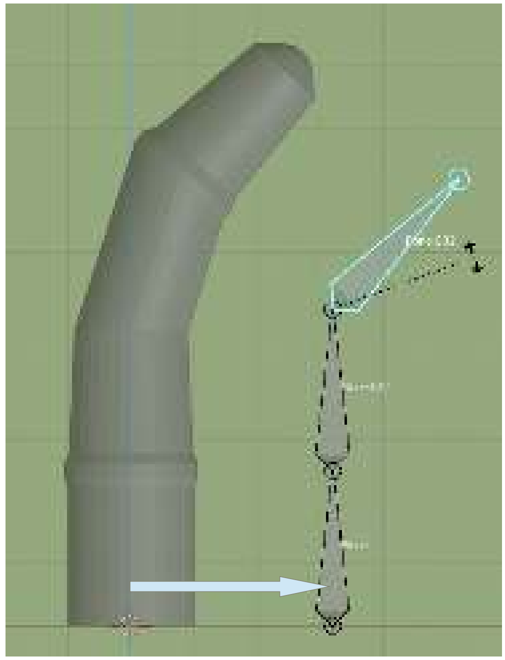


Figure 20.40

The armature may be located well away from the finger and still deform the Mesh. The Field of Influence of the Armature described in the previous exercise is not enforced, but with the Armature displaced away from the Mesh, the Mesh deformation is exaggerated (Figure 20.40).

The foregoing has outlined the manual procedure for creating a Vertex Group and employing an Armature Modifier.

Note: In the Armature Modifier, **Object: is set as Armature** and **Bind To; is set as Vertex Groups**. In the Object Data Properties for the Mesh Model the single Vertex Group is named the same as the controlling Bone (Bone.002).

As you can image, in a complicated Mesh/Armature arrangement manually creating and assigning vertices to group fore each Bone would be a tedious task. That being the case, Blender incorporates **semi automatic** process. This is demonstrated using the same Mesh Finger with the three Bone Armature.

Note: Be aware that when using these processes adjustments may be required to refine the control.

The automated processes are selected from the **Set Parent To** menu.

20.14 Assigning Vertices – Set Parent To Menu

In the Mesh Finger – Armature arrangement (Figure 20.41), in Object Mode, select the Mesh then Shift select the Armature. Press Ctrl + P key and in the **Set Parent To** menu that displays chose (click) one of the Armature Deform options.

With Empty Groups creates a child parent relationship between the Mesh Object and the Armature such that when a Bone in the Armature is moved in Pose Mode part of the Mesh follows. This is accomplished by automatically creating an **Armature Modifier** for the Mesh with **Object: Armature** and **Bind To: Vertex Groups** (see the Modifier Properties). At the same time Vertex Groups are created and named in accordance with the Bones in the Armature (see the Object Data Properties). Both sets of Properties are selected in the Properties Editor with the Mesh Object selected in the 3D Viewport Editor in Object Mode.

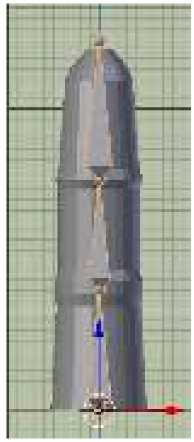


Figure 20.41

Note: Although Vertex Groups are created and named in accordance with the Bones in the Armature, Vertices **have not** been assigned to the Vertex Groups. Hence **With Empty Groups**.

With the Mesh Object in Edit Mode, select Vertices and assign to each Vertex Group.

Moving a Bone in the Armature, in Pose Mode, will see the assigned Vertices follow the movement.

With Envelope Weights creates the same Armature Modifier and Vertex Groups but this time you change **Bind To** from **Vertex Groups** to **Bone Envelopes** in the Armature Modifier and the Envelope will control which Vertices move when the Bone is moved in Pose Mode. You may alter the Bone Envelope size to adjust the control.

With Automatic Weights, again, creates an Armature Modifier and Vertex Groups but this time Vertices are automatically assigned to the Vertex Groups. The automatic assignment may or may not create the desired effect, therefore, you manually correct the assignment of vertices to the Vertex Groups.

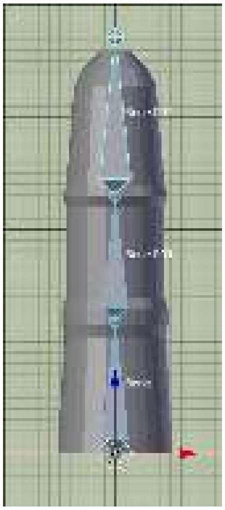
20.15 Assigning Vertices – Weight Paint

Blender has a painting method that selects and assigns Vertices to a group, automatically linking to an armature Bone. The Paint method allows a graduated weight to be given to vertices that dictate how much influence the armature Bone will have over the deformation of the Mesh.

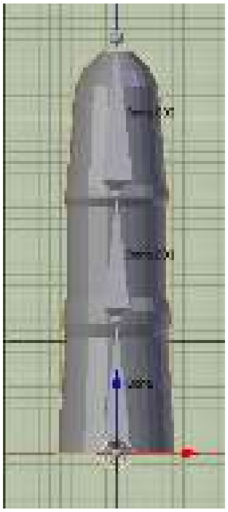
Set up a new Scene as you did for the previous examples. Select the **Finger** in **Object Mode** and add an **Armature Modifier** in the Properties Editor. Don't forget to enter **Armature** in the **Object panel**. Select the Armature and enter **Pose Mode**. In the **Properties Editor, Object Data buttons**, **Viewport Display Tab**, tick **Names** to display the Bone names in the 3D Viewport Editor; the names should be **Bone, Bone.001** and **Bone.002** as before.

When ticking **Names** make sure you are in the **Object Data Properties buttons** not the **Bone Properties**(Object) buttons. If you are in the Object buttons only the name Armature will display.

With the Armature as the selected Object in the 3D Viewport, in Pose Mode, select **Bone.002** (the upper Bone) then change to Object Mode and left click the Finger to select it. With the finger selected, go to the 3D Viewport Header and change from Object Mode to **Weight Paint Mode**. The Finger displays speckled gray, indicating that no Vertices are selected (Figure 20.42).



Armature
Pose Mode



Finger
Object Mode

The Finger displays in speckled gray, which indicates that no Vertices are selected.

Figure 20.42

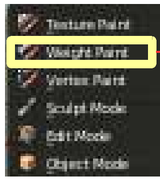
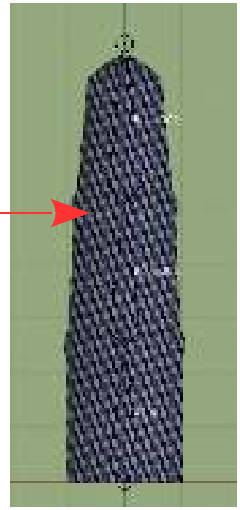


Figure 20.43

3DViewport Editor Header
Click to select Editor Modes



Finger
Weight Paint

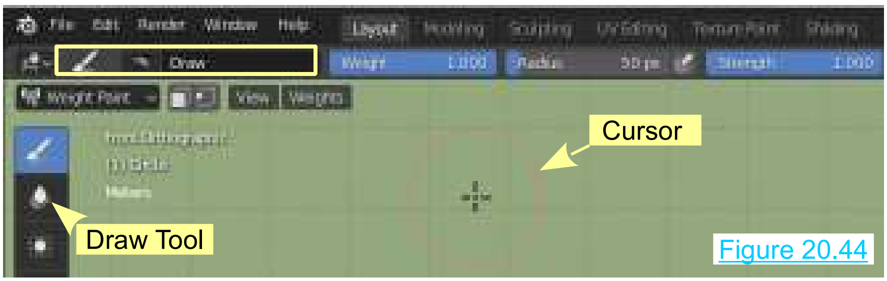
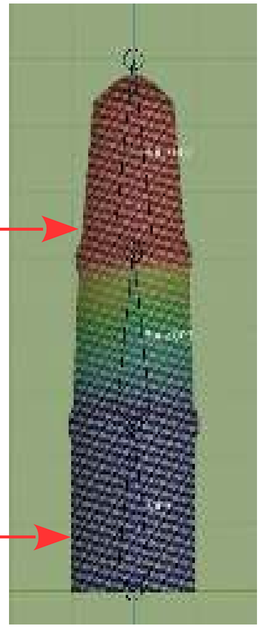


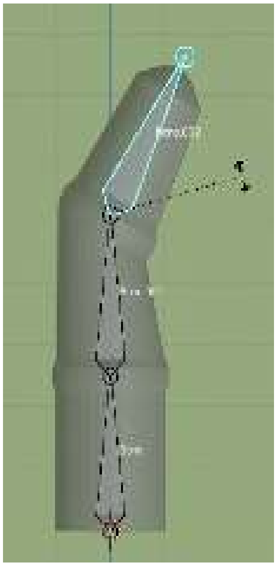
Figure 20.44

In the **Tool Panel** at the left-hand side of the 3D Viewport have the **Draw Tool** selected. In the Header click **View** and check **Tool Settings**. Make sure the **Weight** and **Strength** sliders are set to 1.000 in the Header (Figure 20.44). You are about to paint over the finger mesh to select Vertices, and by setting the strength to a high value you are telling Blender that the selected Vertices are to be rigorously controlled by Bone.002. In Weight Paint Mode, the cursor in the 3D Viewport Editor is a circle (Figure 20.44). The Radius control for the circle is in the Header. You want the upper part of the finger to be transformed by Bone.002, therefore, click, hold, and drag the Cursor circle over the upper part of the Finger. As with selecting vertices make sure **Toggle X-Ray** is turned on in the Header.

The part of the Finger painted turns red, which indicates a rigorous control (Figure 20.45). Altering the **Strength** value changes the control strength and will display a different color.

Figure 20.45





Turn the mesh around and paint the Vertices on the back side of the finger (pan the 3D Viewport around).

Vertices Assigned (Red)

Figure 20.46

Having painted the finger, note that in the **Properties Editor, Data buttons, Vertex Groups Tab** a **Vertex Group** has been created and named Bone.002. Selecting **Bone.002** in **Pose Mode** and rotating it will move the upper part of the finger (Figure 20.46). Repeat the process for the remaining Bones.

Vertices Not Assigned (Blue)

20.16 Inverse Kinematics Constraint

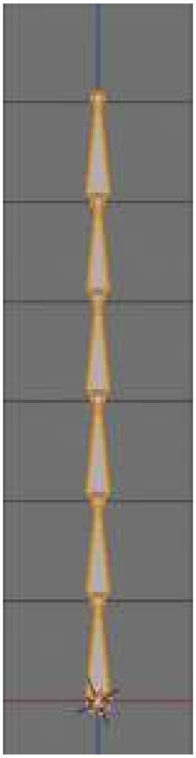
Inverse Kinematics (IK) Constraint is a method of controlling the posing and animation of a chain of Bones. This is a wonderful tool for animators. The activation of the tool is found in the **Properties Editor, Bone Constraints buttons** which are only displayed when an Armature has been added in the 3D Viewport Editor.

With IK, dragging the end Bone of the chain will result in the chain following the selected Bone.

IK (Inverse Kinematics) is the opposite of FK (Forward Kinematics). With FK, you have to rotate the chain of Bones one by one to pose for animation; this is a tedious process but gives you full control.

Do not confuse **IK (Inverse Kinematics)** with the **Spline IK** .

An example of **Inverse Kinematics** would be to create a chain of Bones (Figure 20.48 over). An **Armature – Single Bone** has been added to the 3D Viewport Editor then Extruded up from the Tip creating six Bones. The Bones are automatically connected forming a single Armature.



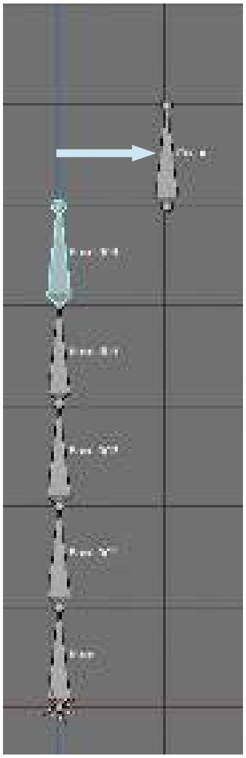


Figure 20.48 Figure 20.49

In Figure 20.49 the top Bone has been selected in Edit Mode and disconnected from the Armature by pressing **Alt + P Key** and selecting **Clear Parent** in the menu that displays. In Edit Mode **Control** (the top Bone) has been moved aside.

With the Armature selected in Object or Edit Mode, Bone names are displayed in the 3D Viewport by checking **Names** in the Properties Editor, Object Data buttons, Viewport Display Tab (Figure 20.47).

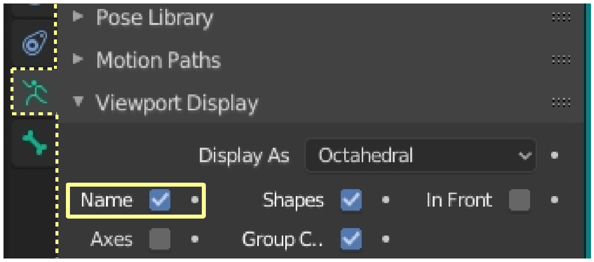


Figure 20.47

The disconnected top Bone has been renamed **Control** in the **Outliner Editor**. The Bones forming the Armature are listed in the Outliner Editor in the order of connection (Figure 20.50).

Note: The Bone named **Control** is shown separate to the list. This Bone will be, as the name suggests, a Control Bone for manipulating the Armature.

The Bones in the Armature are connected but at this stage, selecting an individual Bone in Pose Mode will only see it Rotate about its Base. Bones above in the chain will also Rotate but that is the limit of the Posing.

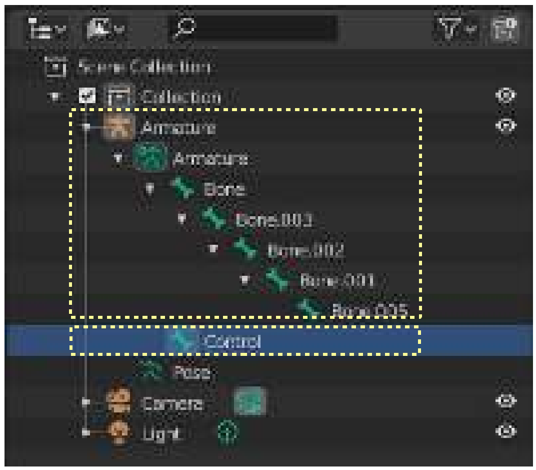


Figure 20.50

For the Armature to follow the Control Bone an **Inverse Kinematic (IK) Constraint** is required.

An IK Constraint is applied to one of the Bones in the Armature with the Constraint instructed to use the Armature Control Bone.

Note: Bone Constraint buttons only display with an Armature selected in the 3D Viewport Editor. Without an Armature only Object Constraints display.

To demonstrate the IK Constraint select Bone.004 in the Armature in **Pose Mode**. In the Properties Editor click the **Bone Constraints** button and click **Add Bone Constraint**. Select **Inverse Kinematics** in the menu that displays.

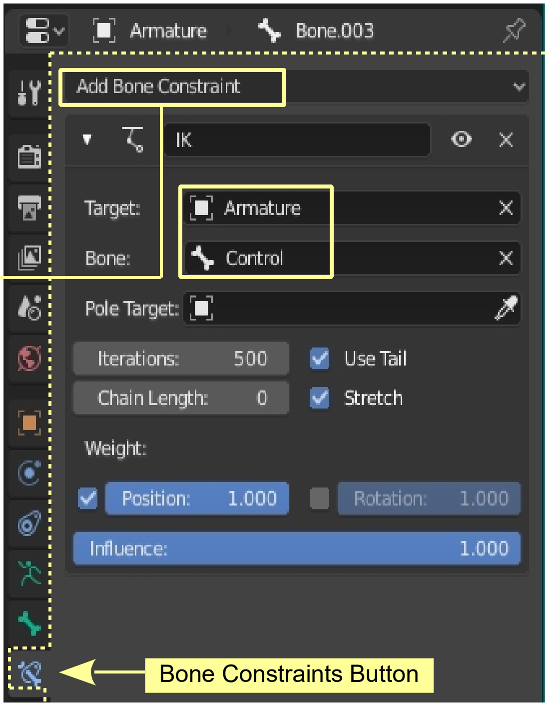


Figure 20.51

In the IK Bone Constraint Panel (Figure 20.51) set **Target** as **Armature** and **Bone** as **Control**.

Remember: This is setting controls for Bone.004 in the Armature. When the Control Bone is selected in Pose Mode and Translated in the 3D View Editor Bone.004 follows. Having the IK Constraint in place means the remainder of the Bones in the Armature Chain follow.

Make particular note of the **Chain Length** setting in the IK Constraint Panel. Chain Length: 0 means all the Bones in the Armature Chain are affected (Figures 20.52, 20.53, 20.54).

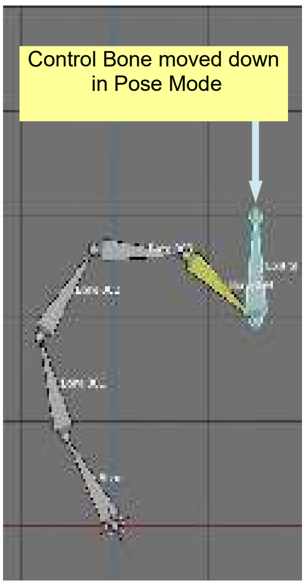


Figure 20.52

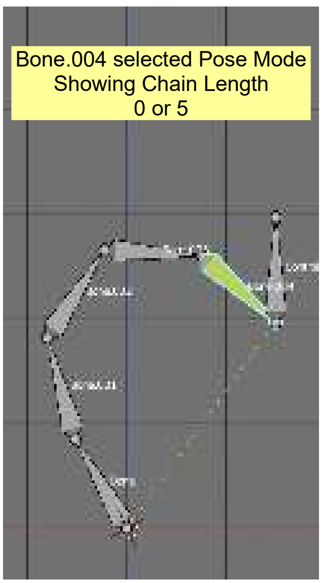


Figure 20.53

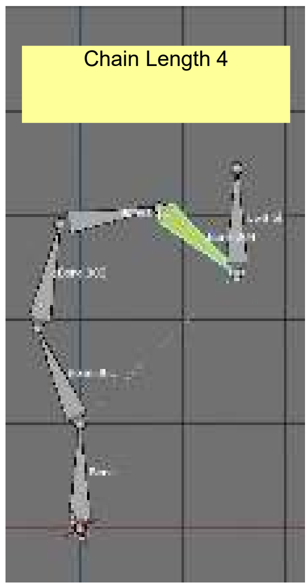


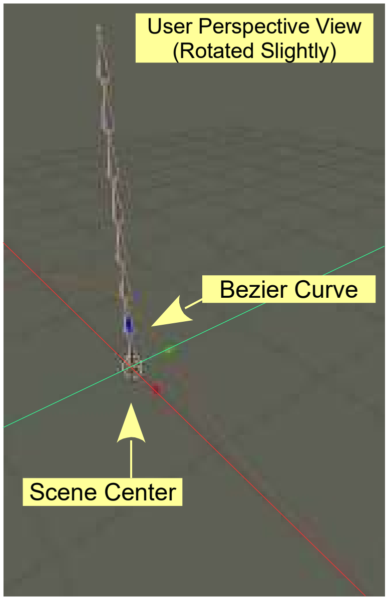
Figure 20.54

20.17 Spline IK Constraint

The **Spline IK Constraint** forces a multi Bone **Armature** to follow the shape of a Curve. With the Armature constrained to the Curve, the Curve is then manipulated to adjust the shape of the Armature and in turn any mesh assigned to the Armature.

To demonstrate, in the default 3D Viewport Editor, delete the **Cube** and add a **Bezier Curve**. Scale the Curve up twice. Create a multi Bone **Armature** (add Armature, scale x 2, subdivide). (Figure 20.55).

Figure 20.55



Leave the 3D Viewport in **User Perspective View**.

Both the origin of the Armature and the center of the Bezier Curve are located at the center of the Scene.

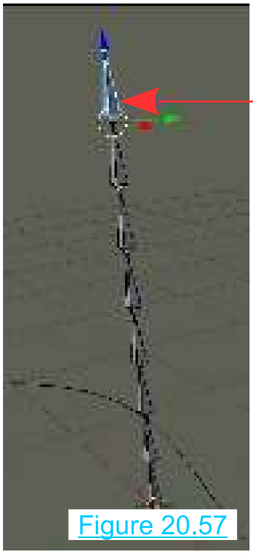


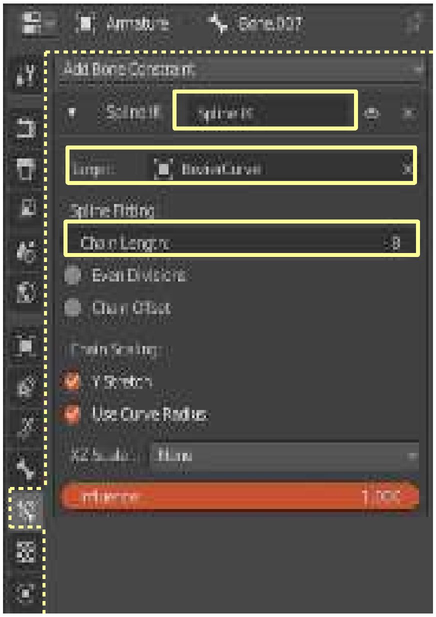
Figure 20.57

With the Armature selected, go into **Pose Mode**. **When selected,** the outline of the Armature will be displayed in blue.

Deselect the Armature then <u>select the top Bone</u> in the Armature (Figure 20.57).

In the **Properties window, Bone Constraints buttons** add a **Spline IK Constraint** (Figure 20.56).

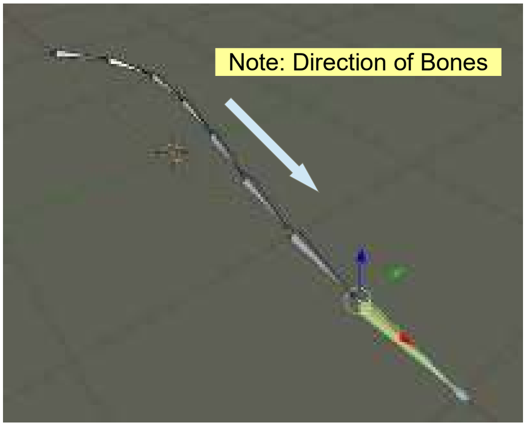
Figure 20.56



In the **Constraint panel** change the **Spline Fittings: Chain Length** value to 8 (the number of Bones in the armature).

In the **Target** panel select **Bezier Curve**.

Figure 20.58



In selecting the target the Armature is relocated in the 3D Viewport Editor and shaped to the Curve.

The Armature Bones are arranged with the direction of the curve. If the Curve were being used as an Animation Path, the movement along the path would be in the direction of the chevrons spaced along the Curve (Figure 20.59).

The direction may be reversed **in Edit Mode** by clicking RMB to display the **Curve Context Menu** and selecting **Switch Direction**. In doing this the chevrons are reversed and so are the Bones in the Armature.

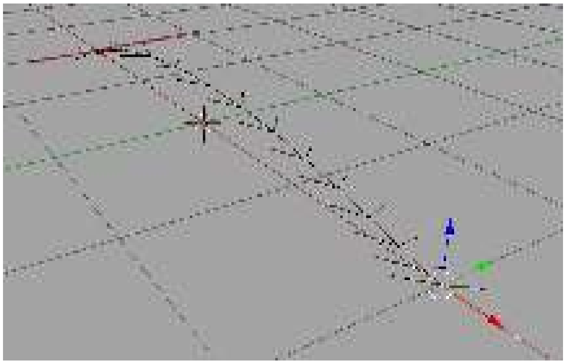


Figure 20.59

With the Armature constrained to the curve the **Armature** may be posed by selecting the **Control Handles** on the **Bezier Curve**. The Curve may be subdivided in Edit Mode to add additional control handles and give more control over the posing. Remember the practical use of the Armature is to control the shape and movement of a mesh Object which is assigned to the Armature.

Hooks may be assigned to the control handles of the Curve giving a non renderable Object with which to translate and pose the Armature. To add a **Hook** place the Curve in **Edit Mode** and ensure everything is **deselected**. Select a Control Handle then press **Ctrl + H key** and select **Hook to New Object** in the menu that displays. A **Hook** is displayed in the form of a **3D Cross**. To display the **Hook** in a different format go to the **Outliner Editor,** RMB click on **Empty - Select** . In the **Properties Editor, Object Data buttons** the **Empty tab** will show with a **Display As** selection menu. You select a different display format from this menu .

Anther method of introducing an non renderable Objects to allow Curve manipulation, when you have an Armature constrained to the Curve, is to add single Bones. You then parent the Bone to the Hook.

20.18 Forward

With knowledge of Armatures and how they are constructed, manipulated and used to deform Mesh Objects you are placed to learn the intricacies of Character Rigging. This is the process of constructing an Armature to fit a Character model. The model can be anything your imagination allows but for demonstration purposes, the subject will be devoted to Character Rigging a Humanoid Figure.

There are pre-assembled Rigs you may download from the internet which are free to use, but using a ready made Rig for your particular application may require you to modify the download. It is therefore advisable to understand how a Rig is constructed.

20.19 Character Rigging

Character Rigging is the process of creating an Armature to suit a Model of a Character then associating the Bones in the Armature with parts of the Model. The Bones are Posed and animated and the parts of the Model follow suit. To facilitate Posing, special Control Bones are incorporated in the Armature to manipulate the Bones.

Before constructing an Armature and Rigging you require a Mesh Model of a Character.

Free to use models may be downloaded from the internet or you may construct your own model in Blender or use an external application such as the Make Human program.

Constructing a crude humanoid figure by extrusion in Blender was discussed in Chapter 11–11.6.

Constructing a model of a human figure can be a lengthy process depending on the detail employed. There are several websites where you can download pre-built models, some of which are pre-rigged. To understand the rigging process you should begin with a simple **Low Poly Mesh** model. **Low Poly** means a mesh model with a minimum number of Vertices, Edges and Faces.

Figure 20.60

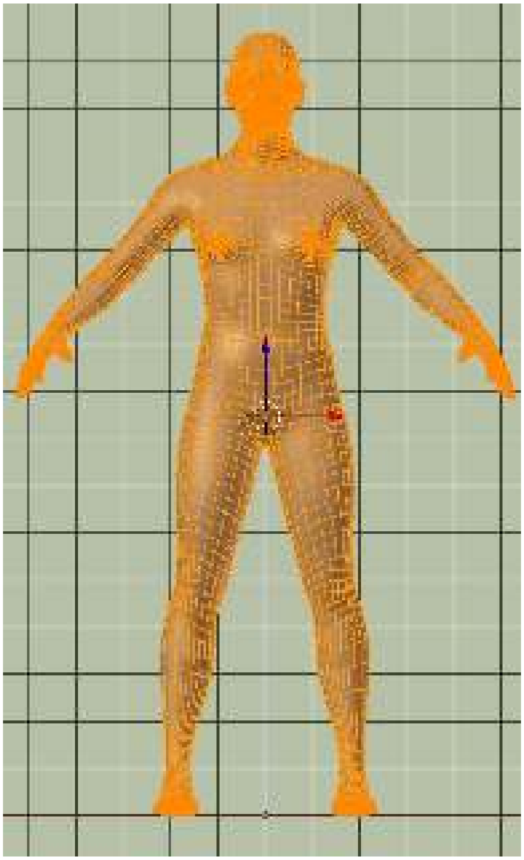


Figure 20.61

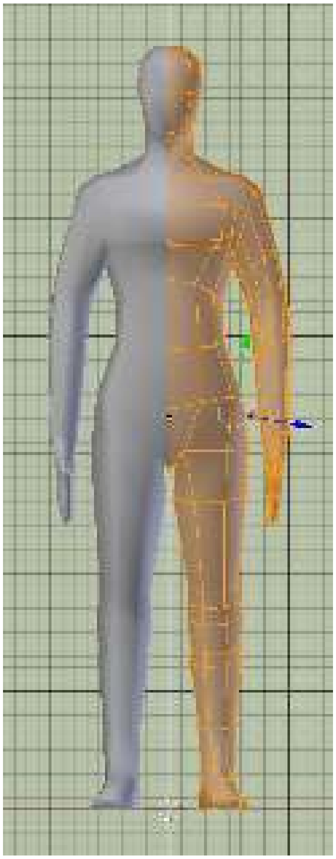


Figure 20.60 shows a model created using the **Make Human** program. As you see there is a vast difference in the number of vertices in the **Low Poly** model in Figure 20.61.

The **Low Poly** Model of a human is shown in Figure 20.61, supplied by **tweediez** released under the Creative Commons Attribution 3.0.

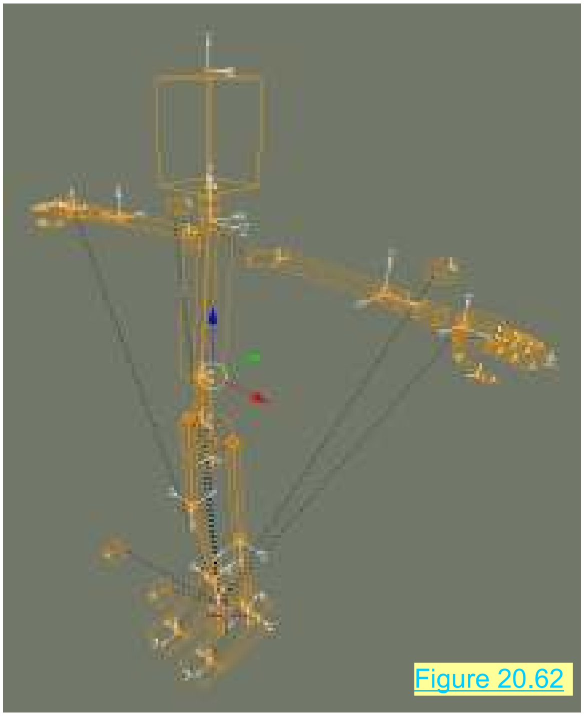


Figure 20.62

Rigged Armature – B-Bone Display Type

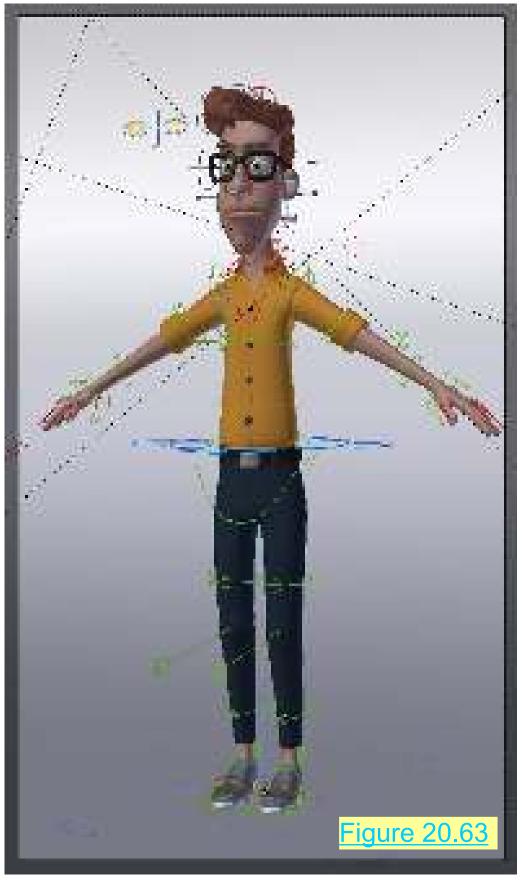


Figure 20.63

Figures 20.62 and 20.63 show examples of pre-rigged character models which demonstrate where you will be heading in the following exercise.

In the exercise a model created in Blender in the file named **ChibiBase.blend** will be used.

Proviso

Rigging a Character Model is a reasonably intricate operation. This exercise is intended as an introduction which will allow you to understand detailed tutorials. The Rigging process, even at a basic level, requires patience, perseverance and attention to detail.

It is too enticing to reach for a pre-rigged model and create fantastic animations but when you understand the process involved in Rigging you will be able to modify what you download and generate your own unique characters.

Download a Character Model

The Character Model to be used is named **Chibi**. To get this model go to the **Blend Swap** Website;

http://www.blendswap.com/

To download a model you have to register as a member. This means entering an email address and creating a user password and agreeing to the terms of use. If you don't do this you won't be able to download any of the fantastic **free models** available on the site.

Assuming that you have signed up, log in, then click on **Search** in the header at the top of the website home page. Select **Search** in **Blends** and enter **Chibi** in the Search Keywords bar. Click on **Search**.

The Model you are looking for is titled **CHIBI MODEL BASE**.

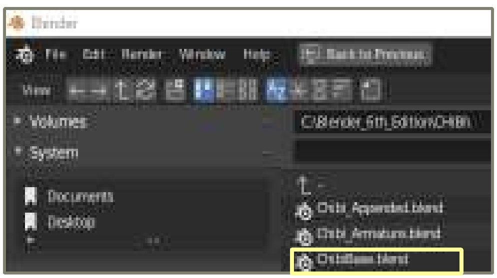
When you are logged in there will be a download link. The download is a ZIP file which you have to decompress to get the Blender file containing the model. Remember where you download to, and where you unzip to on your computer.

At this point it is assumed you have the file downloaded and unzipped.

The unzipped file is named ChibiBase.blend and will be located on your computer where you unzipped to.

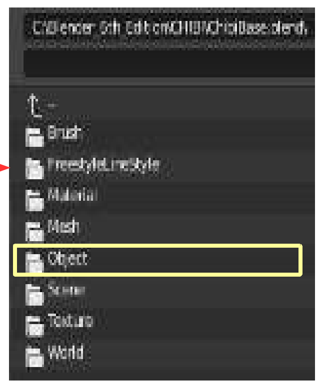
Important: Although ChibeBase.blend is a Blender file with the .blend suffix and it will open in Blender Version 2.80, you will find anomilies when opening the file in 2.80. That being the case and since you are only seeking to obtain a model on which to work, it is better to Append the Mesh Model from the ChibiBase.blend file into a **new Blender file** opened in Blender 2.80.

How to Append an element from one Blender file to another is described in Chapter 3 – 3.11.



To save you the frustration of reviewing that procedure, open a new Blender file in 2.80. Delete the Cube Object then click on **File** in the Screen Header and click Append in the menu that displays. The File Browser Editor opens where you go find your ChibiBase file.

Click on the file name in the File browser to see the content of the file.



Click on **Object** in the menu.

Figure 20.64

The Chibi model has probably been developed by modeling from the default Cube Object which appears in a new Blender file and the name hasn't been changed. In the Object folder Chibi is, therefore, seen as Cube.

Click on Cube in the folder menu, then click on Append from Library in the upper RH corner of the File Browser.

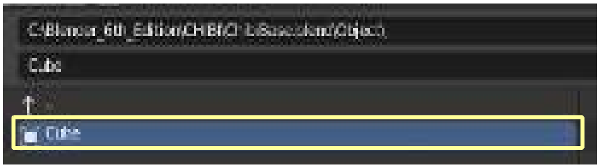
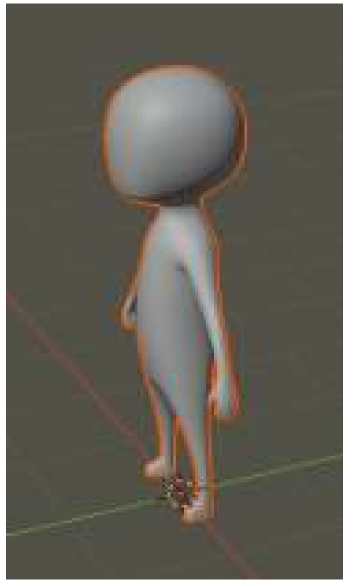


Figure 20.65

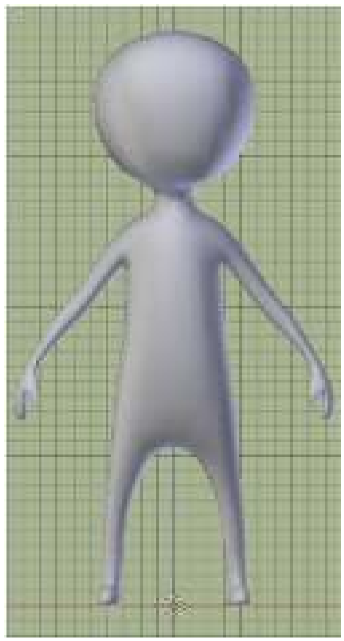


Say hello to Chibi

Chibi is a humanoid character (Figure 20.65). Use your imagination to decide whether Chibi is a child or an alien or a little bow legged guy with a big head. Chibi can be whatever you decide.

The first thing you want to do is save the **ChibiBase.blend** file as a new Blender file with a new name. This gives you a new file to work with and leaves ChibiBase.blend for a future work.

Here, it is assumed you have the new Blender file opened.



Click RMB on **Chibi** to select the model. It is not selected when you first open the file. The 3D Viewport Editor is in **Front Orthographic View.**

Note: In the **ChibiBase.blend** file all you have is a Mesh Character Model. There is no Camera or Lamp in the Scene. You may see a slight resemblance to the model created in Chapter 11–11.6. Chibi is a much nicer model.

Chibe has been created by **Magiclass** and released under the **CC Zero License**.

Figure 20.66

Note: When you Append a Mesh Model from one Blender file to another you also Append the Model's properties, such as, any Modifiers ised in construction.

Prepare the Character Model

When you download a model or append from another Blender file, you should examine it before using. In examining **ChibiBase.blend** you will see, in the **User Preferences Editor, Object data buttons, Vertex Groups tab**, that **Vertex Groups** have been generated. These are probably left over from a previous Blender operation. To begin with a clean slate, click on the minus button at the side of the list until all groups have been deleted. You may also find the 3D Viewport Editor Header at the bottom of the Editor.

Take a closer look at Chibi. **Tab** into **Edit Mode**. You see that the model only has Vertices on the right hand side (your right, Chibie's left) (Figure 20.67). In the **Properties Editor, Modifier buttons** you will see that a **Mirror Modifier** and a **Subserf** (Subdivision Surface) **Modifier** have been used when creating the model. The Mirror Modifier allows Vertex creation and manipulation on one side to be mirrored on the other side. Subserf makes the surface of the model appear smooth without increasing the Vertex count.

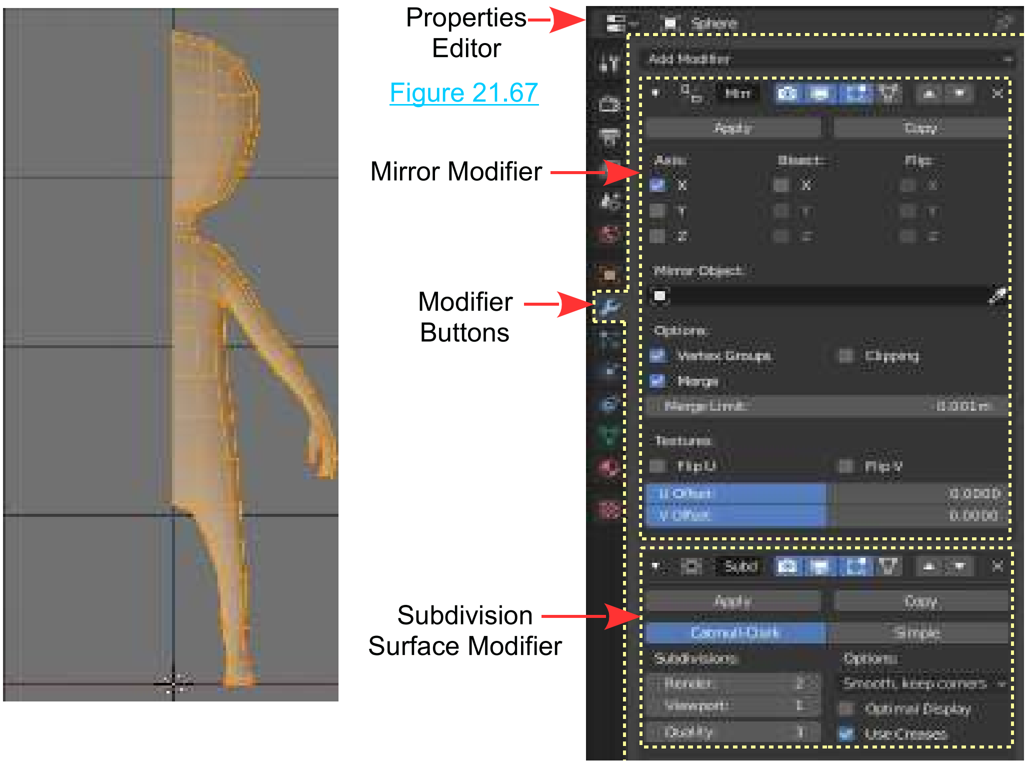


Figure 21.67

Actually, it will be better to have a few more Vertices when posing the figure so go ahead and click **Apply** in the **Subserf Modifier** panel (in Object Mode). You have to be in Object Mode to Apply a Modifier. Note that in the Modifier panel, under **Subdivisions**, the **View value is 1**. This means that when the Modifier is applied, the mesh surface of the model will be subdivided once. In other words the Vertices will be doubled. In Edit Mode you will see there are more Vertices than before. You also want the model to have Vertices on both sides, so go back into **Object Mode** and apply the **Mirror Modifier** (click the Apply button).

Figure 20.68 shows Chibi with the Subserf Modifier and the Mirror Modifier applied.

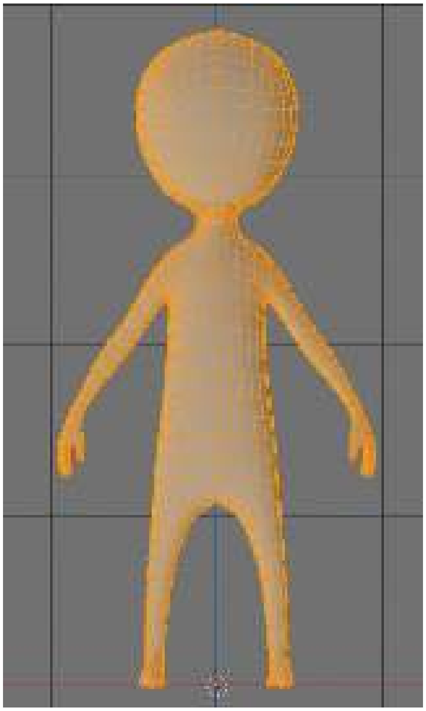


Figure 20.68

Some Definitions: This chapter has been titled Character Rigging, therefore, what does Character Rigging mean?

A Character refers to a Model, specifically a model of a Human Character. The model is a Mesh Model in that it is made up of a surface mesh constituting Vertices connected by Edges. There is nothing inside the mesh to begin with.

An Armature is constructed inside the mesh, specifically a Multi-bone Armature (single individual Bones connected together). The Armature may be considered as a skeleton for the Human Character.

Areas of the surface mesh are assigned (associated with or connected) to single Bones of the Armature or to multiple Bones.

Following the construction of the Armature the bones are translated or rotated (moved) to set the mesh in various poses or animated to move. When the bones move the surface mesh associated with the bones follow, therefore, the Character Model is set into a Pose or animated to move.

20.20 Creating the Armature (Root Bone)

The Armature **Root Bone** is the starting point for creating the Armature and acts as the primary Control Bone for moving and manipulating the Model in the Scene.

With Chibi displayed as shown in Figure 20.68, **Tab to Object Mode** in **Front Orthographic View**. This presents the figure face on with the Object's center located on the center of the Scene mid way between the feet. The center of the Scene on the XZ Axis is located between the feet.

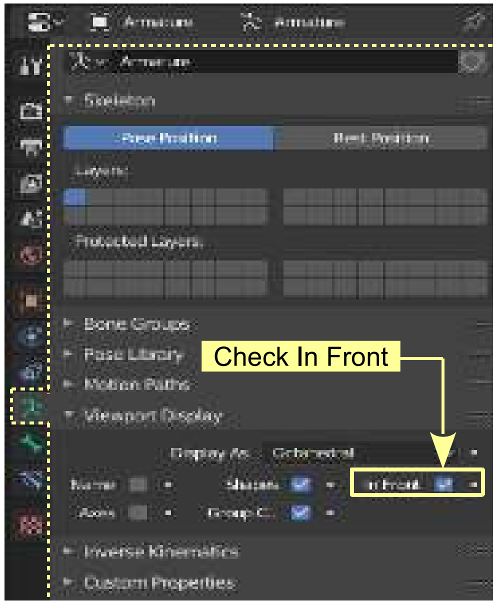
Make sure you have the 3D Viewport Editor Cursor located at the center of the Scene. Be in Object Mode with **everything deselected**. Press **Shift + S Key** to display the **Snap Pie Menu** and select **Cursor to World Origin** .

> **Tip:** In following this demonstration save the Blender file repeatedly at each stage of the exercise. If you get off track it will be frustrating to have to repeat the entire procedure. If you have to repeat, the consolation is that repeating consolidates the learning process. I do it often.

With Chibi **deselected** add an **Armature** (by default a Single Bone). The Bone is entered at the location of the 3D Viewport Editor Cursor at the center of the Scene (Center of World Origin). This will be the **Root Bone**.

With the Root Bone bone selected **Tab to Edit mode**. The Tip of the Bone will be selected as shown by the orange outline.

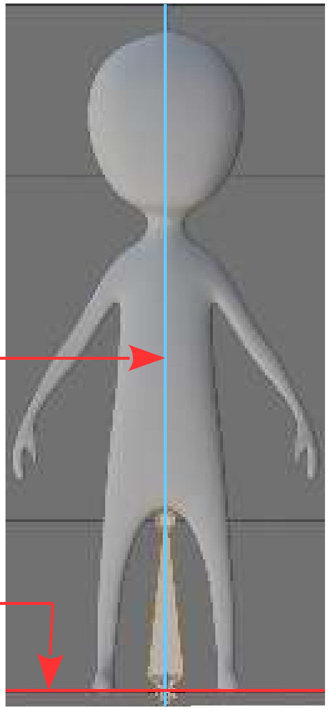
The Bone is orientated vertically with its Tip at the top and with the Base of the Bone accurately located at the center of the Scene. Lay the Bone flat along the ground plane of the Scene on the Y Axis (Figure 20.69).



In the **Properties Editor, Armature buttons, Viewport Display Tab,** check **In Front**.

Z Axis

X Axis



Front Orthographic View

Y Axis

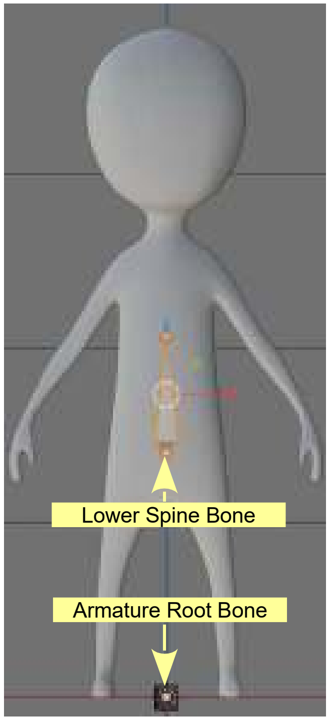
Right Orthographic View

Figure 20.69

To lay the bone flat and accurately, position it on the Y Axis and use **Snap to Grid**. With the Tip selected in Edit Mode, **G Key** (grab), drag the Mouse down and locate the Tip on the Y Axis. To accurately position, click **Armature** in the Header, select **Snap – Selection to Grid**.

Deselect the Tip of the Armature Bone and place the 3D View Editor in **Front Orthographic View**. Remain in Edit Mode. Additional Bones are to be added and you want them to be part of a Rig, that is Parented to the Root Bone. The Root Bone and all additional Bones will be Parented forming a Rig assembly.

20.21 Adding More Bones



A second Bone will be added to the Rig. Select the **Body** of the **Armature_Root Bone** in **Edit mode** then press **Shift + D key (Duplicate)**. Drag the mouse and move the duplicated bone up to the pelvic area of the figure, rotate scale and position as shown in Figure 20.70 by selecting the Body of the Bone, or by selecting the Tip or the Base.

Figure 20.70

Remember: In the Properties Editor, Data buttons, Display tab (with the Bone selected) have **In Front** checked (ticked) so you can see the Bone inside the model.

The Base should be positioned approximately where the pelvis would be. Switch between Front Orthographic and Right Orthographic views to orientate the Bone.

Consider this Bone to be the **Lower Spine Bone**.

The Armature_Root bone was Duplicated in Edit Mode to produce the Lower Spine because this second Bone has to be linked to the Armature_Root Bone and to be part of the Rig. Duplicating in Object Mode would cause the new Bone to be an independent Armature not connected to the Rig.

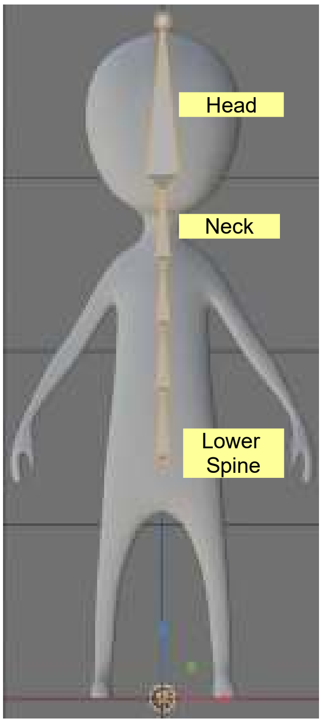


Figure 20.71

When selecting either Armature_Root or Lower Spine in Object Mode both Bones will be selected. In Object Mode you are selecting the entire Rig not individual Bones. To select individually you have to be in Edit Mode.

With the Lower Spine Bone selected **in Edit Mode** move the Base down to where the belly button would be then extrude Bones to form the remainder of spine (Figure 20.71). In Edit mode select the Tip of Lower Spine, press E key then Z and drag the mouse to extrude a new Bone (E key – extrude, Z key confines the extrusion to the Z axis.).

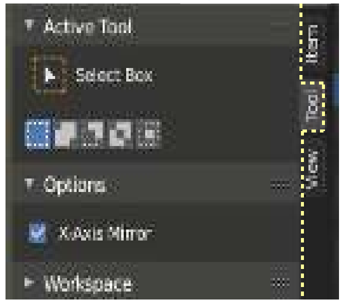
Repeat the process for each new Bone in the spine. Right Orthographic view allows you to position Bones to shape the spine. In Front Orthographic view the Bones follow the centerline of the figure. For the Head Bone restrain the extrusion to the Z axis by pressing E key + Z key.

Note: In positioning the Bones in Right Orthographic View it is not intended to replicate a human spine. Bones are placed to associate with parts of the Mesh model i.e. the Neck Bone will be linked to the Neck mesh.

Obviously there are many more Bones in a human skeleton than shown in the diagrams. In creating an Armature for animation it is good practice to minimise the number of Bones since this saves computer power in the animation process and simplifies the naming. The more Bones you have in a **Rig** the more flexible posing will be, therefore, you have to compromise.

20.22 Creating Arm Bones

Figure 20.72



Note: In creating Bones for the arms Blender has the ability to mirror Bones to the opposite side of the model.

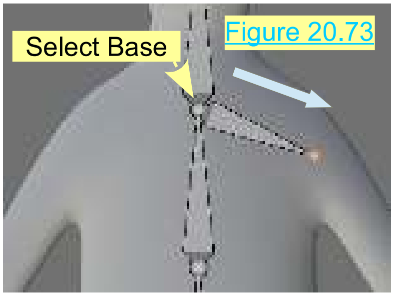


Figure 20.73

In **Edit Mode** select the base of the Neck Bone **in Front Orthographic view** and extrude a Shoulder Bone (Figure 20.73). Press the **N Key** for the **Properties Panel**, select **Tool** and check **X-Axis Mirror** in the panel (Figure 20.72).

Note: There is no effect in the 3D View Editor.

When extruding a Bone the **Extrude Panel** displays in the lower RHS of the Screen. With X-Axis Mirror checked in Armature Options, check **Forked** in the Extrude Panel (Figure 20.74) to duplicate the Bone on the opposite side of the Armature.

Figure 20.74

Shoulder Bone Duplicated

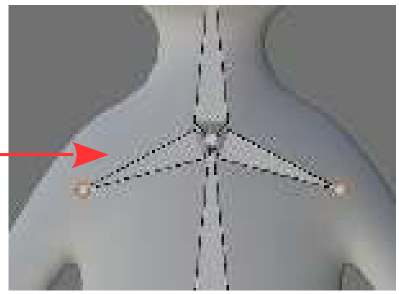


Figure 20.75

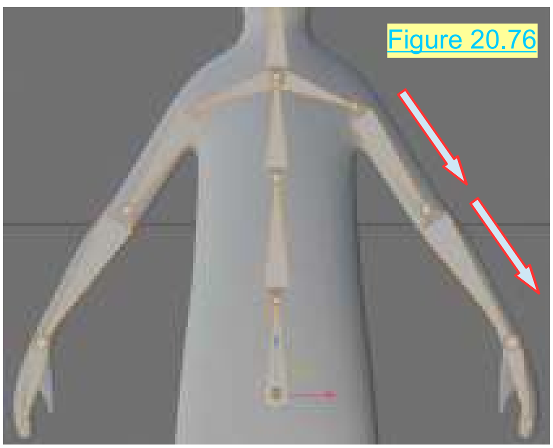


Figure 20.76

You may extrude Arm Bones from the Tip of the Shoulder Bone and they will be produced on either side of the Armature (Figure 20.76).

Figure 20.77

When extruding Bones position the Tips at the appropriate joints in the Character Model, shoulder, elbow, wrist.

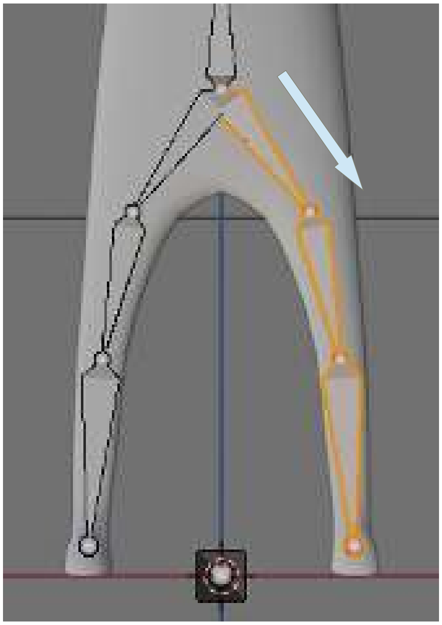
In Right Orthographic View select the Bone Tips and align the Bones with the Model.

20.23 Creating Leg Bones

To add leg Bones for the figure repeat the process used for the arms, this time extruding from the Base of the Lower Spine Bone (Figure 20.78). At the first extrusion check Forked in the Extrude Panel.

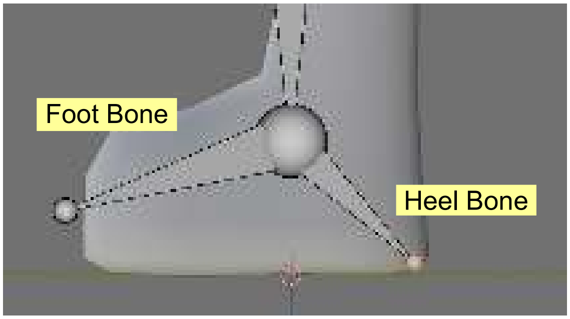
When you come to the Ankle go to Right Orthographic View and extrude a Foot Bone and a Heel Bone (Figure 20.79).

Figure 20.78



Legs - Front Orthographic View

Figure 20.79



Foot – Right Orthographic View

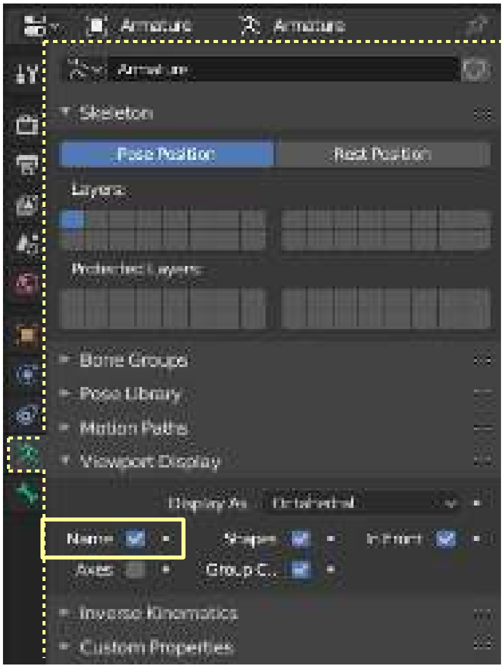
20.24 Bone Naming

At this point you have created a significant number of Bones even in this relatively simple Armature. The individual Bones have been referred to as Armature Root, Lower Spine, Neck, Head etc. but there is nothing in the View to specifically indicate which Bone is which. Naming Bones and giving the Bones meaningful names is very important, especially in a complicated Rig.

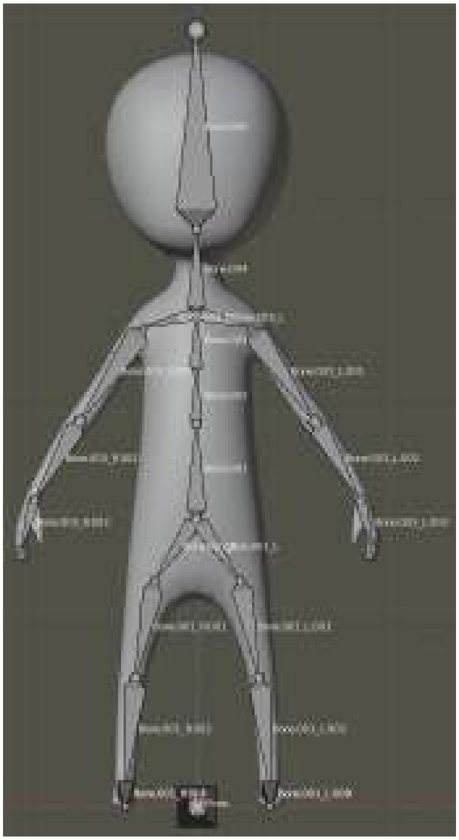
Blender automatically names Bones as they are extruded but the naming system provides names such as Bone, Bone.001, Bone.002 etc. and when Mirroring is involved, Bone.002_R and Bone.002_L.

Bone Names may be displayed in the 3D Viewport Editor by checking Names in the Properties Editor, Data buttons for the Armature in the Display Tab (Figure 20.80).

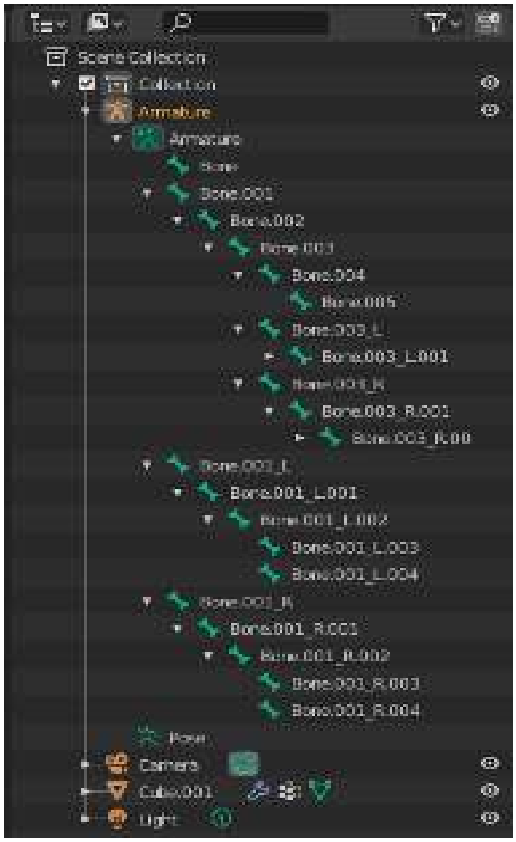
Figure 20.80



The default names are displayed adjacent to each Bone in the Armature in the 3D Viewport Editor and a hierarchy listing is shown in the Outliner Editor (Figures 20.81 and 20.82 over).



Default Name Display Figure 20.81



Outliner Editor Name Display Figure 20.82

Individual Bones can be renamed by selecting a Bone in Edit Mode then editing the Bone name in the Properties Editor, Bone buttons (Figure 20.83).

Alternatively click on the name in the Outliner Editor (Figure 20.84) to select the Bone. Double click to edit.

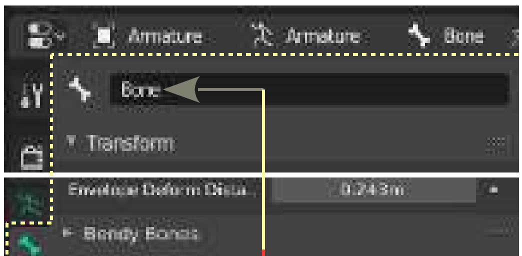


Figure 20.83

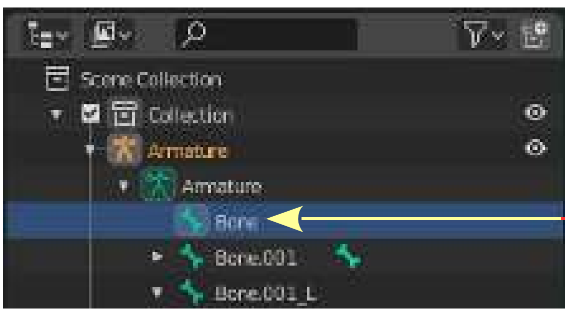


Figure 20.84

Double click, backspace or delete and retype the name.

In either case the edited name will be displayed in the 3D Viewport Editor adjacent to the selected Bone.

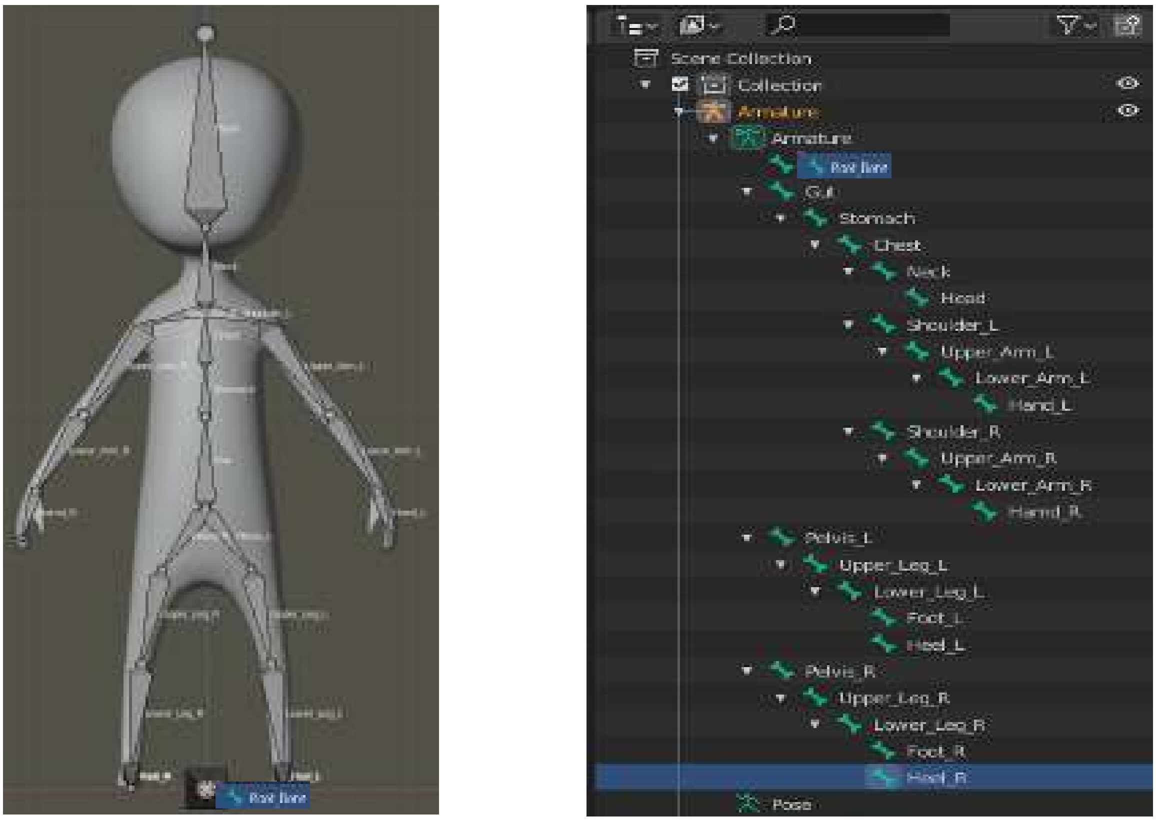
20.25 Assigning the Mesh

At this point, although the **Armature Rig** is incomplete, you may assign it to the **Mesh Figure**.

This is the process of linking Vertex Groups (groups of vertices) on the figure's mesh surface to individual Bones. **Blender has an automated process for doing this**. The Bones will then control the posing or posturing of the mesh.

At this point it is worth reviewing the complete Armature assembly by comparing the Rig in the **3D View Editor** with the name displaying the hierarchy of Bones in the **Outliner Editor** (Figure 20.85).

Figure 20.85



In Figure 20.85 the 3D Viewport Editor is shown in Object Mode. To see the full list of all the Bones in the Outliner Editor expand each entry.

Note: Bones are named according to Chibi's Left and Right not your's.

Before engaging the automated mesh assigning process you need to exclude the **Root_Bone**. This bone is a **Control Bone** for moving the figure around in the Scene and is not a **Posing Bone**. Posing is the process of posturing the figure.

In the 3D Viewport Editor in **Edit Mode** select **Root_Bone**. In the **Properties Editor, Bone buttons, Deform tab** click on the **Deform button** to remove the tick. This tells Blender that you do not want **Root_Bone** to be part of the deforming Rig.

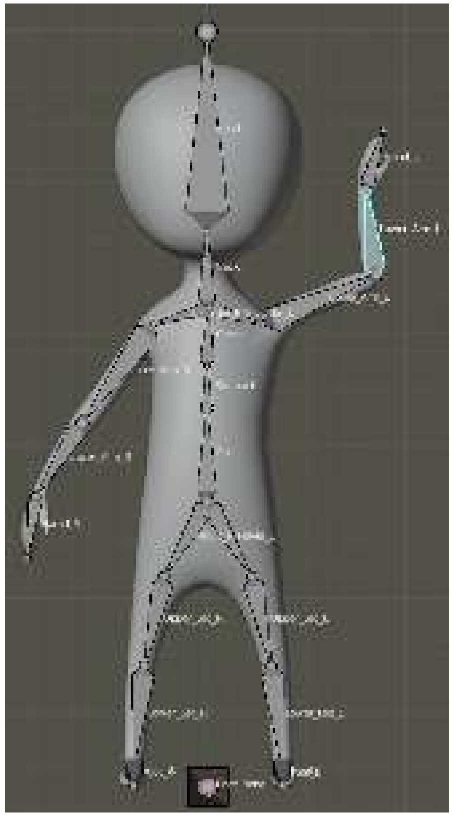


Figure 20.86

In the **3D Viewport Editor** deselect the bone and change to **Object Mode**. Press the **Alt + A key** to deselect the Armature Rig.

Assigning Mesh to Armature

Select Chibi in Object Mode and in the Properties Editor, Modifiers buttons, click **Apply** in the Mirror and Subsef Modifiers to permanently assign the Modifiers. Both Modifiers will disappear from the Properties Editor.

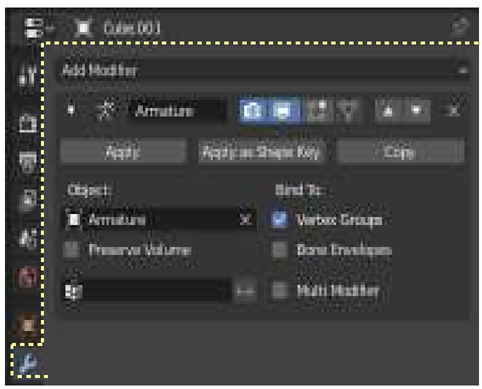
Important: Before assigning the Mesh to the Armature make sure the individual Bones are positioned inside the parts of the Mesh. Check the Front and Right Orthographic Views.

With the **Mesh figure (Chibi)** selected **Shift** select the **Armature Rig** (LMB click the Figure, hold Shift, LMB click on the Armature protruding from the Head). With the mouse cursor in the 3D Viewport Editor press **Ctrl + P key** to display the **Set Parent To** menu and select the **With Automatic Weights** option. **Note:** In assigning Automatic Weights a new Armature Modifier is assigned to the Mesh Figure in the Properties Editor.

Deselect the Mesh Figure and the Armature in the 3D Viewport Editor then select the Armature only. Go into **Pose mode** and select and rotate individual Bones to pose the figure (Figure 20.86 - Bones **Lower_Arm_L** and **Upper_Arm_L** are rotated).

20.26 Vertex Groups

Figure 20.87



When you employ the automatic Mesh Assignment two things happen:

An Armature Modifier is added to the Mesh (Figure 20.87) and Vertex Groups are created in the Mesh and assigned to each Bone in the Armature.

With the mesh selected in **Object Mode** go to the **Properties Editor, Data buttons, Vertex Groups tab** and you will see the **Vertex Groups** (Figure 20.88 over) There is a scroll bar at the RHS of the Vertex Group panel or expand the panel).

The Vertex Groups may be used for correcting incorrect Mesh Deformation. This is accomplished by selecting a **Vertex Group** and employing the **Weight Paint Tool** to clean up the connections between the Mesh and the Vertex Groups (refer to the section on Weight Painting).

> **Note:** After posing in **Pose mode,** Bones will be returned to their original positions (Reset), individually by selecting each bone or collectivly by selecting all Bones and pressing **Alt + R key** (Reset rotation) and **Alt + G key** (Reset Location - Resets Grab).

In a complicated Rig, as well as incorrect Mesh assignment, there may be Parenting issues which require addressing. Detailed tutorials provide instruction for correcting such issues but at this stage just be aware that automatic processes do not always provide perfect results.

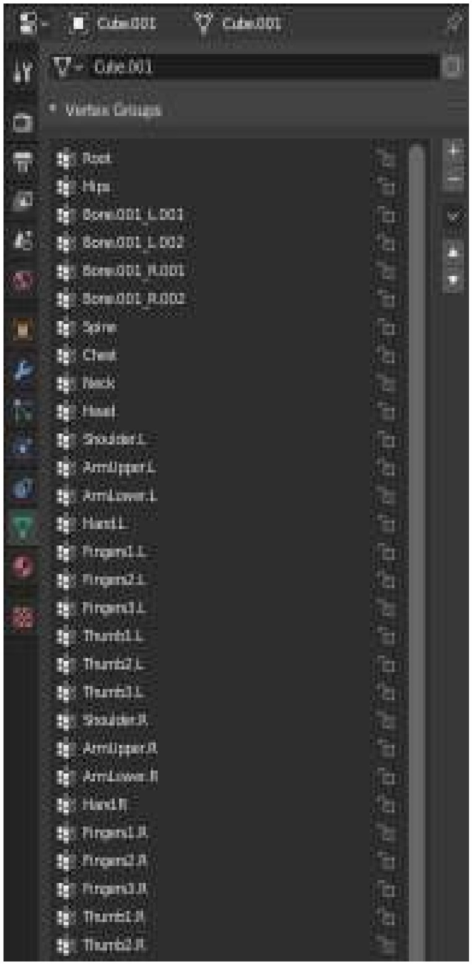
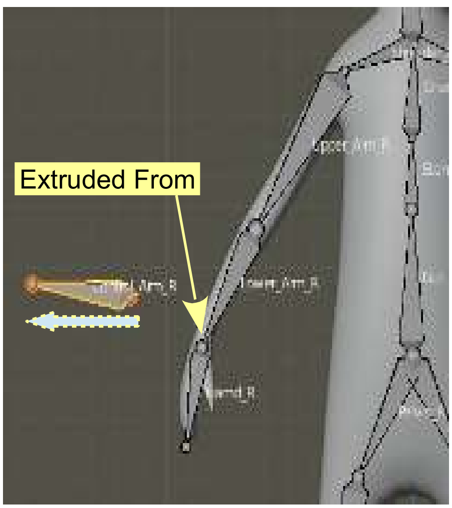


Figure 20.88

20.27 Posing the Character Model

Posing a Model may be simply to give a character attitude when creating a still image but is mainly employed to create Keyframes in an animation sequence (see Chapter 18-18.6).

Even with a relatively simple Character Rig, posing individual Bones to create **Keyframes** can be a tedious process. There are semi automated procedures which can be set up such as using an **Inverse Kinematics Constraint** (see 20.16) with a Hand or Foot such that when either is moved the Arms or Legs follow.



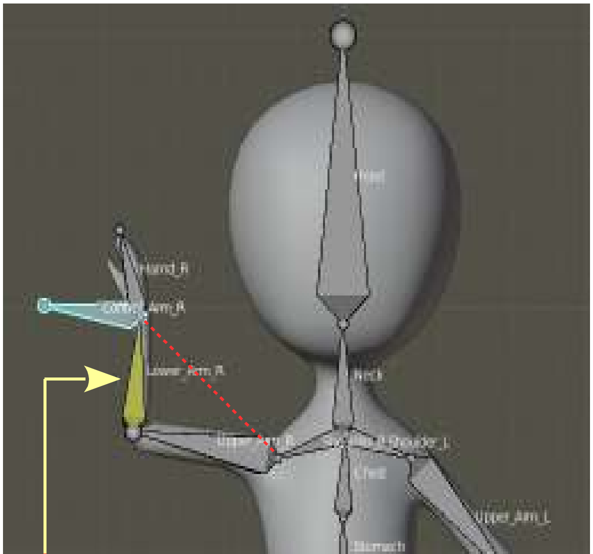
In Figure 20.89 a Control Bone has been extruded from the Tip of Lower_Arm_R.001. The Parenting has been cleared and the Control Bone moved aside in Edit Mode.

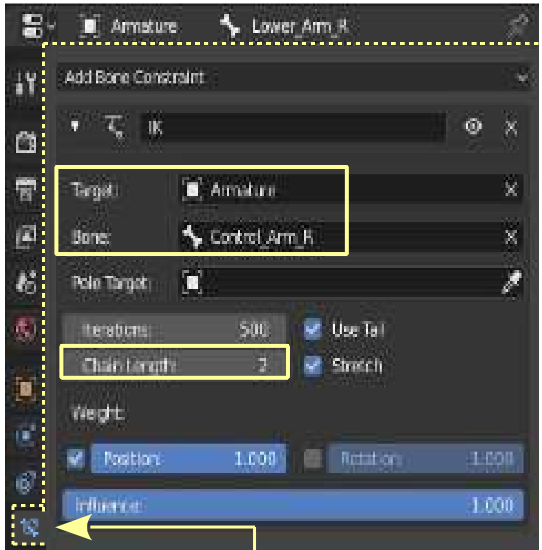
Figures 20.90 and 20.91 (over) show an Inverse Kinematic Constraint applied to Lower_Arm_R.001 The Target in the Constraint is set as Armature with Bone set to Control_Arm_L. (See 20.16)

Control_Arm_L has been renamed in the Outliner Editor.

The **Chain Length** in the Constraint is **2** making the Constraint effective only to Lower_Arm_R and Upper_Arm_R.

Figure 20.89





Lowe_Arm_L displays olive green indicating that a constraint has been applied. Figure 20.90

Bone Constraints Figure 20.91

Selecting the Control Bone, Control_Arm_R in Pose Mode and Translating allows the left arm to be Posed. Control Bones would be generated for the right arm and the legs in the same maner and in fact for any portion of the Armature you wish to Pose.

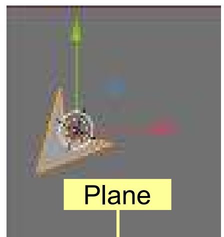


Figure 20.92

Control Bones may be displayed as different individual shapes to distinguish from the Bones in the Armature. In the 3D Viewport Editor, create a shape from one of Blenders Primitives. Figure 20.92 shows a Plane Object reshaped. Park the Object to one side in the Scene.

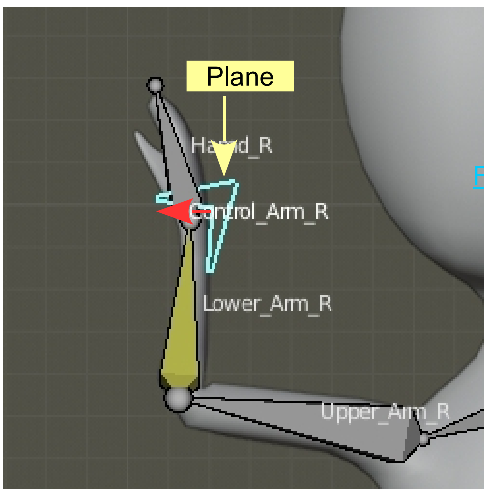
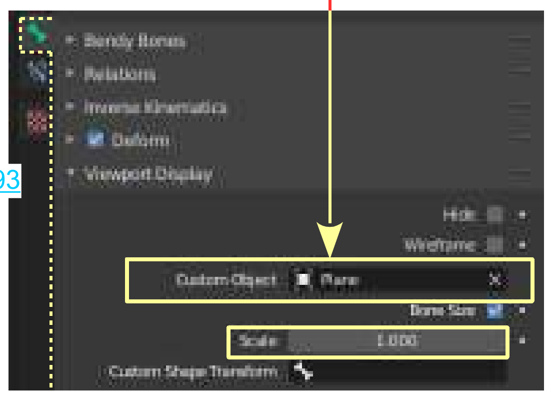


Figure 20.93



Select the Control Bone in Pose Mode and in the Properties Editor, Bone buttons, Viewport Display Tab enter the name of the new Object in the Custom Object panel. Adjust the Scale.

At the beginning of the chapter it was emphasised that the instructions were to be an introduction to Character Rigging only. The forgoing is intended to get you started and encourage you to research detailed tutorials. The following images depict how a Character Rig may be developed to provide detailed control of Posing.

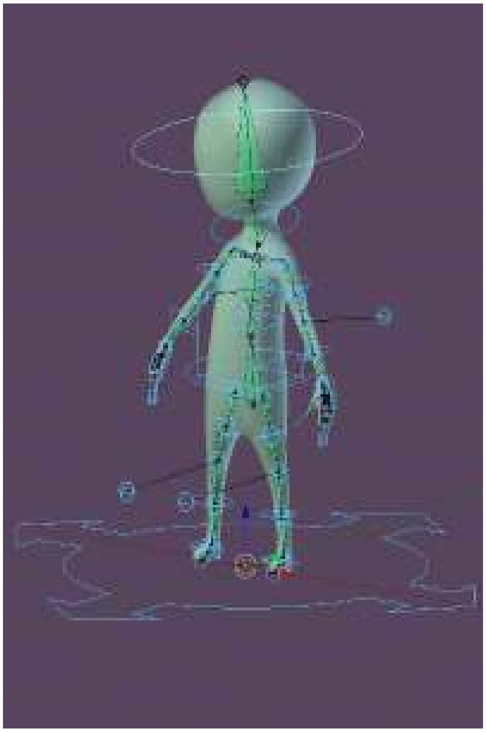
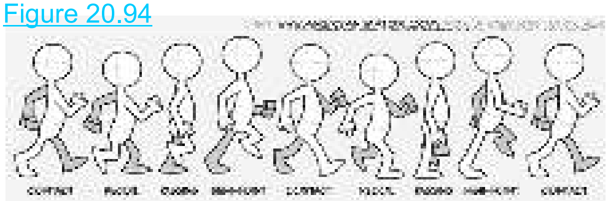


Figure 20.94 shows Chibi with a myriad of Control Bones which are more precisely named Control Handles. Each handle allows Posing of separate parts of the Character Mesh.

The large Control Handle at the Base of the Character is developed from the Root_Bone and is used for moving the entire Rig in the Scene.

Using Control Handles the Character Figure is Posed at Frames in an animation creating Keyframes. This produces a Walk Cycle.

Figure 20.94

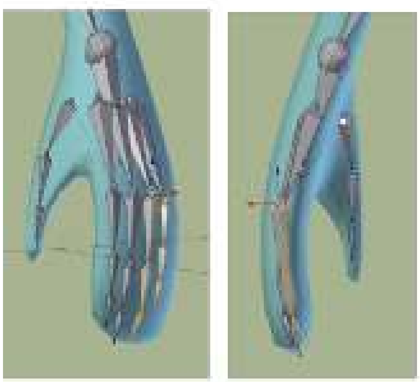


Walk Cycle

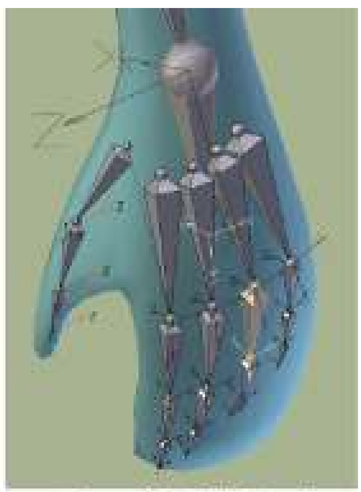
Animating the Base Control Handle to follow a Path creates the illusion of the Character walking in the Scene.

Armatures may be generated to include intricate detail such as Chibi's hands. Again, Control Handles can be created to manipulate fingers and thumbs.

Figure 20.95



Hand Bones inside the Mesh



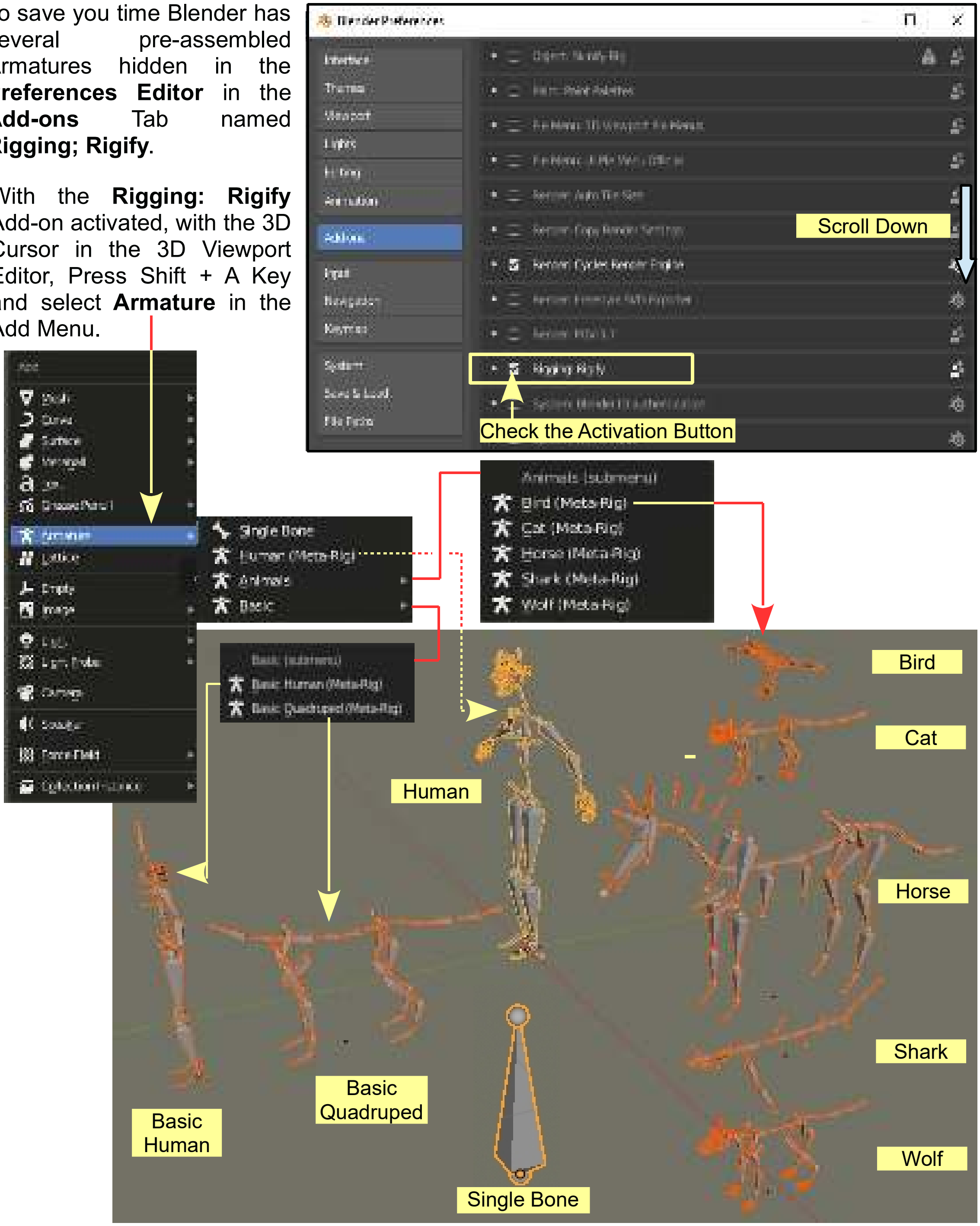
Bone Axis Displayed

20.28 Pre-Assembled Armatures

Figure 20.96

To save you time Blender has several pre-assembled Armatures hidden in the **Preferences Editor** in the **Add-ons** Tab named **Rigging; Rigify.**

With the **Rigging: Rigify** Add-on activated, with the 3D Cursor in the 3D Viewport Editor, Press Shift + A Key and select **Armature** in the Add Menu.



21

Shape Keys & Action Editors

21.1 Shape Key Editor
21.2 Add a Key Slider
21.3 Set Limits of Movement
21.4 Inserting Keyframes
21.5 Inserting Multiple Keyframes
21.6 The Animation
21.7 Additional Keyframes
21.8 Action Editor
21.9 Shapes Keys and Action Editor in Practice

The **Shape Key** and **Action Editors** provide a method of quickly controlling the shape of an Object or the pose of a character when setting the Keyframes in an Animation Timeline. Armature Control Handles allow the posing of the character as a whole but when detail is animated, such as facial expression or finger movement, a more refined control is desirable.

If you think about an Object or a character model and all the Vertices contained in its mesh surface you will realise the impossibility of individually manipulating Vertices between the Frames of an Animation.

The **Shape Key** and **Action Editor** allow you to create **Slider Controls** for manipulating shapes or poses and setting **Animation Keyframes.**

The **Shape Key Editor** controls the manipulation of Vertices or groups of Vertices, while the **Action Editor** allows you to set up an animation of an Object's movement and scale.

21.1 Shape Key Editor

The **Shape Key Editor** allows you to control the manipulation of Vertices or groups of Vertices.

The Shapes Key Editor is located in the **Dope Sheet Editor**.

To demonstrate, start with the default Blender Scene, delete the Cube, and add a simple Plane Object which contains four Vertices. Place the Scene in **Top Orthographic View** and zoom in.

Below the 3D Viewport Editor is the **Timeline Editor**. Change the Timeline to the **Dope Sheet Editor**.

In the Dope Sheet Editor, click on the drop down in the Header where you see **Dope Sheet** and select **Shape Key Editor**.

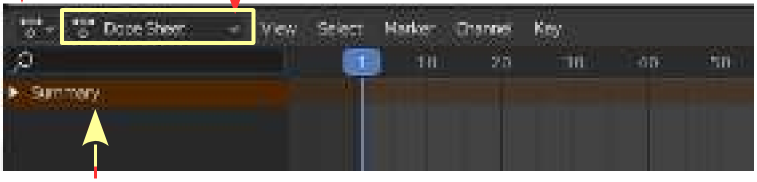


Figure 21.1

Summary only displays if you change from the Shape Key Editor back to the Dope Sheet.

With the **Shapes Key Editor** selected, the Editor has become a simple Animation Timeline (Figure 21.2) with **Frame** numbers in the horizontal bar along the top of the Editor. There is also a vertical blue line in the Editor which is the **Timeline Cursor**.

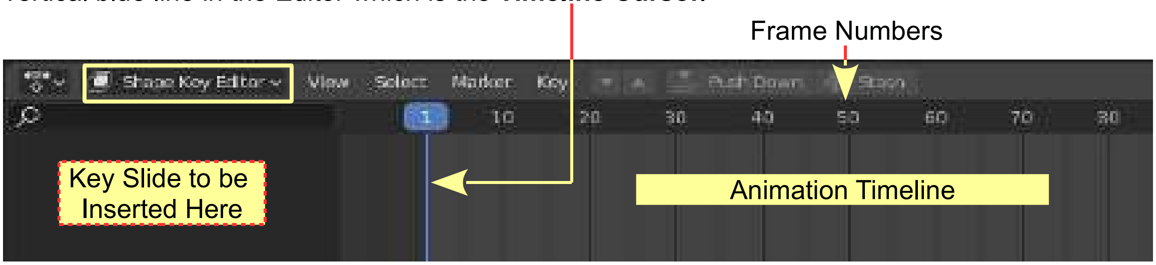


Figure 21.2

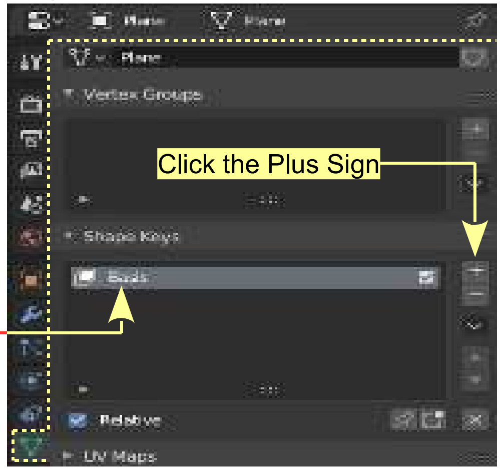
Key Sliders will be added in the Shape Key Editor which will allow you to control the shape of an Object in the 3D Viewport Editor. The movement of the Object's Vertices will be set within minimum and maximum limits. By moving the Vertices, via the Key Sliders, to different positions within the limits, at different Frames of the Animation Timeline you create an animation of the change in shape of the Object.

21.2 Add a Key Slider

Select the Plane in the 3D Viewport Editor. In the **Properties Editor, Data buttons, Shape Keys Tab** click on the **Plus sign** (Figure 21.3).

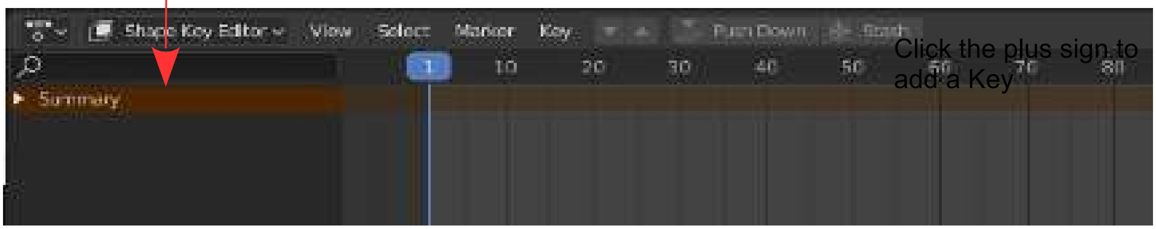
Figure 21.3

Properties Editor



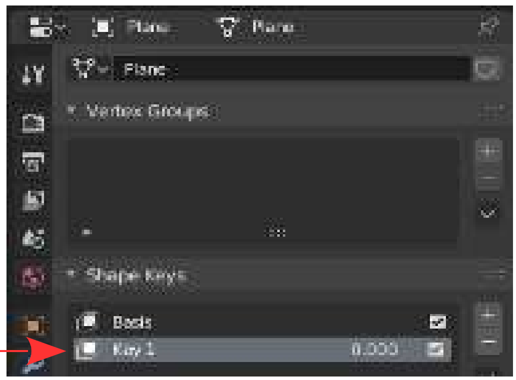
The tab expands, showing a **Basis Key** inserted.

Dope Sheet Summary displays in the Shape Key Editor.



In the **Properties Editor, Shape Keys Tab** click on the plus sign again and **Key 1** will be added.

Figure 21.4



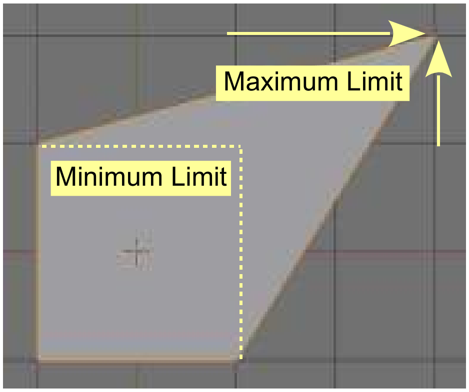
In the **Dope Sheet Summary, Key 1** is displayed.

Click the triangle adjacent to Summary to show the Key.

Figure 21.5

21.3 Set Limits of Movement

Figure 21.6



With the Mouse Cursor in the 3D Viewport Editor, in Top Orthographic View, **Tab to Edit Mode**. Deselect the Plane (Alt + A Key). Select a Vertex and drag it (press the G Key and drag the Mouse) to where you want it to move to (maximum movement Limit - Figure 21.6). Tab back to **Object Mode.** The Vertex reverts to its original position. Moving the vertex in Edit Mode has **set the limits** for the movement.

In Object Mode drag the **Key 1 Slider all the way to the right** (0.000 – 1.000 Figure 21.7) then return to 0.000. The Plane changes shape in the 3D Viewport Editor.

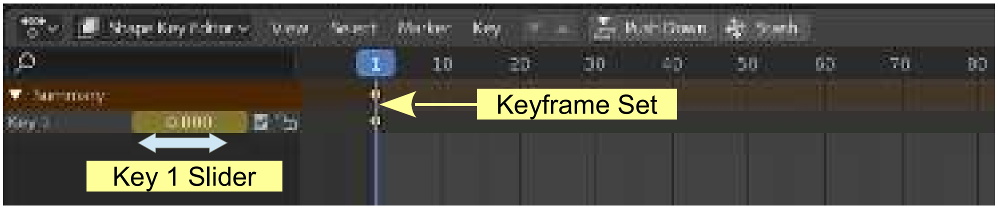


Figure 21.7

21.4 Inserting Keyframes

Dragging the slider in the Shape Key Editor and returning it to 0.000 automatically sets a **Keyframe** in the **Timeline**. The Keyframe is placed at the location of the Timeline Cursor (the blue line at Frame 1) and displays as little orange diamonds (Figure 21.7).

Note: Dragging the slider moves the selected Vertex only within the limits that were set. The slider value is from 0.000 to 1.000, that is from the initial position to the maximum limit of the movement.

Inserting a Second Keyframe

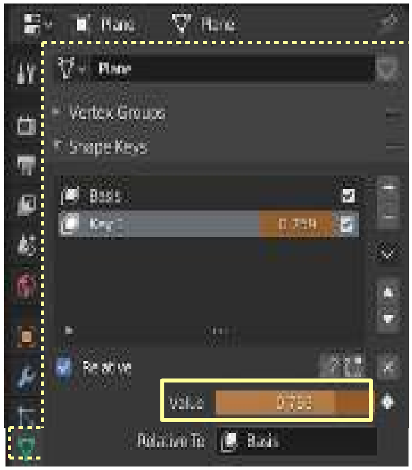
To insert a second Keyframe move the blue line **Cursor** in the **Shapes Key Editor** to another Frame (Frame 50). Move Key 1 Slider until the Vertex in the 3D Viewport Editor is where you want it (0.759). Release the mouse button (Figure 22.8). Leave the Slider at the chosen value of the second Keyframe. Return the blue line Cursor to Frame 1.

When you drag the blue line Cursor, the shape of the Plane in the 3D window changes with the corner (Vertex) moving from its initial rest position to where you positioned it at Frame 50.

Maybe you didn't get the position of the Vertex exactly where you intended. Dragging the Key Slider is a bit touchy when you want an exact location.

Deleting a Keyframe

Figure 21.8



To delete a Keyframe and start over, place the blue Cursor in the Shape Key Editor at the Frame in the Timeline where you want to remove Keyframes. **RMB click on Value bar** (Figure 21.8) in the **Properties Editor, Data buttons, Shape Keys Tab** and select **Delete Keyframe**.

Note: The relative Value Bar replicates the Key 1 Slider.

Add a New Keyframe

You may add a new Keyframe by moving the Key 1 slider again. If you want an exact value double click the slider and type in a value.

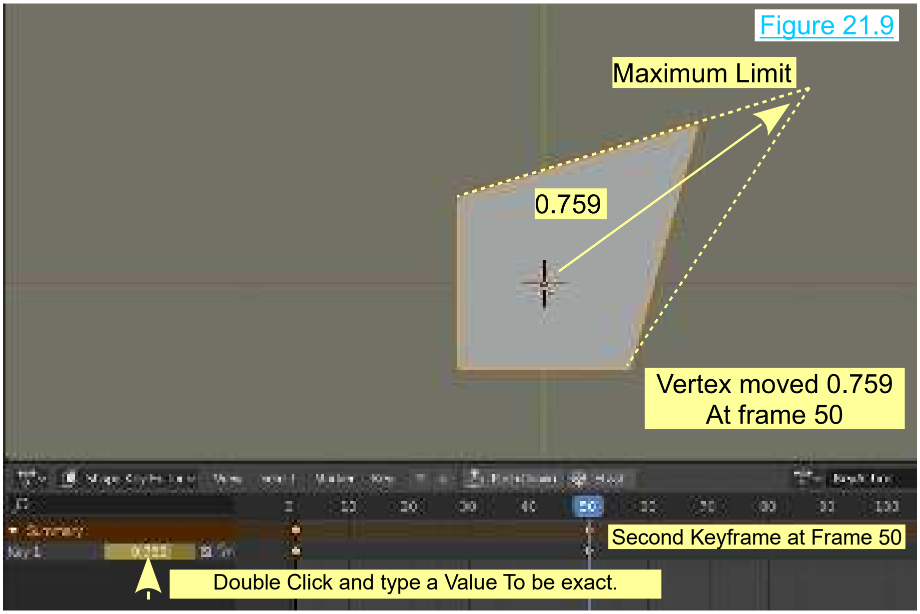


Figure 21.9

21.5 Inserting Multiple Keyframes

After placing a Keyframe you do not have to return the Timeline Cursor to frame 1. Move it to another Frame. Move the Key 1 Slider. Another Keyframe is added. Repeat the process for multiple Keyframes (Figure 21.10).

Figure 21.10

21.6 The Animation

To this point Keyframes have been added in the **Shape Key Editor Timeline**. You may scrub the Timeline (drag the blue line Cursor) to see the shape change in the 3D Viewport Editor. To see an animation play open the **Timeline Editor** and press the **Play** button (Figure 21.11).

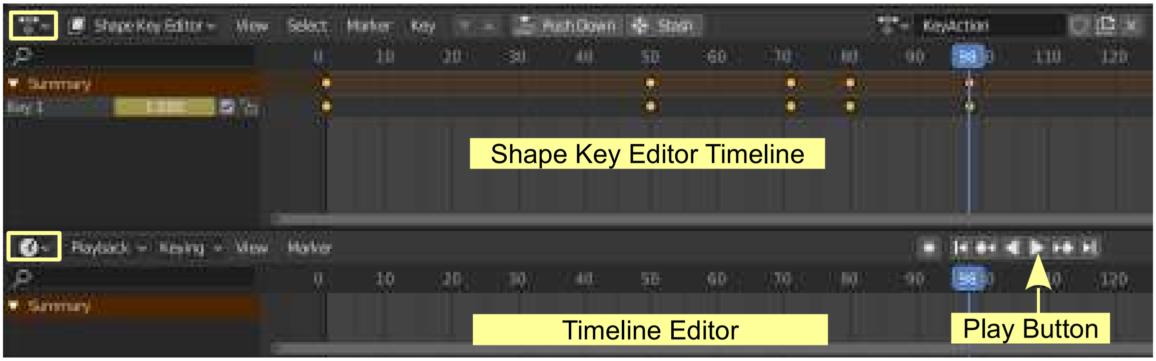


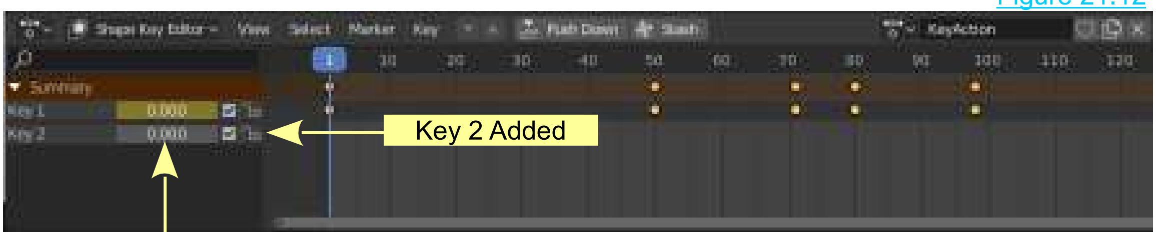
Figure 21.11

21.7 Additional Keys

Additional Keys are added in the Dope Sheet Summary for Animating other parts of the Mesh (other Vertices).

Move the cursor in the **Shapes Key Editor Timeline** to Frame 1. In the **Properties Editor, Data buttons, Shape Key Tab**, click on the plus sign again to add **Key 2** (Figure 21.4). In the 3D Viewport Editor, Tab to Edit Mode, select a different Vertex, and move it somewhere to set the limit of movement. Tab back to Object Mode and you'll see that Key 2 has been added to the Dope Sheet Summary (Figure 21.12). Repeat the Keyframing process using Key 2 for the new Vertex.

Figure 21.12



Drag the Slider to see the Limit of Movement for the new Vertices.

After inserting Keyframes for the new Vertex controlled by Key 2, scrubbing the Timeline Editor Cursor or playing the Animation will show both Vertices moving as the animation plays.

21.8 Action Editor

Click to display the Menu

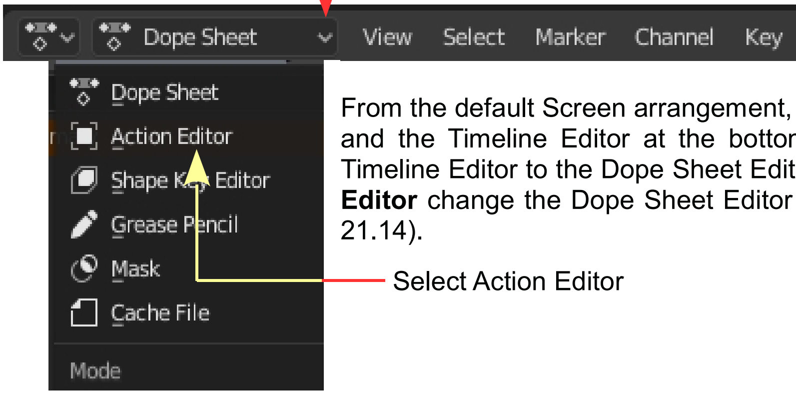


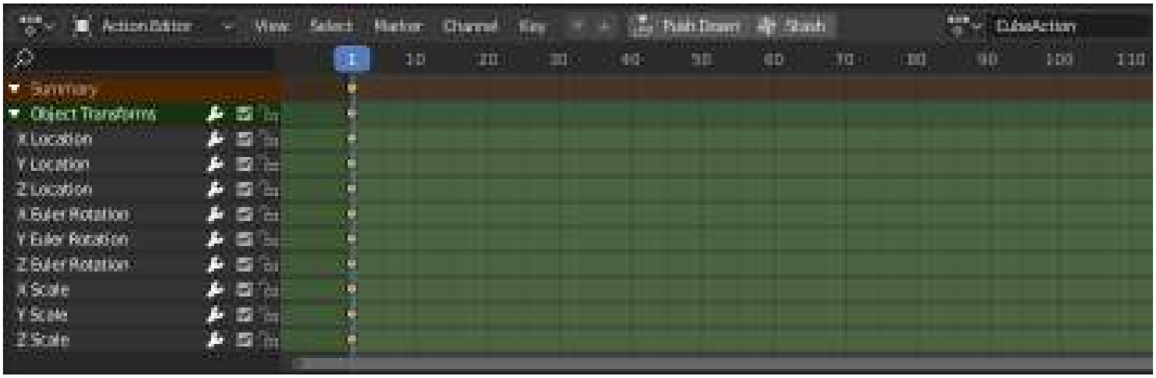
Figure 21.13

From the default Screen arrangement, with the 3D Viewport Editor and the Timeline Editor at the bottom of the Screen, change the Timeline Editor to the Dope Sheet Editor. To demonstrate the **Action Editor** change the Dope Sheet Editor to the **Action Editor** (Figure 21.14).

Select Action Editor

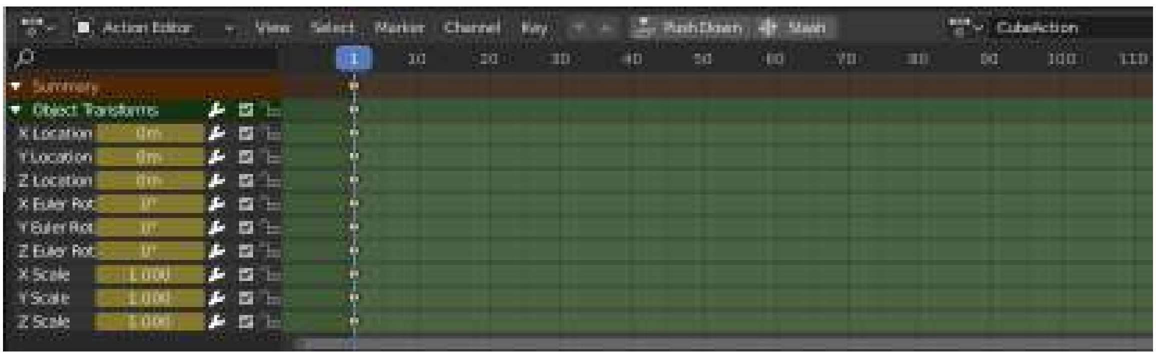
In the **3D Viewport Editor** select the default **Cube**. With the Mouse Cursor in the 3D Viewport Editor press the **I** Key and select **LocRotScale**. This inserts a **Keyframe at Frame 1** and enters **a Dope Sheet Summary** in the **Action Editor** with an **Object Transforms** summary**.** Click on the triangle preceding **Object Transforms** to display the Keyframe entries for **X,Y and Z, Location Rotation and Scale.**(Figure 21.14).

Figure 21.14



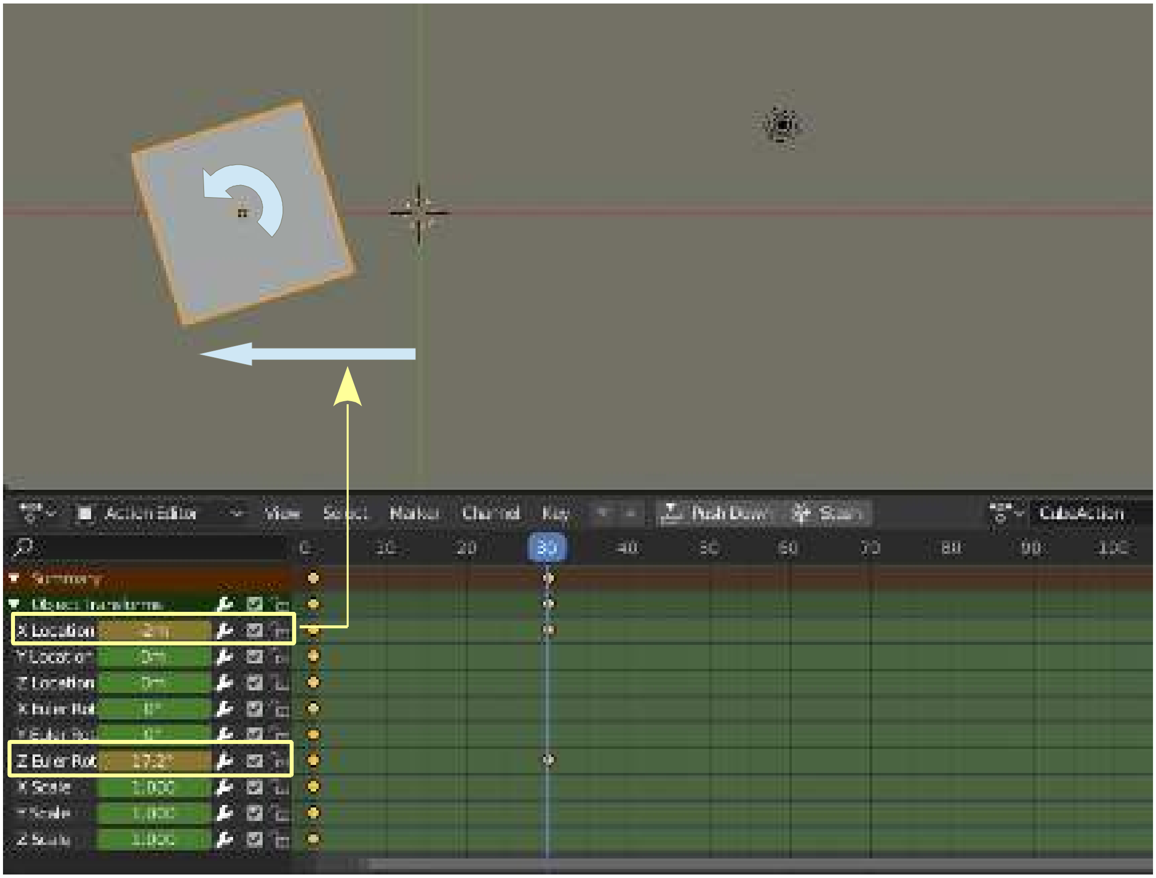
In the **Action Editor Header**, click on **View** and check (tick) **Show Sliders**; sliders display for each Keyframe component (Figure 21.15).

Figure 21.15



By repositioning the Cursor (blue line) in the Action Editor to a new Frame and moving the Sliders, you manipulate the Cube in the 3D Viewport Editor (Figure 21.16). After moving the Slider, **RMB click** on the new value and select **Replace Keyframe**. When the Cursor is positioned at a different Frame and slider values are changed, Keyframes are inserted, which produces an animation.

Figure 21.16

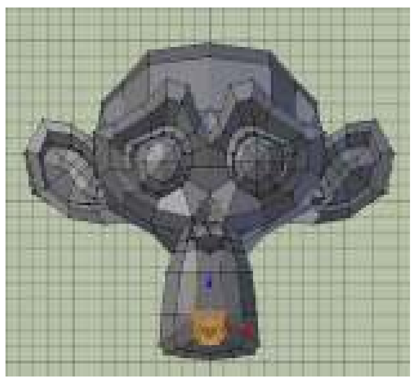


21.9 Shape Keys and Action Editor in Practice

The forgoing examples show you the fundamentals of the tools but they are not very exciting and you could be left wondering what to do with them in some practical application. To expand on the topics perform the following exercise:

In a new Blender Scene delete the **Cube** and add a **Monkey Object**. Place the Scene in **Front Orthographic view** and zoom in to fill the 3D Viewport Editor with Suzanne's head. **Tab to Edit Mode** and select the Vertices in the face as shown in Figure 21.17.

Figure 21.17



Change the Timeline Editor to the Dope Sheet Editor then to the **Shape Key Editor**. In the 3D Viewport Editor position Monkey to have the mouth visible (Figure 21.16 -18).

Tab to Object mode.

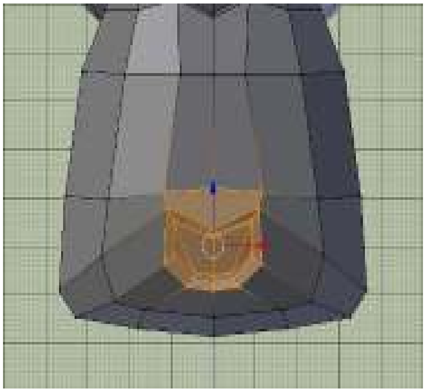


Figure 21.18

In the **Properties Editor, Data buttons, Shape Key tab** click on the plus sign to add a **Basis Key** which places a Dope Sheet Summary in the Dope Sheet, Shape Key Editor. Click the plus sign again to insert **Key 1**.

You are about to make Suzanne speak.

In the **3D Viewport Editor** change to **Right Orthographic View** . Tab to **Edit Mode**. Use the widget and move the selected Vertices to the left making Suzanne's lips protrude slightly (Figure 21.19). Change to **Front Orthographic View** . Scale the selected Vertices up on the Z Axis and a little bit on the X Axis (Figure 21.20). Using the widget move the Vertices up. **Tab to Object Mode**. The Vertices revert to their original location.

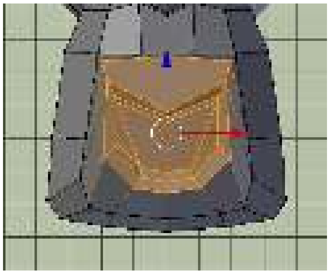


Figure 21.20

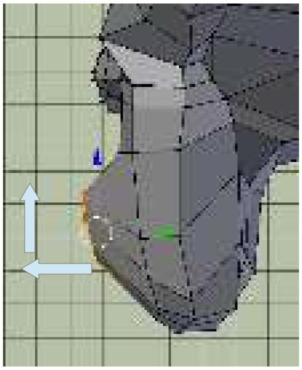


Figure 21.19

In performing the scaling and location operations you have set the limits of movement for Key 1 for each of the Vertices that were selected.

Move the Key 1 Slider and see Suzanne's mouth move. Remember, moving the Slider inserts a Keyframe at the Frame number in the Animation Timeline where the Timeline Cursor is positioned (Frame 1) (Figure 21.20). If you don't want Suzanne to start laughing at the start of the animation move the cursor down the track in the Timeline. Also remember that by default Blender has a 250 Frame animation set in the Timeline. If you place the Shape Key Editor Cursor beyond this it will have no effect unless you change the End Frame value in the Timeline Editor Header.

Place a series of Keyframes in the animation. Move the Cursor to Frame 10 and move the Key slider leaving it in position. This inserts a Keyframe at frame 10. Move the Cursor to frame 20 – move the slider. Move the Cursor to frame 30 – move the slider etc. (Figure 21.21). Go back to Frame 1 and play the animation. Monkey's mouth moves as the animation plays.

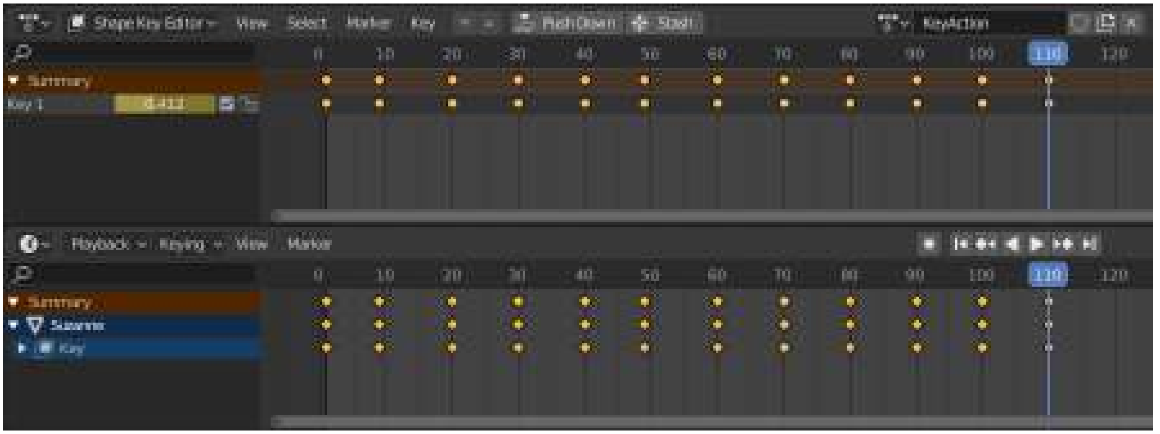
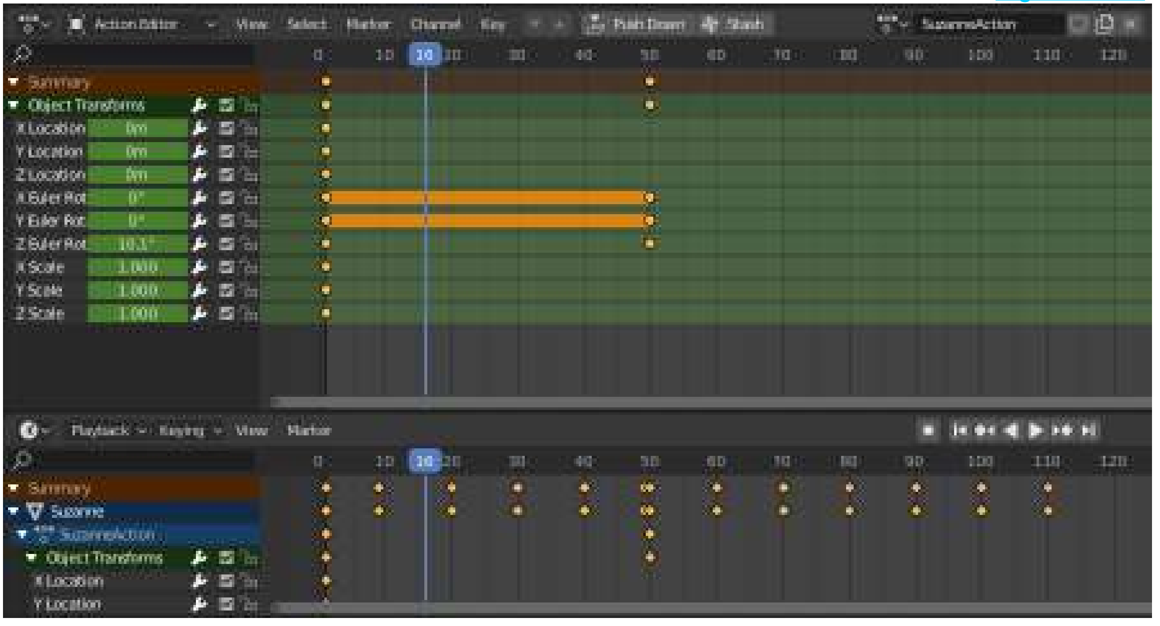


Figure 22.21

Change the Shape Key Editor to **Action Editor mode**. Zoom out on the 3D Viewport Editor. With the Cursor at Frame 1, Press **I** Key and select LocRotScale to place action Keyframes (Figure 21.22). Move the Cursor to Frame 50 to coincide with the **Shape Key** animation and move the **Z Euler Rotation slider to 45 degrees** (Rotation in Blender is measured in Euler units). RMB click the Z Eular Rotation value and select Replace Keyframe.

Figure 22.22



Place the 3D Viewport Editor in Camera View and play the animation. Suzanne's mouth moves while turning to face the Camera.

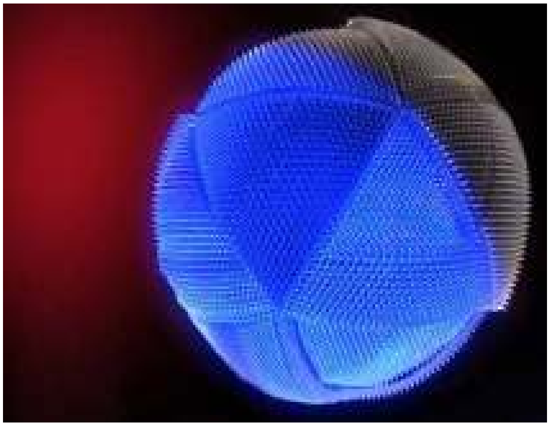
This has been a very simple practical demonstration so use your imagination and experiment, experiment, experiment!

22

Particle Systems

22.1 The Default Particle System
22.2 The Emissions Tab
22.3 The Source Tab
22.4 The Cache Tab
22.5 The Velocity Tab
22.6 Particle Display
22.7 Particle Emission Options
22.8 Order of Emission
22.9 Normals
22.10 Particle Modifiers
22.11 Particles Array
22.12 The Viewport Display Tab
22.13 Particle Interaction
22.14 Wind Force Effect
22.15 Boids Particles
22.16 Hair Particles
22.17 Particles for Arrays
22.18 More Arrays
22.19 The Assignment Panel
22.20 Particle Exercises
22.21 Multiple Particle Systems
22.22 Keyed Particles

Particle Systems are used to simulate effects like fire, dust, clouds and smoke and for creating hair, fur, grass and other strand based Objects. When a Particle System is applied to an Object it causes the Object to generate and emit Particles which may be configured to display in a multitude of ways creating static and animated patterns or as Models of Characters. For example, like an army of solders or a swarm of insects.



The preceding examples are screen captures from a YouTube video created by:

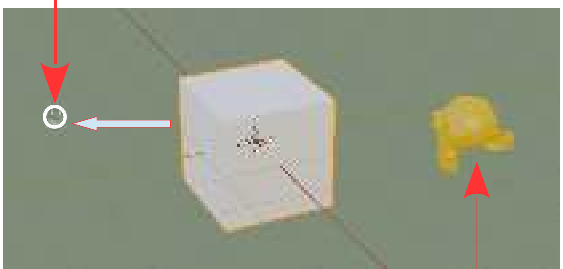
Iago Mota https://www.youtube.com/watch?v=UHmRP3iLztU

In Blender **Particles**, by default, appear as points or small circles on the computer screen, being emitted from an Object. To Emit Particles from an Object a **Particle System** is assigned (added) to the Object then an animation sequence is run.

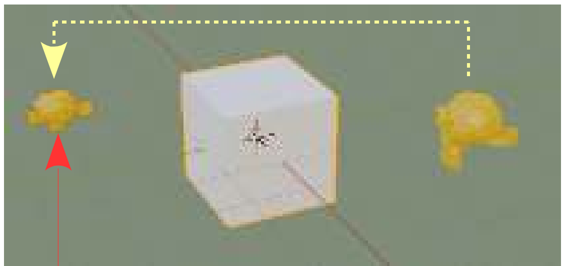
Adding a Particle System to an Object creates a system with default settings which is ready to run by itself. To create Particle effects you modify the settings.

Particles themselves are simply points on the computer Screen which can be configured to display in different ways allowing you to see them. The Particles (points) do not render when the Scene is Rendered. The Particles are reconfigured to display as other Objects in the Scene which will Render.

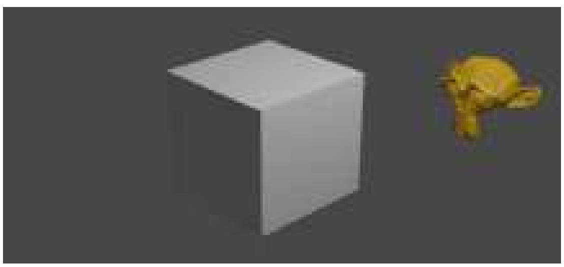
A single Particle being emitted from the Face of the Cube Object



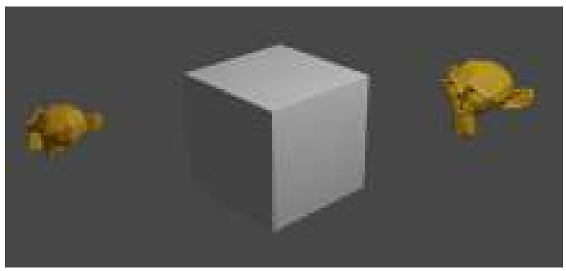
Monkey Object in the Scene



The Particle displaying as the Monkey



Render of Camera View
Before reconfiguring the Particle
To display as the Monkey



Rendered of Camera View
After configuring the Particle
To display as the Monkey

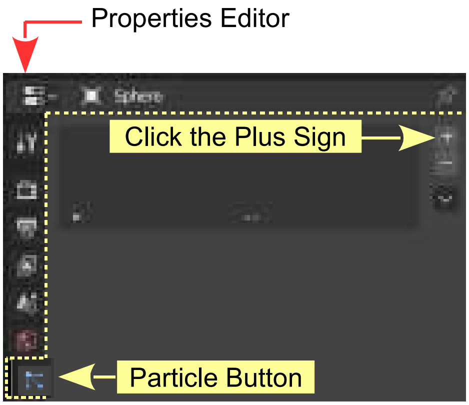
Usually a Particle System will be used to generate more than one Particle. In fact, it is usual to create thousands of Particles and possibly from multiple Objects in a Scene.

To see how this is accomplished follow a few simple instructions and run a Particle System.

22.1 The Default Particle System

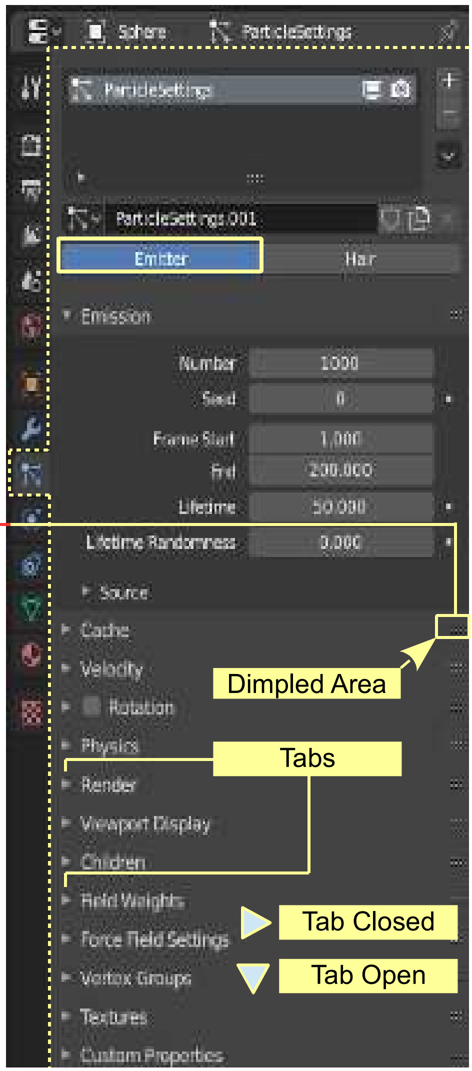
To set up a default **Particle System** open a new Scene in Blender. Delete the default Cube Object and add a **UV Sphere**.

Figure 22.1



Particles are emitted from the Vertices, the Faces or from the Volume of a mesh. Using a UV Sphere provides a reasonable number of Vertices and Faces from which to emit the Particles. Leave the default values for the Sphere as they appear in the Properties Editor. With the UV Sphere selected, go to the **Properties Editor, Particles buttons**. Click on the **plus sign** to add a **Particle System** (Figure 22.1).

Figure 22.2



The **Particles buttons** open displaying the **Tabs** (panels) that control the system. Blender has automatically created a default Particle System for the UV Sphere (Figure 22.2).

Note:
When a Particle System is created it is unique to the selected Object in the 3D Viewport Editor.

The arrangement of the **Tabs** (panels) in the **Properties Editor** is purely a matter of convenience. There is no order of priority. The Properties Editor is arranged with the Tabs in a vertical stack at the LHS of the panel. The Tabs (panels) may be moved up or down by clicking and dragging the dimpled area in the upper RH corner of each Tab.

Particles only display in the 3D Viewport Editor when an animation sequence is run by activating Play in the Timeline Editor or scrubbing (dragging) the Timeline cursor (vertical blue line) to a Frame in the animation.

The default Particles display as small white circles.

Note the default **Type: Emitter** under **Particle Settings.**

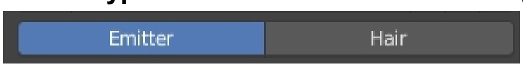


Figure 22.3

The alternative system is **Hair** (Figure 22.3). Type: Hair is a unique system which will be discussed later in this chapter.

To see the default **Particle System** in action, with the Mouse Cursor in the 3D Viewport Editor, press the **Play button** in the **Timeline Editor.** This runs an animation sequence showing Particles being generated (Figure 22.4).

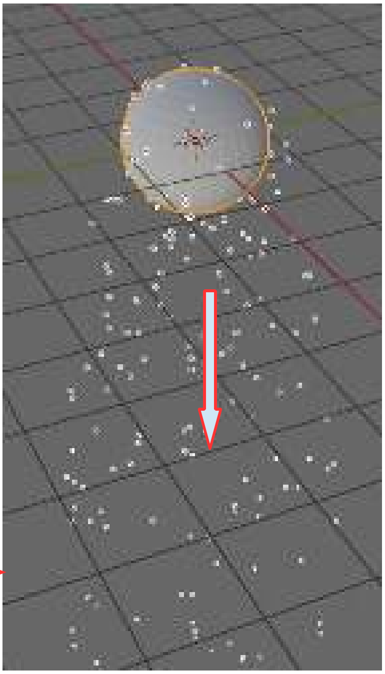


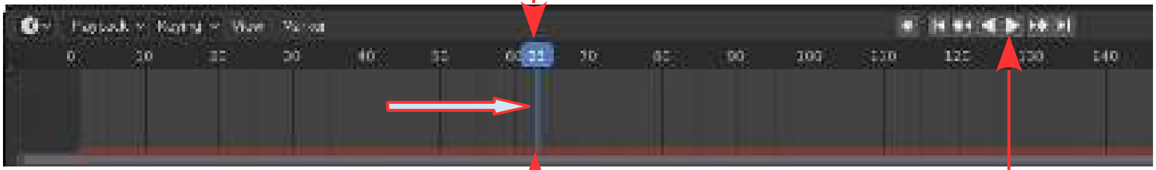
Figure 22.4

Note: The Timeline Editor is displayed across the bottom of the Screen (Figure 22.5). The blue line (Timeline Cursor) moves as the animation plays. With the Emitter Object selected (the UV Sphere), the animation will play showing Particles as small white circles being emitted and falling towards the bottom of the Screen.

The animation plays for 250 frames then repeats. Press **Esc** to stop the animation. Advance the animation to Frame 63 by pressing the right arrows on the Keyboard (**with the Mouse Cursor in the Timeline Editor**) or by clicking RMB, holding and dragging the blue line Cursor in the Timeline Editor or by RMB clicking on frame 63 in the Timeline Editor. The Particles will be displayed as they occur at Frame 63.

Timeline Editor Cursor

Figure 22.5



Frame 63

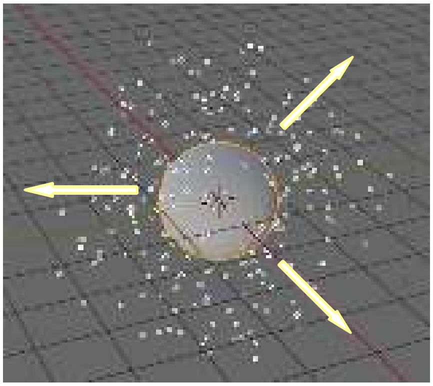
Timeline Editor Play Button

The example has demonstrated a simple Particle System being applied. The Particles emitted from the Sphere cascade down; this occurred since there is a **gravitational effect** applied (see the Scene buttons in the Properties Editor).

In the **Properties Editor, Scene buttons, Gravity Tab,** click on the tick next to **Gravity** (removes the tick) to remove the gravitational effect.

Set the animation in the Timeline Editor back to Frame 1 and replay the animation.

Figure 22.6

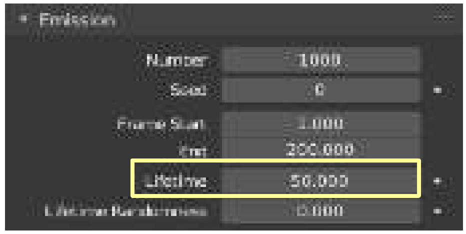


Replaying the animation shows Particles Emitted from the UV Sphere disperse in all directions away from the Sphere (Figure 22.6).

Note: The Particles move for a certain time and disappear before the end of the animation. The time that the Particles display is set in the **Emission Tab** (**Lifetime** Figure 22.7).

22.2 The Emissions Tab

Figure 22.7



You control the Particle display in the 3D Viewport Editor in the **Emissions Tab** by adjusting values as follows (Figure 22.7).

Number: The total number of Particles to be Emitted over the length of the animation.
Seed: Sets a randomized **Emission** variation.
Frame Start: The Frame number in the animation to start emitting.
End: The Frame number to stop Emitting Particles.
Lifetime: The number of Frames in the animation that Particles, **which have been Emitted**, will display for.
Lifetime Randomness: Gives **Lifetime** a random variation.

With the default settings 1000 Particles will be emitted over the length of the animation. The default animation length is 250 Frames (see the Timeline Editor). The Particles will begin Emitting at Frame 1 and end at Frame 200. The Particles display for a Lifetime of 50 Frames, therefore, the last Particle to be emitted (at Frame 200) displays for 50 frames, that is, to the end of the animation.

22.3 The Source Tab

Figure 22.8

Emit From: Faces. The Particles Emit from the Faces of the Object's **Mesh**. The alternatives are from the **Verts** (Vertices) or from **Volume** (the body of the mesh). See 22.7. The remainder of the settings in the Source Tab govern the order in which Particles are emitted (see 22.8).

22.4 The Cache Tab

Figure 22.9

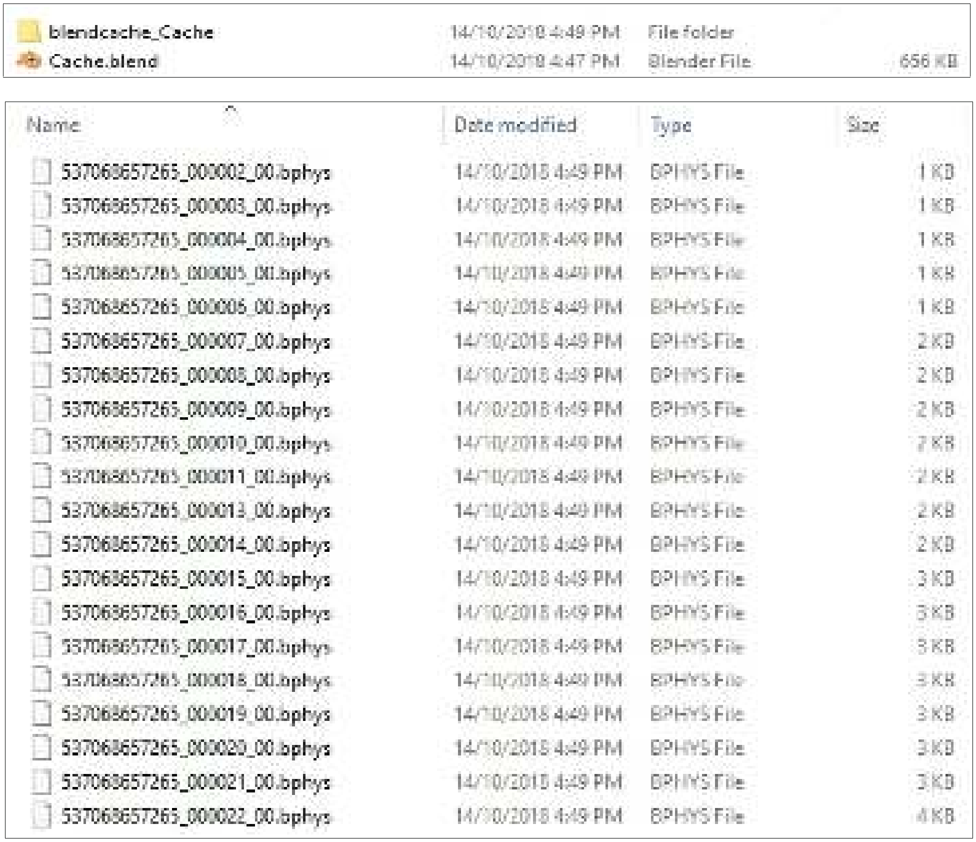
When a Particle System is played for the first time in the default Blender Scene the computer calculates the information required to display each Frame in the simulation (animation) and stores it in RAM (memory). When the simulation is played a second time the computer recalculates the information with any changes made to the settings and again stores the information in RAM. If the Blender file is closed without being saved the information is lost.

With a complicated Particle Simulation, writing data to RAM can use a considerable amount of memory which in turn can influence the performance of the computer. It is, therefore, advisable to save the Blender file as early as possible. With the file saved you have the option to save the simulation to a Cache which frees up memory.

Note the statement in the **Cache Tab: Options are disabled until the file is saved**. This is basically saying, you can't save to the Cache until you have saved the Blender file. With the file saved check **Disk Cache** which will save the data to the Cache using the Library (Lib) Path.

Playing the simulation with **Disk Cache** checked creates a **blendcache_Cache** file and places it in the same directory as the .blend file. When Disk Cache is checked after saving the file you will see a red line at the bottom of the Timeline Editor indicating the data that has been saved. Playing the simulation with the default settings creates a solid line since data is recorded for each Frame of the default 250 Frames. In the directory where the Blender file is saved you will find the blendcache_Cache folder containing 250 BPHYS files.

Figure 22.10



blendcache_Cache	14/10/2018 4:49 PM	File folder	
Cache.blend	14/10/2018 4:47 PM	Blender File	656 KB

Name	Date modified	Type	Size
537068657265_000002_00.bphys	14/10/2018 4:49 PM	BPHYS File	1 KB
537068657265_000003_00.bphys	14/10/2018 4:49 PM	BPHYS File	1 KB
537068657265_000004_00.bphys	14/10/2018 4:49 PM	BPHYS File	1 KB
537068657265_000005_00.bphys	14/10/2018 4:49 PM	BPHYS File	1 KB
537068657265_000006_00.bphys	14/10/2018 4:49 PM	BPHYS File	1 KB
537068657265_000007_00.bphys	14/10/2018 4:49 PM	BPHYS File	2 KB
537068657265_000008_00.bphys	14/10/2018 4:49 PM	BPHYS File	2 KB
537068657265_000009_00.bphys	14/10/2018 4:49 PM	BPHYS File	2 KB
537068657265_000010_00.bphys	14/10/2018 4:49 PM	BPHYS File	2 KB
537068657265_000011_00.bphys	14/10/2018 4:49 PM	BPHYS File	2 KB
537068657265_000013_00.bphys	14/10/2018 4:49 PM	BPHYS File	2 KB
537068657265_000014_00.bphys	14/10/2018 4:49 PM	BPHYS File	2 KB
537068657265_000015_00.bphys	14/10/2018 4:49 PM	BPHYS File	3 KB
537068657265_000016_00.bphys	14/10/2018 4:49 PM	BPHYS File	3 KB
537068657265_000017_00.bphys	14/10/2018 4:49 PM	BPHYS File	3 KB
537068657265_000018_00.bphys	14/10/2018 4:49 PM	BPHYS File	3 KB
537068657265_000019_00.bphys	14/10/2018 4:49 PM	BPHYS File	3 KB
537068657265_000020_00.bphys	14/10/2018 4:49 PM	BPHYS File	3 KB
537068657265_000021_00.bphys	14/10/2018 4:49 PM	BPHYS File	3 KB
537068657265_000022_00.bphys	14/10/2018 4:49 PM	BPHYS File	4 KB

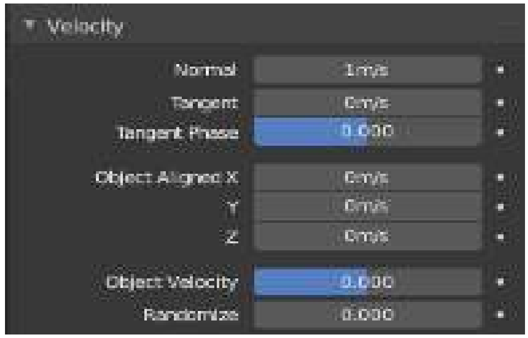
250 BPHYS Data Files, one for each Frame in the Simulation

Timeline Editor – Red Line indicates files saved. Figure 22.11

With the default simulation (250 Frames) there are 250 BPHYS Files. The longer the simulation the more files are created. To save space in the Cache, when you have a lengthy simulation, you may elect to only save data for some of the Frames. To do this increase the Cache Steps value. Increasing the value to 10 means every tenth frame is recorded, therefore, the number of BPHYS files in the Cache for the default 250 frame simulation would be 26 (25 divisions – Frame at each end). Increasing the Cache Steps saves space on the Hard Drive at the expense of a lesser quality in the simulation.

22.5 The Velocity Tab

Figure 22.12



The settings in the **Velocity Tab** control the direction and speed of the Particle Emission (Figure 22.12).

Normal: Gives the Particles an initial Velocity normal (at right angles to) the point of origin.

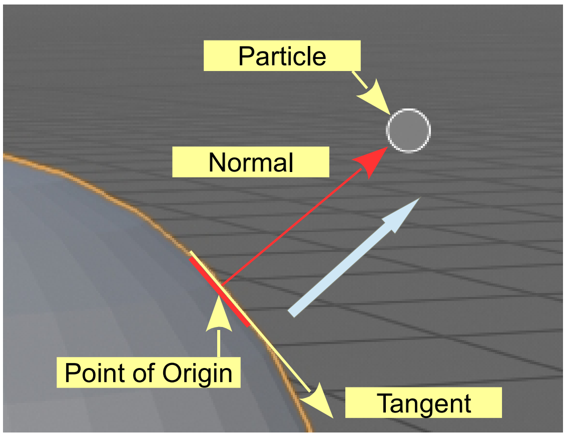
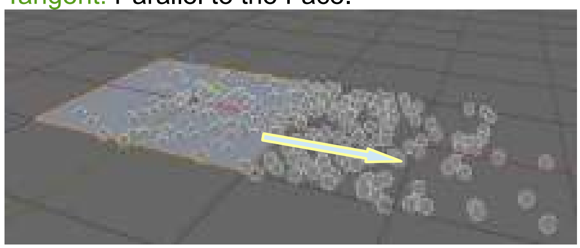


Figure 22.13

The Particle is being emitted from the point of origin on the Face, normal to the Face (at right angles to the Face).

Tangent: Parallel to the Face.

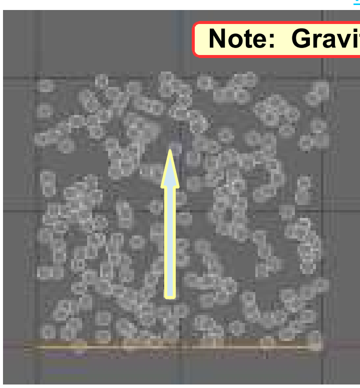


Normal: 0.000 – X: 1.000

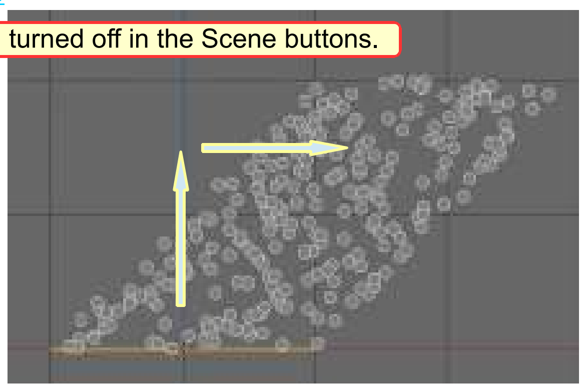
Object Alignment: Controls the Emission direction between Normal and Tangent.

Figure 22.14

Note: Gravity has been turned off in the Scene buttons.



Normal: 1.000 – X: 0.000



Normal: 1.000 – X: 1.000

Figure 22.14 shows Particles being emitted from the single Face of the Plane Object. By changing Face to **Verts** (vertices) in the **Source Tab**, with the default values (Normal: 1.000 – X: 0.000) the Particles are emitted from the four **Vertices** of the Plane, normal to the face of the Plane (Figure 22.15).

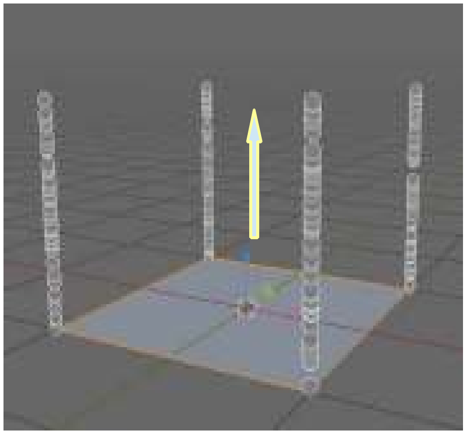


Figure 22.15

At this point you have just enough information to control the Emission of Particles but they are just Particles, little white circles, and not particularly interesting. The circles represent positions on the computer Screen for the display of other Objects with the objective being, to create visual displays.

22.6 Particle Display

A Particle will display as an Object which has been added to a Scene.

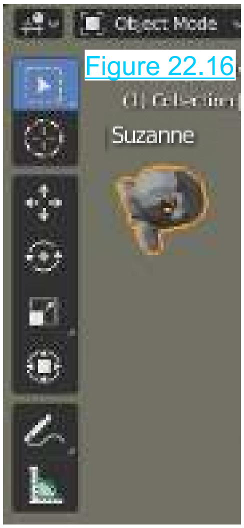


Figure 22.16

To demonstrate; have a Plain Object and a Monkey Object in a Scene. Scale the Monkey way down and park it off to one side (Figure 22.16).

Have the Plane selected in the 3D Viewport Editor and apply a Particle System. **Turn off Gravity in the Scene buttons.**

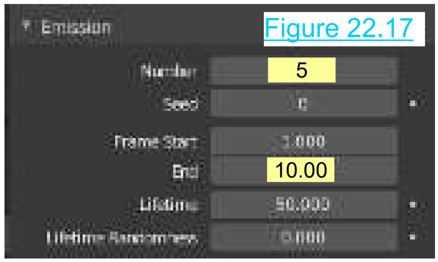


Figure 22.17

In the **Emission Tab** (Figure 22.17) in the Particles buttons for the Plane decrease the Number to 5 (Emit 5 Particles only) and change the End value to 10 (the 5 Particles will be Emitted in 10 Frames). In the Render Tab (Figure 22.18) change **Render As** to Object. Selecting Object introduces an Object Tab. Click where you see **Instance Object** and select **Suzanne** (Monkey).

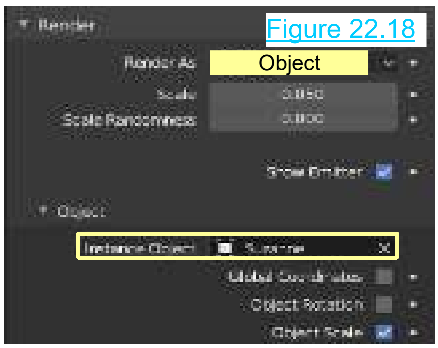


Figure 22.18

Figure 22.19

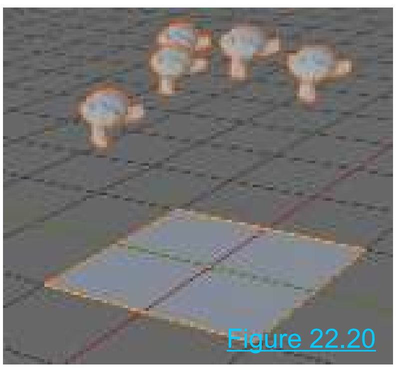


Figure 22.20

Play the animation in the Timeline Editor (you may stop at Frame 50 since the Particles will only display for 50 Frames). Position the Timeline Cursor at Frame 45 then zoom in on the Plane. If you look closely you will see five tiny Monkeys sitting above the Plane. In the **Render Tab** increase the **Scale**.

22.7 Particle Emission Options

The options for Particle Emission have been briefly mentioned when discussing the Source Tab in 22.3 and Emission from Vertices demonstrated in 22.5, Figure 22.15. To clarify the options look at the default Cube Object in the default 3D Viewport Editor. Have the Cube displayed in **Wireframe Display Mode**. Click the button in the Header (upper RH side of Screen) (Figure 22.21).

Wireframe Display

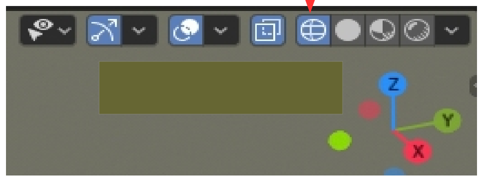
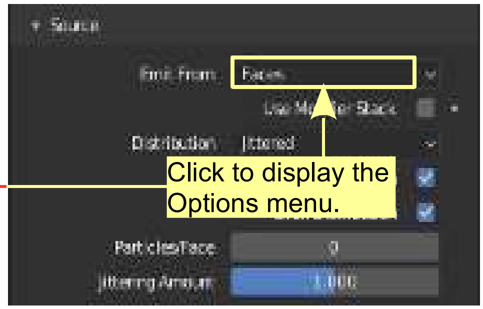


Figure 22.21

The Particle Emission options are accessed in the Properties Editor, Particle buttons, Source Tab (Figure 22.22).



Single Particle at Frame 1

Figure 22.22

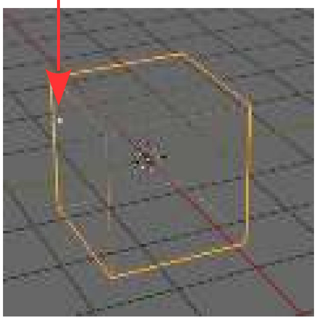
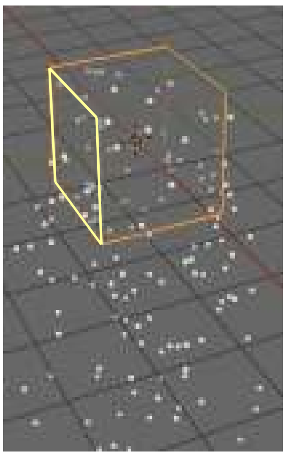


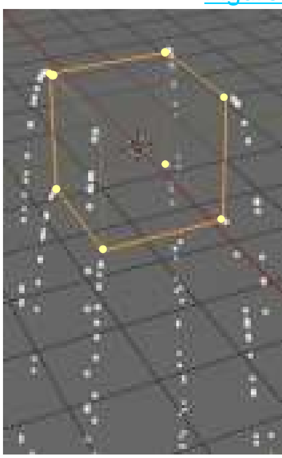
Figure 22.23

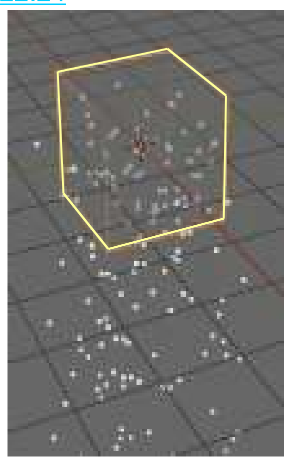
Figure 22.23 shows the default Cube with the default Particle System applied at Frame 1 (One Particle Showing). The default **Emit From** value in the **Source Tab** is: **Faces** (Figure 22.22).

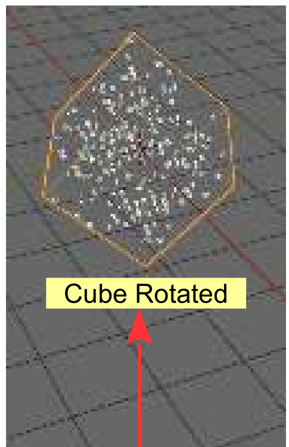
Wireframe Display Mode

Figure 22.24









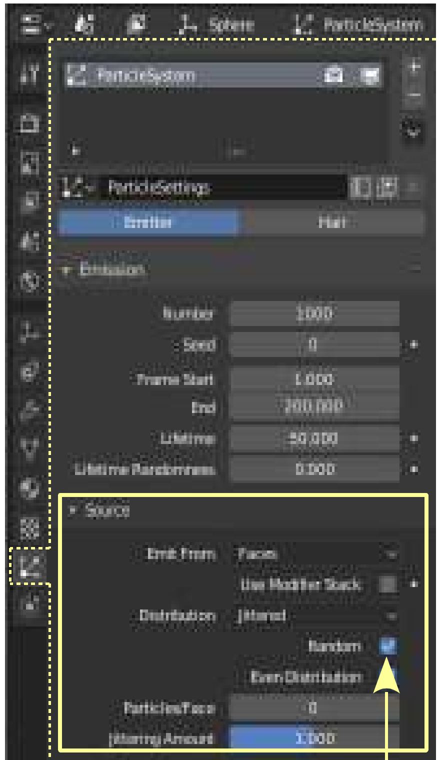
Emit From: **Faces** Emit From: **Verts** Emit From: **Volume**

Figure 22.24 shows particles being Emitted with the different options selected.

Emit From: Volume with Velocity Normal = 0.00 and Gravity turned off. The Particles accumulate inside the Volume of the Cube.

22.8 Order of Emission

Figure 22.25



To demonstrate the Order of Emission options, replace the default Cube in the 3D Viewport Editor with a UV Sphere. The Sphere has significantly greater number of Vertices and Faces from which to Emit Particles.

Disable Gravity in the Scene buttons.

The Order Of Particle Emission is controlled in the Properties Editor, Particle buttons, **Emission Source Tab** (the Source Tab only displays when the Emission Tab is opened).

By default Particles are set to **Emit From: Faces** in a **Random Order** (Distribution).

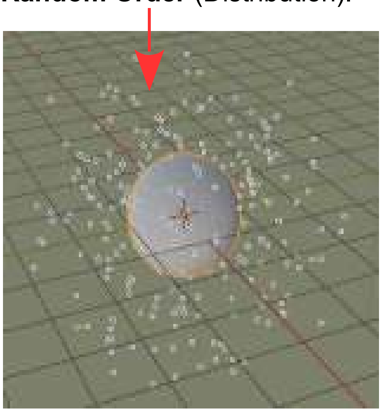
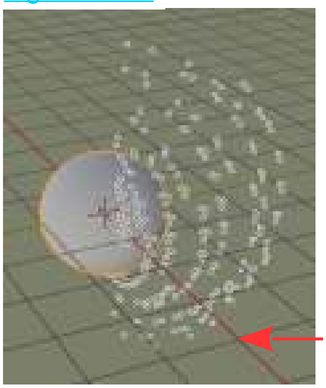


Figure 22.26



In the Source Tab **uncheck Random** and replay the animation.

The 3D Viewport Editor, by default, is in **User Perspective View**, therefore, it is difficult to see what has been achieved by removing the Random tick. Change the view to **Top Orthographic View** (Figure 22.27) then to **Front Orthographic View** (Figure 22.28). With the Timeline Editor Cursor, advanced to Frame 50, you will see an ordered array of Particles.

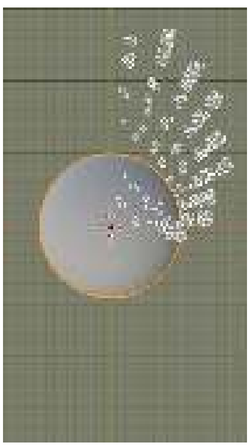


Figure 22.27

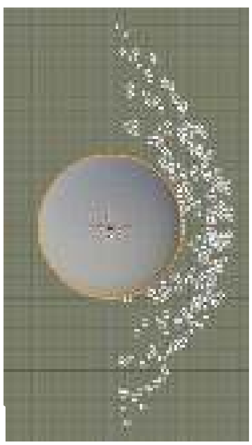


Figure 22.28

Note: In both views the Particles are being Emitted from Faces.

By changing Emit From to **Verts** in the Source Tab (figure 22.29) the array of Particles is even more ordered (Figure 22.30 over).

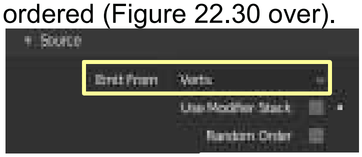
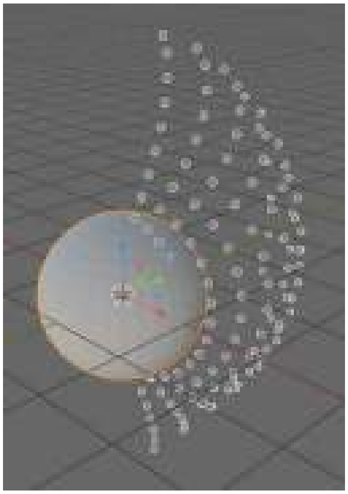
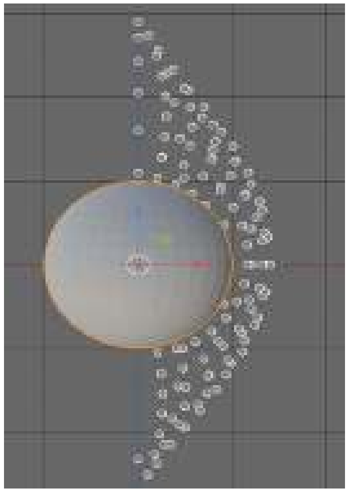


Figure 22.29

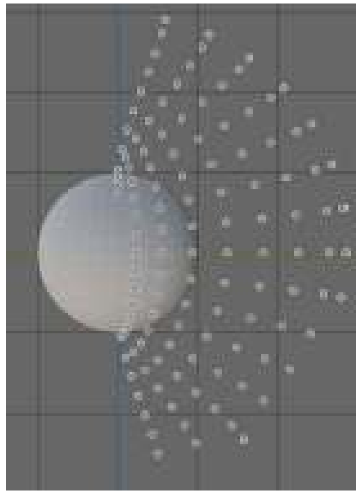
Particles Emitted from Vertices at Frame 50



User Perspective View



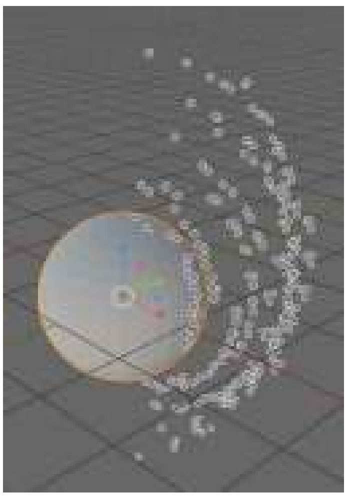
Front Orthographic View



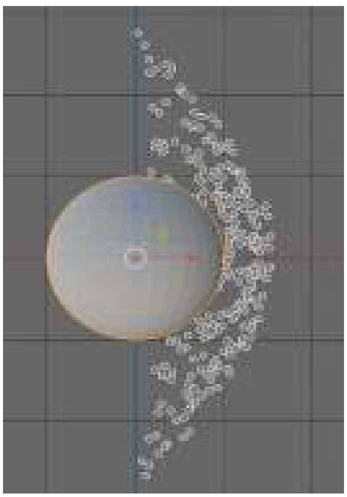
Right Orthographic View

Figure 22.30

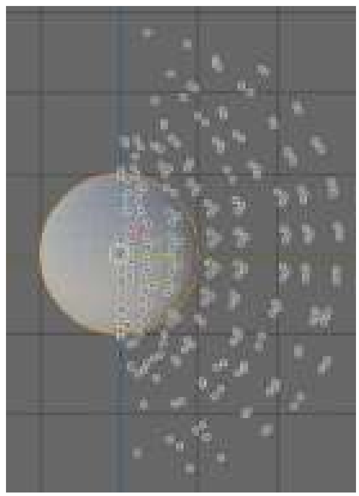
Particles Emitted from Faces at Frame 50



User Perspective View



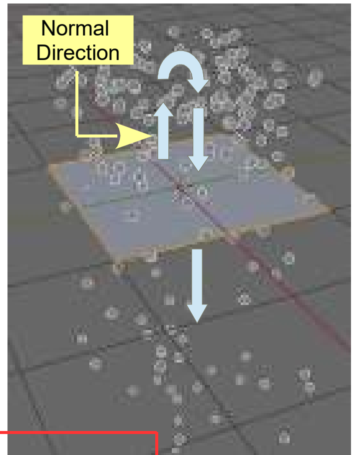
Front Orthographic View



Right Orthographic View

22.9 Normals

Figure 22.31



Particle Effects may be created by using different shaped Objects as Particle Emitters and manipulating **Normal** values in the Particle buttons (see 22.5 The Velocity Tab – Normals). Understanding how to control Normals is a key factor.

Have a Plane Object in the 3D Viewport Editor and apply a Particle System. When the animation is played in the Timeline Editor, Particles are emitted from the Face of the Plane and descend in the Scene due to the Gravitational force. In the **Velocity Tab** increase the Normal value to 5.000 and replay the animation.

You will observe that the Particles rise from the surface of the Plane before descending (Figure 22.31).

Screen Header

The Particles are emitted from the surface, Normal to the Face. In the default Particle System the direction of the Normal is upwards. Rotate the Plane 45° about the X Axis (R Key + X Key + 45).

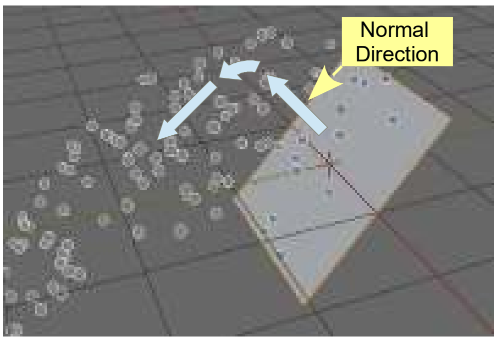
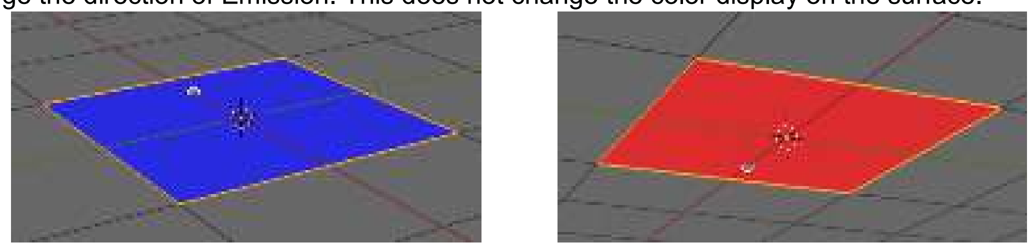


Figure 22.32

With the Plane rotated Particles continue to be emitted Normal to the Face of the Plane (Figure 22.32). The direction of the Normal is relative to the Face.

The direction of Normals may be visualised in two ways

In **Object Mode** click on **Overlays** in the Header and check **Face Orientation**. In the default Scene the upper surface of the Plane displays blue indicating the positive direction for Emission. By rotating the view you will see the underside of the Plane is displayed red (negative) (Figure 22.33). Bear in mind that you can enter positive and negative values in the Velocity Tab which change the direction of Emission. This does not change the color display on the surface.

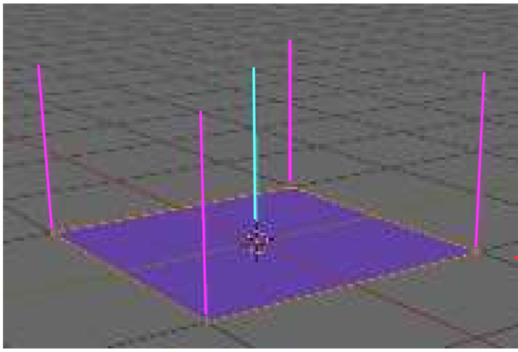


Top Side - Positive Figure 22.33 Bottom Side - Negative

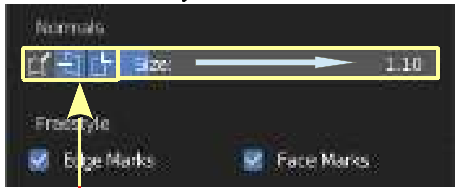
In **Edit Mode Overlays** (at the bottom of the panel) you will find **Normals** (Figure 22.34).

Figure 22.34

3D View Editor – Edit Mode



Overlays Panel

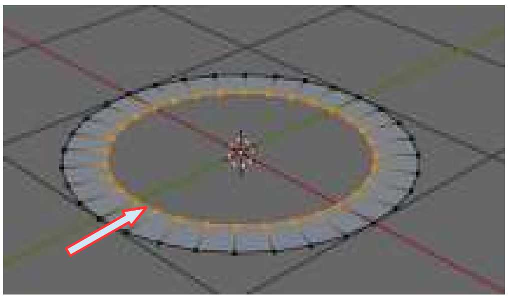


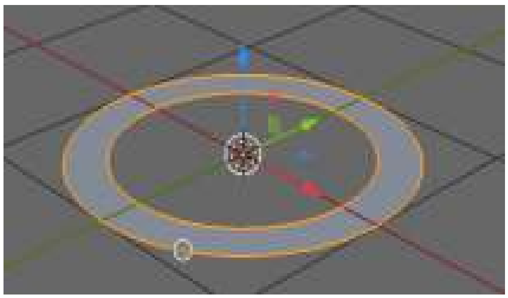
Click to toggle hide and display of Normals in the 3D View Editor. Adjust the Size slider to increase or decrease the Normal display.

Note: Adjusting the Size value does not change the Velocity for emission.

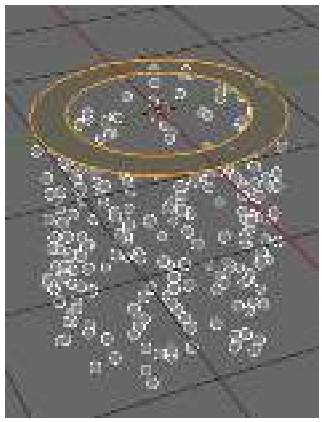
Knowing how Particles will be Emitted from an Object allows you to set up a Particle Display.

As an example, construct a flat disk Object as shown in Figure 22.35 by selecting a Circle Object in Edit Mode. Press the E Key (Extrude – DO NOT Move the Mouse). The Vertices are duplicated. Scale the duplicated Vertices in.





Edit Mode Figure 22.35 Object Mode



Turn off **Gravity** in the **Properties Editor, Scene buttons, Gravity tab**.

With the Disk Object selected in the 3D Viewport Editor, in Object Mode, add a **Particle System** leaving the default values in place. Play the animation in the Timeline Editor.

Particles will be Emitted from the Faces of the Disk and **fall** towards the bottom of the Screen despite Gravity being turned off. (Figure 22.36).

Figure 22.36

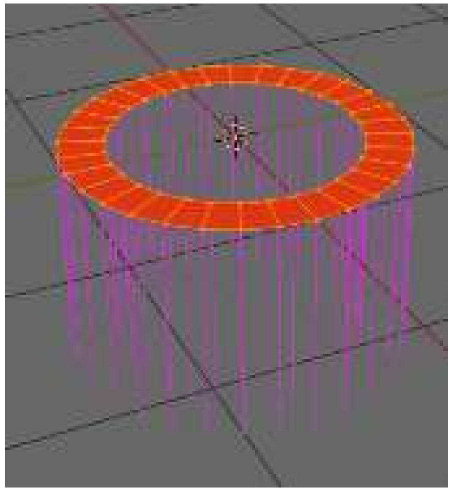
Particles are Emitted with a default starting velocity of **Normal = 1**. The velocity value is seen in the **Particle buttons, Velocity Tab**.

By turning on Normal visualisation as previously described you can see that the Normal direction is down, hence the descent (Figure 22.38).

You may quickly change direction in the Edit Mode Screen Header, Mesh Button by selecting **Normals, Flip** (Figure 22.37).

Figure 22.37

Figure 22.38



An example of creating a Particle Effect is as follows:

With the disk as shown in Figure 22.39, flip the Normals into the upward direction. In Object Mode change the Emit From: Faces to **Verts** in the Source Tab and **uncheck Random Order**. Change the Lifetime value in the Emission Tab to 200.

When the animation is replayed the Particles are Emitted progressively around the disk from the mesh Vertices and rise up forming a spiral configuration (Figure 22.39). The Particles are grouped in short columns.

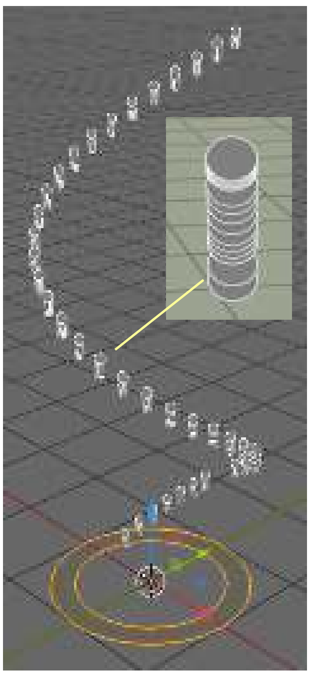


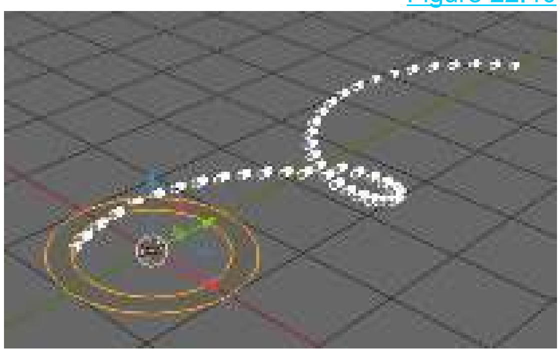
Figure 22.39

In the Velocity tab make the Emitter Geometry, **Normal: 0.000** and the **Emitter Object Y: 1.000**.

When the animation is replayed the Particles spiral on the Y Axis in the Scene (Figure 22.40).

Up to this point Particles have been displayed in the 3D Viewport Editor as little white circles in Object mode.

Figure 22.40



22.10 Particle Modifiers

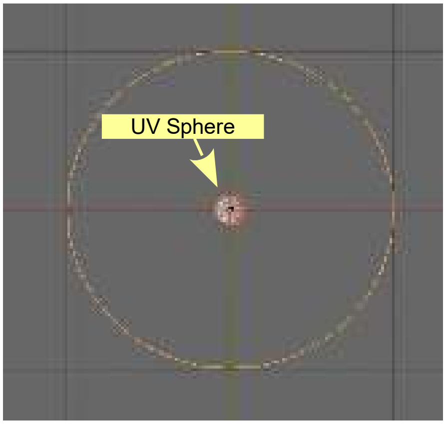
In the Modifier selection menu you will find the **Particle System Modifier** and the **Particle Instance Modifier**. Having gained a little knowledge in respect to the Particle System it is appropriate to mention these two Modifiers.

Particle System Modifier

Adding a **Particle System Modifier** to a selected Object merely adds a default Particle System. This is the same as going to the Particle buttons and clicking the **Plus Sign**. With the Modifier added you manipulate settings to achieve the desired result.

Particle Instance Modifier

Figure 22.41



The **Particle Instance Modifier** allows you to create an array of Objects mimicking the array of Particles which are being Emitted.

To demonstrate, set up a Scene in **Top Orthographic View** containing a Circle Object and a UV Sphere Object (scaled down) positioned as shown in Figure 22.41.

Turn Gravity off.

Have the Circle selected and add a Particle System with values as follows:

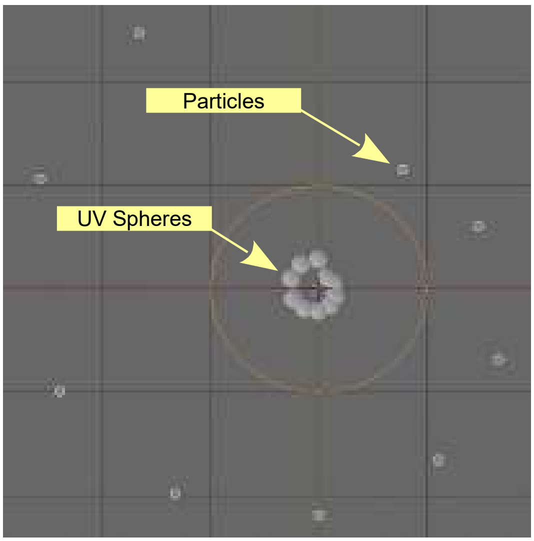
In the Emissions Tab:	Number: 10	
	Lifetime: 200	
In the Source Tab	Emit From: Verts	
	Uncheck Random Order	
In the Velocity tab:	Normal: 0.250	

Do not play the animation at this point.

Deselect the Circle and select the UV sphere.

In the Properties Editor, Modifier buttons, Add a **Particle Instance Modifier** and enter **Circle** as the Object (the Circle being the Object with the Particle System applied).

Figure 22.42



Play the animation in the Timeline window to see an array of Spheres generated in a spiral configuration mimicking the spiral of the Particles (Figure 22.42).

22.11 Particles Array

With the control of Particle Emission and the display of Particles as other Objects you can create arrays for effect when combined with the application of Materials and the addition of lighting (Lamps). The following is an example.

In the default Blender Scene delete the Cube and add a UV Sphere. The default Scene has a single Point Light. Add a second Point Light and a Sun Light and position above and spaced around the UV Sphere.

Add an **Ico Sphere**, set to smooth shading and scale 0.500. **Add a Material Color**. Park the Ico Sphere to one side of the Screen. You may hide the Ico Sphere from view by clicking the eye icon in the Collection in the Outliner Editor.

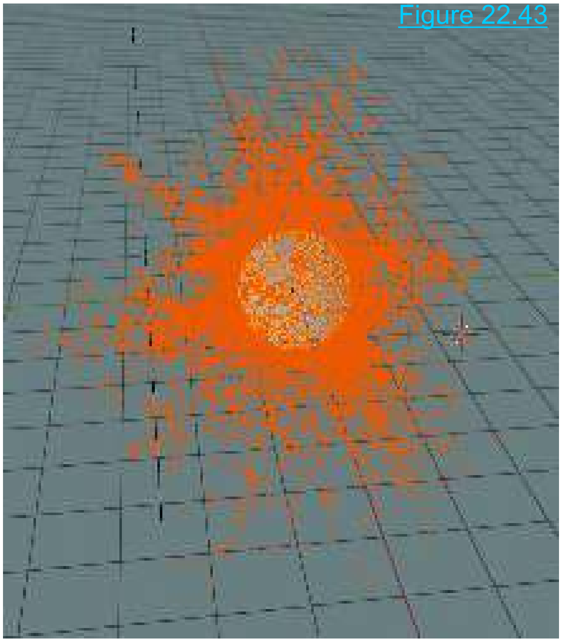


Figure 22.43

Select the UV Sphere (the Emitter Object) and add a Particle System. Increase the Emission Number to 30 000. In the Render Tab, Render as Object with the Ico Sphere as the Instance Object in the Object Tab. Deselect the UV Sphere.

Turn Gravity Off.

Add a Turbulence Force Field to the Scene (Shift + A Key – Force Field – Turbulence - Strength 5m) (set the Strength value in the Properties Editor, Physics buttons, Settings Tab).

Play the animation to see the flow of Objects. Figure 22.43 shows the flow in **Material Preview Viewport Shading Mode** with the 3d Viewport Editor background (Gradient High/Off) color modified).

In the Particle buttons change Lifetime to 999 (forever) and the End value to 100. In the render Tab leave Scale: 0.050 but change Scale Randomness to 0.800.

Move the Timeline editor Cursor to frame 120 and rotate the Viewport to see the scatter of Ico Spheres.

Divide the 3D View Editor in two and have one in Material Preview Viewport Shading Mode and the other as Rendered Viewport Shading (Figure 22.44 over).

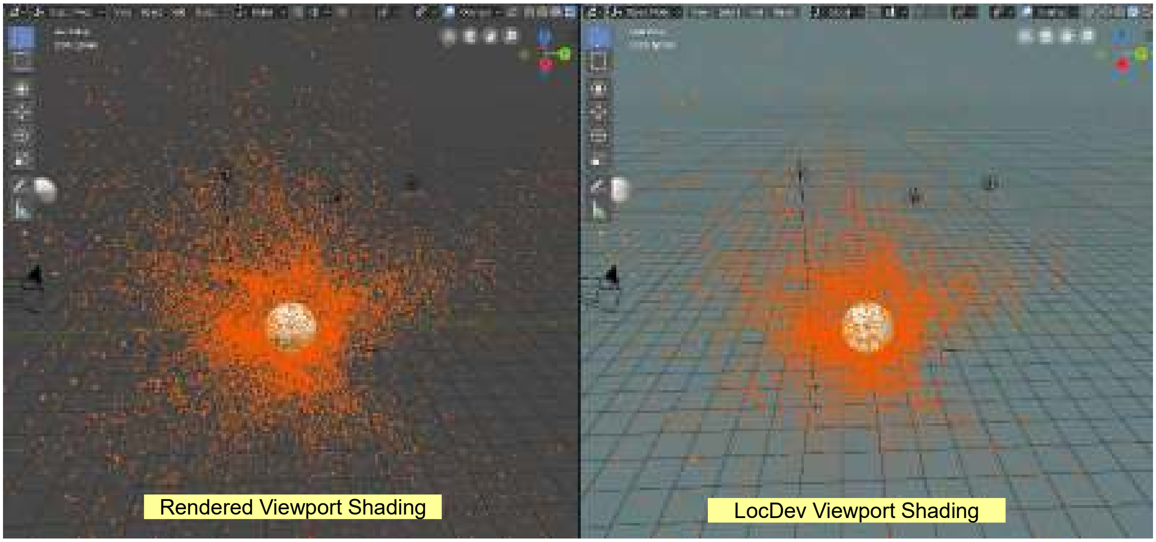


Figure 22.44

Select the UV Sphere and add a Material and set to Smooth Shading.
Select the Ico Sphere and add a Material using the Node Arrangement shown in Figure 23.45.

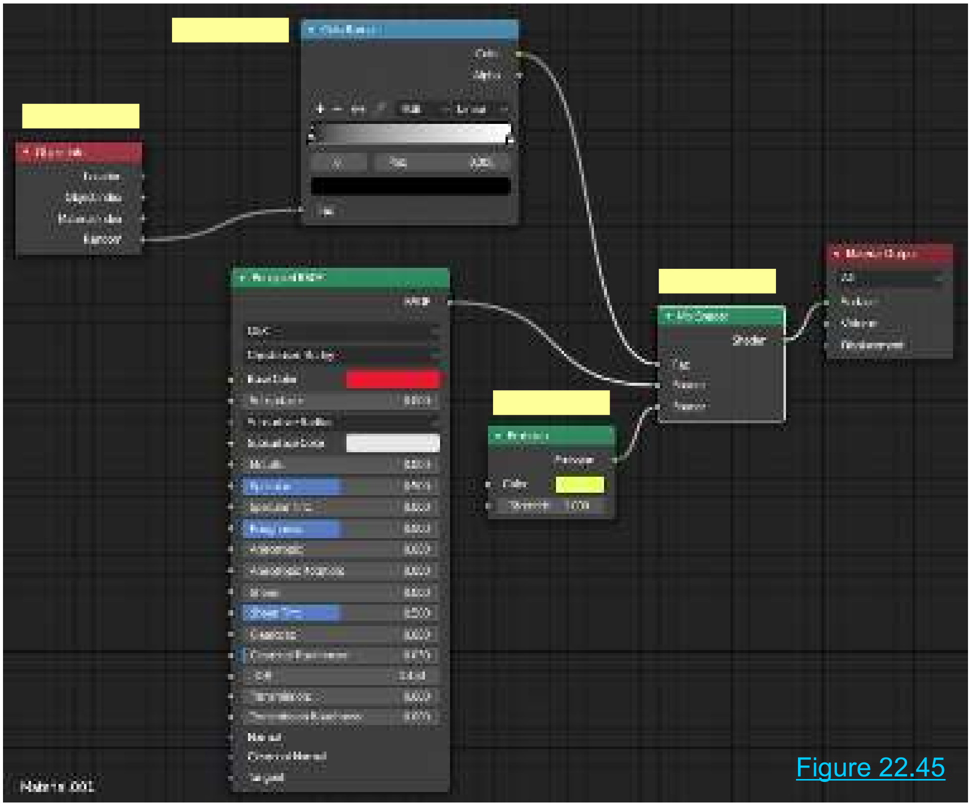


Figure 22.45

Rendered View Figure 22.46

22.12 The Viewport Display Tab

How Particles display is controlled in the **Properties Editor, Particle buttons Viewport Display Tab**.

When multiple Particle Systems are in play it is advantageous to display Particles from one system differently to another. This is not to be confused with what takes place in a Rendered Image of a Scene. Particles themselves do not Render. In Figure 22.46 above, the Particles are Rendered as the Ico Sphere (the Instance Object). In the 3D Viewport Editor the Particles display as white circles.

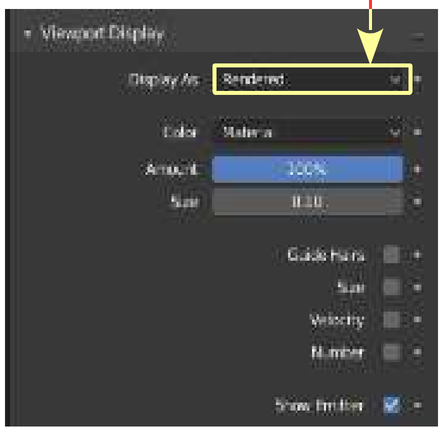
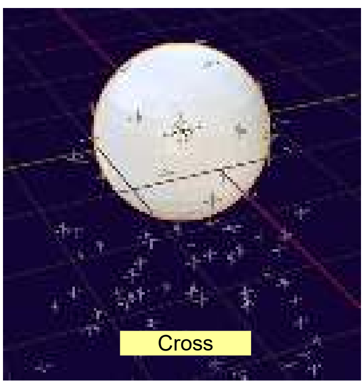
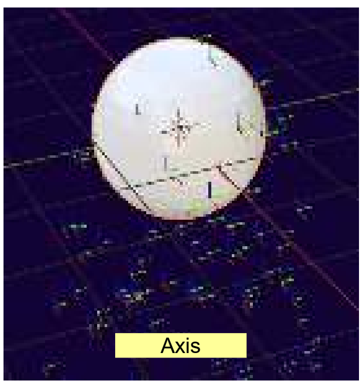
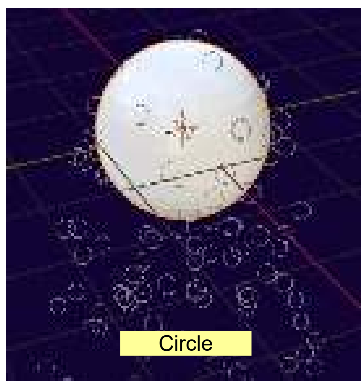


Figure 22.47

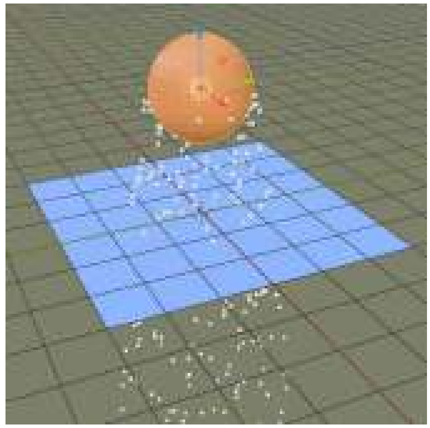






22.13 Particle Interaction

Figure 22.48

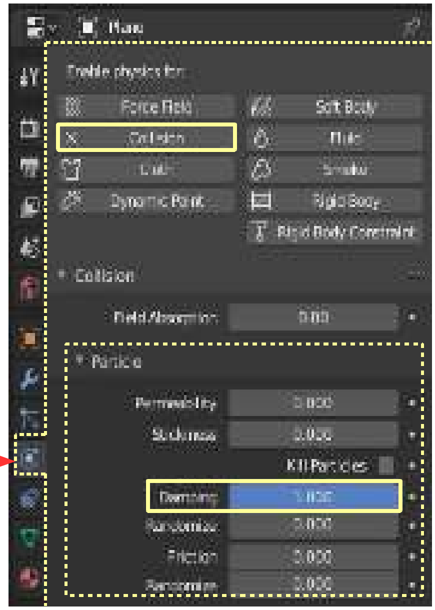


Particles can interact with other Objects and be affected by Forces like wind. Particles can bounce off other Objects and act like sparks or droplets. To show how these features work, set up a Scene with a UV Sphere positioned above a Plane as shown in Figure 22.48 (the Plane is scaled up three times).

With the UV Sphere selected, go to the **Properties Editor, Particle buttons** and add a **Particle System** (to the UV Sphere).

In the **Emission Tab**, set the **End** value to 100 and in the **Velocity Tab**, set the **Object Aligned: Z value** to –3.000 (Emitter Object gives the Particles a starting velocity -3 xdown).

Figure 22.49



Physics Button

In the Timeline Editor press the Play button . You will see the Particles fall and pass through the Plane (Figure 22.48).

To stop the Particles passing through the Plane, select the **Plane** and go to the **Properties Editor, Physics buttons** (Figure 22.49). Select **Collision** and replay the animation (**remember** you must be at frame 1 before you replay).

Figure 22.50

The Particles bounce up from the surface of the Plane (Figure 22.51).

By increasing the **Particle Damping: Factor** value in the **Particles Tab** to 1.000 (Figure 22.50), the Particles will land on the Plane but they will no longer bounce; they will just slide on the surface (Figure 22.52).

Figure 22.51

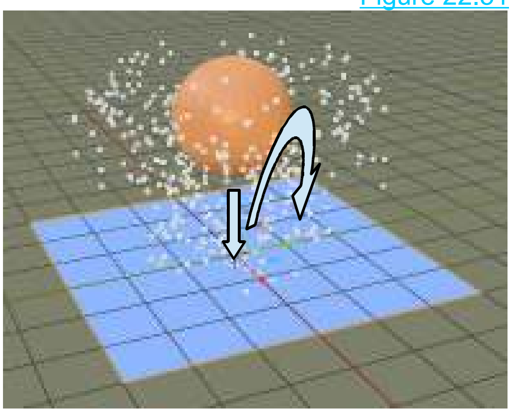
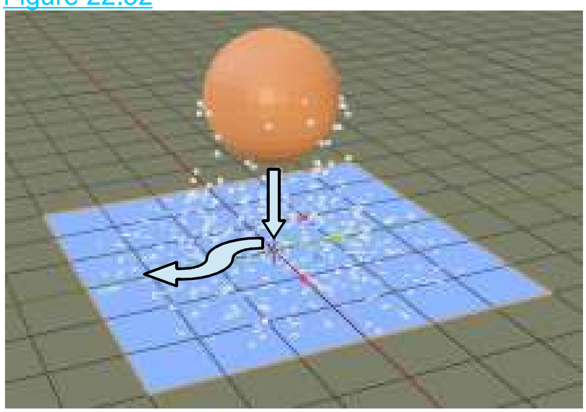
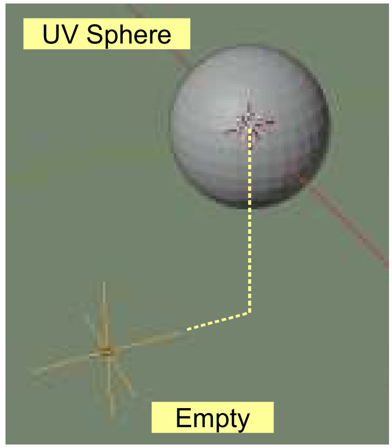


Figure 22.52



22.14 Wind Force Effect

Figure 22.53

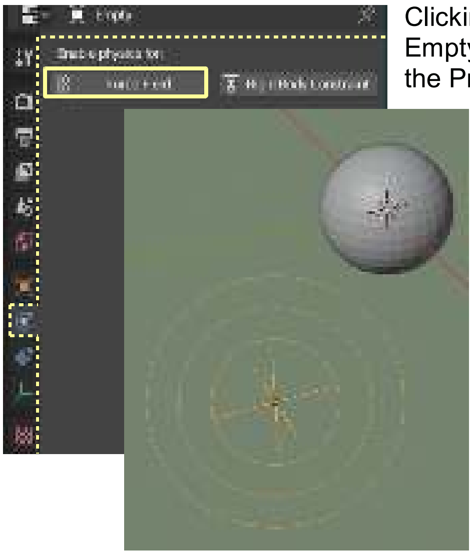


Particles can be influenced by a simulated **Wind Force**. To create a wind effect, you have to place an Object in the scene and assign a wind Force to it. The **Empty** Object is ideal for this since it doesn't render.

Set up a Scene with an Empty Object located below a UV Sphere and off to the side (Figure 22.53). Add the default Particle System to the UV Sphere. The UV Sphere will emit Particles that will fall downwards since the Gravity box is ticked in the Scene tab.

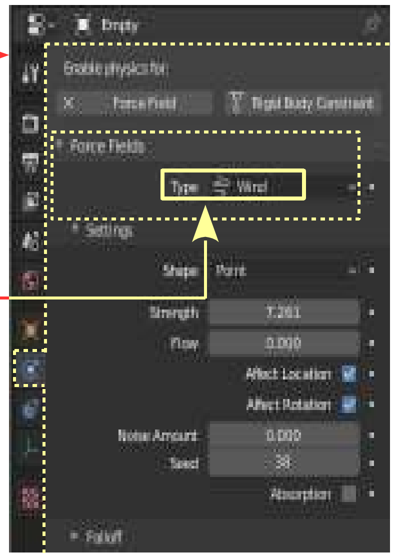
With the **Empty** selected in the 3D Viewport Editor, go to the **Properties Editor, Physics buttons** and click on the **Force Fields button** (Figure 22.54).

Figure 22.54

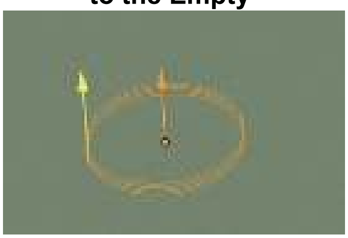


Force Type: Point applied to the Empty

Clicking the **Force Field** button applies a Force Field to the Empty Object and displays the controls for the Force Field in the Properties Editor.



In the **Force Field Tab** click on **Type** and select **Wind** in the menu that displays.



With the default **Force Type: Point** applied there is no effect on the Particles whit emit from the UV Sphere when an animation is played.

Force Type: Wind applied

Note: With the **Force Type: Wind** the 3D Viewport Editor shows a series of concentric rings. The orange arrow indicates the direction of the Force and the Yellow arrow is a control handle for adjusting the strength of the Force. Strength may also be adjusted in the Properties Editor.

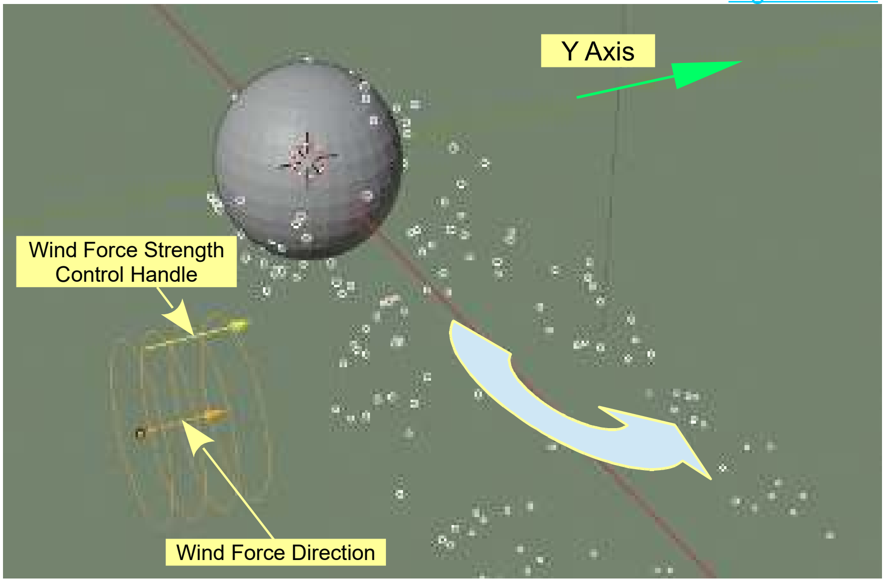
The objective in this demonstration is to have the Wind Force blow Particles descending from the UV Sphere to the right along the Y Axis of the Scene.

With the Empty selected press the R Key (rotate) + X Key + minus 90 (rotate minus 90°about the X Axis).

Increase the Strength value to approximately 7.26.

With the Empty positioned as shown in Figure 22.55, Particles being emitted and descending due to the force of Gravity will be directed in the positive Y Axis direction.

Figure 22.55



Note: The Wind Force Strength is indicated by the seperation of the orange rings.

The position of the Empty Object in the Scene, in this demonstration, has been to provide a visual perception of wind blowing the Particles. In fact the position of the Empty with the Wind Force is irrelevant. The Wind Force is applied over the entire Scene.

22.15 Boids Particles

Boids Particle Systems are used to simulate flocks, swarms, herds and schools of various kinds of animals or anything that acts with similar behaviour. **Boids** Particle Systems are of **Type: Emitter** with **Boids Physics** applied.

Boids Particles in one Particle System can react to Particles in another system or they can react to Particles within their own system.

Boids are given **rules of behaviour**, which are listed in a Stack. The rules at the top of the Stack take precedence over rules lower down, but the Stack is able to be rearranged once it is written.

Since only a certain amount of information is evaluated, if the memory capacity is exceeded, rules lower down the Stack are ignored.

The procedure for setting up **Boids Particle Systems** will be demonstrated with the following examples.

Example 1: A Flock of Birds

Since you are working with the basics, the Particles will act like a flock of birds but won't actually look like birds.

Open a new Blender Scene with the default Cube. The Cube will be the **Particle Emitter**. In the **Properties Editor, Particles buttons**, add a new Particle System. Leave all the button settings with their default values, except for the following:

- **Emission Tab**
  - Number: 300 (Have a small flock.)
  - Lifetime: 250 (The default animation length in the timeline.)
- **Physics Tab**
  - Select Physics Type:**Boids**.
- **Boid Brain Tab** (in the Physics Tab)

  With **Separate** highlighted, hit the **minus** sign to delete it. Click on the **plus** sign at the RH side of the window to display a selection menu for **Boids rules** and select **Follow Leader**. Click on the up arrow below the minus sign to move Follow Leader to the top of the Stack.

You have instructed the Particles to follow the leader while flocking together. You will now give the Particles a leader to follow.

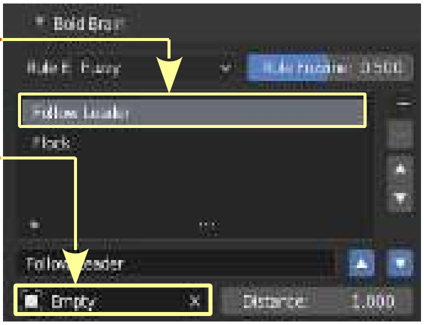
Deselect the Cube in the 3D Viewport and add an **Empty Object.**

The Empty is a location point that can be animated to move in the Scene but does not render.

Select the Empty and move it to the side. Deselect the Empty and select the Cube.

In the **Boid Brain Tab** , make sure **Follow Leader** is highlighted.

Below the stack panel Click in the panel and select **Empty** from the menu that displays.



You have instructed the Particles to follow the Empty.

Animate the Empty to move across the Screen (see Chapter 18 for a refresher on Animation. Say 12 grid spaces in 250 Frames-gives PS time to catch up).

When the animation is played Particles Emitted from the Cube, head towards the Empty, and attempt to follow it as it moves across the Screen (Figure 22.56).

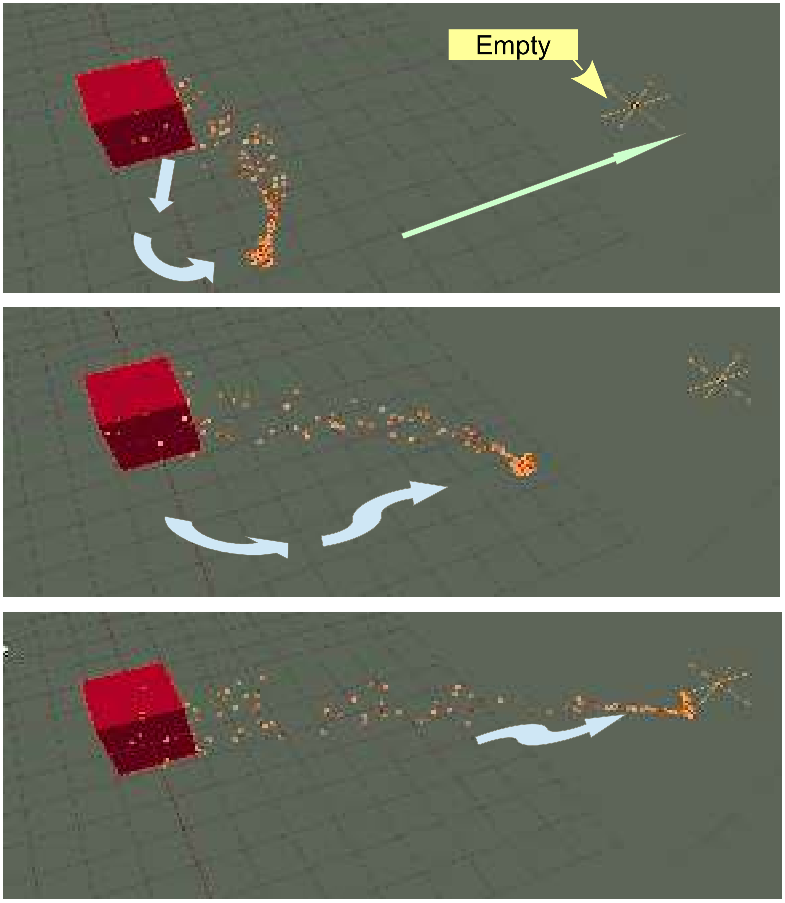


Figure 22.56

Note: With a high Particle amount, Blender may crash due to overload when calculating data. This depends on the capability of your computer.

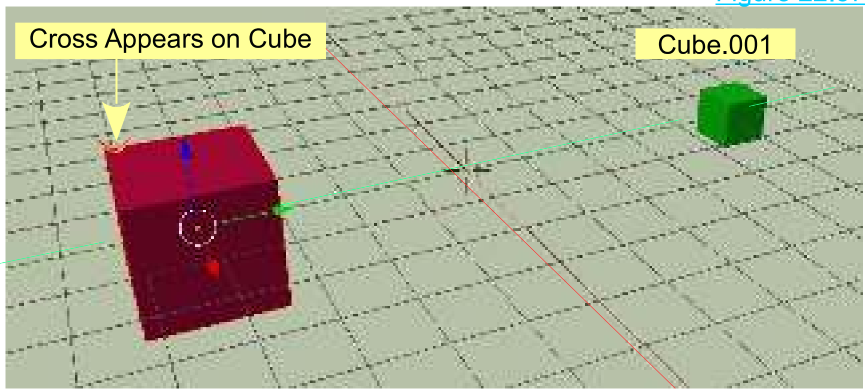
Example 2: Directing Movement

This example will demonstrate how to direct Particles to move from one object to another.

Start a new Scene and add a second Cube Object. Note that the default Cube is named **Cube** (see the upper left side of the 3D Viewport Editor) and the new Cube is named **Cube.001**.

Position the Cubes as shown in Figure 22.57, and scaling the new Cube down.

Figure 22.57



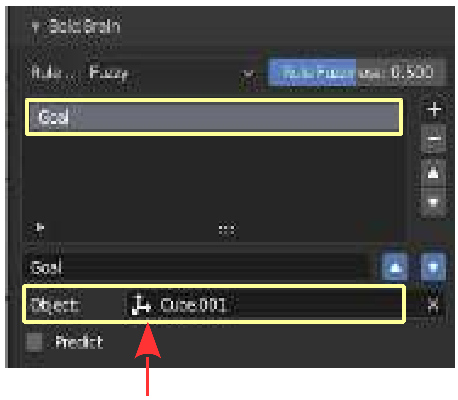
Select the original Cube and add a Particle System with **Boids Physics**. In the **Emission Tab**, reduce the **Number** value to **10** and set the **Lifetime** value to **1500**; you want to keep the number of Particles low and have them visible for a fair amount of time in the animation.

Go to the **Timeline Editor** and set the animation **End** value to 1500 frames.

In this example a Particle will be displayed as a cross.

In the **Particles button, Viewport Display Tab**, set **Display As: Cross** and set the **Size** value to **0.1m** ; you will see a cross appear on the Cube (Figure 22.58).

Figure 22.58



In the **Boid Brain Tab**, remove **Separate** and **Flock** and add **Goal** (Figure 22.620).

Click in the **Object Panel** below the Rule Panel and select **Cube.001 -** this tells the Particles Emitted from the original cube to go and find the target which is Cube.001.

Play the animation to see the result. Crosses emitted from **Cube** migrate across the Screen and accumulate on the target Cube.001(Figure 22.59).

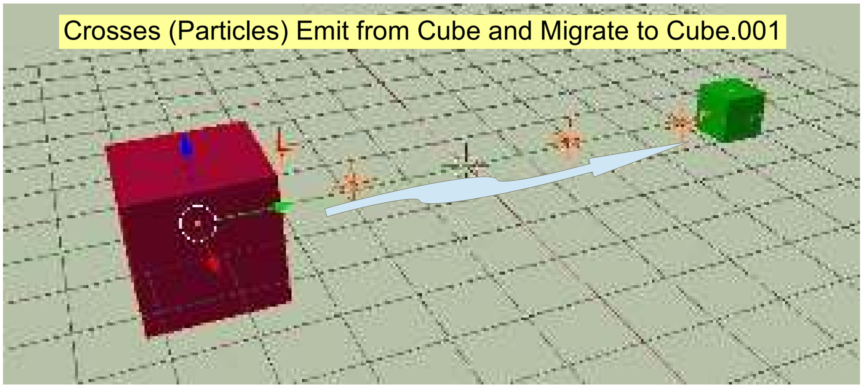
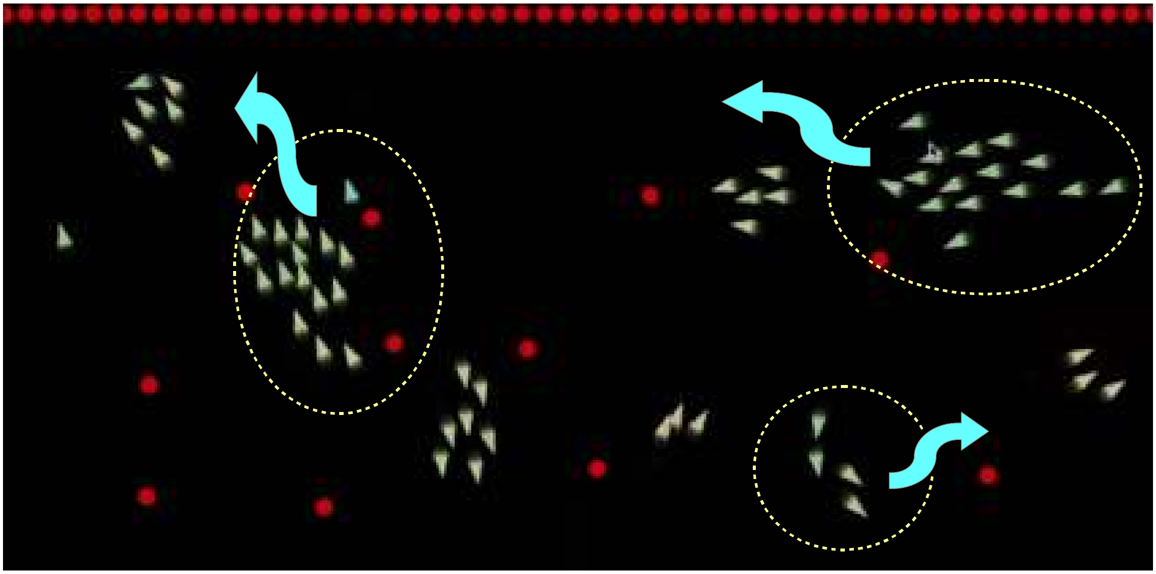


Figure 22.59

Remember that the location of either or both of the Cubes in the Scene may be animated at the same time. Animating the target Cube can cause the Particles confusion. They may head over to where the target Cube was originally located , have a think, then chase the target. Some Particles may take off in a completely different direction but in letting the animation play on they will eventually find out they have made a mistake and discover where they should be going.

Boids Example - Swarming



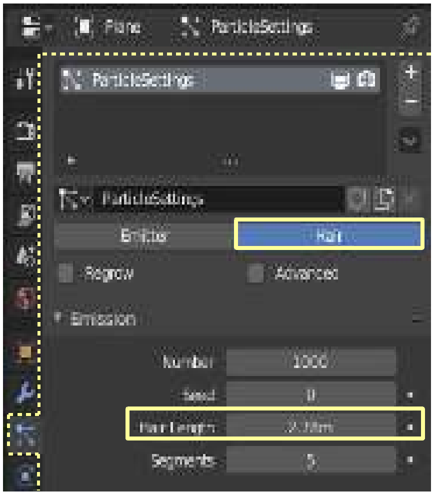
Boids Particles forming Swarms

22.16 Hair Particles

Type: Hair Particles are rendered as strands and may be edited in the 3D Viewport Editor. Hair Particles may be used to represent such things as grass, fur, hair, or anything that has a surface with fibrous strands.

In the 3D Viewport Editor, delete the default Cube object, add a Plane, and zoom in.

Figure 22.60

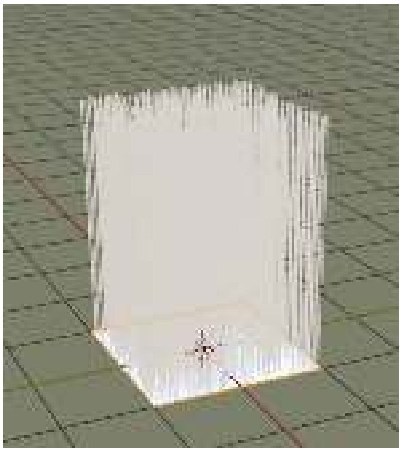


With the Plane selected, go to the **Properties Editor, Particles buttons** and add a **Particle System.**

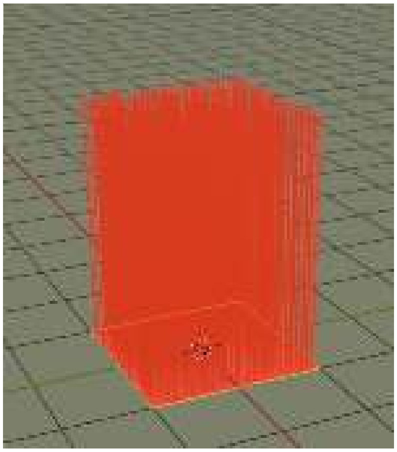
In the top panel of the Particles Editor select **Hair** (Figure 22.60).

The Plane in the 3D Viewport Editor will show long strands sticking up from the surface. The **Hair Length** value in the **Emission Tab** allow you to adjust the length of the strands. (Figure 22.60).

Figure 22.61



Hair Particles Emitted From Plane
Default Material



Hair Particles Emitted From Plane
Material Added
Material Preview Viewport Shading

Adding Hair to a Character

Start a new Blender Scene, delete the Cube, and add a **Monkey Object**. Give Suzanne a head of hair and a beard.

Adding Hair

If you add a **Hair Particle System** to **Suzanne** you will get a hairy-headed Monkey with hair sticking out in every direction (Figure 22.62).

Figure 22.62

Try for a more clean-cut look. **Remove the Particle System** by clicking the minus button.

Properties Editor, Particle buttons

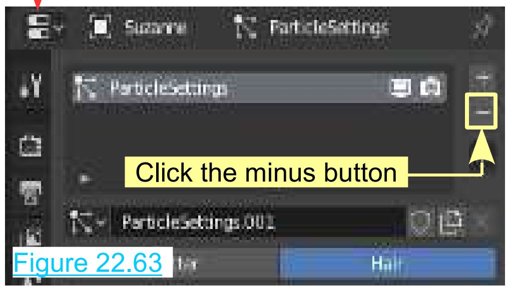


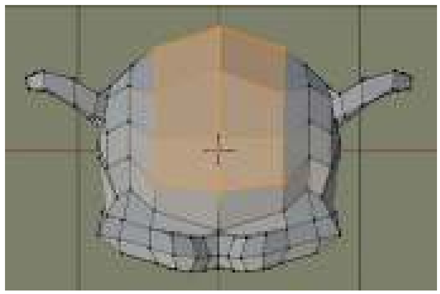
Figure 22.63

You designate specifically where the hair is to grow by selecting a **Vertex Group** (Chapter 05 – 5.9 Creating Vertex Groups)**.**

Create a Vertex Group on the top of Suzanne's head.

Name the Vertex Group **Hair.**

Figure 22.64



At this point you have nominated an area on the head by selecting a group of Vertices. **You do not have hair.** Go to the **Particles buttons** and add a new **Particle System**. Change **Type: Emitter** to **Type: Hair.** Nothing happens because you are in **Edit mode**.

Note: Blender has named the new Particle System simply, **Particle Settings** as before.

Tab to **Object Mode** in the 3D Viewport Editor and you will see plenty of hair. In fact, there is hair everywhere.

To correct this look, in the **Hair Length box** in the **Emission Tab,** decrease the value until the hair strands look reasonable; say, about 0.820.

Still in the Particles buttons, go down to the **Vertex Groups Tab** and in the panel next to **Density** click and select **Hair** from the menu that displays (Figure 22.65).

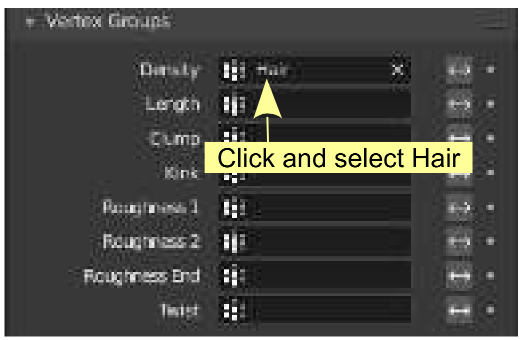
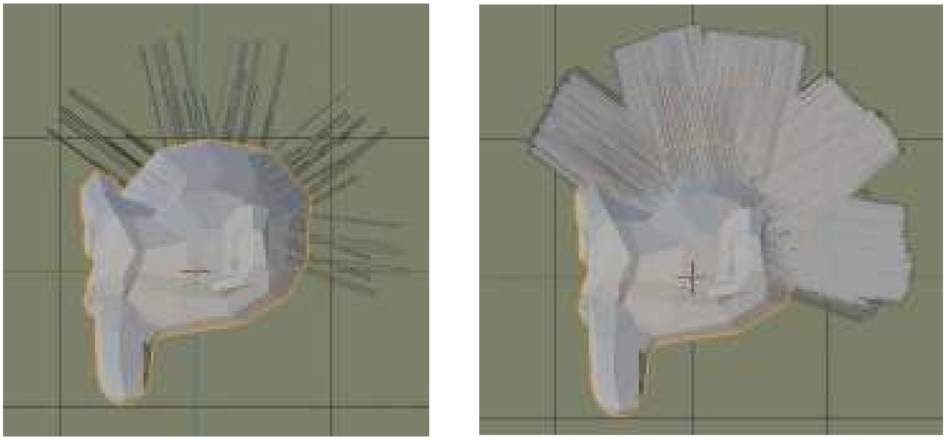


Figure 22.65

You will have hair only on the area selected. Press Num Pad 3 to get a side view (Figure 18.74). To fix the scrawny look, go to the **Children tab** and click on **Simple** to get a bushy, Mohawk (Figure 22.66).

Figure 22.66



Adding a Beard

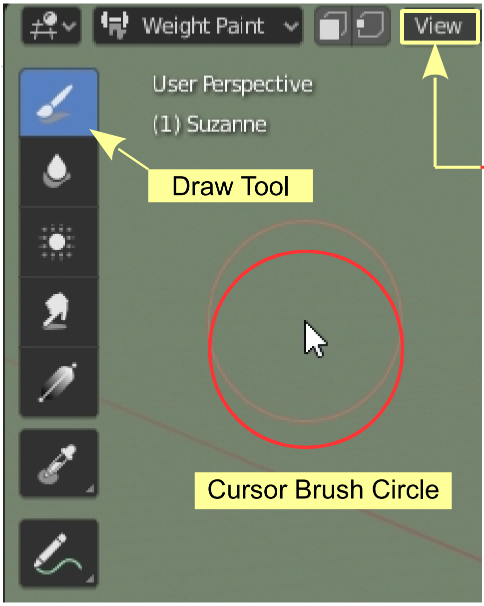
Continue on and add a beard. To make the process interesting , vary the procedure just a little. You previously created a Vertex Group, named it, then assigned selected Vertices to the Group.

With **Suzanne** selected in **Object Mode** in the 3D Viewport Editor, go to **Properties Editor, Object Data buttons** and click on the plus sign in the **Vertex Groups Tab** to add a new Vertex Group. Blender names the new group, **Group**. Rename this to **Beard** as you did before for the hair. You now select the Vertices to assign to the new group. You could use the procedures as outlined previously, but do it a different way.

Figure 22.67

Tab into **Edit Mode** and **deselect** all the Vertices. In the 3D Viewport Editor Header, change to **Weight Paint Mode**. Suzanne turns blue in the 3D Viewport Editor, which indicates that no Vertices are selected (Figure 22.67).

Note that **Beard** is high-lighted in the **Vertex Groups Tab**. Click on **Hair**. If you select (highlight) the Hair Vertex Group and look closely amongst all that hair (it may help to rotate the view), you will see a red scalp; this is showing the area that was previously selected. Tab to Edit Mode and click on **Select** in the **Vertex Groups Tab** and you'll see the vertices that were painted for Hair. Press the **Alt + A Key** in the 3D Viewport Editor to **deselect**, and click on Vertex Group **Beard** again in the **Object Data buttons, Vertex Groups Tab**. Select **Weight Paint Mode** in the 3D Viewport Editor and look at the **Tools Panel** at the left hand side of the screen (Figure 22.68).



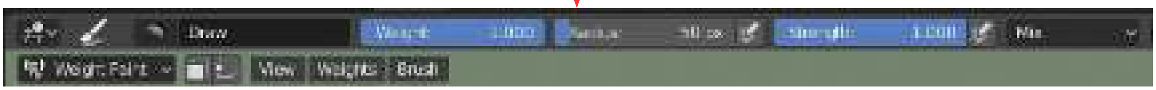
By default the **Draw Tool** is selected and the Cursor is a circle.

At this point controls for the **Brush** (Circle) may be hidden. Click on **View** in the Header and check **Tool Settings**.

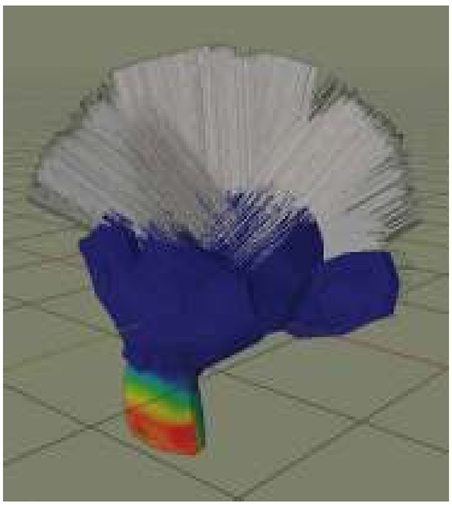
Controls for the Brush display in a new Header. **Note; The Weight** value in the Header is 1.000. In the 3D Viewport Editor, click LMB, hold and drag the Cursor (circle) over Suzanne's chin. You will see the color change as you drag.

Figure 22.68

Header Brush Controls



Keep dragging until the chin is all red (rotate the 3D Viewport Editor as you paint). The red chin means that you have selected this area as the new Vertex Group for the beard (Figure 22.68).



Tab to **Edit mode**, making sure all Vertices are **deselected**, then in the **Vertex Groups tab,** with **Beard** highlighted (selected), click on **Select** (Beard Vertices Display) then click **Assign** to assign the painted Vertices to the beard Vertex Group. Click **Select** to see them.

With the painted Vertices selected (you are in Edit Mode) go to the **Particles buttons** and add a second **Particle System** (click on the plus sign next to where you see **ParticleSettings** highlighted).

Note that Blender names this new system **Particle Settings.001**.

Select **Type: Hair**, decrease the **Hair Length value** in the **Emission Tab** to 0.290, and go down to the **Vertex Groups Tab**, click in the **Density box**, and select **Beard**.

In the **Render Tab** check that **Path** is in the **Render As** panel. **Tab** to **Weigh Paint** Mode in the 3D Viewport Editor.

You have scrawny hair on the Suzanne's chin. Go to the **Children tab** and click **Simple** for a hairy Beard (Figure 22.69).

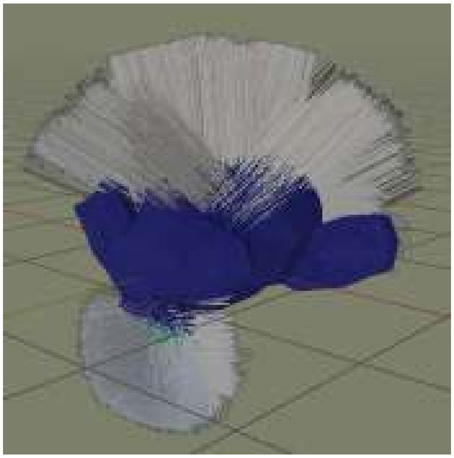


Figure 22.69

It doesn't matter in which order you do it, the procedure is the same: select Vertices to define the area, create a Vertex Group, assign Vertices to the Vertex Group, create a Hair Particle System and assign it to the Vertex Group.

> **Note:** If you elect to select Vertices, assign them to a Vertex Group then add a Hair Particle System you may find the Hair displaying as dots instead of strands. **In the Render tab click on Path**.

In Object Mode in the 3D Viewport Editor you have a gray Monkey with a grey beard and hair (Figure 22.70). This is fine, but it isn't all that exciting in a render. Jazz it up by adding different **Materials** to Suzanne's surface and to the two Vertex Groups (Chapter 5 – 5.9).

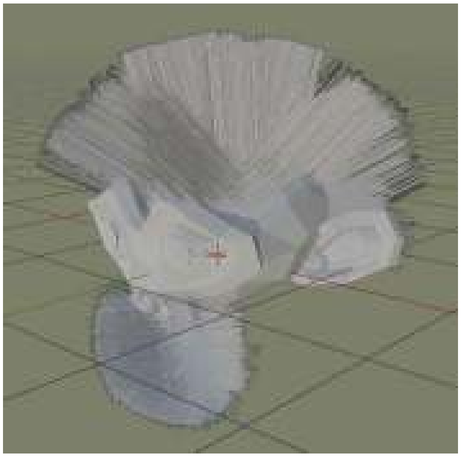


Figure 22.70

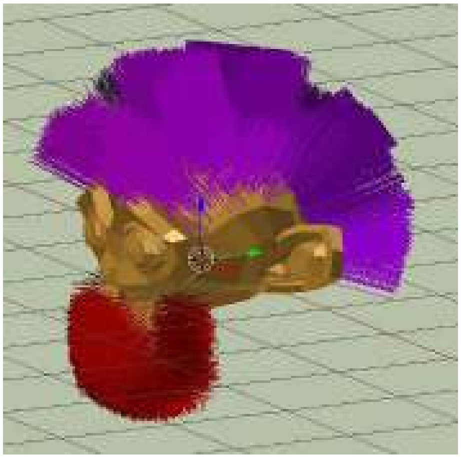


Figure 22.71

Final Note

Adding hair to an Object can add an awful lot of Vertices, which when rendering can take an awful lot of time and may even cause your computer to stall out. If you are not doing anything serious and have a slow machine to start with, keep the number of strands low.

22.17 Particles for Arrays

Particles emitted from an animated Object may be used to create interesting Arrays.

To continue with the information obtained in the preceding examples have a Plane Object in the Scene as the Emitter Object with an IcoSphere as the rendered Object.

When you add the IcoSphere the **Add Ico Sphere panel** displays in the lower LH corner of the Screen. You will see Subdivisions: 2 as the default setting. Reduce this to Subdivisions: 1. This reduces the Vertex count on the surface of the Ico Sphere. This is not necessary here but is good practice when creating simulation where it's advisable to use a minimum number of Vertices.

Park the IcoSphere off to the side of the Screen or you may place it in a separate Collection to hide it from view. Give the Ico Sphere a nice bright Material. Have the 3D Viewport Editor in **Material Preview Viewport Shading Mode**.

Animate the Plane to Rotate (See Chapter 18 – 18.14 Rotation)

Select the Plane. Follow these cook-book instructions.

With the Timeline Editor Cursor at Frame 1, turn **ON** Auto Keyframing. Press R Key + Z Key + 1 + R Key + Z Key Minus 1 + Enter (a Keyframe is entered at frame 1).

Note: The Properties Editor, Transform Tab inexplicably shows Rotation X = -11. Delete and enter 0.000.

With the Timeline Cursor at frame 30, press R Key + Z Key + 90 + Enter. Repeat for Frames 60, 90 and 120.

In the Graph Editor press Shift + E Key and select Linear Extrapolation.

Turn OFF Auto Keyframing.

Playing the animation will show the Plane continually rotating about the Z Axis.

Figure 22.72

Add a Particle System

Add a Particle System to the Plane with Particles being Emit from **Verticies** and rendering as the Ico Sphere Object. Play with the Scale and Randomness settings. Increase the **Lifetime to 250** and in the **Source Tab** uncheck **Random Order.**

Playing the simulation (animation) in the Timeline Editor show Particles displayed as Ico Spheres being emitted and rising in spirals as the Plane rotates (Figure 22.72).

This is a relatively simple exercise demonstrating how an effect is created by combining the different Particle settings. There are no hard and fast rules which have to be obeyed. The way to create something is to experiment and when you produce a worthwhile result, save the file and record results for future use. The following example incorporates more combinations.

22.18 More Arrays

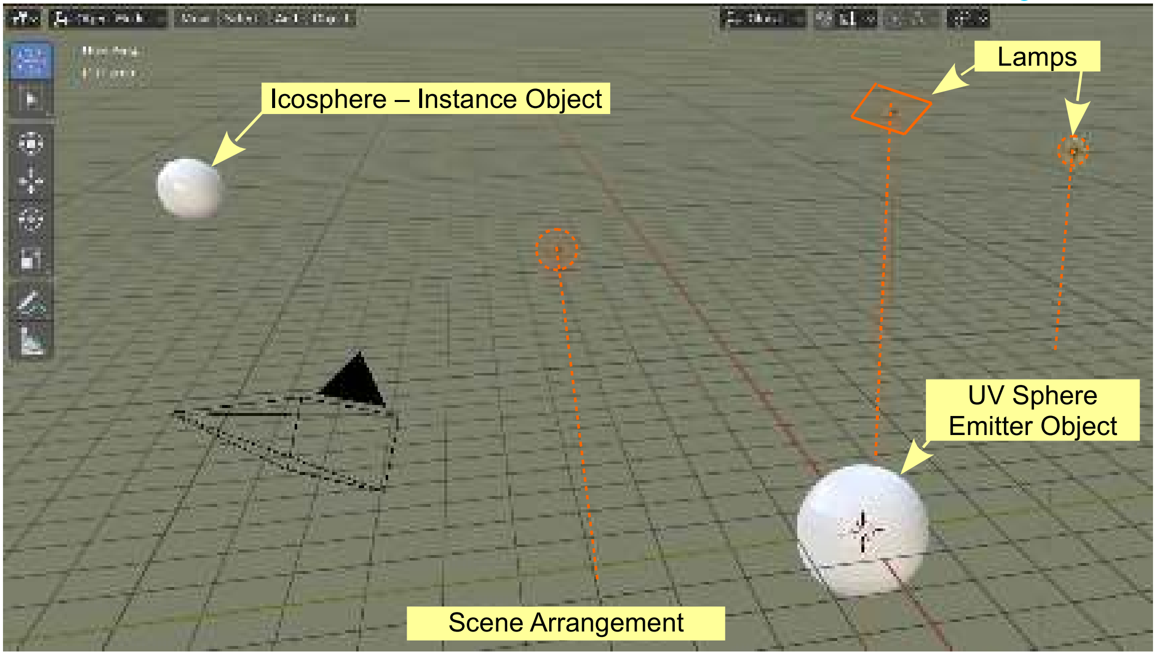
Particle Arrays are only limited by your imagination and your knowledge of what tools to use and where the tools are located. This example will help you on your way.

In the default Blender Scene replace the default Cube with a **UV Sphere** as a **Particle Emitter** and add an **Ico Sphere** to be used as a rendered Object (Instance Object).

Give the Ico Sphere Smooth Shading and park it to one side of the Scene. Scale down to approximately 0.250. The Ico Sphere will be what is termed the **Instance Object**. When Particles are generated by the UV Sphere they will display as this Object.

Add Lamps to improve illumination in the Scene.

Figure 22.73



The objective in the exercise is to create an array of small Objects that could represent a swarm of insects hovering around the UV Sphere or a cloud of stars in a far off galaxy. This is where your imagination comes into play. For realism you would create a small model of what the Objects in the Array were to be but for simplicity, the Ico Sphere will be used.

Turn off **Gravity** in Scene buttons to make the Particles disperse in 3D Space.

Select the UV Sphere and add a Particle System.

Playing an animation in the Timeline Editor at this point with the default Particle System would see particles being emitted as small circles which float away from the UV Sphere and disappear after 50 Frames from their point of creation (Lifetime 50.000).

To generate something a little more exciting modify the Particle System.

In the Emission Tab

Increase **Number** to 30 000.
Change Lifetime to 999 (i.e. Forever).
Leave Start: 1 and End: 200.000.
Change Lifetime Randomness to 0.800

In the Render Tab

Change Render As from Halo to Object.
Leave Scale at 0.050
Change Scale Randomness to 0.080.

In the Render, Object Tab click where you see **Instance Object** and select **Ico Sphere.**

In the Timeline Editor play the animation then move the Timeline Cursor to Frame 120 and rotate the Viewport.

Figure 22.74 shows the Array generated in Rendered Viewport Shading Mode. The Array is ordered as seen by the Particles radiating out from the UV Sphere as scattered lines. By zooming in on the 3D Viewport Editor you will see that each Particle is an Instance (copy) of the Ico Sphere parked in the Scene.

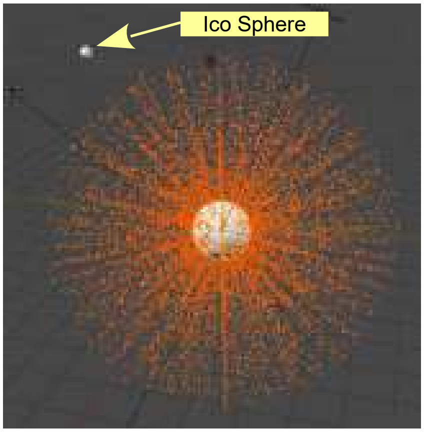


Figure 22.74

From this point you make further modifications to settings to alter the appearance of the Array.

Add a Material to the Ico Sphere. Figure 22.75

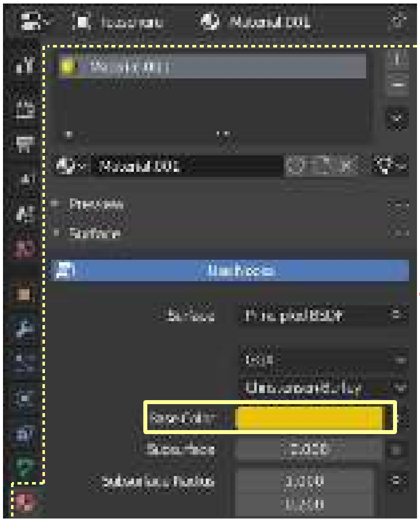
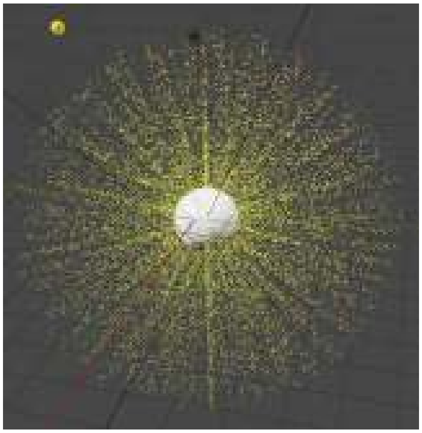


Figure 22.76



To see the Material be in **Material Preview Viewport Display Mode**.

Deselect the UV Sphere and add an **Empty Object** and activate a **Force Field, Type Turbulence**, Strength 5 in Physics buttons (Figure 22.77 over).

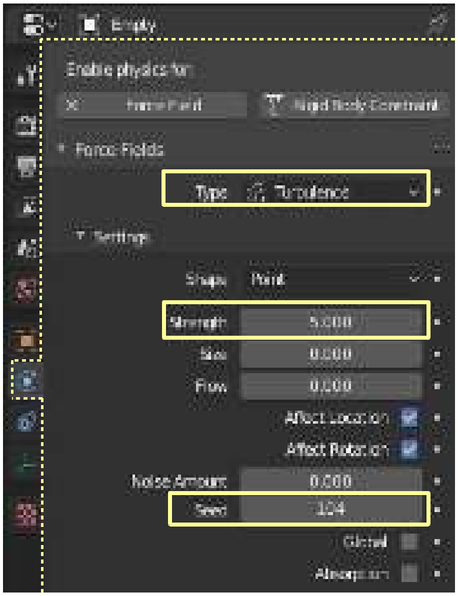
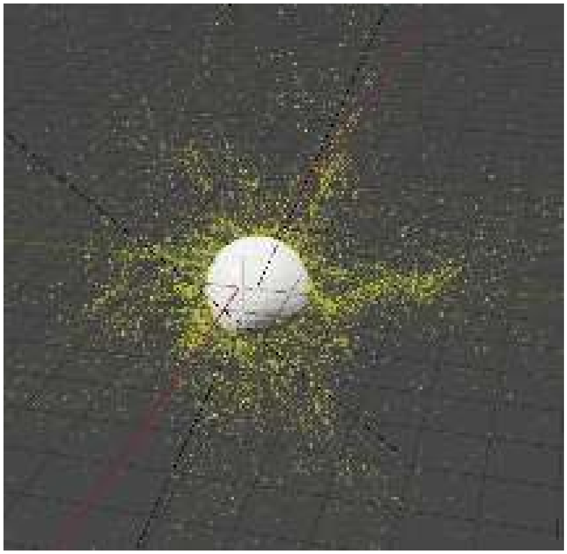


Figure 22.77



Particles Dispersed by Force Field Figure 22.78

Play animation to see flow of Particles.

Figure 22.78 shows a Screen Capture taken while playing the animation at approximately Frame 120

Select the **UV Sphere** and change the **Particle System to Emitter Type: Hair**. With the animation in the Timeline Editor at Frame 1 the UV Sphere displays as a red disk.

In the **Particle System, Render Tab**, change **Render As** to **Path**. In the Children Tab select Simple for a different sort of Array (Figure 22.79).

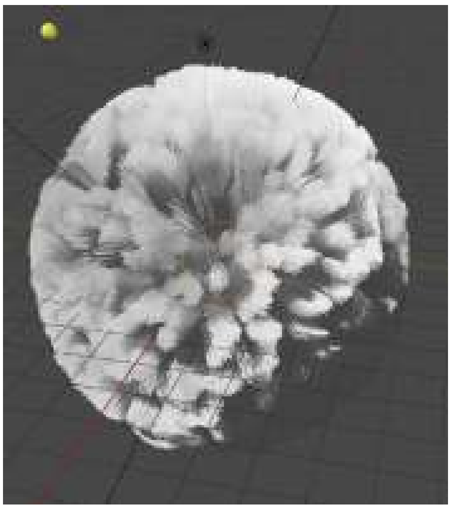


Figure 22.79

The possibilities are endless, therefore, experiment and record settings or save Blender files for future use.

22.19 The Assignment Panel

When a **Particle System** is first added to a Scene by clicking on the plus sign in the Particles buttons, Blender introduces data to the Scene that creates a default Particle System. Blender names this data block **ParticleSettings**, as seen in the **Settings panel**. The data block named **ParticleSettings** is automatically linked to the default Particle System that is named **ParticleSystem**. ParticleSystem is placed in the Assignment Panel where it is assigned to an Object in the 3D Viewport Editor.

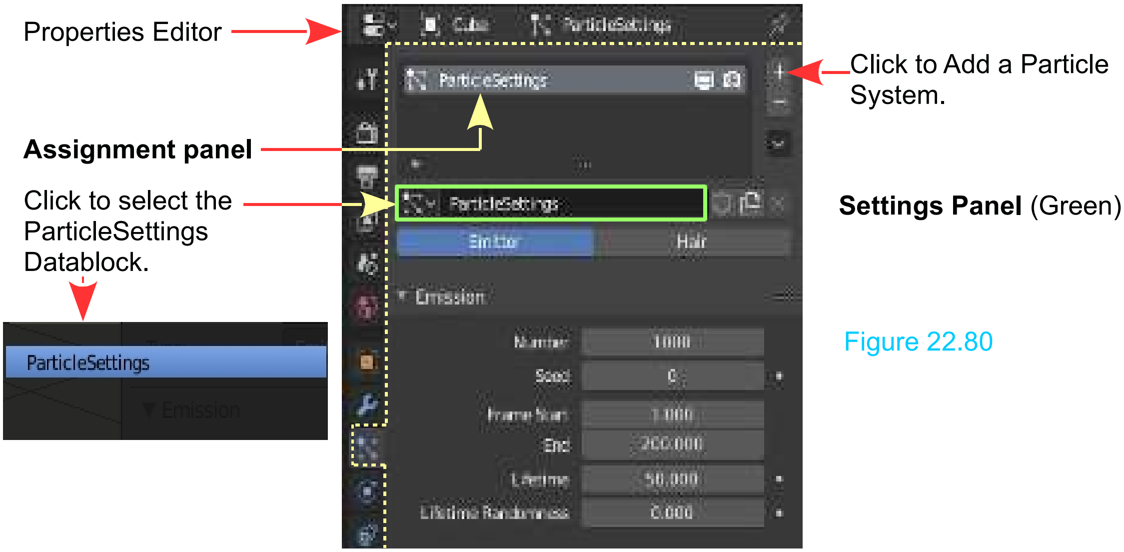


Figure 22.80

There is no **Assignment Tab** or **Assignment Panel** as such, but for the purpose of this discussion consider the **Settings Panel** marked in green as the Assignment Tab and the panel displaying **ParticleSystem** as the Assignment Panel (Figure 22.80).

Below the Settings panel there is a Particle Type selection menu with the two options, **Hair** and **Emitter**.

Type: Emitter is the default selection, which means that with the Particle System assigned to an Object in the Scene, that Object becomes the emitter of the Particles. In either case, the Object becomes an emitter with a Particle System assigned. **Type: Hair** may be viewed as a specialized static emitter.

In Figure 22.80, Particle System, Type: Emitter is selected for the ParticleSettings Datablock. This is assigned to the ParticleSystem which in turn is assigned to the Object which is selected in the 3D Viewport Editor.

Note that the names **ParticleSettings** and **ParticleSystem** may be renamed by double clicking in the panels, deleting the name and retyping a new name. This is useful when there are multiple Objects, Data Blocks and Particle Systems. Multiple Objects in the 3D Viewport Editor can each have a different Particle System assigned, and each Object may have more than one Particle System.

When a new Particle System Data Block is added to the Scene, Blender creates a new name for the Data Block. The default particle settings Data Block is named **ParticleSettings** as previously stated. When a second Data Block is added, it is named **ParticleSettings.001**, a third would be named **ParticleSettings.002**, etc.

Renaming Data Blocks to something more relevant to Objects in the Scene would be an advantage. When new Data Blocks are created, they are stored in a cache for reuse by other Particle Systems.

When a new Particle System is added to the Scene, Blender assigns that system to the Object selected in the 3D Viewport Editor. If no Objects are selected, the new Particle System is assigned to the last Object that was introduced to the Scene. Particle Systems added to a Scene initially have the default ParticleSettings Data Block linked and a new name applied as described previously. At this point, the Data Block settings may be altered to create a new unique Data Block or a previously created Data Block may be selected and linked to the new Particle System. Clicking on the icon in front of the Particle Settings panel reveals a drop down menu showing the Cache, mentioned previously, with Data Blocks for selection.

The forgoing statements may seem confusing and not easily related to what has been labelled the **Assignment Tab.** The following exercise will attempt to clarify the statements and at the same time demonstrate the application of Particle Systems in practical terms.

18.20 Particle Exercises

Open a new Scene in Blender and delete the Cube from the 3D Viewport Editor. Add three separate Plane Objects and position them at the center of the Scene so that they are all visible in Camera View . Add a diffuse Material color to each of the Planes. Make the colors red, green and blue. (Figure 22.81). To see Materials in the 3D Viewport Editor be in Material Preview Viewport Shading Mode.

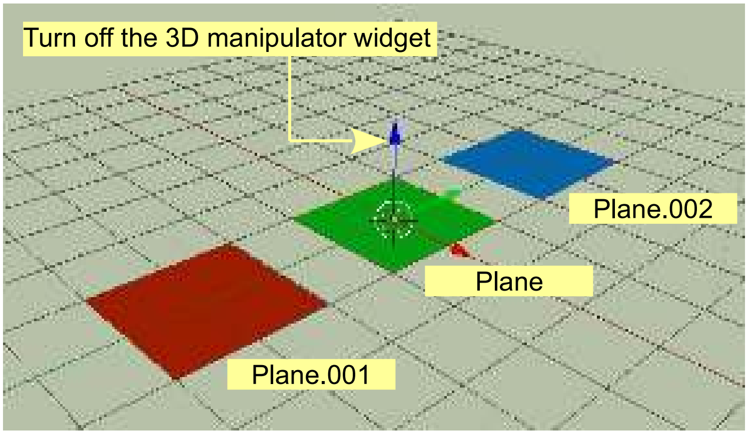


Figure 22.81

Turn off the **Gravity** setting in the Properties Editor, Scene buttons, Gravity tab (untick).

Turn off the 3D Manipulator Widget in the 3D Viewport Editor.

At this time, the three Plane Objects have been named **Plane**, **Plane.001**, and **Plane.002** by Blender, as seen in the upper left-hand corner of the 3D View Editor when each is selected. In the diagram the green Plane was entered first followed by the red Plane then the blue Plane.

This automatic naming is not all that relevant to what is in the Scene, therefore, the Planes will be renamed.

In the 3D Viewport Editor, select the red Plane and go to the **Properties Editor, Object buttons**. At the top of the Editor you will see **Plane.001** in the Data Block ID name panel (Figure 22.82).

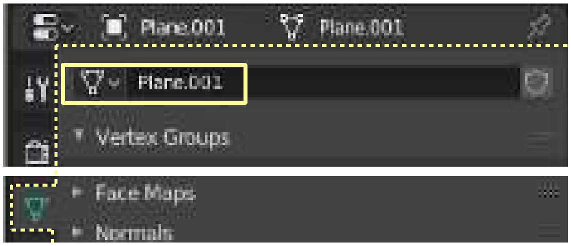


Figure 22.82

Click on the name to highlight it, hit delete, type in **Red_Plane** and press Enter. Select the green plane in the 3D Viewport Editor and rename it **Green_Plane**, and then similarly for the blue Plane.

> **Note:** Renaming may be done in the Properties Editor, Object buttons, Datablock ID name panel or in the Outliner Editor (upper RH of the Screen)

It is time to add **Particle Systems** to the Planes. Select the red Plane and click on the **Particles button** in the **Properties Editor**. Click **the plus sign** to add a Particle System. The Particle System panel displays with all the tabs and buttons for controlling the settings and has been set up with default values. Leave all the values as they are displayed except for the **Lifetime** and **Number** value in the **Emission Tab**. Change the value as shown in Figure 22.83. This will give you a better view of Particles being generated.

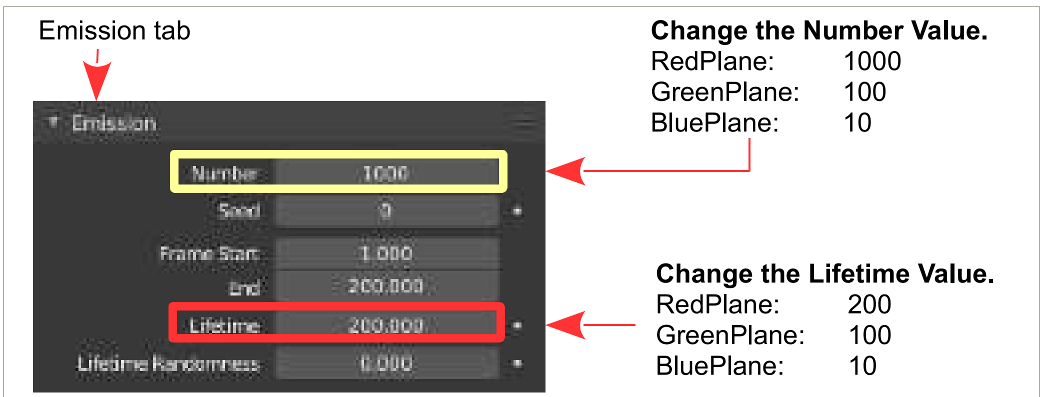
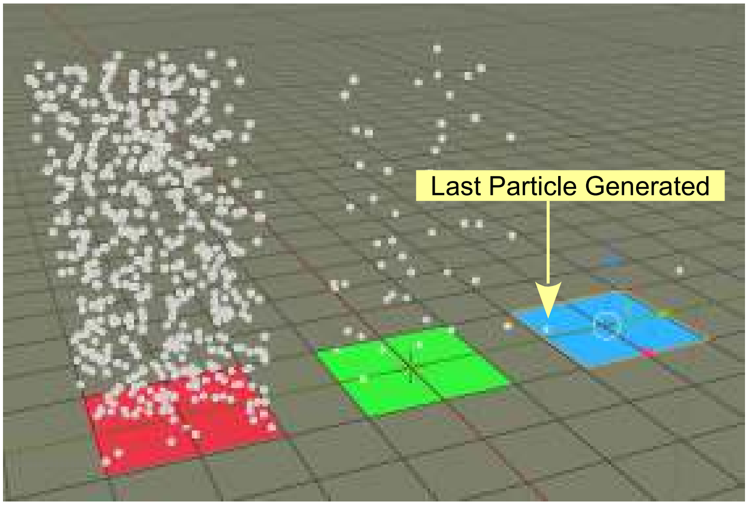


Figure 22.83

Do the same for the other two Planes. Shift select all three Planes in the 3D Viewport Editor and play the animation in the Timeline Editor to show Particles being generated.

Cycle through the animation in the Timeline Editor (drag the Timeline Cursor) to frame 180 and observe the Particles (Figure 22.84). You have three different Planes with three different Particle Systems—RedPlane: 1000 Particles, GreenPlane: 100 Particles, BluePlane: 10 Particles.

Figure 22.84



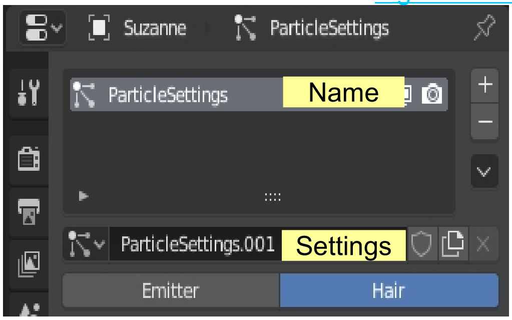
3D Viewport Editor at Frame 180

Blender generates Particles beginning at Frame 1. The number of Particles set for each Plane is generated and spread over 200 Frames (200 is the End value in the Emission tab). The actual length of the Animation is 250 Frames. In Figure 22.84 BluePlane is selected showing the last of the 10 Particles being generated. For BluePlane the Particle Lifetime is set at 10 Frames, therefore, it disappears at Frame 190.

In the 3D Viewport Editor select each Plane separately and note the names that display in the panels in the **Properties Editor, Particles buttons , Assignment tab**, (Figure 22.85).

- **Red_Plane**
  – Name: ParticleSettings
  – Settings: ParticleSettings.001
- **Green_Plane**
  – Name: ParticleSettings
  – Settings: ParticleSettings.002
- **Blue_Plane**
  – Name: ParticleSettings
  -Settings: ParticleSettings.003

Figure 22.85



Entries for the Red_Plane

It was previously stated that there were three separate Particle Systems, however, you see that the three names are all **ParticleSettings**, but each one has a different **Settings** name. At this stage it's probably a good idea to do some renaming.

Change the names to the following:

- **Red_Plane**
  – Name: RedPSystem
  – Settings: RedPSettings
- **Green_Plane**
  – Name: GreenPSystem
  – Settings: GreenPSettings
- **Blue_Plane**
  – Name: BluePSystem
  – Settings: BluePSettings

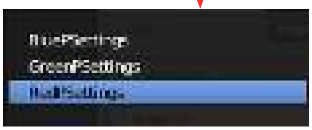
After renaming, proceedings should be easier to follow.

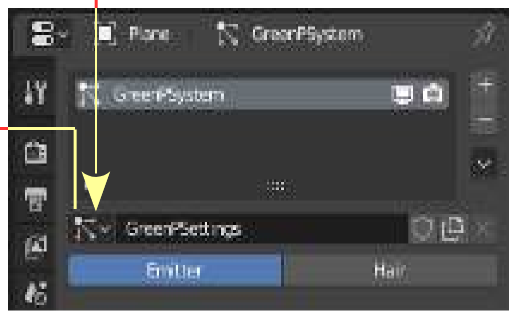
To continue; In the 3DView Editor select the **Green Plane** to reassign some settings.

In the **Properties Editor, Particles button, Assignment Tab**, click on the button just in front of the name panel and next to Settings.

Figure 22.86

Browse Particles Settings to be linked menu





The menu that displays has the names of the three **Particle Settings Data Blocks** (Figure 22.87). Whenever a new group of Particle Settings is created, Blender puts it into a cache for reuse. You can see these **Data Blocks** in the **Outliner Editor** in **Data API Mode**.

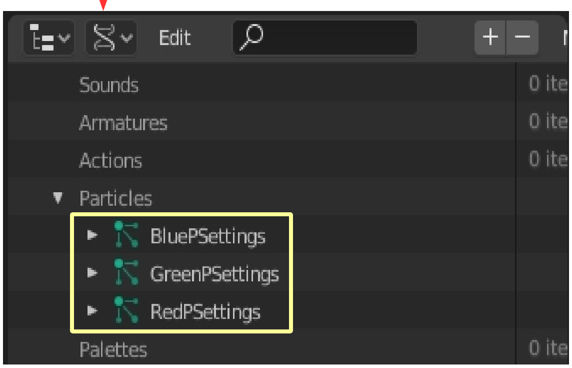


Figure 22.87

With the **GreenPlane** selected in the 3D Viewport Editor, click on **BluePSettings** in the **Browse Particles to be linked menu.**.

You will have the **BluePSettings** assigned to the **GreenPSystem**.

If you replay the Particle generation animation, the green and blue Planes generate the same number of Particles.

Note that in the **Settings panel** for the green and the blue Planes, a number 2 has appeared; this tells you that **BluePSettings** is being used by two systems. The number of Particles Emitted is set by the Particle System settings.

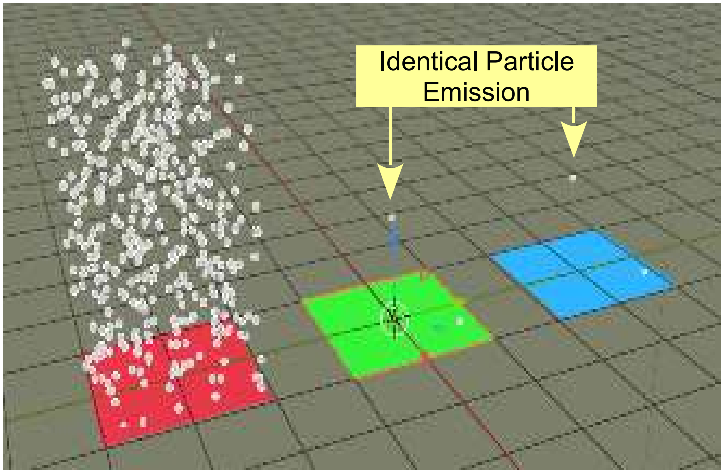
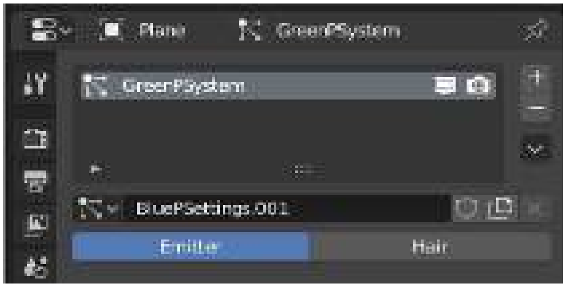


Figure 22.88

The forgoing has demonstrated that you can select any Data Block of settings and assign it to any Particle System.

Continue by clicking on the number 2, which makes the Data Block a single user. Blender does this by leaving the original as it is and creating a new Data Block, however, the new Data Block is identical to the original.

Figure 22.89



You can see that the settings name is **BluePSettings.001** (Figure 22.89).

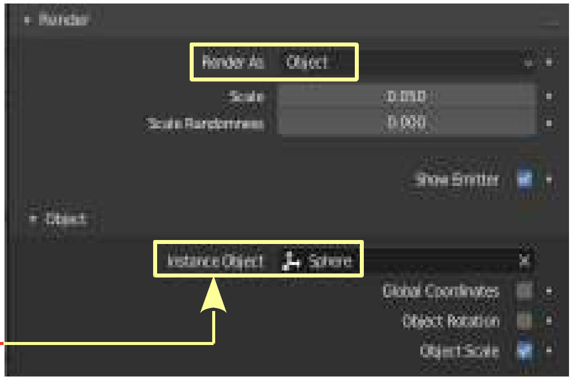
In the **Emission tab** change the **Number** value to 10 and the **Lifetime** value to 30.

In the 3D Viewport Editor, add a **UV Sphere** to the Scene and give it a yellow Diffuse Material color.

Note: Blender has named the Sphere simply, **Sphere**. Make sure it is off to one side in the Scene away from the planes.

Select the Green Plane in the 3D Viewport Editor and then go back to the **Particle buttons** in the **Properties Editor**.

Figure 22.90



Change some data in this new Data Block (BluePSettings.001) which is assigned to the GreenPSystem for the green Plane.

In the **Render Tab** in the **Particles buttons** (scroll down a bit). In the bar labelled **Render as** click and select Type: **Object** (Figure 22.90).

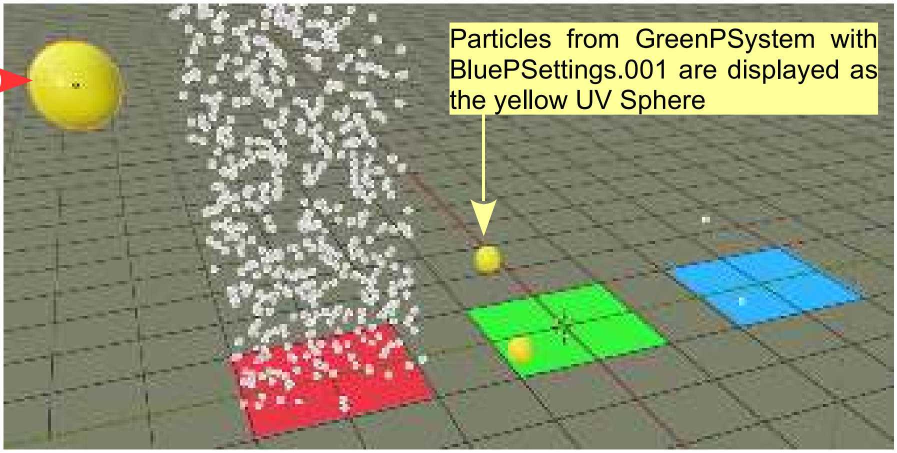
Selecting **Type: Object** instructs Blender to Render (Display) Particles as an Object entered in the Scene .

In the **Object Tab** that displays, click where you see Instance Object and select Sphere (the yellow UV Sphere).

You are telling Blender to display and render the Particles as replicas of the yellow Sphere entered in the Scene. Play the particle generation animation and you will see yellow Spheres being generated (Figure 22.91). (increase the Render Scale Value).

Yellow Sphere (Instance object) entered in the Scene Parked to one side

Figure 22.91



The size of the Spheres generated is determined by the size of the yellow Sphere entered in the Scene and the Scale value in the Particle buttons, Render Tab .

This exercise has demonstrated how manipulating values in the Properties Editor controls the Emission of Particles in the 3D Viewport Editor. This can be used to create visual effects in a Scene. **Note:** An Object can have more than one Particle System in operation at the same time.

22.21 Multiple Particle Systems

Work through the following exercise to see how to apply **Multiple Particle Systems**. A Plane Object is entered in the 3D Viewport Editor with a blue Material applied. The 3D Viewport Editor is in Material Preview Viewport Shading Mode.

A Particle System is added to the Plane in the Properties Editor, Particle buttons with the Emission values as shown in Figure 22.93 (default settings except Lifetime 200). Gravity has been turned off in the Scene buttons.

Playing the animation in the Timeline Editor produces the array of Particles shown in Figure 22.92.

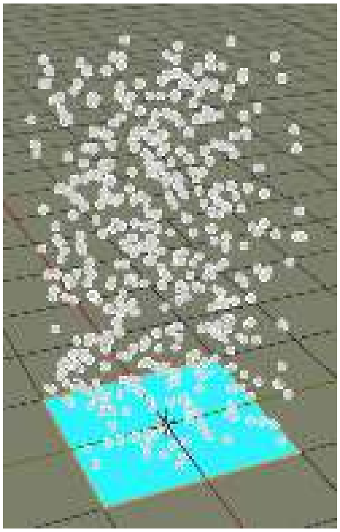


Figure 22.92

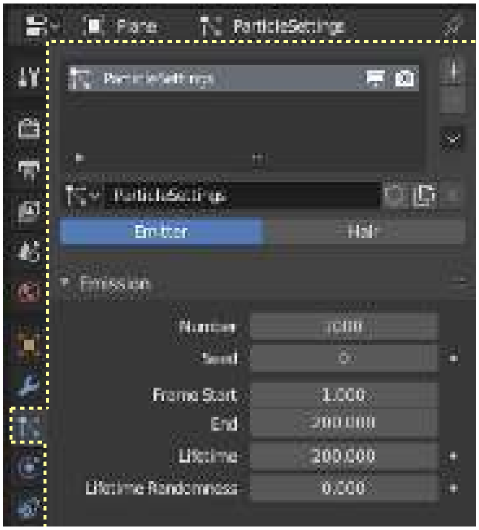


Figure 22.93

You may have the Particles display as another Object. Add a UV Sphere to the Scene. Give the Sphere a nice bright Material (color) and park it off to the side.

In the Render Tab change **Render As** to **Object** (Figure 22.94) then in the Object Tab select Sphere as the **Instance Object**.

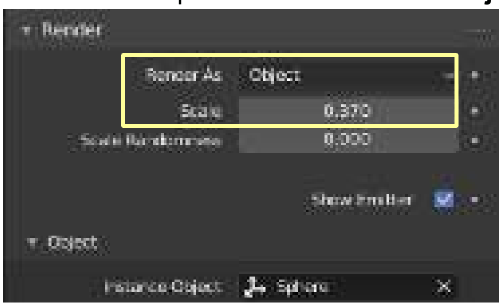


Figure 22.94

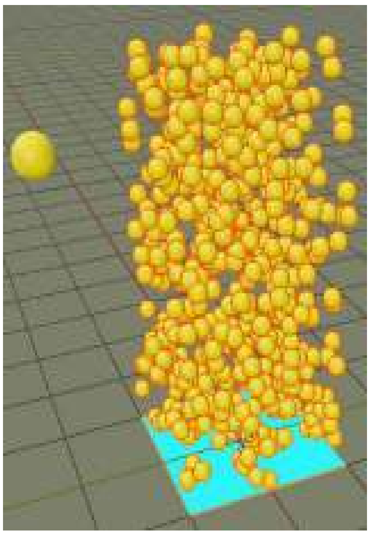


Figure 22.95

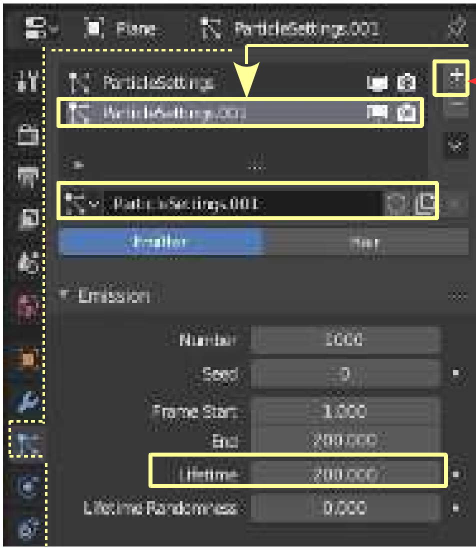
Replay the animation for a colorful display (Figure 22.95).

To add a second Particle System to the Plane click on the Plus icon adjacent to the Assignment Panel.

ParticleSettings.001 is entered in the Assignment Panel. **Note;** Settings: Particle Settings.001.

Change the **Lifetime** in the Emission Tab to 200 so that the Particles remain visible when the animation is played.

Add a Monkey Object to the Scene with a Material and park it to one side.



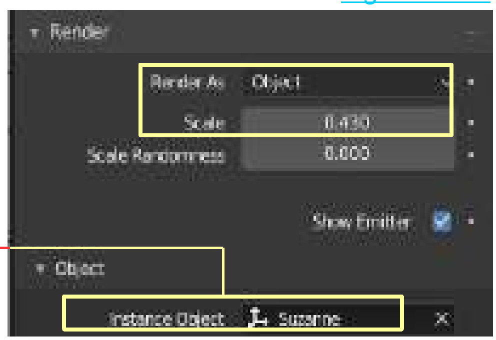
Assignment Panel

Click to add a second Particle System

Figure 22.96

At this point a second Particle System is applied to the Plane with **Settings: ParticleSettings.001**. The Settings (at this point) are identical to the original ParticleSettings (Figure 22.96), therefore, playing the animation will produce two identical Particle displays (yellow spheres) and appear as if nothing has changed. To make it obvious that two systems are in play modify the settings for ParticleSettings.001.

Figure 22.97



With **ParticleSettings.001** selected (highlighted) change the values in the Render Tab as shown in Figure 22.97.

Change values in the Velocity Tab (Figure 22.99) as shown to change the direction of emission of the second set. Play the animation.

Instance Objects

Figure 22.98

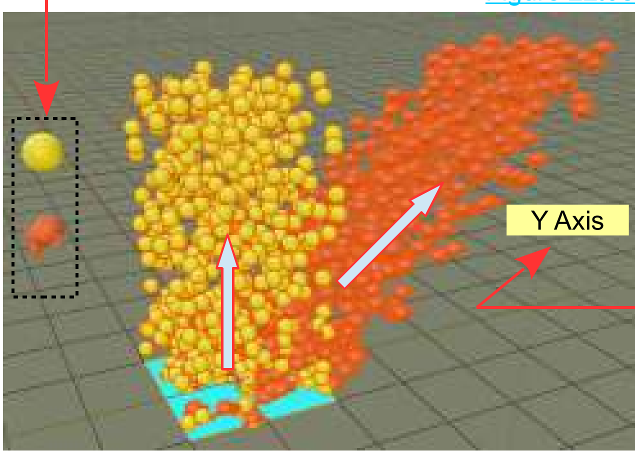
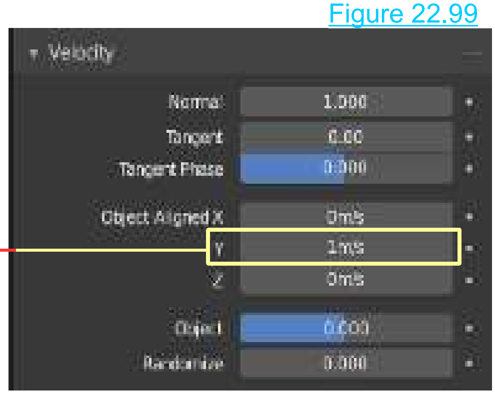


Figure 22.99



22.22 Keyed Particles

Keyed Physics is a way of controlling the movement of particles by directing them from the original Emitter Object to a second Target Object and onto subsequent Target Objects. The flow of Particles may be used as an animation or used to create a static image. The following procedure for setting up a keyed system will demonstrate the principles involved.

Open a new Scene in Blender and delete the default Cube. Add three separate Plane Objects and position them as shown in Figure 22.100. Note that in the **Outliner Editor** under **Collection** the first Plane (red) will be named **Plane**. The second Plane (blue) named **Plane.001** and the third (green) **Plane.002**.

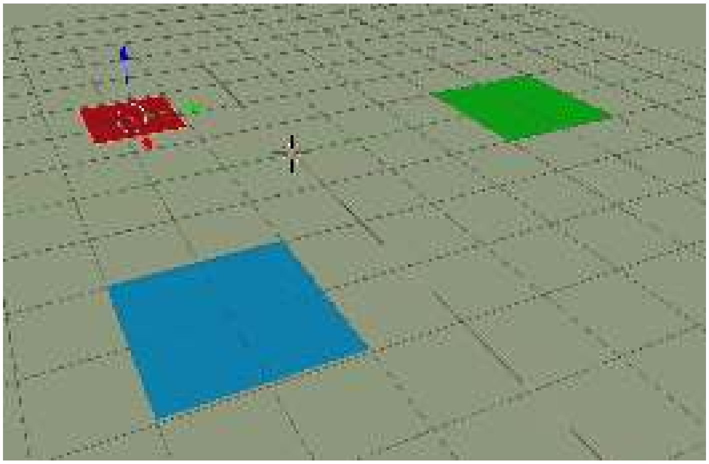


Figure 22.100

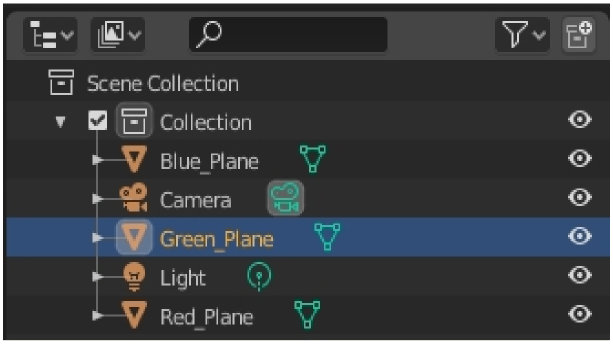


Figure 22.101

In the **Outliner Editor** rename the Planes, **Red_Plane**, **Green_Plane** and **Blue_Plane.**

Note: You can go to the Properties Editor – **Object Data buttons** and edit the name in the **Name box** at the top of the panel or you can edit the names in the **Outliner Editor**. You could use any name you like but since the Planes are colored it's best to name per the colors assigned.

Select the first plane, **Red_Plane** and in the **Properties Editor, Particles buttons**, add a Particle System. In the **Physics Tab** change Physics Type: Newtonian to **Keyed.**

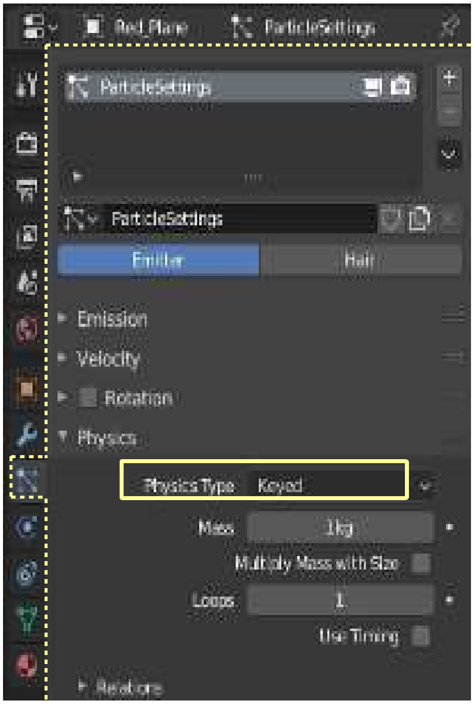


Figure 22.102

Deselect **Red_Plane** in the 3D Viewport Editor and select **Green_Plane** and **Blue_Plane** in turn, repeating the procedure for adding a **Keyed** type particle system.

Go back and select **Red_Plane**. At this point you are about to tell the Particles emitted from Red_Plane to migrate to Blue_Plane then on to Green_Plane. This is done by designating Blue_Plane and Green_Plane as **Targets** in the **Physics, Keys, Relation Tab**.

Click on the plus sign at the RHS of the Relations panel. This enters a Target Channel and inserts **Invalid target**. Below the relations panel click in the **Target Object** panel and select **Red_Plane**.

Click the plus sign a second time and repeat the process, this time entering **Green_Plane** as the Target. Repeat for **Blue_Plane**.

OK! You have the objects, **Red_Plan, Green_Plane** and **Blue_Plane** each with a **Keyed** particle system and you have told the particles generated from **Red_ Plane** to assemble.

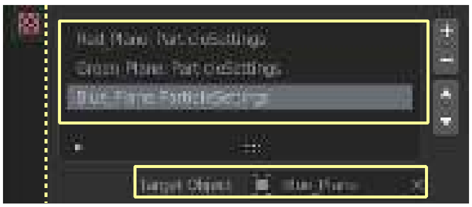


Figure 22.103

When the animation is played Particles emitted from Red_Plane travel towards Green_Plane then turn and head over to Blue_Plane.

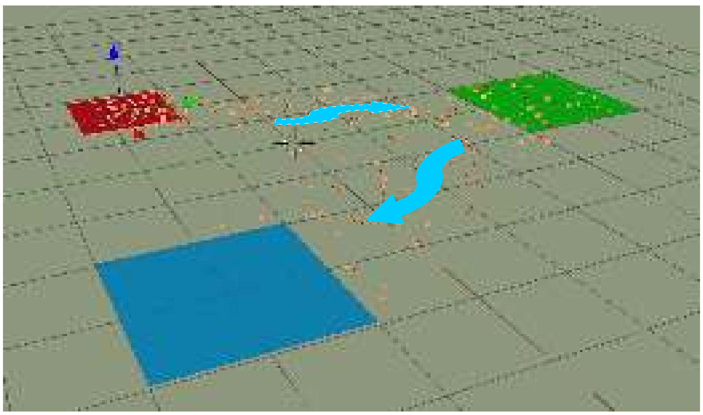


Figure 22.104

Remember: All the rules for number of particles, Lifetime, Start, End, and Normal velocity apply.

23

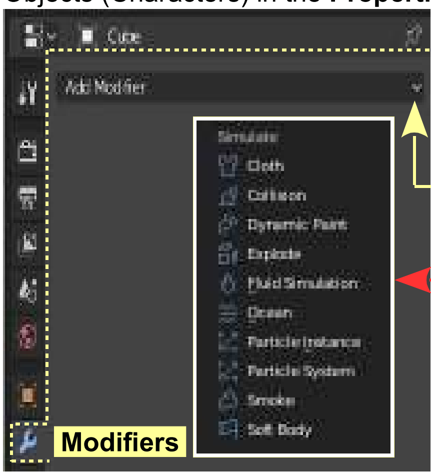
Physics and Simulation

23.1 Real World Physics
23.2 Modifiers and Physics
23.3 Force Field
23.4 Collision Physics
23.5 Cloth Physics
23.6 Soft Body Physics
23.7 Fluid Simulation
23.8 Quick Methods
23.9 Fluid Simulation Continued
23.10 Fluid Simulation Experiments
23.11 Smoke and Fire Simulation
23.12 Force Fields

Creating an animation is the process of simulating actions which take place in the real world and consequently involves applying or simulating the application of real world Physics.

When Objects and characters in a Scene move and interact they generally obey the rules of Physics which exist in the real world. Characters jump up and fall down obeying the law of gravity. They collide with with each other and with obstacles in the Scene. These actions may or not be exaggerated or strictly adhere to the laws of physics, depending on the story being depicted.

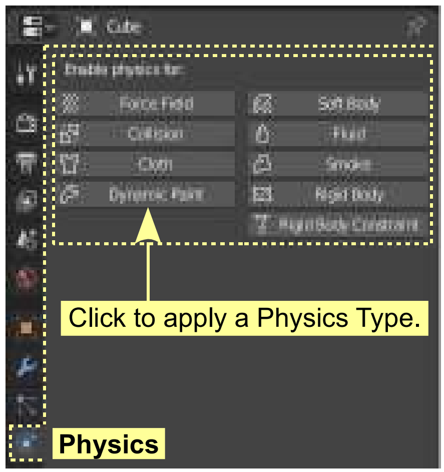
To simulate **Real World Physics** Blender incorporates Modifiers. The Modifiers are applied to Objects (Characters) in the **Properties Editor**:



Modifiers buttons
and
Physics buttons
Figure 23.1

Click to display the Modifiers selection menu.

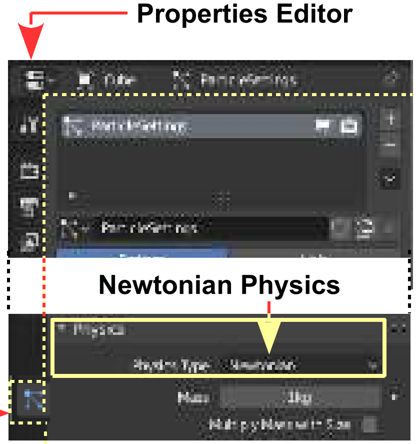
Selecting a Simulate Modifier refers you to the Physics Buttons where the Physics Type is applied.



23.1 Real World Physics

In Chapter 22, Particles, you will have observed that Particles being generated from a default Object descended in the Screen when an animation sequence is played. The Emitter Object remaines stationary unless it is animated to move.

Figure 23.2



The default Blender Scene may be considered to be a view of a 3D World. There is a gravitational force in existence, but generally, Objects placed in the Scene will not react to Gravity until **Real World Physics** is applied to the Object. Particles are an exception since, by default, they have **Newtonian Physics** applied (Figure 23.2).

Real World Physics is referred to as; **Rigid Body Physics** (the Object is said to be a Rigid Body).

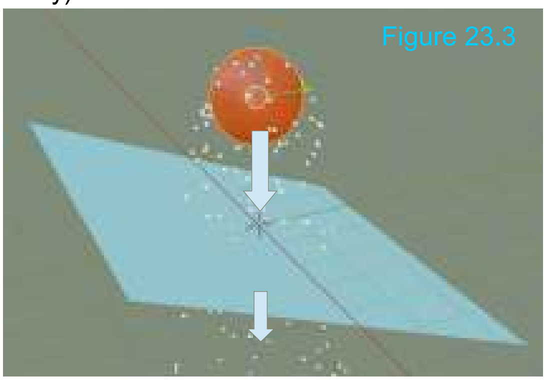
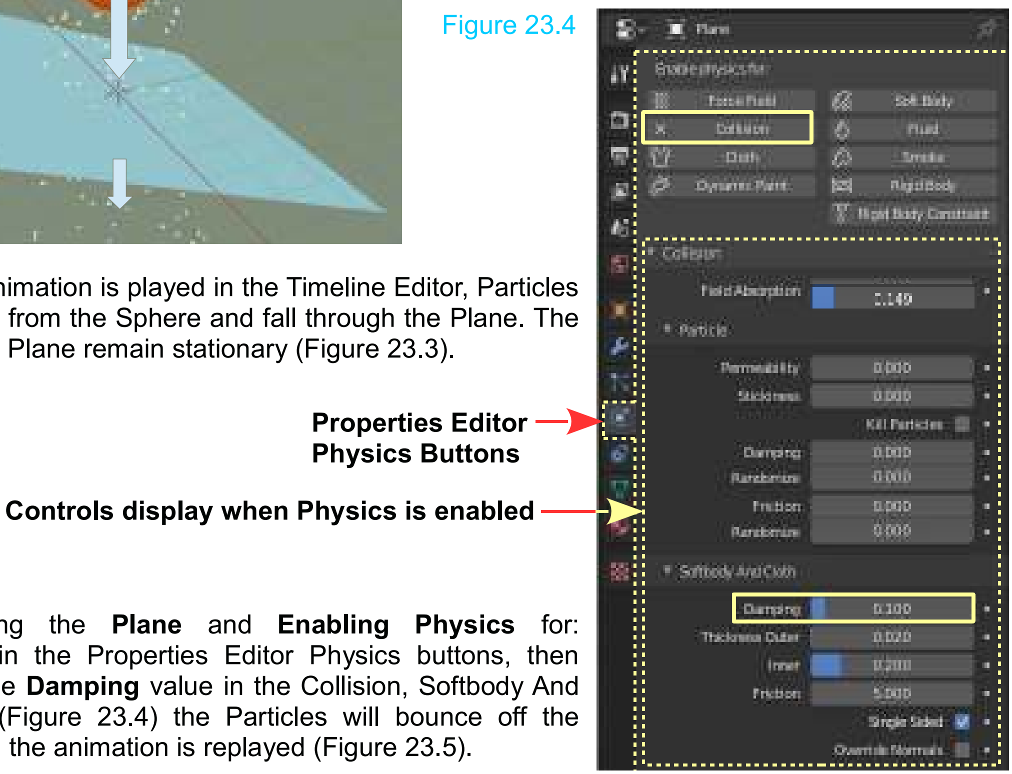


Figure 23.3

Figure 23.3 shows a UV Sphere positioned above a Plane which has been rotated on the X Axis to form an incline. The Sphere has a Particle System applied.

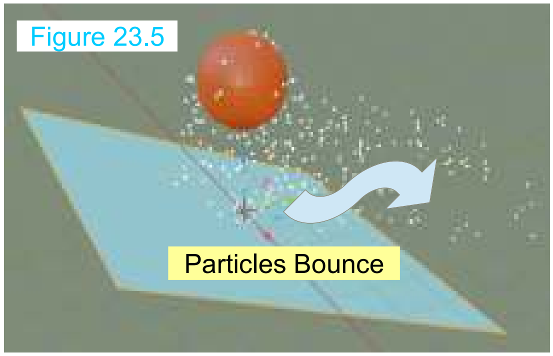
Figure 23.4



When an animation is played in the Timeline Editor, Particles are Emitted from the Sphere and fall through the Plane. The Sphere and Plane remain stationary (Figure 23.3).

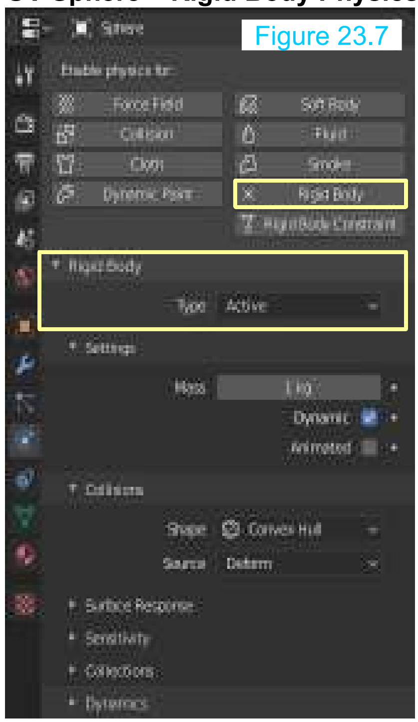
By selecting the **Plane** and **Enabling Physics** for: **Collision**, in the Properties Editor Physics buttons, then adjusting the **Damping** value in the Collision, Softbody And Cloth Tab (Figure 23.4) the Particles will bounce off the Plane when the animation is replayed (Figure 23.5).

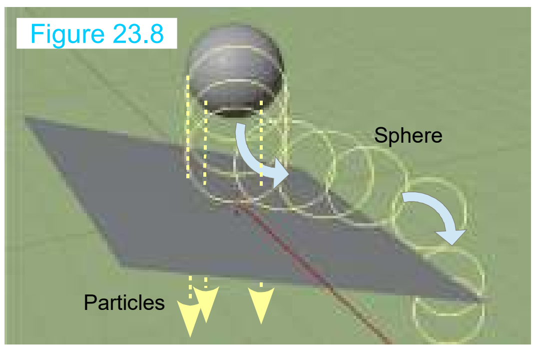
To have the Sphere fall and roll down the Plane, add **Ridged Body Physics** to both the Sphere and the Plane **AND** in the **Rigid Body Tab** set **Type: Active** for the Sphere (Figure 23.7) and **Type: Passive** for the Plane (Figure 23.6) . The Sphere will fall, the Plane remains stationary.



Plane – Rigid Body Physics

UV Sphere – Rigid Body Physics

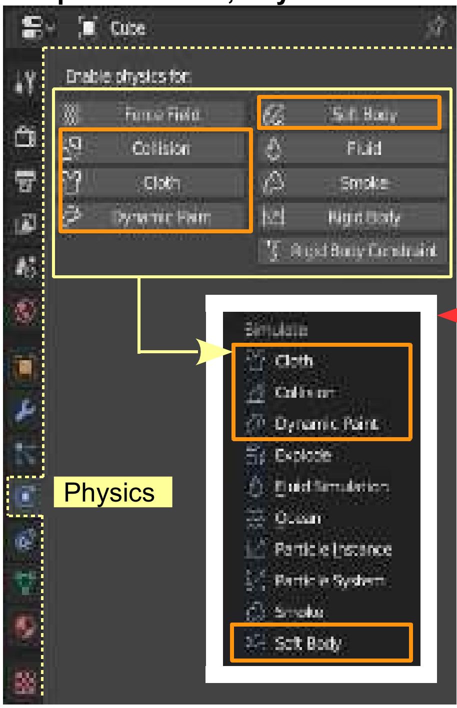




If you remove the **Collision Physics** from the Plane the Sphere still rolls down the incline on impact but the Particles being Emitted pass through the Plane (Figure 23.8).

23.2 Modifiers and Physics

Properties Editor, Physics buttons



As shown in Figure 23.1 a comparison of the **Properties Editor, Modifier** selection menu and the **Properties Editor Physics** buttons reveals duplication (Figure 23.9).

In Chapter 22, when discussing Particles, Wind and Turbulence **Force Fields** and **Collision Physics** were used in examples. This was a gentle introduction in the application of Physics in animation.

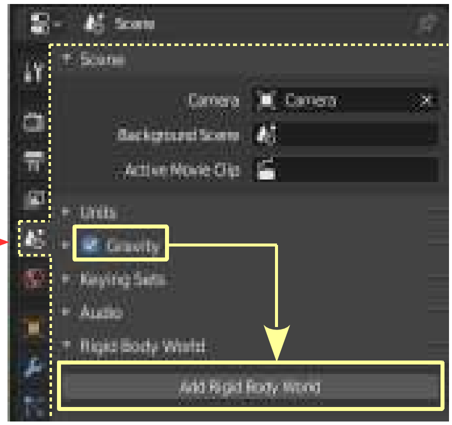
Figure 23.9

Modifiers Menu (Properties Editor - Modifiers)

It should be noted that, in some cases, Physics can only be applied with **Rigid Body World** activated. Rigid Body World creates a space where the laws of physics in the real world are simulated.

Figure 23.10

Properties Editor Scene button.



Gravity is a Force present in the real world which is activated separately in the Scene buttons (Figure 23.10).

Physics Attributes are applied to an Object in the Properties Editor Physics buttons.

23.3 Force Field

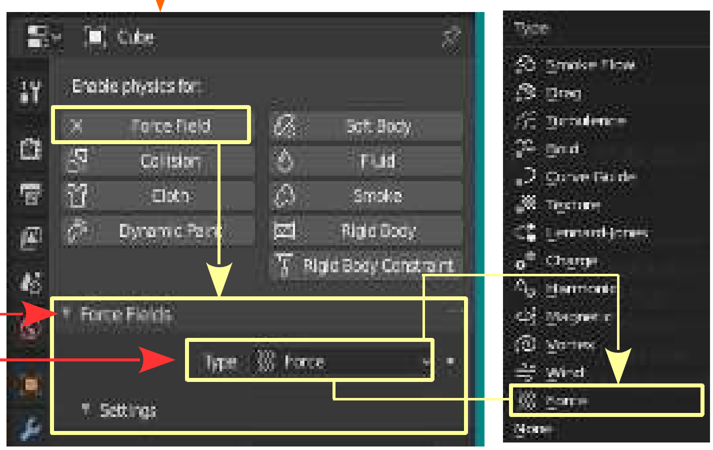
Clicking **Force Field** in the Physics buttons opens the **Force Field Tab** where you select a **Force Type**.

Figure 23.11

Force Field Tab

Select the Force Type

Force Type: **Force** selected



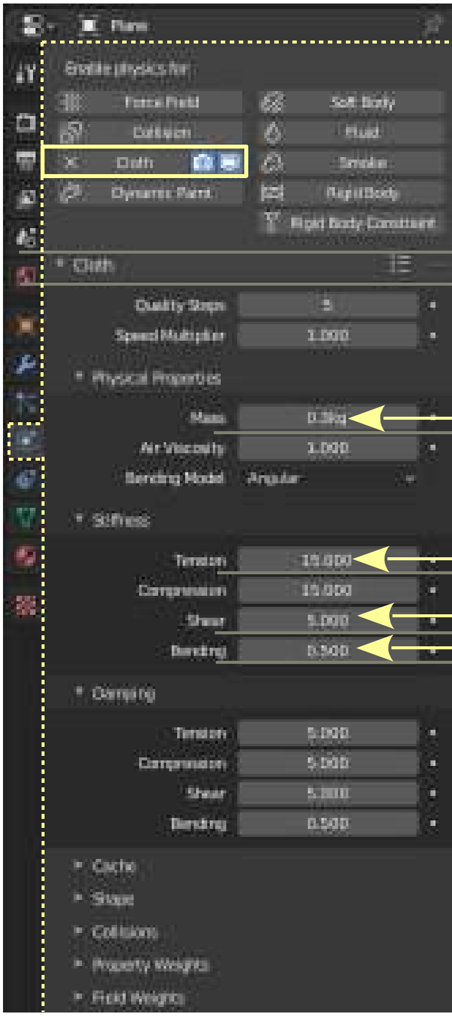
23.4 Collision Physics

As seen when discussing Real World Physics Section 23.1, Applying **Collision Physics** to an Object causes it to interact with other Objects in the Scene.

23.5 Cloth Physics

With **Cloth Physics** applied, an Object exhibits the characteristics of different types of fabric. With Cloth Physics activated, controls display in the Properties Editor (Figure 23.12).

Consider a **Plane Object** in the 3D Viewport Editor in Object Mode, **Subdivided ten times** (in Edit Mode). With the Plane selected in Object Mode, click **Cloth** in the **Physics buttons**. If you click on the Modifier button in the Properties Editor you will see that a Cloth Modifier has been added to the Plane referring you to the controls in the Physics buttons.



The default Cloth settings in the Physics buttons give the Plane the characteristics of a cotton fabric.

As a guide the following setting changes may be made for other **fabric materials**.

Default

Figure 23.12

Cotton	Leather	Rubber	Denim	Silk
0.300	0.4	3.000	1.000	0.150
15	80	15	40	5
5	25	25	25	0.0
0.5	150	25	10	0.05

To see the Plane acting as a cotton fabric leave the default settings in place.

At this point playing an animation in the Timeline Editor will see the Plane exhibit the characteristics of a piece of cloth as if it had been released in space after being laid out perfectly flat. The cloth simply falls away under the influence of Gravity. There is no air resistance or other obstacle to impede its descent.

With the Plane selected in the 3D Viewport Editor, Tab into Edit Mode, deselect all vertices then select two corner vertices and create a **Vertex Group** (Chapter 5 – 5.9) with just the two. The Vertex Group is names **Group.**

In the Properties Editor, Physics buttons expand the **Shape Tab** (Figure 23.13). You are about to fix (Pin) the two Vertices in space, something like pegging the corners of a sheet on a clothes line, **without the line**.

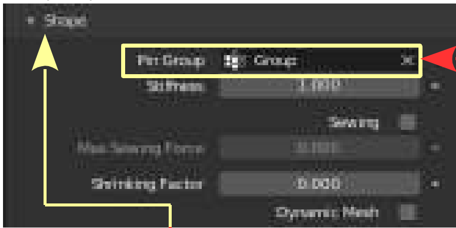
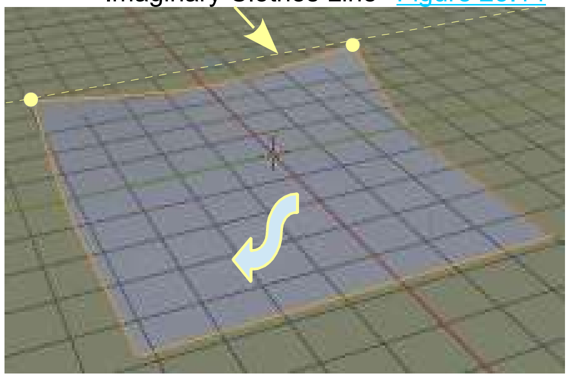


Figure 23.13

In the **Shape Tab**, click where you see **Pin Group** and select **Group** (the Vertex Group created) from the menu that displays.

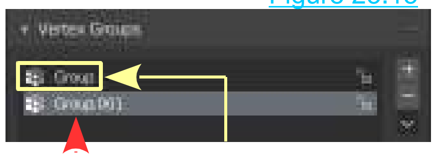
Imaginary Clothes Line Figure 23.14



Tab back to Object Mode. Replay the animation in the Timeline. The Cloth swings down pinned at the corners (Figure 23.14).

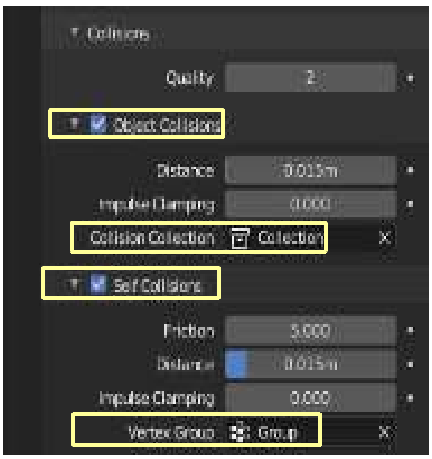
To further demonstrate Cloth Physics, position a UV Sphere below the Plane **before playing the animation**. Create a second Vertex Group for the Plane, this time, including all Vertices on the Plane. **Activate Collision in the Physics buttons for the Sphere.**

Figure 23.15



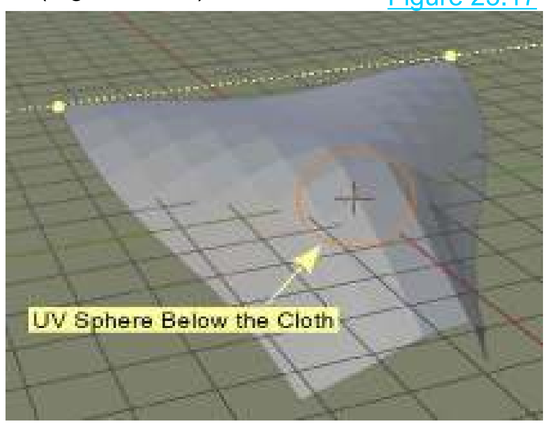
All Vertices Pin Group

Properties Editor, Physics Buttons Figure 23.16



With the Plane selected, in the Cloth Physics buttons, Collision Tab, have **Object Collision** checked with **Collision Collection: Collection** entered. Also have **Self Collision** checked with **Vertex Group: Group** entered (Figure 23.16). Replay the animation to see the Cloth droop over the Sphere (Figure 23.17).

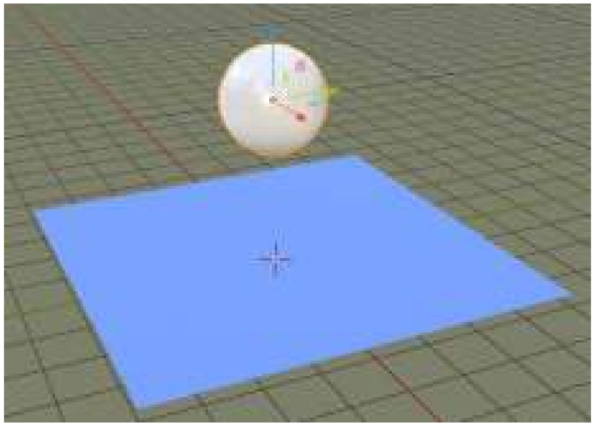
Figure 23.17



Note: Dynamic Paint is the next entry in the Physics list. This is detailed in Chapter 24.

23.6 Soft Body Physics

Figure 23.18



Soft Body Physics, when applied to an Object, causes it to act like dough or clay or anything that is soft and pliable.

As an example, set up a UV Sphere Object above a Plane (Figure 23.18). The Sphere is a good object for the demonstration since it has a reasonable number of Vertices forming its mesh surface.

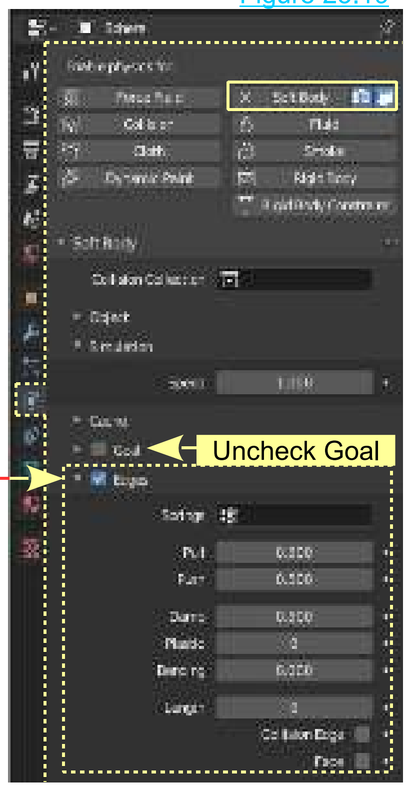
With the Sphere in Object Mode add **Soft Body Physics** to the UV Sphere .

Playing an animation in the Timeline Editor at this point sees the UV Sphere remain in situ and bounce up and down slightly.

In the Properties Editor, Physics buttons, Soft Body Tab, **uncheck Goal** (Figure 23.19) to have the Sphere fall in the animation. The Sphere falls straight through the Plane.

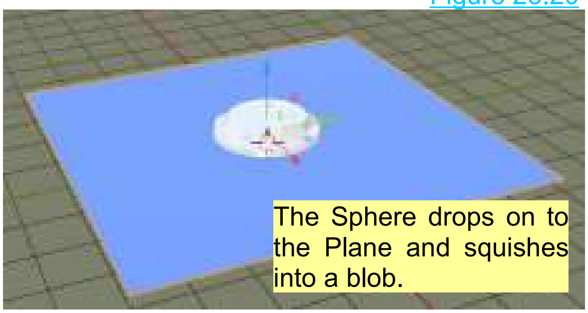
Select the Plane and in the Properties editor, Physics buttons, **enable Physics for: Collision**.

Figure 23.19



Playing the animation again, shows the UV Sphere crumpling when it makes contact with the Plane. Initially the crumpling will be hesitant and the animation will hesitate due to the time for the computer to calculate the deformation. Let the animation run its course. The deforming data will be written to the Cache (memory) then on replay the Sphere will squish into a blob and settle on the Plane. The amount of hesitation in the initial animation will depend on how fast the computer can perform the calculation.

Figure 23.20



The speed and deformation of the Sphere on impact may be controlled by adjusting values in the **Edges Tab** with the Sphere selected.

23.7 Fluid Simulation

Fluid Simulation, as the heading describes, simulates how fluid behaves in the real world. How a fluid behaves depends on its environment which comprises physical obstacles and physical forces such as gravity and pressure. The physical composition of the fluid also has an effect on its behaviour. As you can guess, the laws of physics have a great deal to do with how a fluid behaves.

In Blender, a fluid simulation means, a graphical display is generated on the computer screen tricking the observer into believing they are seeing a fluid react to an environment. It should be remembered that this is an illusion and what you think you see is a clever bit of trickery.

In Blender version 2.80 an extensible framework called **Mantaflow** has been incorporated in the program for the execution of fluid and gas simulations.

mantaflow.com

Mantaflow is an open-source framework targeted at fluid simulation research in Computer Graphics. Its parallelized C++ solver core, python scene definition interface and plugin system allow for quickly prototyping and testing new algorithms. A wide range of Navier-Stokes solver variants are included. It's very versatile, and allows coupling and import/export with deep learning frameworks (e.g., tensorflow via numpy) or standalone compilation as matlab plugin.

The above definition means its a clever bit of gear for creating gas and liquid simulations.

The Concept in Blender

To create a Fluid Simulation you create a mini world inside the artificial 3D World in a Blender Scene. The mini world is called the **Domain** and the simulated flow of fluid takes place entirely inside this space. The Domain will contain a **Fluid Emitter** Object which generates the fluid and other Objects which act as controls and obstacles. The Domain is shaped to fit in amongst other Objects in the Scene, therefore, creating the illusion that the Fluid Flow is moving in the Scene.

To demonstrate the basic concept work through the following exercise beginning with the default Blender Scene containing the Cube Object.

Place the 3D Viewport Editor in **Wireframe Display Mode**.

Domain and Emitter Set Up

Scale the default Cube twice on the Z Axis. Deselect the Cube and add a second Cube scaling it down in size (S Key + 0.173). Both Cubes will be located at the center of the 3D World. Move the second, smaller Cube, up towards the top of the default Cube (Figure 23.21). The default Cube will be the **Domain** (the mini artificial World) and the second smaller Cube will be the **Fluid Emitter**. Note; it is very important to keep all Objects participating in the Fluid Simulation entirely inside the Domain (nothing protruding outside) (Figure 23.21).

When setting up a Domain containing a Fluid Emitter, the scale of the Emitter relative to the Domain is important. A large Emitter will produce a large amount of fluid in a short time.

In the **Outliner Editor** rename the small Cube, **Fluid** and the default Cube, **Domain** (Figure 23.22).

Figure 23.21

Fluid Emitter

Domain

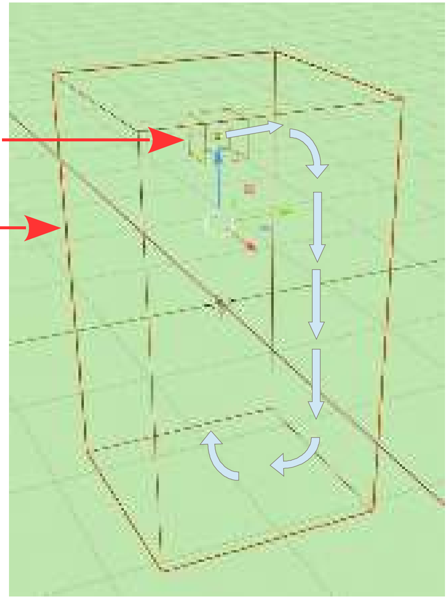
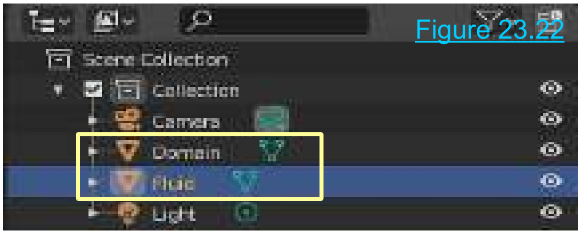


Figure 23.22



Fluid Flow

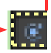
In this simple demonstration Fluid will be generated by the Emitter Object and delivered as a continuous stream. The stream will be, initially, directed along the Y Axis where it will contact the side of the Domain before descending and filling the Domain as if it were a container. In Figure 23.21 the direction of flow is shown by the blue arrows.

Simulation Controls

Figure 23.23

Controls for Fluid Simulation are found in the **Properties Editor, Physics Buttons** (Figure 23.23). You have to set up both Fluid Emitter Controls and Domain Controls.

Physics Button



Fluid Emitter Controls

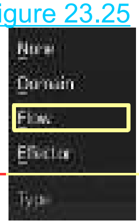
Figure 23.24

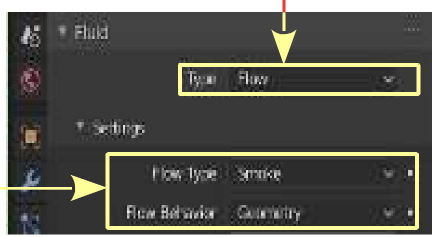
Deselect the Domain and select the Fluid Emitter Cube.

In the **Properties Editor, Physics buttons** click on **Fluid** (Figure 23.23) to display the **Fluid Tab** (Figure 23.24).

Click where you see **Fluid Type: None** and select **Flow** in the menu that displays (Figure 23.25).

Figure 23.25





Two more settings to go: In the Settings tab change Flow Type: Smoke to **Liquid** and **Flow Behavior: Geometry** to **Inflow** (Figure 23.26).

Flow Behavior Inflow sets the Emitter Object Cube to deliver a continuous flow of fluid. The flow of fluid is generated when an animation is played in the Timeline Editor. Note: At this point nothing will occur if the animation were to be played.

Figure 23.26

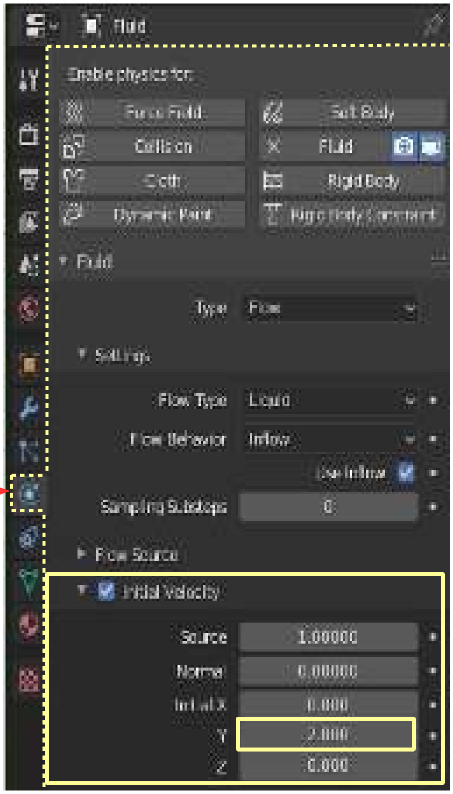


Figure 23.21 shows the fluid inflow direction, initially, along the Y Axis of the 3D World. You set this by giving the fluid an initial velocity. In other words give the fluid a kick start in the Y direction. To do this check the **Initial Velocty Tab** and set the **Initial Y** value to 2.

The completed set up for the Emitter Object in the Properties Editor is shown in Figure 23.26.

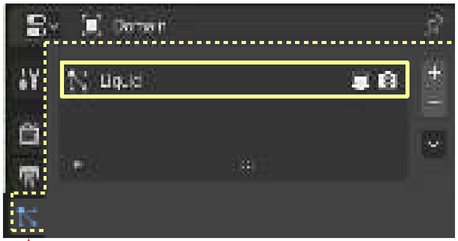
Physics Button

Domain Object Controls

Initially the Domain Control set up is identical to the Emitter Controls. With the Domain Cube selected in the 3D Viewport Editor open the Physics buttons in the Properties Editor, click Fluid. This time change Fluid Type None to Type: **Domain**. In the Settings Tab change Domain Type from the default Gas to **Liquid** (Figure 23.27).

Overview of Procedure

Figure 23.27



Particle Buttons

From this point forward you adjust settings in the Physics buttons to create the Fluid Simulation.

The Fluid Simulation relies on **Particles** (Chapter 22) being generated by a Particle System which obeys the Gravitational affect in the Scene and interact with Objects acting as obstacles or receptacles.

With the Domain selected in the 3D Viewport Editor and Physics buttons set to **Type: Domain** and the Settings having **Domain Type: Liquid** as described above, you will see that a Particle System has been set up in the **Properties Editor Particle buttons**. By default the Particle System is named **Liquid** (Figure 23.27).

Initially the Particles merely represent the Fluid Flow. The Particles can be seen in the 3D Viewport Editor but do not render, therefore, a second stage creates a **Mesh** based on the Particle distribution which does render and is animated. A final optional third stage allows you to introduce additional Particles which you display as Objects intermingled in the second stage. These are viewed as **spray, foam or bubbles**.

With the Domain selected in the 3D Viewport Editor and the Domain Object Controls set as previously described (Fluid Type: Domain and Domain Type: Liquid – All other Controls Default) you are set to generate Particles to represent the Fluid Flow.

Generating the Particles creates a whole heap of Data which uses a whole heap of computer power when displaying the Particles on the Screen. Depending on how much power you have available the display may or may not be satisfactory, could be very jerky and unpleasant. To get around this, the data will be written to memory which save the computer overworking each time the simulation is played.

Writing the Data to Memory is termed: **Baking**. You see the different Bake buttons in the Physics buttons for the Domain ie. Bake Data, Bake Mesh and Bake Particles.

When you Bake, you write to memory, therefore, you should designate where on your hard drive to save the data. Scroll way down to the bottom of the Properties Editor, Physics buttons to the **Cache tab**. The default location for saving is **//cache_fluid** (Figure 23.28).

Figure 23.28

Click to open the **File Browser Editor** and choose a new Folder for saving the **Cache**.

The file path to the **cache_fluid folder** on my Windows PC is shown in Figure 23.29.

Figure 23.29

After Baking Data the cache_fluid folder contains two sub folders, **config** and **data,** each of which contain Fifty (50) **.uni** (Data Files).

In the Cache Tab, note, the Frame **Start and End** values. By default Baking produces an animation of 50 Frames. You can change this to anything you like bearing in mind that Baking can take a long time with many frames in the animation.

For experimenting 50 Frames will keep the Bake time reasonable.

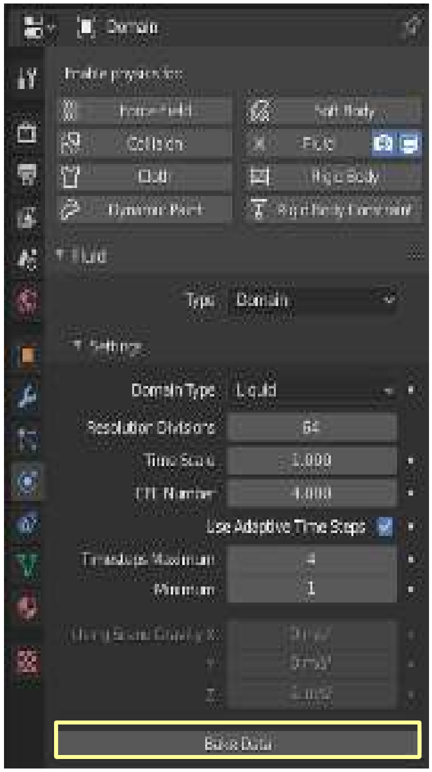
In the **Timeline Editor** (Figure 29.30) set the **End Frame** for the animation at **50**. This will allow you to cycle through the animation as you experiment.

Timeline Editor

Figure 23.30

Bake Data

Figure 23.31



Withe the Domain selected in the 3D Viewport Editor click **Bake Data** in the Physics button in the Properties Editor (Figure 23.31).

The Bake commences with a Progress Bar displayed at the bottom of the Screen.

With the default settings the Bake time is approximately 18 seconds (this is on my PC).

When the Bake is complete you see Particles consolidated on the Emitter Cube (Figure 23.32).

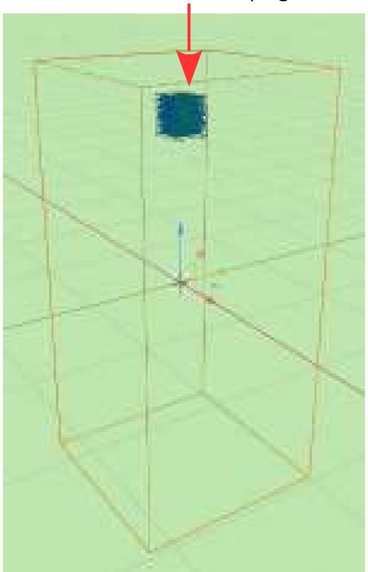


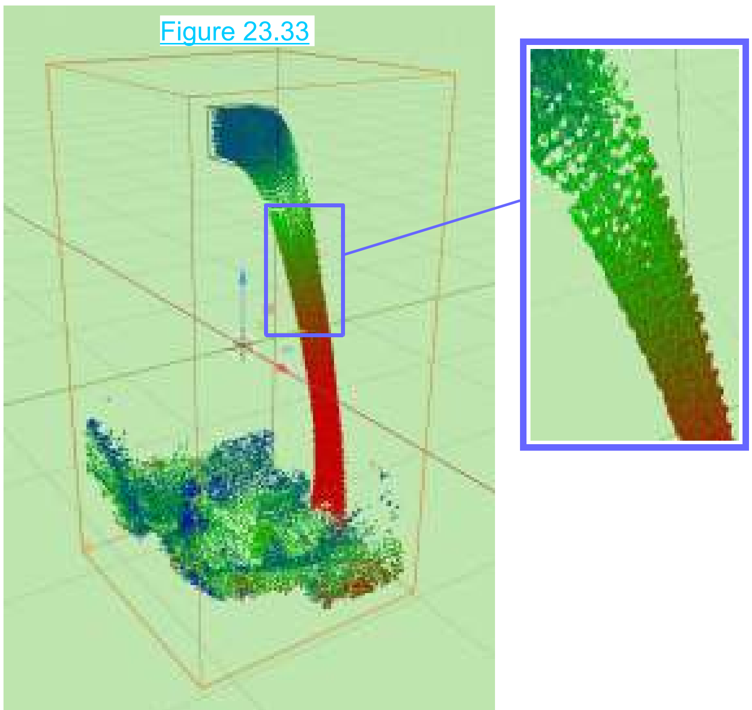
Figure 23.32

Play the animation in the Timeline Editor to see the Particles emitted and cascade into the Domain (Figure 23.33).

Remember: Particles do NOT Render.

Rendered View

Figure 23.33



Bake Mesh

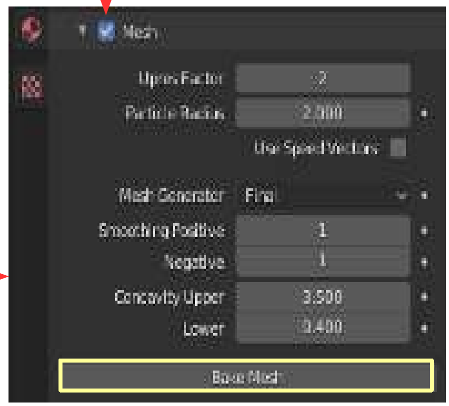
Having Baked the Data creating Particles that define the Fluid Flow in an animation you **Bake Data to create a Mesh**. The Particles will not Render but the Mesh does and the Mesh shape will be animated.

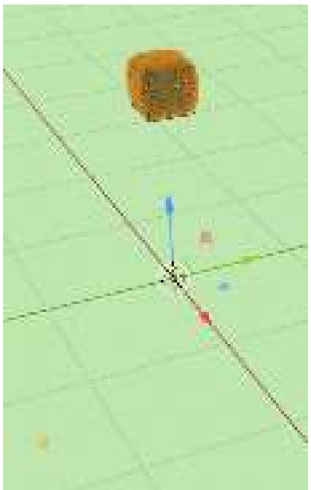
Figure 23.34

To Bake the Mesh have the Domain selected in the 3D Viewport Editor and in the Properties Editor, Physics buttons **check Mesh** in the Mesh Tab (Figure 23.34).

Check Mesh

Physics Buttons – Mesh Tab





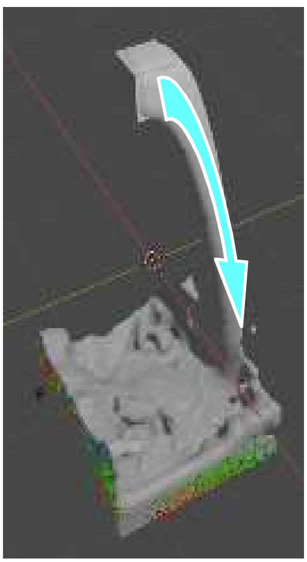
Click **Bake Mesh** to start the Bake and display the progress bar at the bottom of the Screen.

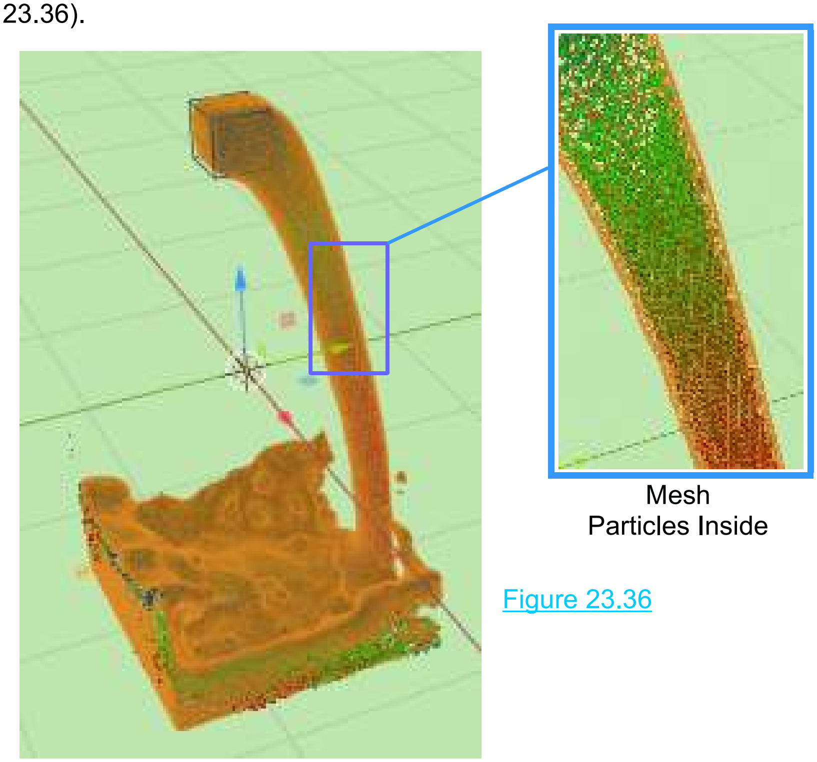
Figure 23.35

When the Bake is complete the Mesh displays in the 3D Viewport Editor consolidated on the Emitter Cube (Figure 23.35).

Replay the animation to see Particles surrounded by a Mesh (Figure 23.36).

Rendered View





Mesh
Particles Inside

Figure 23.36

Play the animation with the 3D Viewport Editor in **Rendered Viewport Shading Mode** to see the Fluid Flow.

At this point the Rendered View shows the Fluid Mesh as a gray color. Since the demonstration began by using the default Cube Object as the Domain the default gray Material is displayed. With a few tweaks in the Material buttons (Figure 23.37) you can have hot chocolate (Figure 23.38).

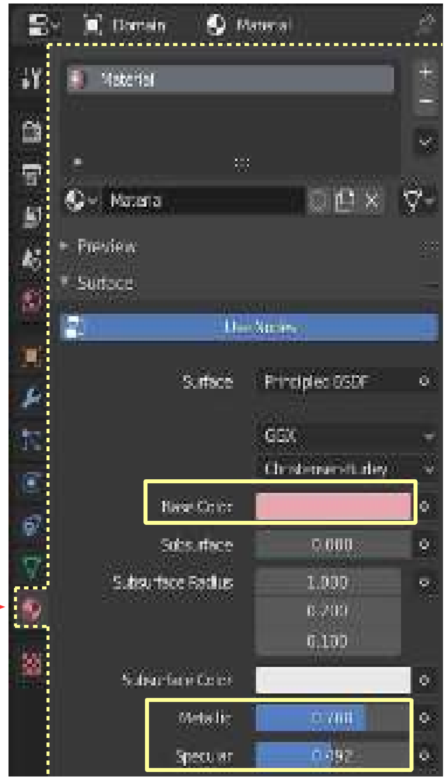


Figure 23.37

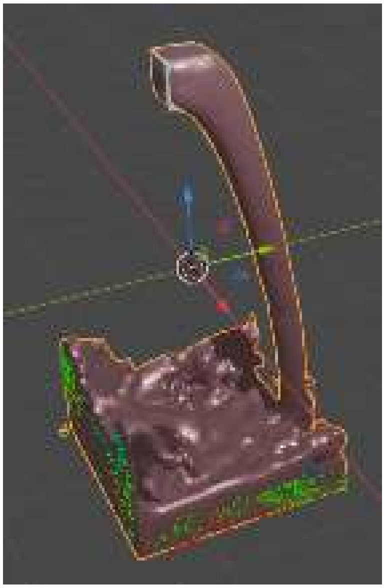


Figure 23.38

Material Buttons

Remember: If your Domain is not created from the default Cube Object you will have to apply a New Material.

Rebaking

You may pause a Bake at any time by pressing the **Esc Key.** Pausing allows you to preview the Fluid being generated in the 3D Viewport Editor. If it looks OK you can continue the Bake.

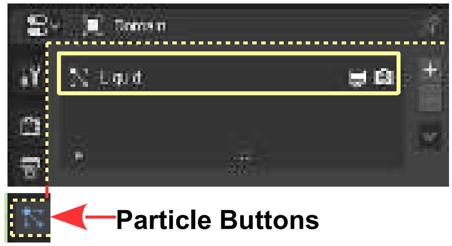
The Bake buttons in the Properties Editor will display a **Resume button** to allow you to restart the Bake.

Note: As soon as you start a Bake the Physics button Controls become grayed out. At this point you can not change settings.

The Bake Data and Bake Mesh buttons change to **Free Data** and **Free Mesh**. Clicking either of these cancels the data saved to memory in the Cache and makes the controls active. You may then adjust settings and Rebake. You may Rebake the Mesh without Rebaking the Data.

Particles on Particles

Figure 23.39



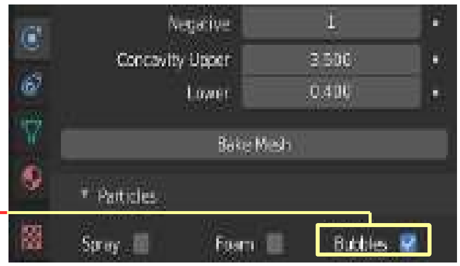
Particle Buttons

So far Particles have been generated which simulate a fluid flow. These were created when the Data was Baked. In the Properties Editor, Particle buttons, with the Domain selected. You will see that a **Particle System named Liquid** has been automatically applied to the Domain.

Note: You can not edit this Particle System in the Particle buttons.

Additional Particles may be created to act as **Spray**, **Foam** or **Bubbles**. To create these Particles you check either one or all of the buttons in the **Properties Editor, Fluid Physics buttons, Particles Tab** (Figure 23.40). The controls in the Particles may be adjusted to affect the selection as a whole.

Figure 23.40

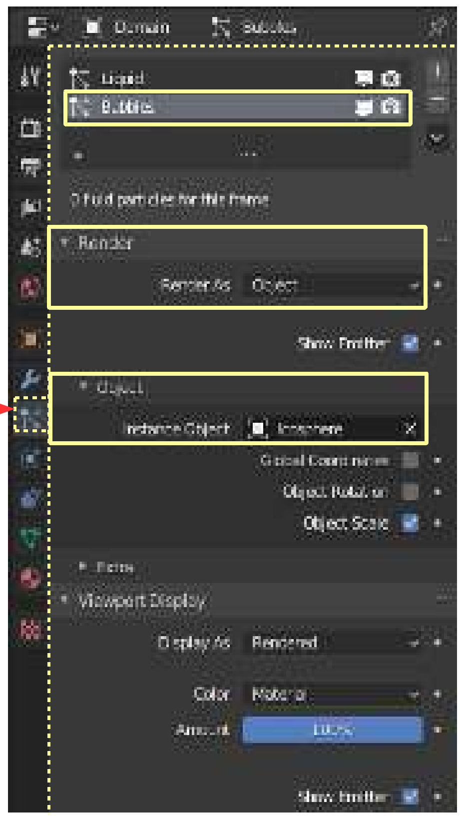


Having checked a selection you will find that a Particle System has been automatically created and added to the Properties Editor, Particle Buttons tab.

In Figure 23.40 **Particle Type: Bubbles** is selected in the Particles Tab.

In Figure 23.41 you see the **Particle System** named **Bubbles** has been automatically created.

Figure 23.41



Remember: Particles do not Render.

To have the Bubbles display amongst the fluid in the 3D Viewport Editor you add an Object to the Scene and set the Particle System to Render the Particles (display) as that Object.

In this exercise the Object will be an **Icosphere.**

Particle Buttons

Summary

In following this exercise, at this juncture, you may be in danger of loosing your way, therefore, a summary follows.

The default Cube Object has been assigned as the Domain.

A second Cube has been scaled down relative to the Domain and positioned inside the Domain. This Cube has been designated as the Inflow Object.

In the Properties Editor, Physics buttons, with the Domain selected, Fluid Data and Mesh Data have been Baked.

In Baking the Data the length of the animation has been set as 50 Frames, therefore, in the Cache Folder you will find three sub folders named; **config** and **data** for the Data Bake and **mesh** for the Mesh Bake. These folders contain 50 x **.uni** files in the case of the Data Bakes and 50 x **.bobj** files for the Mesh Bake.

To continue; Add an **Icosphere** to the Scene in the 3D Viewport Editor. When you add the Icosphere set the **Subdivisions** in the **Last Operator panel** to 1, the objective being to have an Object with a minimal number of vertices which the Particles will render as. This minimises the number of calculations for the computer when Baking Data.

Add a nice bright Material to the Icosphere and set Shading to Smooth. Park the Icosphere off to one side in the Scene (Figure 23.42).

In the **Properties Editor, Particles buttons** (with the Domain selected) (to select the Domain click on Domain in the Outliner Editor) select (click on) the **Particle System named Bubbles** (Figure 23.40). In the **Render Tab** set **Render As** to **Object** and in the **Object Tab** set **Instance Object** to **Icosphere** (Figure 23.41).

In the Viewport Display Tab set Display As to **Rendered.**

Remind yourself that this is fun and when you become conversant with the settings you will produce fantastic results.

Bake your Bubbles. In the Properties Physics buttons, Particles tab click **Bake Particles**.

You could have Spray Particles and Foam Particles set up and Bake these at the same time.

With the Bake complete, play the animation and pause at a Frame (Figure 23.42).

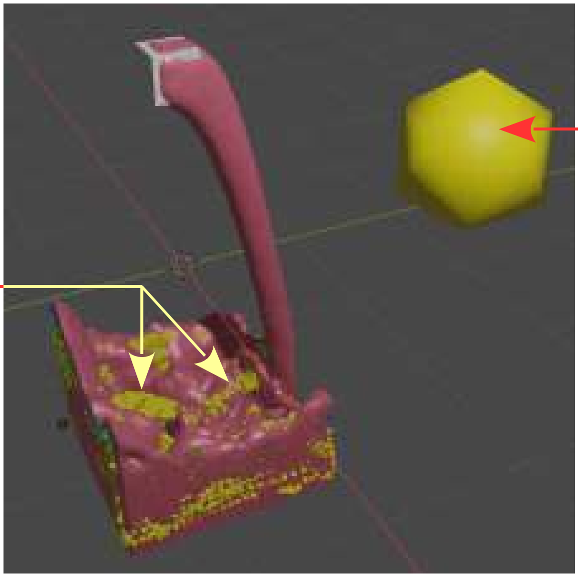


Figure 23.42

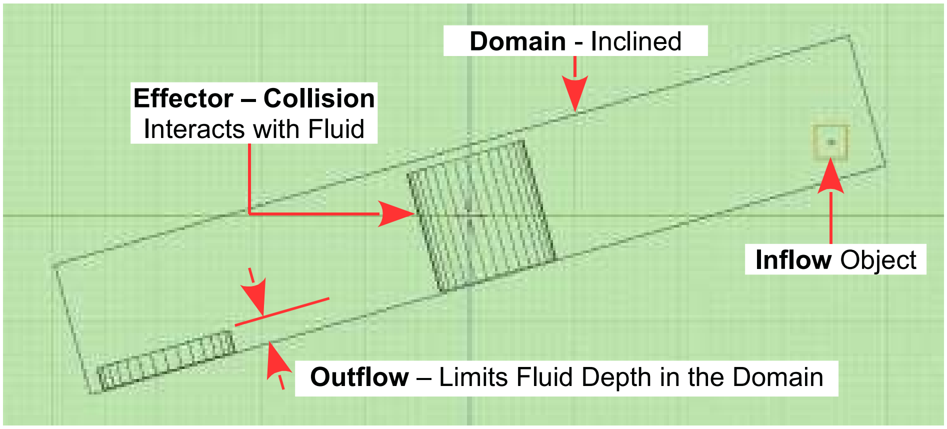
Icosphere parked to one side

Adjusting the size of the Icosphere changes the size of the Particles.

Bubble Particles displaying as the Icosphere

In this exercise settings have been kept to a minimum. Obviously there are many many settings with which to experiment, but the foregoing should help in understanding the basic procedure for Fluid Simulation.

Before you go! Look at **Effector – Collision and Outflow Objects (Figure 23.43)**



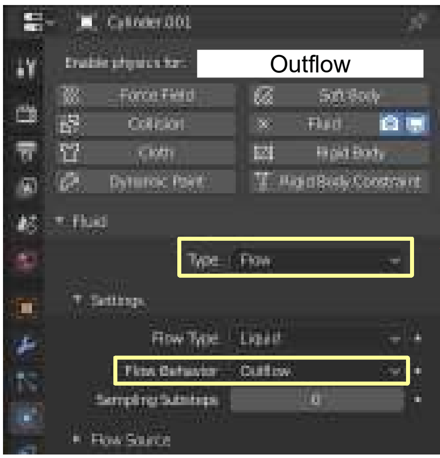
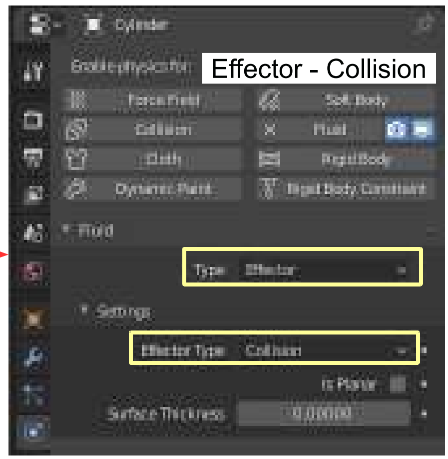
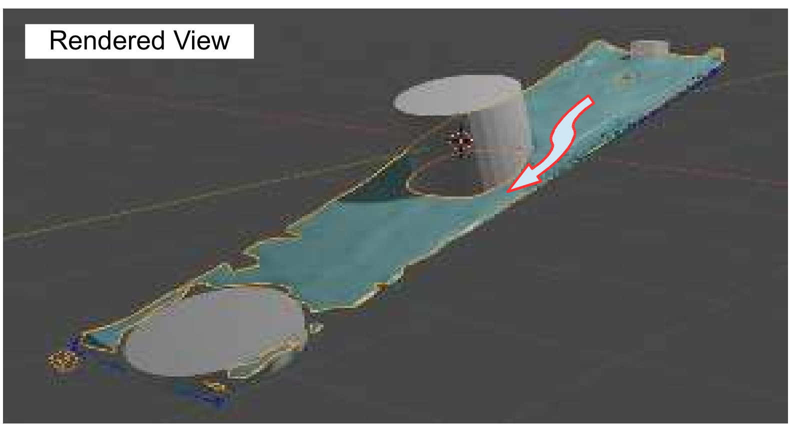


Figure 23.43

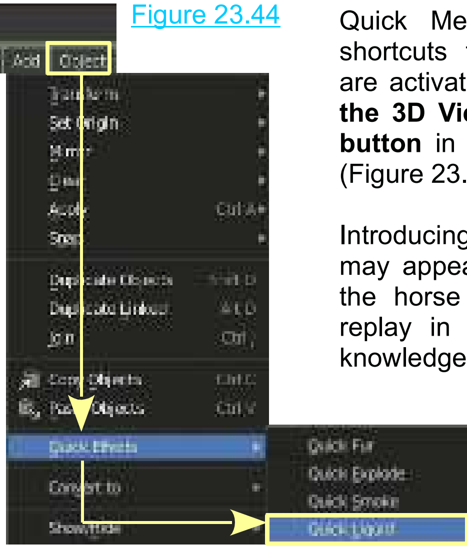
Physics Buttons



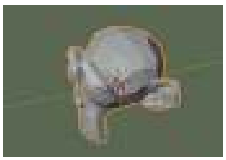


23.8 Quick Methods (Reference: Quick Fur – Hair Particles, Quick Expload - Modifiers)

Figure 23.44



With an Object selected click the **Object button**.



Monkey selected in the 3D Viewport Editor.

Quick Methods or **Quick Effects** are shortcuts for creating Simulations. They are activated **with an Object selected in the 3D Viewport Editor** from the **Object button** in the 3D Viewport Editor Header (Figure 23.44).

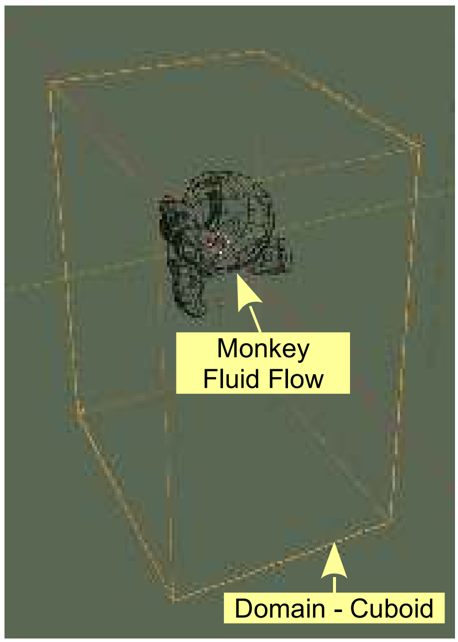
Introducing Quick Methods at this juncture may appear to be shutting the door after the horse has bolted but activating the replay in Physics Simulation requires a knowledge of Simulation Controls.

It is also advantageous to understand how a Quick Effect works, in a practical sense, so you can use a Quick Effect by adding to it.

Consider a Quick Effect for a Fluid Simulation. The Quick Effect for Fluid Simulation is labelled **Quick Liquid**.

As an example, delete the default Cube in a new Blender Scene and add a Monkey Object. **With the Monkey selected** click on the Quick Liquid button in the Quick Effects menu.

Figure 23.45



The Monkey is entered in the 3D Viewport Editor with the Editor in Solid Viewport Shading Mode. Activating the Quick Liquid Effect changes the 3D Viewport Editor to Wireframe Display Mode and the Monkey is surrounded by a Cuboid.

A Fluid Simulation has been created with the Cuboid being the **Domain** and the **Monkey is now a Fluid Flow Object, Flow type Liquid with Flow Behavior: Geometry**.

Controls have been set in the Properties Editor, Physics Buttons (Figures 23.46 and 23.47 opposite).

Flow **Behavior Geometry** sets the Liquid in the Simulation to be delivered as a Mass inside the Domain.

In previous versions of Blender the Simulation could be played by simply pressing the Play button in the Timeline Editor. At the time of writing a secondary control is required.

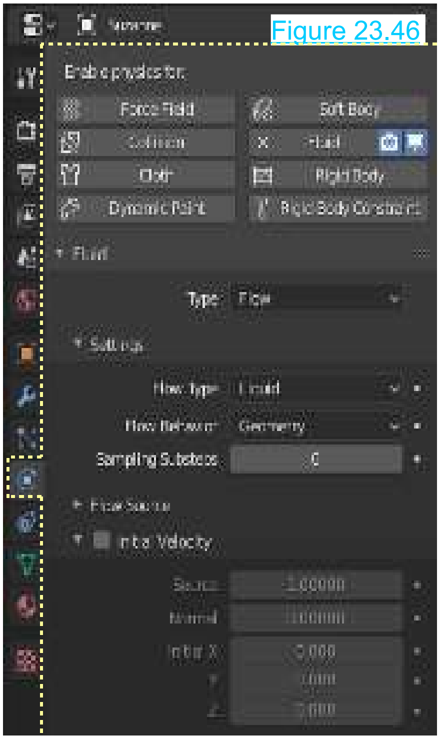


Figure 23.46

Monkey – Fluid flow

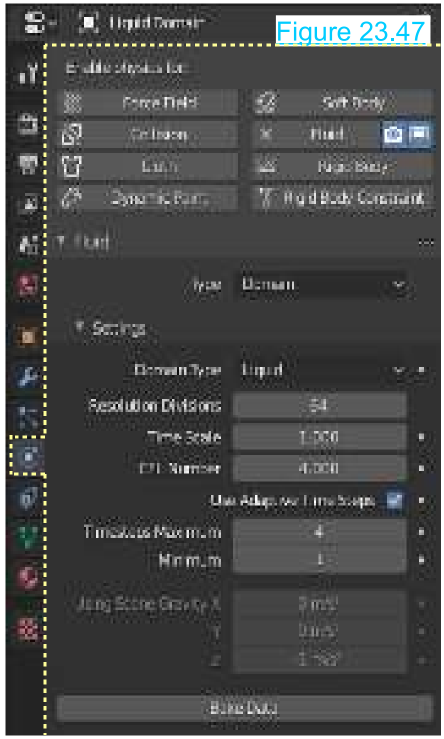
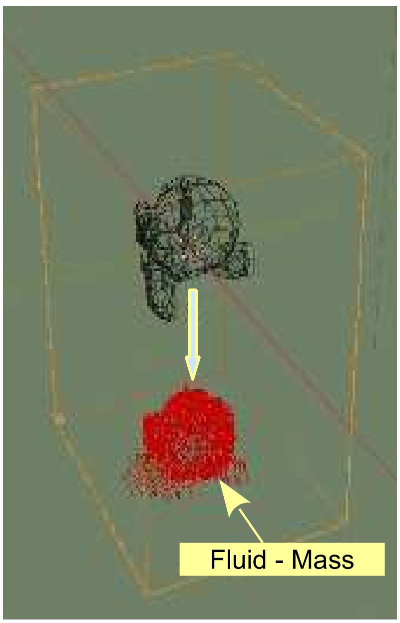


Figure 23.47

Domain Cuboid

Properties Editor, Physics buttons, Cache tab.

Figure 23.48



To see a Simulation play when using one of the Quick Methods, select the Domain in the 3D Viewport Editor then go to the Properties Editor, Physics buttons, Cache tab and **change Type Modular** to **Replay.**

Press Play in the Timeline Editor.

Figure 23.49

Note: Changing Type Modular to Replay when setting up any Simulation allows you to Play the Animation and preview the action before performing a Bake. This is very useful in determining if the Simulation will perform correctly.

23.9 Fluid Simulation Continued

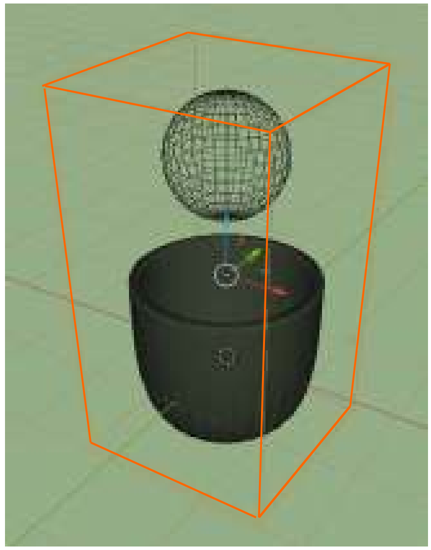
The Fluid Simulation setup in section 23.7 has demonstrated a basic configuration using a Fluid Flow Type: **Flow** with Settings, **Flow Type: Liquid** and Flow **Behavior: Inflow**.

Flow Behavior: Inflow produces a continuous delivery of Fluid over the length of the animation. To expand on the topic examine the difference in Fluid Behavior when **Type Geometry** is employed. Instead of a continuous flow, Type Geometry delivers the Fluid in a mass. An example of this type of delivery would be a single drip of water from a tap.

Filling a Cup

In this example a volume of fluid will be generated to fall into a cup.

Figure 23.50



The arrangement in Figure 23.50 shows the 3D Viewport Editor in Wireframe Viewport Shading Mode. The Scene has been constructed with a fluid Emitter (UV Sphere), a Domain Cube (the default Cube scaled up), and an Obstacle Object (a Cup). For the Cup see Chapter 8 – 8.13 and 8.14.

Note: Providing you have saved a Blender file containing the Cup you will be able to append into a new Blender Scene. **Important: When using the Cup developed in Chapter 8, Apply the Modifiers.**

Domain Object Setup

The Domain is a Cube that has been scaled to enclose the Sphere and the Cup.

For this demonstration default Physics settings will be used.

With the Cube selected, in the 3D Viewport Editor (Figure 23.50). Go to the Properties Editor, Physics buttons (Figure 23.51) and click on **Fluid** to display the Fluid Tab and change the Type to **Domain**. In the Settings tab set **Domain Type** as **Liquid**.

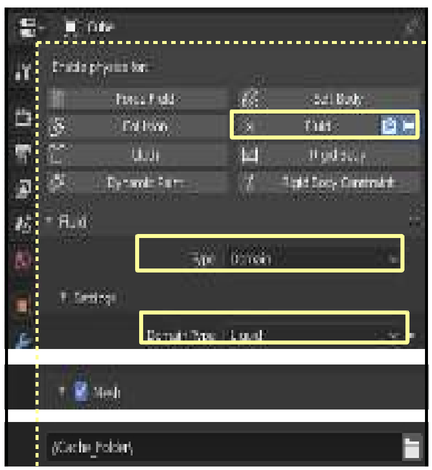


Figure 23.51

Scroll down and check **Mesh**.

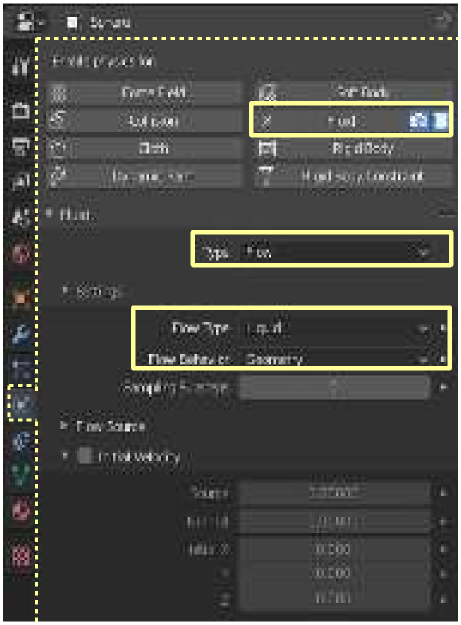
In the **Cache tab** the default End Frame is 50.

In the **Timeline Editor** set the End Frame to 50 (Figure 23.52).

Figure 23.52

Generator Object Setup

Figure 23.53



The fluid is emitted by the Sphere that has been placed in the Domain immediately above the Cup. The convention of calling this type of Object the **Generator** is adopted.

It is tempting to call the Sphere simply the Fluid Object, since it controls the fluid generation, but all Objects included in the simulation which have Fluid Physics applied, are Fluid Objects.

In the Properties Editor, Physics buttons set values as shown in Figure 23.53. Flow Behavior: Geometry sets the Fluid inflow to take the form of the Generator Object. This means the Fluid will be generated as a spherical mass rather than the continuous flow seen in section 23.7.

Obstacle Object Setup

Objects included in the simulation which interact with the fluid are called **Effectors**. The Obstacle to the fluid flow inside the Domain will be the Cup.

Set values as shown in Figure 23.54. Note the Effector Object is named **Cylinder** since the Cup Model has been constructed from a default Cylinder Object and hasn't been renamed. Note also, the **Effector Type: Collision**.

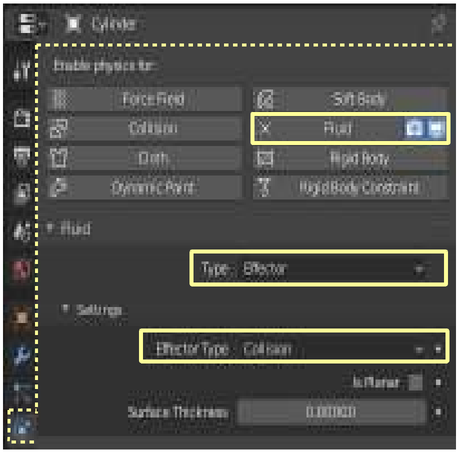


Figure 23.54

Scale and Proportion

When creating a Fluid animation you should consider the proportion (size relationship) of Objects. In this particular simulation the Sphere Flow Object has been scaled relative to the Effector Cup. The volume of the Sphere determines the volume of Fluid generated, therefore, it has been scaled to produce a volume of Fluid that will reasonably fit into the Cup.

As it is, the Cup is 1.99m in diameter which is a very large Cup. If this were to be placed in a Scene with other Objects the scale of everything would have to be relative.

Another factor to consider is Time. Look at the arrangement and think about how long you want this huge drop of Fluid to take to drop into the Cup. So that you can see what happens when this occurs, perhaps two seconds is appropriate.

The animation length has been set at 50 Frames. The output Frame Rate, by default, set in the Properties Editor, Output Properties buttons is 24 fps (Frames Per Second).

50 Divided By 24 = 2.08333 seconds

If you want exactly Two seconds change the Frame Rate to 25.

Viscosity

Yet another factor to consider is **Viscosity**. The viscosity refers to the “thickness” of the fluid and actually the force needed to move an object of a certain surface area through it at a certain speed. Blender uses the kinematic viscosity which is dynamic viscosity.

The table below gives some examples of fluids together with their dynamic and kinematic viscosities.

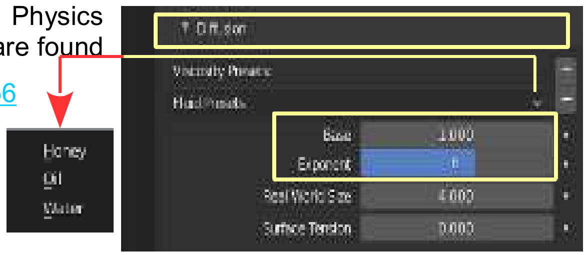
Figure 23.55

Fluid	Dynamic viscosity (in cP)	Kinematic viscosity (Blender, in $m^2.s^{-1}$)
Water (20 °C)	1.002×10^{0} (1.002)	1.002×10^{-6} (0.000001002)
Oil SAE 50	5.0×10^{2} (500)	5.0×10^{-5} (0.00005)
Honey (20 °C)	1.0×10^{4} (10,000)	2.0×10^{-3} (0.002)
Chocolate Syrup	3.0×10^{4} (30,000)	3.0×10^{-3} (0.003)
Ketchup	1.0×10^{5} (100,000)	1.0×10^{-1} (0.1)
Melting Glass	1.0×10^{15}	1.0×10^{0} (1.0)

Blender viscosity unit conversion.

Viscosity is entered in the Properties Editor, Physics buttons, with the Domain selected. The entries are found in the **Diffusion Tab**.

Figure 23.56



By default the Viscosity for Water is set which is;

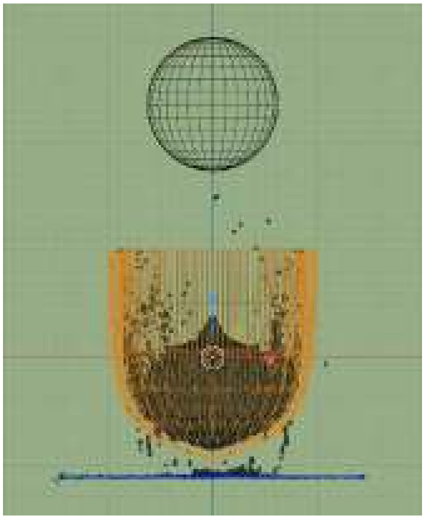
Base: 1.000 and Exponent: 6.

1.002×10^{-6} (0.000001002)

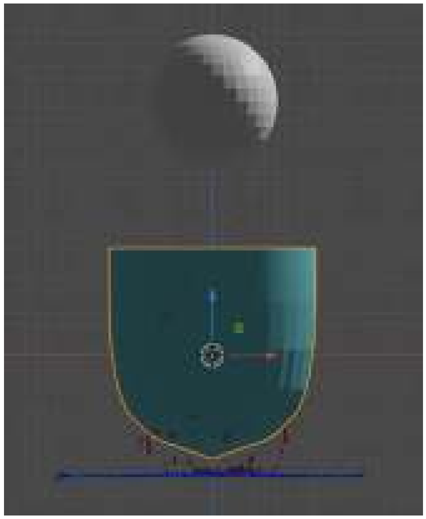
Note: The Diffusion Tab only displays when the Domain Type is **Liquid** and under Viscosity Presets the default display is **Fluid Presets.** Clicking the Fluid Presets button displays a selection menu for Honey, Oil and Water (Figure 23.56). Selecting an option changes Fluid Presets to the option selected.

With these very basic settings in place, **Bake Data** then **Bake Mesh**. How the Bake performs will depend on your computer power. The fantastic video demonstrations on the internet tend to breeze over this process so be warned and be prepared to wait during Baking. On my PC, for this demonstration, Data Bake takes 6 minutes and Mesh Bake takes 10 minutes. The results are as follows.

Figure 23.57



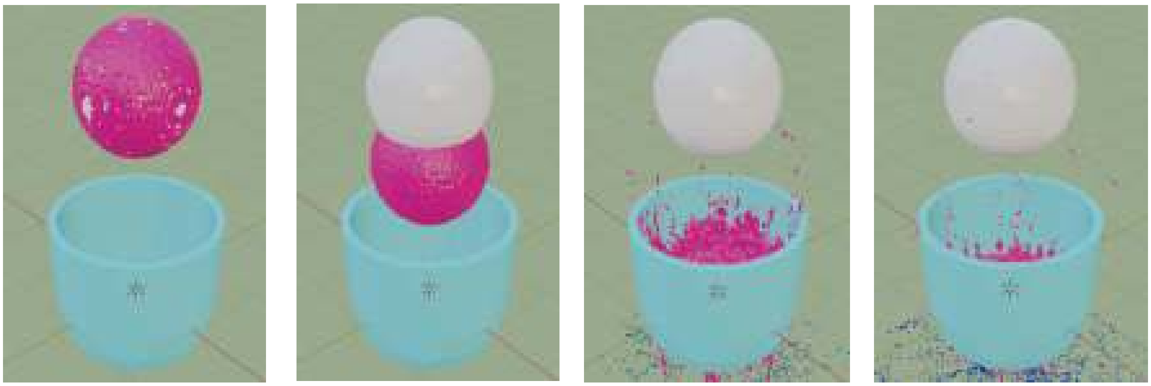
Wireframe Display
Fluid splashing into the Cup
Note: Fluid breaking through the Mesh



Rendered Display

Fluid breakthrough due to low resolution Bake. Add Material to the Domain for Fluid color

Figure 23.58



Note: If the Bake is not performing as expected, it can be terminated by pressing the **Esc Key** or the Cancel button in the Header. Settings can be adjusted to correct the action. To REBAKE the simulation, select the Domain by clicking on Cube in the Outliner Editor (which is now the blob attached to the sphere) and press Resume to continue the Bake. Alternativly, Free the Bake and Bake a second time.

Note: If the demonstration does not perform as expected you could have made an error in the set up. Check your settings and change values accordingly, BUT Note; having changed a setting you will have to Free Data and REBAKE the simulation. Simply changing settings will not correct the action.

Note: Before setting up a new Fluid Simulation clear the data from the Cache file or set a new location for saving the Bake. If data exists in the Cache when a new Domain is created, Blender will attempt to use use the existing data.

In the example Figures 23.57, 23.58 the Fluid is shown partially breaking through the Effector Cup Mesh. After modeling a container, in all probability, you will find that the Fluid, whether its a Inflow or a Geometry, will pass straight through the Effector Mesh.

To demonstrate the foregoing and consolidate Fluid Simulation setup and show how to correct the breakthrough, conduct the following experiment.

23.10 Fluid Simulation Experiment

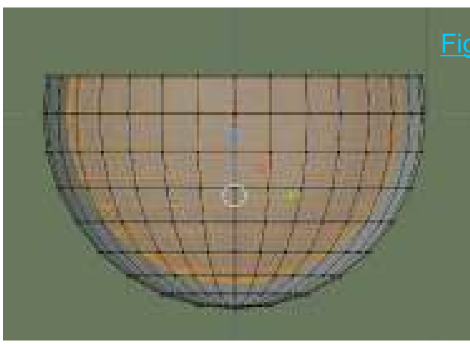
The experiment will show Fluid filling a Bowl.

Modeling a Bowl

A simple method of creating a Bowl is the delete the upper part of a UV Sphere Object by selecting Vertices in Edit Mode (Figure 23.59). With the Vertices deleted and with the remaining Vertices selected, press the E Key to Extrude (duplicates the Vertices) then immediately press the S Key (Scale) and move the Mouse Cursor towards the center, scaling the Extrusion down, forming a inner surface for the Bowl. Finally move the inner selection up to align the rim.

The Bowl will be an Effector Object in the Fluid Simulation and as such must have thickness or be a solid Object. An Object such as a Plane will not work as an Effector.

Figure 23.59



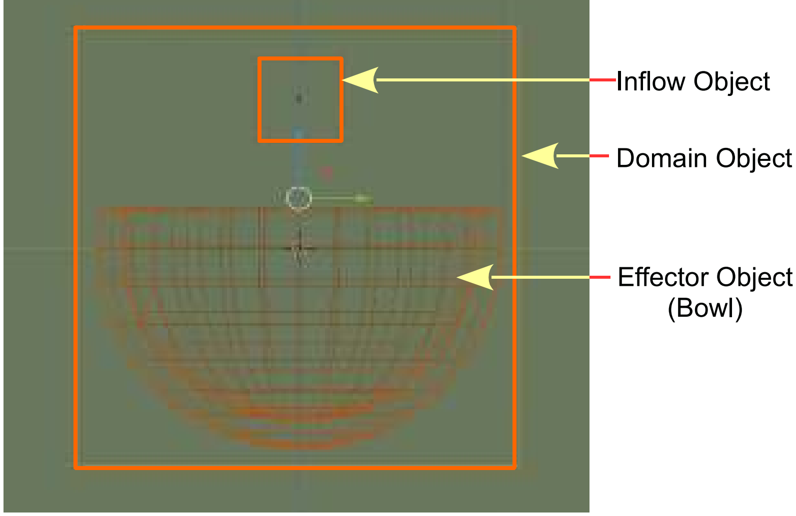
Extruded Vertices aligned at the Rim

Solid Bowl – Solid Viewport Shading Mode

Arrange the model of the Bowl inside a Cube Domain and have a smaller second Cube positioned above the Bowl (Figure 23.60). The smaller Cube will be the Fluid Inflow Object.

Fluid Physics Setup

Figure 23.60



3D Viewport Editor – Wireframe Display Mode

Select each Object to be included in the simulation and apply the following settings in the Properties Editor, Physics Buttons.

Domain: Fluid – Fluid Type: Domain – Settings Domain Type: Liquid.

Have the Liquid tab checked. 

Have the Mesh tab checked. 

Enter the File Path to the Cache Folder. 

Emitter: Fluid – Fluid Type: Flow – Flow Type: Liquid – Flow Behavior: Geometry.
(Flow Behavior Geometry delivers the Fluid as a Mass)

Effector: Fluid – Fluid Type: Effector- Effector Type: Collision.

Note: Apart from the above settings default settings are employed.

Timeline Editor: In the Timeline Editor set the Animation End Frame to 50 to correspond to the end Frame value in the Properties Editor, Cache tab for the Domain settings.

With the above in place, Bake Data (Press Bake Data) in the Properties Editor, Physics Buttons with the Domain selected. (On my PC this bake took 160.93 sec – 2.68 min.)

It is not necessary to Bake Mesh at this juncture. You can play the animation and see the Particles generated to check the Flow in the Domain. **Before playing the animation see over page**.

When you play the animation or step through the animation frames in the Timeline Editor, in all probability, you will see the Fluid Particles generated by the Emitter descend and pass straight through the Bowl splashing into the domain (Figure 23.61). This anomaly is due to the incorrect alignment or direction of **Normals** on the Bowl's Mesh. (Reference: Normals Chapter 22 - 22.5, 22.9)

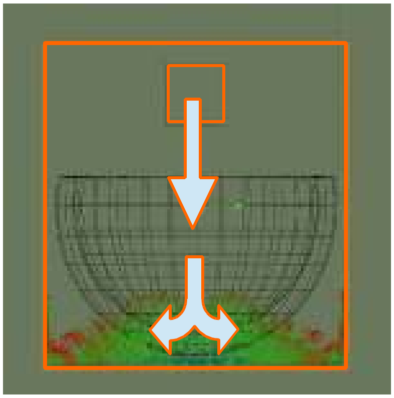


Figure 23.61

To correct, set the animation back to Frame 1 in the Timeline Editor.

With the Domain selected press **Clear Data** in the Physics Buttons to delete the data in the Cache Folder.

In the 3D Viewport Editor, select the Bowl and tab to Edit Mode.

With all Vertices selected, press **Mesh** in the 3D Viewport Editor Header (Edit Mode), select **Normals** in the menu that displays, then click on **Flip** in the sub menu (Figure 23.62).

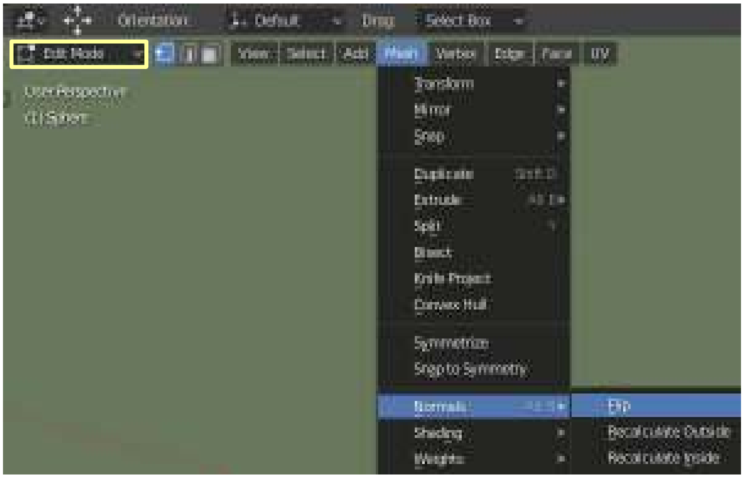


Figure 23.62

Tab back to Object Mode, deselect the Bowl and select the Domain. Rebake Data and play the animation again (Figure 23.63).

With Normals correctly aligned the Fluid splashes into the Bowl (Figure 23.63).

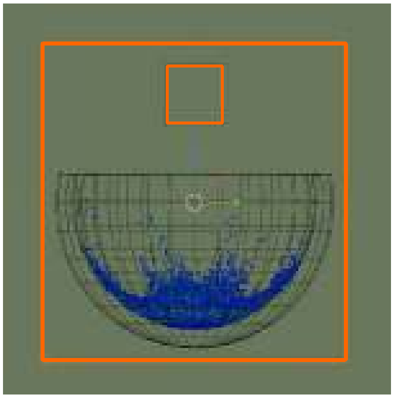


Figure 23.63

At this point you are only viewing the Particles which demonstrate the Fluid Flow. With the Timeline Cursor at Frame 1, **Bake the Mesh** then replay the animation to see **Fluid**.

This experiment has been using a Fluid flow Type Liquid with Flow Behavior: Geometry.

With the identical arrangement, clear the Data to remove data from the Cache Folder then change the Flow Behavior to Inflow. Changing to Inflow will deliver the Fluid in a continuous stream instead of a Mass (Figure 23.64). The stream will descend into the Bowl and continuously fill the bowl, eventually overflowing and filling the Domain (Figure 23.65).

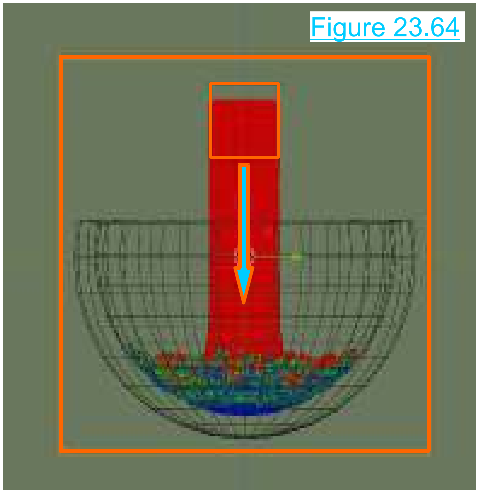


Figure 23.64

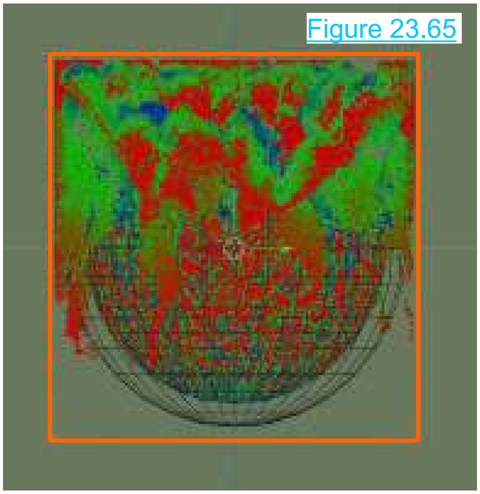


Figure 23.65

With Fluid Simulation the effects are limitless. To discover the possibilities you will have research tutorials on the internet and experiment by yourself. Some effects will be fairly obvious but when you have an idea to create an animation, in the beginning you may find the techniques required to perform the operations required are allusive. The following example will show another variation on what has already been describe.

Ball Dropping into a Cup

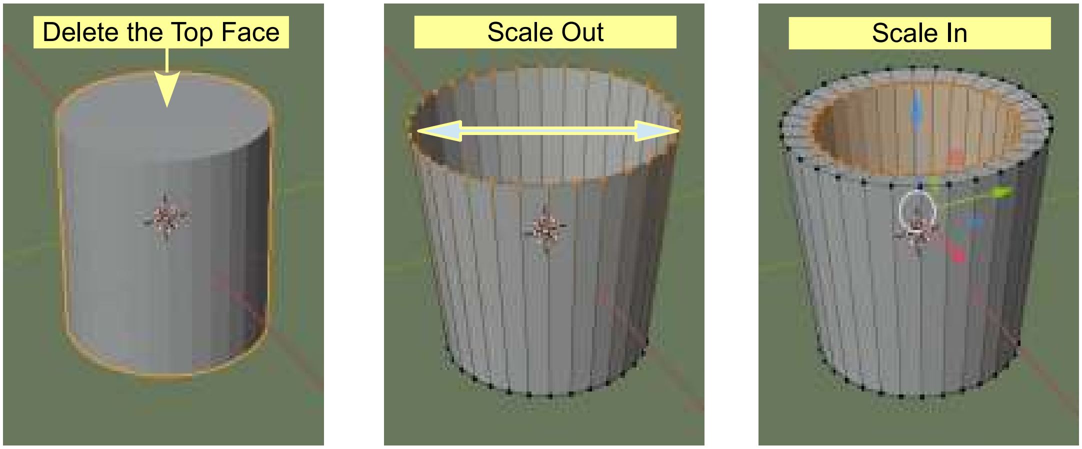
This example will demonstrate how to set up a Sphere to drop into a Cup containing a Liquid.

The first task is to model a Cup. Start with a Cylinder Object and tab into Edit Mode. In Edit Mode change Vertex Select Mode to Face Select Select Mode and delete the top Face of the Cylinder.

Change back to Vertex Select Mode, select the upper rim of Vertices and Scale out slightly forming a thin walled Cup. The Cup will become an Effector Type Collision Object in the Fluid Simulation. Remember; simple planer objects will not work as Effectors.

To give the Cup wall thickness, select all Vertices, Press the E Key (Extrudes – Duplicates selected Vertices), press the S Key (Scale) and move the Mouse Cursor towards the center, scaling the selected (duplicated) Vertices. While remaining selected move the selection up forming a flat rim.

Figure 23.66



From previous experience Fluid generated will in all probability pass through the Cup's Mesh due to the misalignment of Normals. With all Vertices selected, Flip Normals as previously described. Tab into Object Mode.

Arrangement

The arrangement of Objects for this simulation is shown in Figure 23.67 opposite. A Cube has been scaled on the Z Axis forming the Domain. The Cup is scaled to fit inside the Domain and positioned at the bottom. The Cup is an the Flow Object, Flow type: Liquid with Flow Behavior: Geometry.

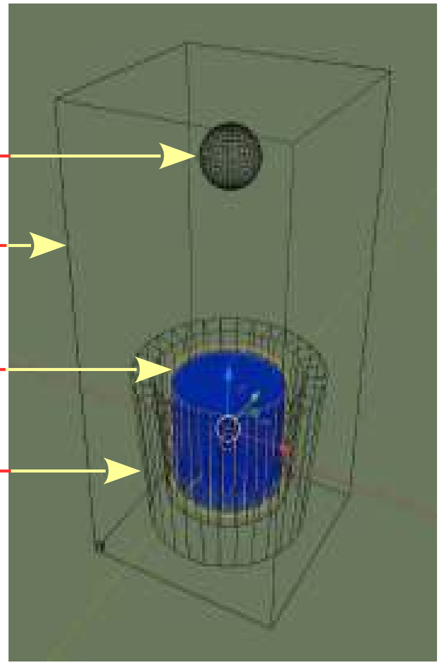
A Cylinder Object is Scaled to fit inside the Cup and positioned just above the bottom of the inner surface of the Cup. In Figure 23.67 Data gas been Baked, therefore Fluid Particles can be seen (blue dots) attached to the Cylinder while at Frame 1 in the animation.

A UV sphere Object is Scaled down and positioned towards the top of the Domain immediately above the Fluid Inflow Object.

Settings

Figure 23.67

In the Property Editor, Physics Buttons, default settings are employed with the Objects participating in the Simulation as follows:



UV Sphere – Fluid Type: Effector - Collision

Domain Cube – Fluid Type: Domain

Inflow Object Cylinder – Fluid Type: Flow – Flow Type: Liquid – Flow behavior: Geometry

Cup – Fluid Type Effector – Effector Type: Collision

In the Domain settings the Liquid Tab and the Mesh Tab are checked. The File path to the Cache Folder is entered in the Cache Tab. The End frame in the Cache Tab is 50 and in the Timeline the End Frame is 50 (Figure 23.68).

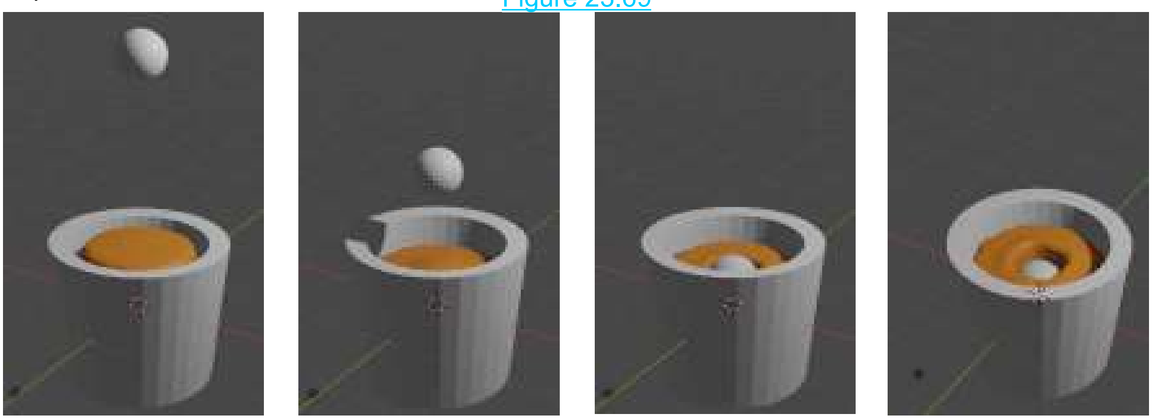
The UV Sphere Effector Object is animated to fall into the Cup starting at Frame 10 and ending at Frame 30.

Figure 23.68

Keyframes

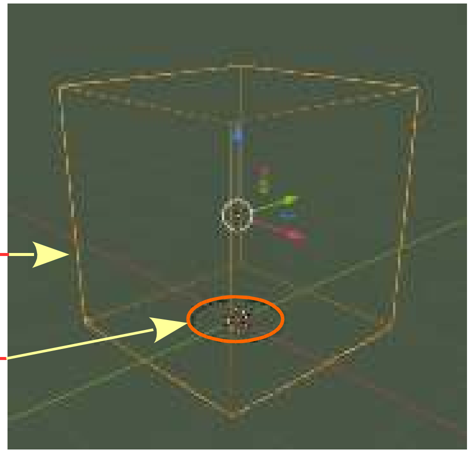
With Data and Mesh Baked, Rendered Viewport Shading Mode sees the Sphere falling into the Liquid.

Figure 23.69



23.11 Smoke and Fire Simulations

Figure 23.70



Domain

Emitter

To setup a Smoke and Fire Simulation the procedure is similar to setting up a Fluid Simulation. The following exercise will demonstrate the very basics using default settings. This is intended as an introduction only enabling you to follow detailed tutorials available on the internet.

The very basic setup requires a Domain Object (default Cube) and an Emitter Object (Circle).

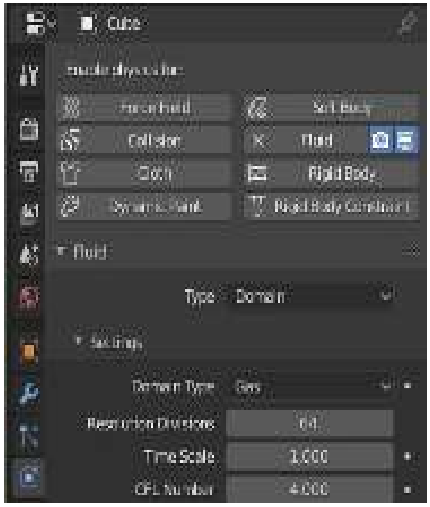
Emitter Object

In the default Blender Scene deselect the default Cube Object, then in Wireframe Display Mode add a Circle Object. Scale the circle down and position inside the default Cube close to the bottom of the Cube (Figure 23.70).

With the Circle selected, Tab to Edit Mode and press the **F Key** to **Face the Circle** (fill in). Tab back to Object Mode.

Domain Object Setup

Figure 23.71



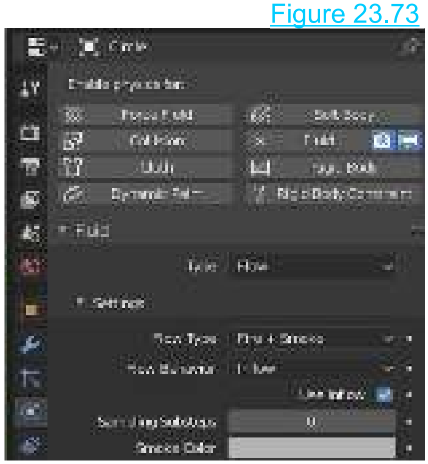
Select the Cube Object in Object Mode. In the Properties Editor, Physics buttons, enable Physics: Fluid (Figure 23.71).

Select Fluid Type: Domain and Domain Type: Gas.

Figure 23.72

In the Fire Tab set the Flame Color (Figure 23.72).

Figure 23.73



In the Cach Tab enter the file path to the folder where you wish the Cache Data to be saved. Make the End Frame in the Cache tab: 100 and change the End Frame in the Timeline Editor to 100.

Emitter Object Setup (Figure 23.73)

Deselct the Cube and select the Circle. In the Properties Editor, Physics buttons, enable Physics: Fluid, Fluid Type: Flow, Flow Type:Fire + Smoke and Flow Behavior: Inflow.

Select the Domain in Wireframe Display Mode and Bake Data then play the animation in the Timeline Editor.

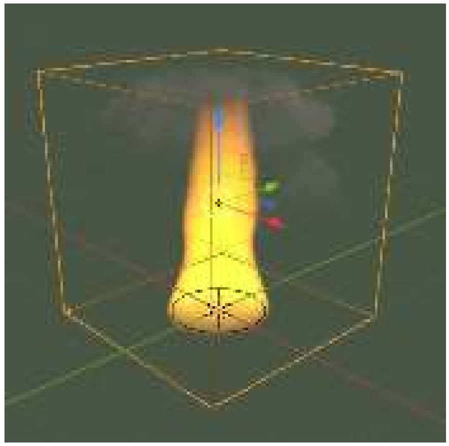


Figure 23.74

At this point you **will not** see Fire and Smoke in Rendered Viewport Shading Mode or in a Rendered Image.

To see a Rendered View, have the Domain selected. Divide the Screen and make one part the Shader Editor.

A **Principled BSDF Node** connected to the Surface Socket of the **Material Output Node** is displayed.

Replace the Principled BSDF Node with a **Principled Volume Node** and connect it to the Volume Socket on the Material Output Node. Have the settings in the Principled Volume Node as shown in Figure 23.75.

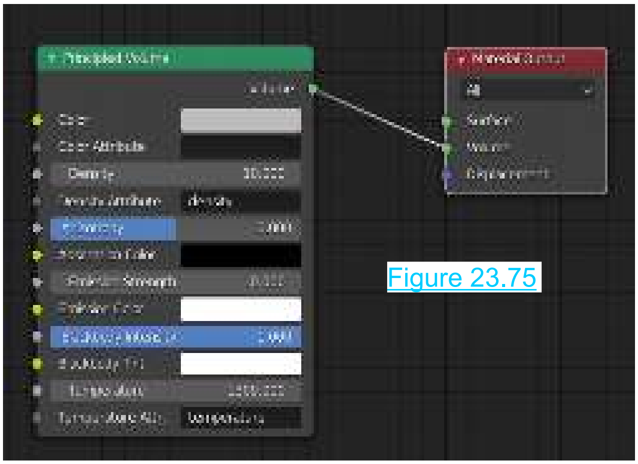


Figure 23.75

Play the animation with the 3D Viewport Editor in Rendered Viewport Shading Mode, pause the animation and render an image (Figure 23.76).

Figure 23.76

As you will observe the rendered Image is not all that brilliant. Playing the animation with the 3D Viewport Editor in Wireframe Display Mode looks better.

Up to this point this has been only an introduction. Once again there are many, many settings to explore and you will find detailed instruction in tutorials on the internet.

To improve the simulation, Free the Bake Data (click Free Data in the Domain, Settings Tab). Freeing Data removes all the Folders and Files from the Cache Folder leaving a clean slate with which to start over. The settings for the Domain and Emitter Objects remain in the Blender File.

Modify the settings in the Blender File per the following instruction notes. Some settings will remain the same but will be repeated to enable you to check them off as you go.

Modified Instructions

Domain Object Settings: Fluid Type: Domain - Settings, Domain Type: Gas - Resolution - Divisions: 64

Scroll down to the **Fire Tab.**

Reaction Speed: Flame Height
(Lower Value – Higher Flame)
Flame Smoke (increase to add more Smoke)
Flame Vorticity (increase to add randomness)

Figure 23.77 Check **Adaptive Domain** and **Noise**.

Adaptive Domain – Speed up the Bake

Upres Factor – Up Resolution (multiplies the Base resolution by this value – 3 x 64 = 192)

Cache – Frame Start 1 – Frame End – 100, Enter the File Path to the Cache Folder.

Figure 23.78

Inflow Object Settings:

Inflow Object Settings are shown in Figure 23.78.

Fluid Type: Flow
Settings Flow Type: Fire + Smoke
Flow Behavior: Inflow

Physics Button

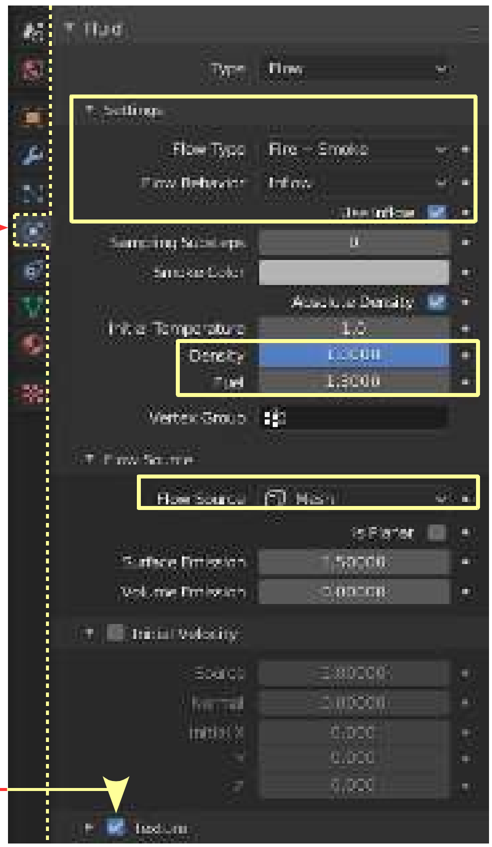
The Flow Source is from the Circle Mesh.
Density controls the thickness of Smoke.
Fuel is another factor controlling Flame Height.

Make particular note that **Texture** is checked at the bottom of the panel.

A Texture may be created which is used to influence how Flames are generated. The Texture is mapped to the surface of the Circle Emitter Object. Dark areas of the Texture produce Fire while lighter areas do not produce Fire.

The Texture Mapping may be animated to move on the surface of the Emitter Object as the simulation animation plays thus enhancing the Flame effect.

Texture Checked

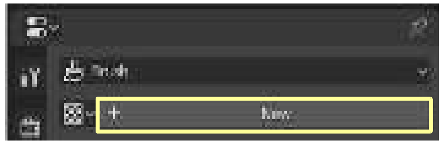


Using a Texture

The first step in using a Texture is to create the Texture.

Note: The Texture may be created independent of any particular Object.

Figure 23.79



In the **Properties Editor, Texture buttons**, click on the **New** button to create a new default Texture (Figure 23.79).

Where you see **Image or Movie**, click and select **Clouds** which is one of Blenders inbuilt Textures (Figure 23.81).

Figure 23.81

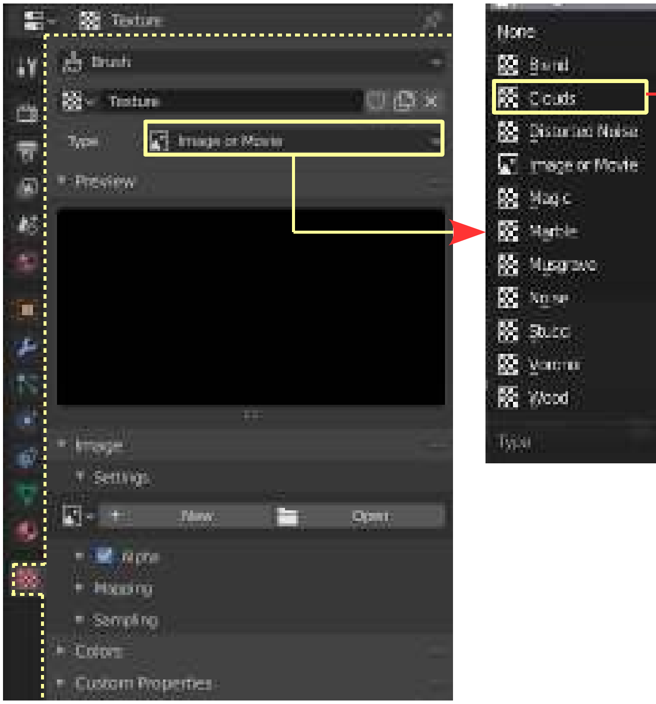
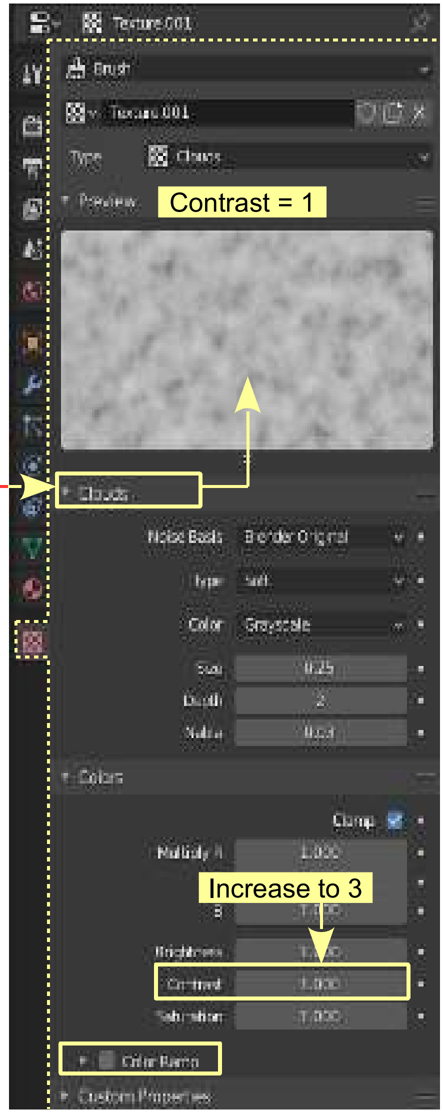


Figure 23.80



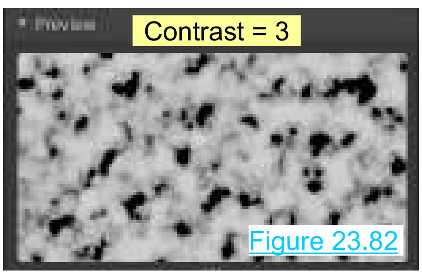
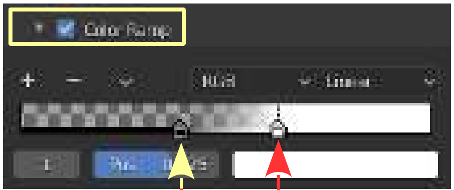


Figure 23.82

When the Texture, in this case, the **Clouds** Texture, is mapped to the surface of the Emitter Object, the lighter, white grey areas will produce Fire in the simulation. The darker grey black areas will have no Fire. Obviously it is preferable to have a more contrast. In the Texture buttons, Colors tab increase the **Contrast value** to **3** (Figure 23.80).

The contrast in the Texture may be further defined by activating and adjusting the **Color Ramp**.

Figure 23.83



Preposition the Stops to adjust the Contrast
(see Chapter 16 – 16.25 Color Ramp)

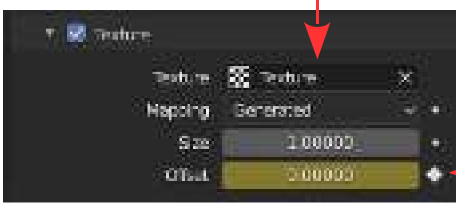
With the Texture created, select the Circle Flow Object in the 3D Viewport Editor and open the Texture Tab in the Properties Editor Physics buttons. Click on the Texture button in the Tab and select **Texture** from the menu that displays. Texture is the new Texture you have created and selecting here automatically maps the Texture to the surface of the Circle Emitter Object.

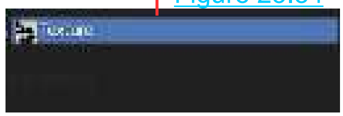
Entering the Texture

With the Texture created it has to be entered in the Physics simulation. Make sure you have the Fluid Flow Object (the Circle) selected and Texture checked in the Physics buttons Texture Tab.

Click on the bar next to Texture and select Texture from the menu (single entry).

Figure 23.84



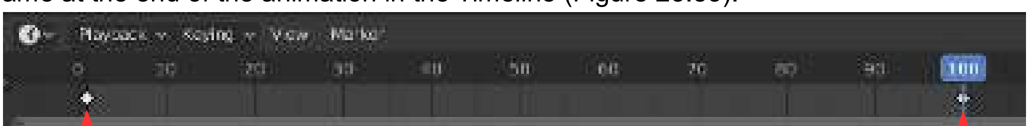


Click the dot (changes to a diamond)

Animating the Texture

By animating the Texture to move on the surface of the Emitter Object the Flames being generated will move accordingly, producing realism.

Have the Timeline editor Cursor at Frame 1. In the Properties Editor, Physics buttons, Texture tab, click the little dot (button) adjacent to Offset. The Offset value (0.00000) turns yellow green and the dot becomes a white diamond. This indicates that an Animation Keyframe has been inserted at Frame I in the animation. Move the Timeline Cursor to Frame 100 (the End Frame), change the Offset value to 0.60000 then click on the white triangle. This inserts a second Keyframe at the end of the animation in the Timeline (Figure 23.85).



Keyframe Figure 23.85 Keyframe

Play the animation to see Flame and Smoke generated from the Circle Emitter.

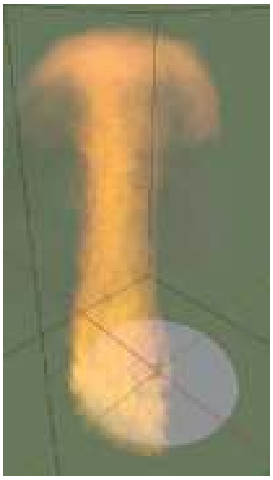
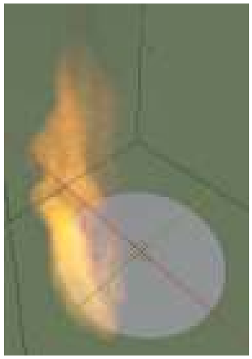
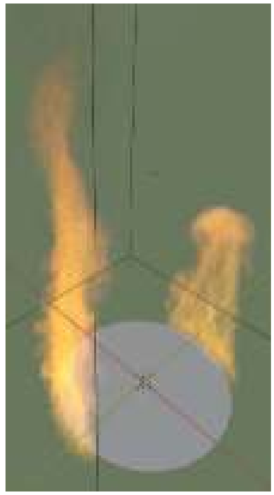


Figure 23.86

Solid Viewport Shading Mode

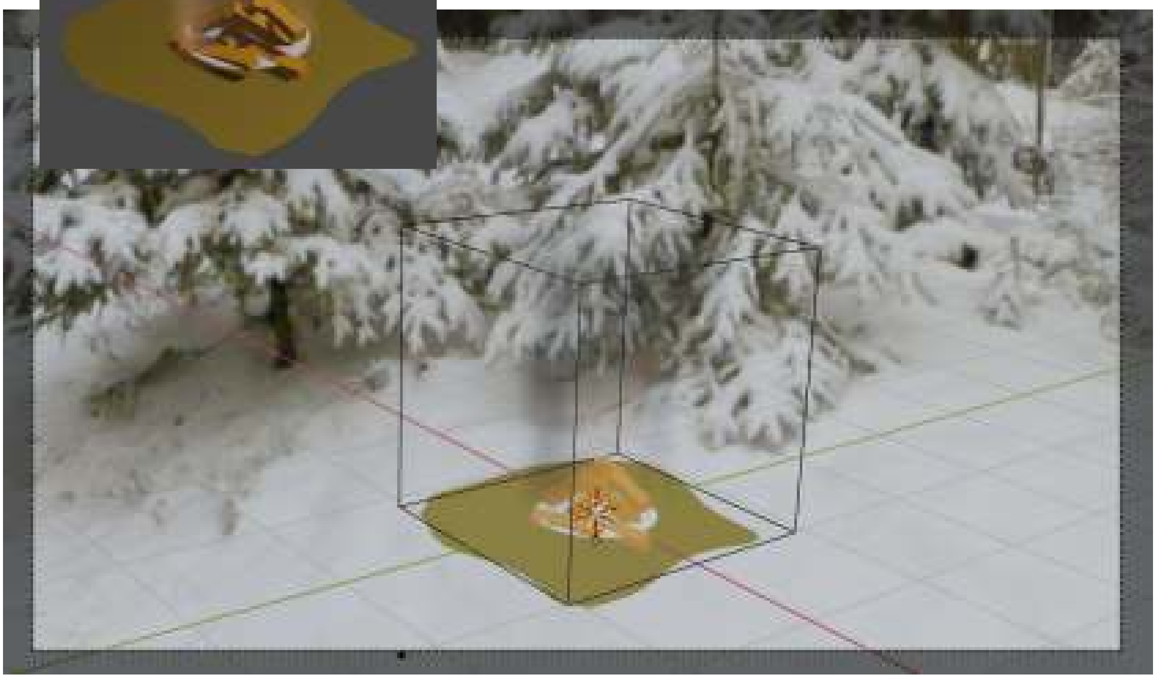




Add Firewood to the Scene then introduce an HDRI image as a background (see Chapter 15 – 15.8).

Figure 23.87

Winter Campfire Scene



23.12 Force Fields

Animating a Texture is one way of adding realism to a Fire and Smoke Simulation. You may also introduce **Force Fields** into a Scene for similar affect.

To demonstrate start with the arrangement in the previous example (Figure 23.88). Note: Unless specified default setting values will be used.

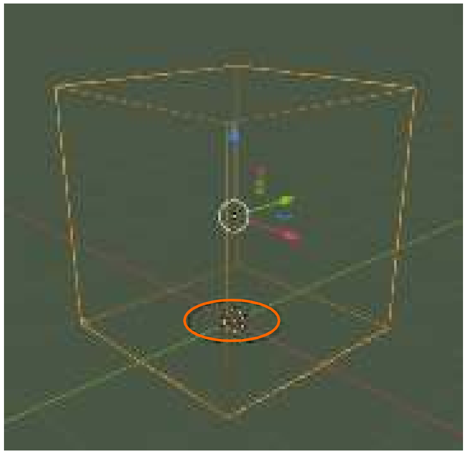


Figure 23.88

In the Properties Editor, Physics buttons for the Domain ensure that all Border Collision options are checked (Figure 23.89). Create a Cache Folder and set the End Frame value to 100 (Figure 23.90). Check Adaptive Domain (speeds up the Bake).

Figure 23.89

Figure 23.90

In the **Timeline Editor**, set the End Frame to 100.

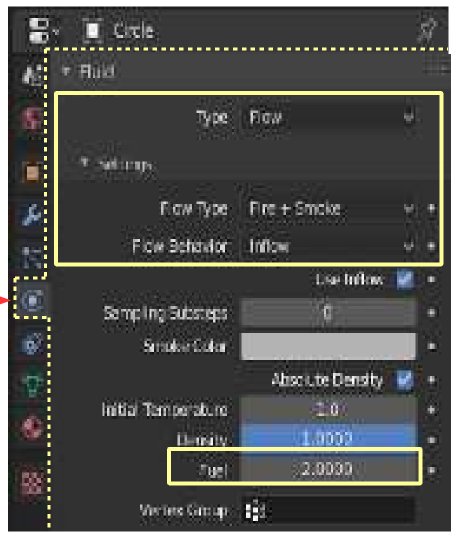
For the **Emitter Object** (Circle) set the Flow Type: Flow

Settings Flow type: Fire + Smoke with Flow Behavior: Inflow.

Change the **Fuel** value to 2 (increases the Flame).

Figure 23.91

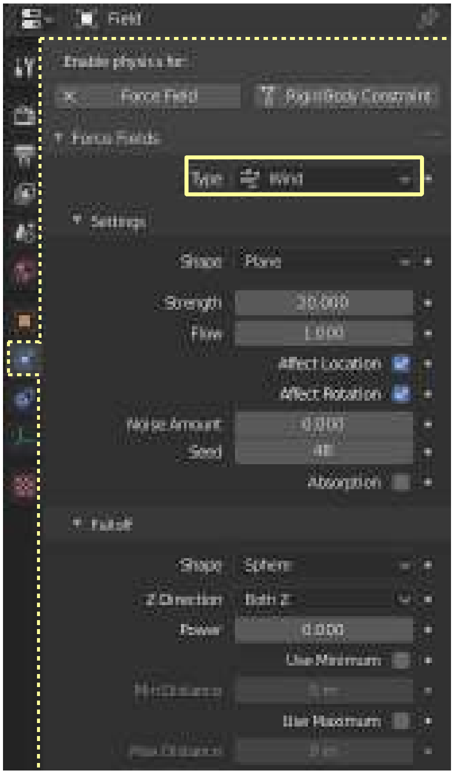
Physics Buttons

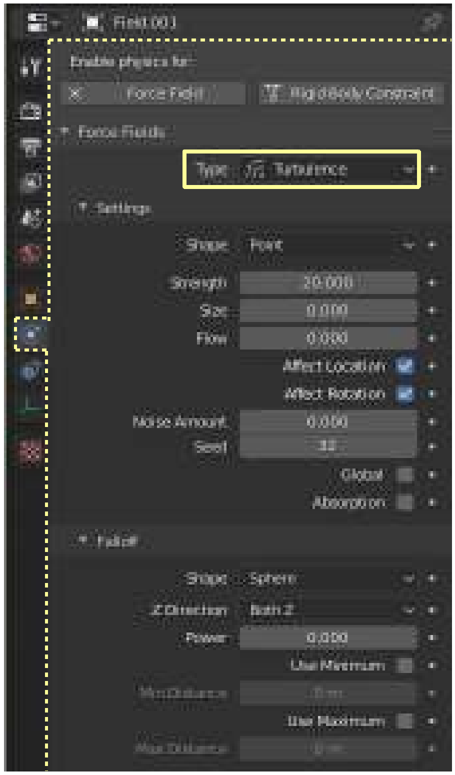


At this point you may preview the Simulation by setting the Cache Type to **Replay** and pressing the Play button in the Timeline Editor. As each Frame in the Animation is calculated Smoke displays filling the Domain and the Domain expands. Replaying the Animation when Frame 100 is reached shows Flame with a reduced Smoke density.

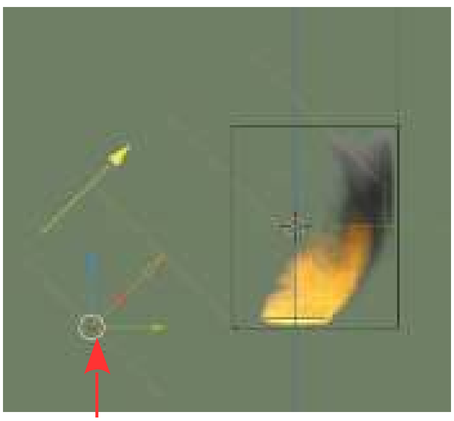
Change the Cache Type back to Modular.

Add a **Wind Force** to the Scene (Figure 23.92) rotated 45° and set the Strength value to 20 in the Properties Editor, Physics buttons. Add a Turbulence Force to the Scene with Strength 20.

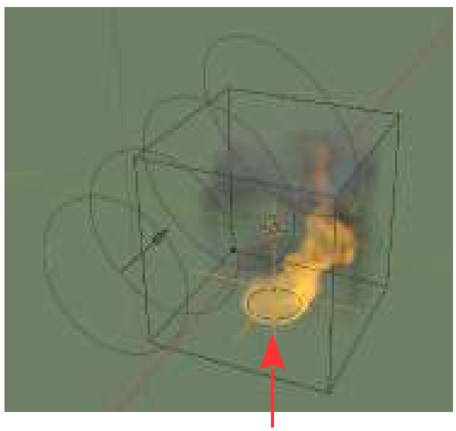




Wind Force Figure 23.92 **Turbulence Force**



Wind Force



Turbulence Force

Bake the Simulation and play the animation to see the Smoke and Flame blown in the direction of the Wind Force and swirled inside the Domain by the Turbulence Force (Figure 23.93).

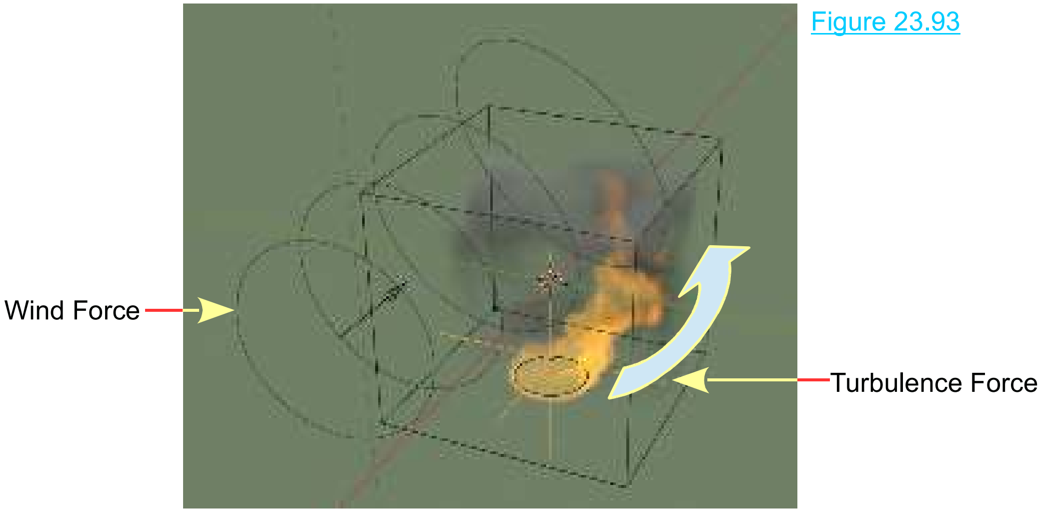


Figure 23.93

24

Dynamic Paint

24.1 Dynamic Paint

Introduction

Dynamic Paint is the process of using one Object to color (paint) or deform the surface of another Object.

When coloring the process is much like painting on a canvas using one Object as a Brush. The Object being painted on is the Canvas.

Although being called Dynamic Paint the process can also deform the surface of an Object by displacing Vertices in a permanent displacement or by simulating a wave formation as one Object moves through the surface of another Object in a dynamic effect.

The following will demonstrate the basic setup when using Dynamic Paint and is intended to show you one method of achieving a result. By adjusting settings in the Properties Editor and creating Node arrangements in the Node Editor the final outputs are infinite.

24.1 Dynamic Paint - Painting

To demonstrate **Dynamic Painting** a UV Sphere Object will be used as a Brush to paint a Material Color onto the surface of a Plane Object, the Canvas. You may use any Object as Brush and paint on to the surface of any Object. A Plane gives a nice flat surface on which to work.

The word Dynamic in the title refers to the fact that, in this process, painting takes place when an animation sequence is being run in the Timeline Editor. The Brush is moved on the surface of the Canvas while the animation sequence is running. This introductory demonstration will employ **Format Type: Vertex** which means that where the Brush Object coincides with the Canvas Object, the Vertices of the Canvas at the intersection, will have color applied.

Set up a Scene as shown in Figure 24.1 with a UV Sphere Object off center of a Plane Object. The Plane is scaled up six times and subdivided, in Edit Mode, **eighty times** producing plenty of Vertices. The Plane has a Material applied (blue).

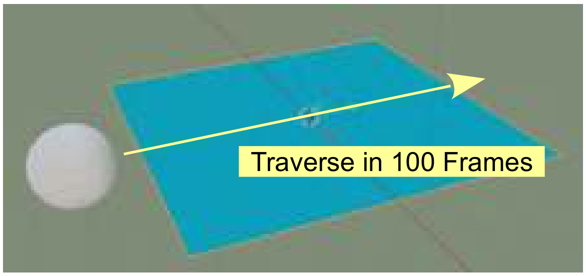


Figure 24.1

For convenience when testing the procedure, animate the UV Sphere to traverse the Plane on the Y Axis in 100 Frames.

> **Caviat:** The following procedure has been developed through experimentation and describes one method only.

Since this exercise is concerned with the application of color have the 3D Viewport Editor in **Material Preview Viewport Shading Mode.**

Brush Configuration

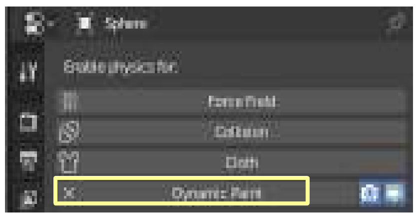


Figure 24.2

Select the UV Sphere (at Frame 1 in the Animation). Note: The Sphere **does not** have a Material applied but is displaying in the viewport with the default Blender gray color.

In the **Properties Physics buttons** (Figure 24.2), click **Dynamic Paint** then in the **Dynamic Paint Tab** set the Type to **Brush** (Figure 24.3) and click **Add Brush to display Settings**.

Make Note: Paint Color is dark blue and in the **Source Tab, Paint** is type **Mesh Volume**. These settings will be revisited later.

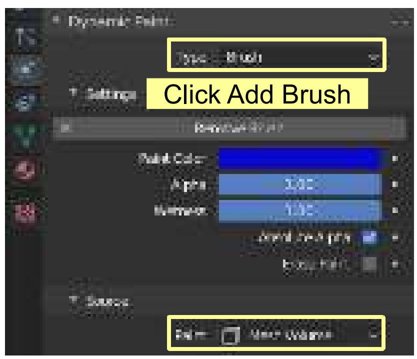


Figure 24.3

Canvas Configuration

Figure 24.4

Select the Plane and Tab to Edit Mode. Ensure that the Mesh is subdivided creating plenty of Vertices.

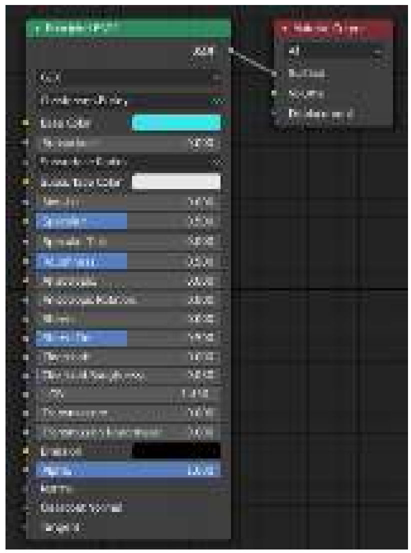
Tab back to Object Mode and activate Physics, Dynamic Paint in the Properties Editor, this time with Dynamic Paint **Type: Canvas**. Click Add Canvas to display the Dynamic Paint Properties.

In the **Surface Tab**, make note that the **Surface Type** is **Paint**.

In the **Output Tab** (way down the bottom) click the plus sign next to **Paintmap Layer**. Clicking the plus sign enters **dp_paintmap** in the Layer bar.

Node Configuration

Figure 24.5



In the initial Scene set up the Plane Object (Canvas) had a Material applied (blue color). Applying the Material created a Node System consisting of a Principled BSDF Node, with the Base Color being blue, connected to a Material Output Node (Figure 25.4).

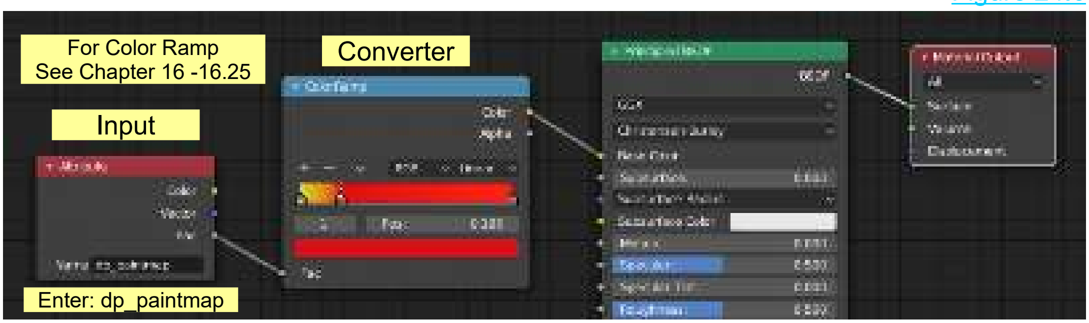
Open the **Shader Editor** to see the Node arrangement.

In using Dynamic Paint the Node Arrangement has to be reconfigured. To apply logic to the exercise consider the following:

In the Properties Editor, selecting Surface Type: Paint, instructs the Dynamic Paint Physics to apply Material Color to the Canvas. Activating the Paintmap Layer (dp_paintmap) says “Paint on a Layer defined by the coincidence of the Brush Object Vertices and the Canvas Object Vertices”.

For this to occur you have to instruct Blender, via the Material Node System to perform the operation. You add and connect Nodes as shown in Figure 24.6 (see Chapter 16).

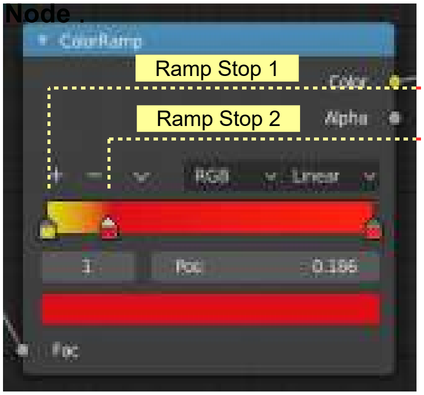
Figure 24.6

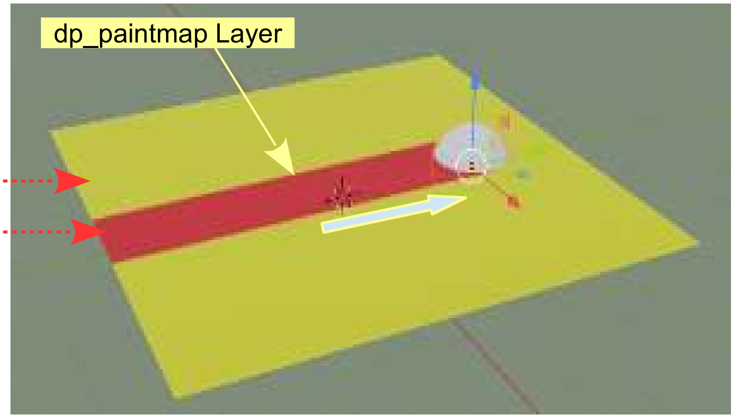


With the Nodes configured, in this particular instance, the Plane displays yellow and when the Animation is played in the Timeline a red stripe is painted where the UV Sphere coincides with the surface of the Plane (Figure 24.7)

Figure 24.7

The color of the Plane and the Paint Color are determined by the settings in the **Color Ramp Node**.





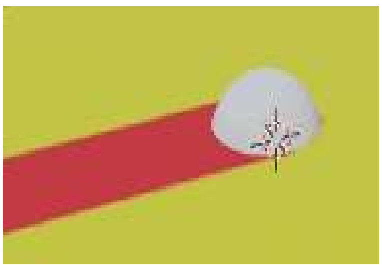
For Color Ramp settings see Chapter 16 – 16.25

Paint Color: In this particular arrangement the Paint Color setting for the Brush, in the Properties Editor, Physics buttons, Dynamic Paint, Settings Tab are superseded by the Color Ramp. However, the **Paint settings** in the Brush (UV Sphere) **Source Tab** have an influence.

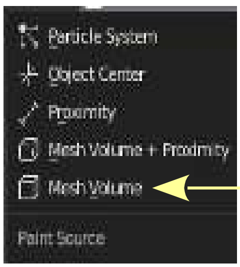
Brush Paint Source Options

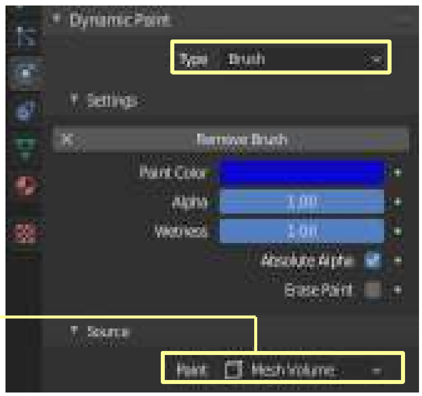
Figure 24.8

Paint Settings in the **Dynamic Paint, Source Tab**.

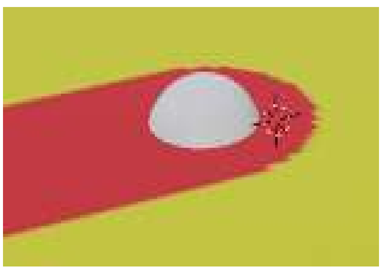


Mesh Volume

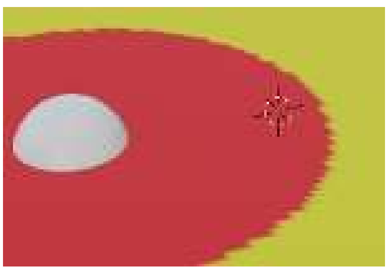




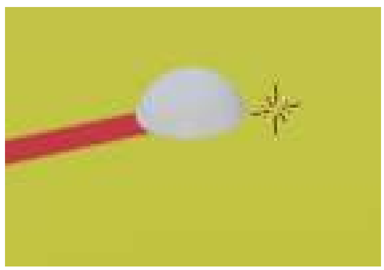
Note: Control settings display when options are selected



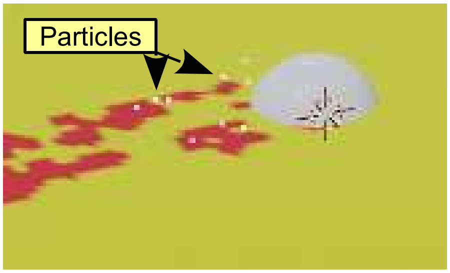
Volume + Proximity

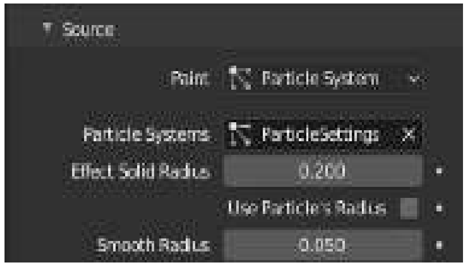


Proximity – Distance:3.400



Object Center – Distance:0.500

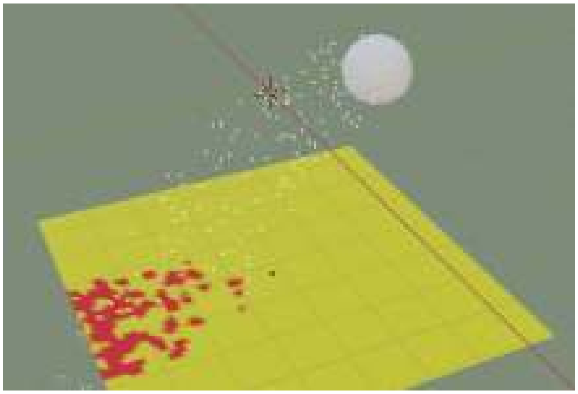




Particle System Figure 24.9

To use the **Particle System** Paint Option the Brush **must have a Particle System applied**. Enter the Particle Settings for the System in the Source Tab. When the Animation is played Particles Emitted from the Brush (UV Sphere) contact the Plane causing the application of color.

Trick of the Trade Figure 24.10



Brush Paint: ParticleSystem with the Brush elevated above the Canvas Plane (Raindrop Effects).

Sphere Brush descending as it transitions.

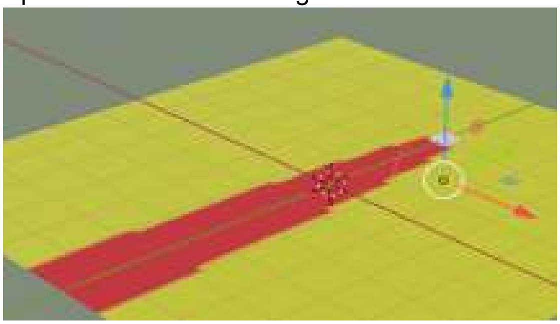
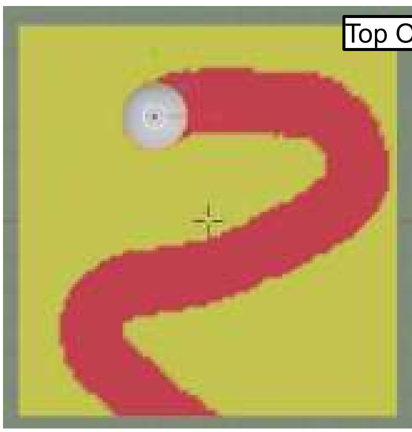


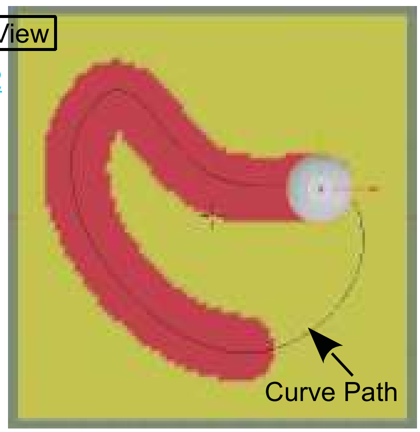
Figure 24.11

Freehand translate the Brush while playing the Animation in the Timeline or Add a Follow Path Constraint with a Curve Path.



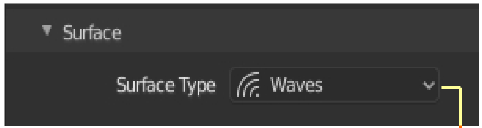
Top Orthographic View

Figure 24.12



Canvas Deformation

Figure 24.13



Besides applying color to a surface the Brush may also be used to deform the surface of the Canvas. **Wave** and **Displace** Options are found in the Dynamic Paint Physics buttons for the Canvas in the Surface Tab, **Surface Type**.

Figure 24.14

Note: When using **Waves** or **Displace** the Attribute and ColorRamp Nodes no longer apply and should be removed. The Material color of the Plane is then controled in the Principled BSDF Node, Base Color.

As an example: With the Plane selected create a wave effect on the surface by changing the **Surface Type** to **Waves**. With the Sphere animated to move on the surface of the Plane the Sphere appears to plough through water (Figure 24.15). Make the Sphere jump from below the Plane and splash down again (Figure 24.16).

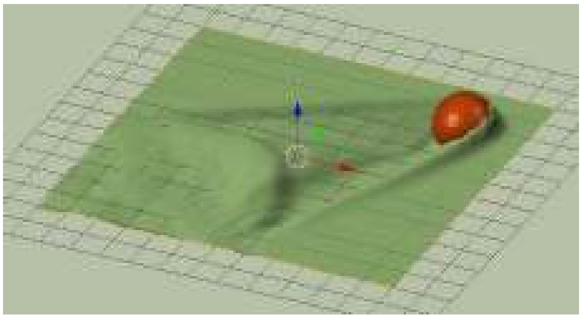


Figure 24.15

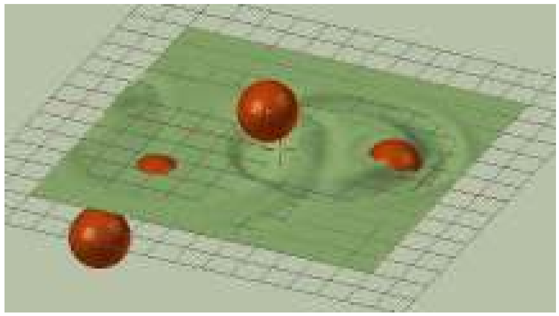


Figure 24.16

With the Sphere selected try the different options in the Properties window, Physics buttons, Dynamic Paint Waves tab.

Change Surface Type: Waves to **Displace** and play the Animation (Figure 24.17).

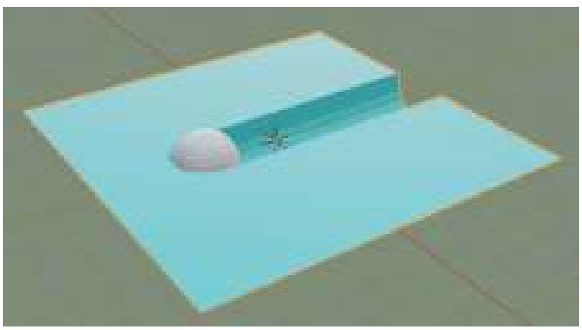


Figure 24.17

25

Making a Movie

25.1 Making a Movie
25.2 Storyboard
25.3 The Video File
25.4 The Sound File
25.5 Video Editing Workspace
25.6 The File Browser Editor
25.7 Preparation
25.8 Video Sequence Editor
25.9 Rendering the Movie
25.10 Additional Features
25.11 Summary

Making a Movie is performed in the **Video Sequence Editor** where you compile a Video Sequences. **Movie** originated from the term Moving Pictures. Moving Pictures were developed to entertain and tell stories and this has developed into modern Communication Systems. The basic concept however, which is, to tell a story, remains .

Blender provides the tools which allow you to tell your story by using animated pictures (animations). You create Scenes in which actors move depicting events that you wish to communicate to an audience. The animated Scenes are recorded and **Rendered to Movie files**. The individual files are not necessarily produced in a sequence that tells the story, therefore, they need to be arranged in the correct sequence, hence the **Video Sequence Editor**.

Movies are made by piecing together short segments of video produced when you render animation sequences. Sound files and special effects are added to enhance the visual and audio presentation.

25.1 Making a Movie

Making a movie in Blender (reference Chapter 17 – 17.10) will be discussed in relation to producing a video from a series of short animations which have been rendered to video files (Video Clips). The animations may have been created in separate Scenes in a single Blender file or in different Blender files. In either case the animations must be pre-rendered into video file format and be saved to a folder on your hard drive. The files should preferably be named or numbered in relation to a sequence of events which will tell whatever story you are about to tell.

25.2 Storyboard

A movie is a visual way of telling a story or communicating a message. To effectively piece together a movie you must have at least an idea of how you want to tell your story. In other words you should have a plan or sketch to use as a reference. The plan is called a **Storyboard**. It is easy to become immersed in the technical detail of the process and lose the plot.

In the movie, in this demonstration, a submarine on the surface of the ocean, dives underwater and conducts a torpedo attack. The story has been broken down into five parts. Submarine on surface, submarine dives, two underwater views and firing torpedoes. Each part has been animated in a separate Scene in the same Blender file then rendered to an **.AVI video file**.

The video files are all rendered from 250 Frame animations which when combined, equals a movie of 1250 Frames. The movie will be rendered for PAL TV which plays at 24 frames per second, therefore, the movie will play for approximately 52 seconds. It is a long way from being a feature film but will give you a basic idea of how a Movie is made.

To demonstrate the process of compiling a Movie work through the procedure as follows. The demonstration will combine the five video files and a sound file.

Sound file? Sound files can be background music, recorded voice, sound effects, in fact anything to enhance the video. For the purpose of the demonstration a sound file has been compiled in **.wav** format. As with video files there are many types of sound files. You are probably familiar with **MP3**, **MP4** etc. Blender supports **WAV** (.wav) files but you can enter **MP3**.

25.3 The Video Files

File Path to the Folder containing Video Files

Figure 25.1

Five .avi Video Files saved in the Folder: **BDemo_Submarine**

25.4 The Sound File

For this demonstration a series of sounds, downloaded from **Free Sounds** at **www.freesound.org**, have been combined (Figure 25.2) using the free program **Audacity**

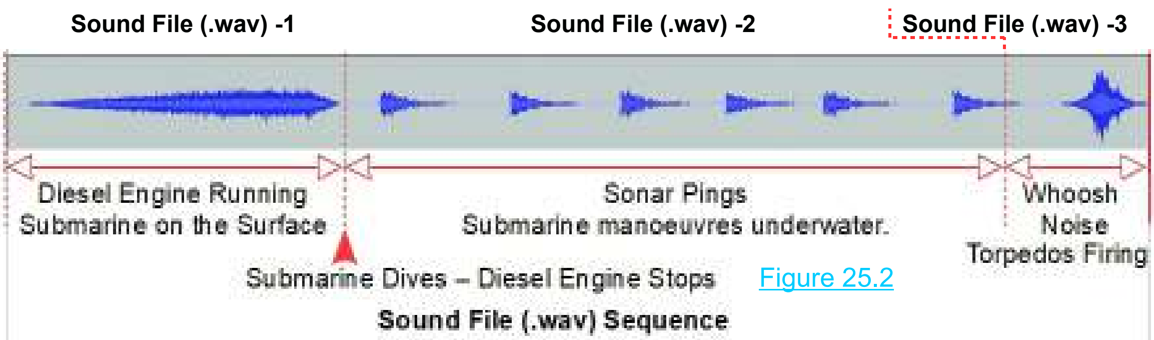


Figure 25.2

Sound File (.wav) Sequence

25.5 Video Editing Workspace

Video assembly is performed in the **Video Editing Workspace** hidden away. In the Screen Header. Click on **File**, then **New** and select **Video Editing** (Figure 25.3).

Figure 25.3

The **Video Editing Workspace** (Figure 25.4).

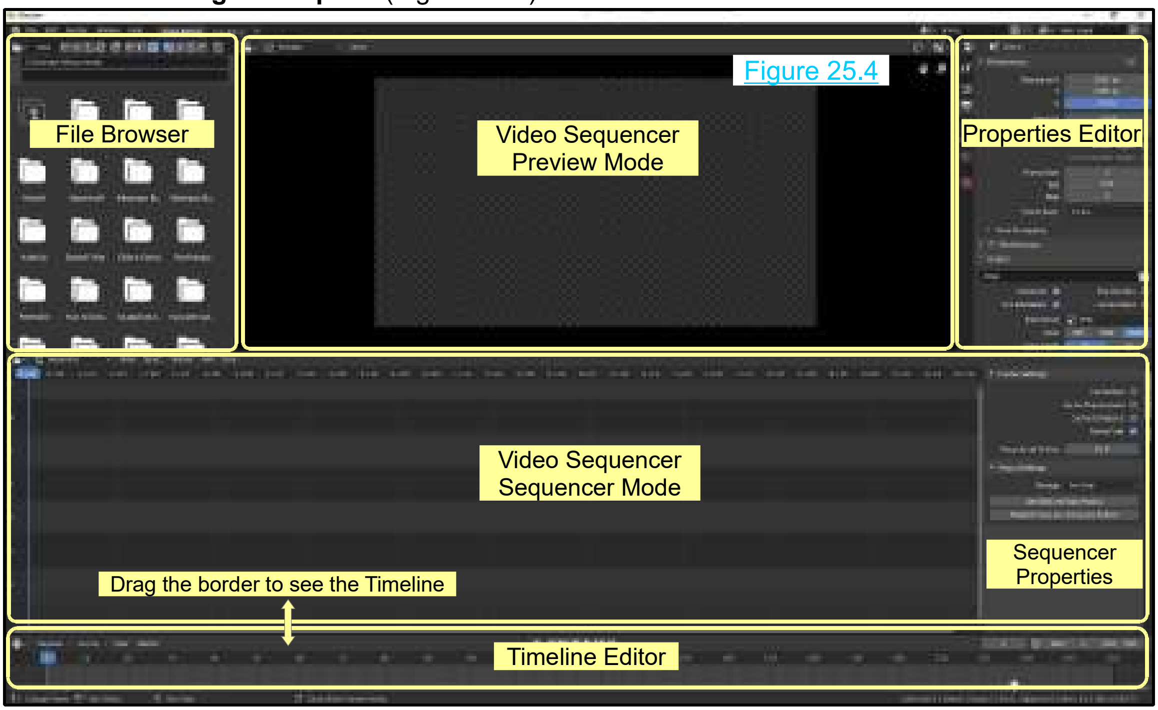


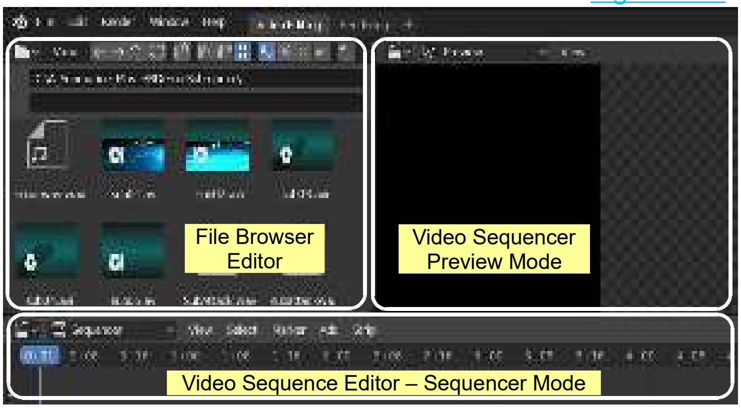
Figure 25.4

VSE Editors and Panels

File Browser Editor:	Where you navigate and select files.
VSE Preview Mode:	Where you see the video playback.
Properties Editor:	Controls relevant to the VSE.
VSE Sequencer Mode:	Where you combine Video Files (clips).
Timeline Editor:	Provides control of how the video sequence plays.
Sequencer Properties:	Video Channel Properties (Withe the Mouse Cursor in the the VSE Sequencer Mode. press the **N Key** to toggle Hide and Display) .

In this basic instruction you will be concerned with the **File Browser Editor** and the **two versions of the Video Sequencer.**

Figure 25.5



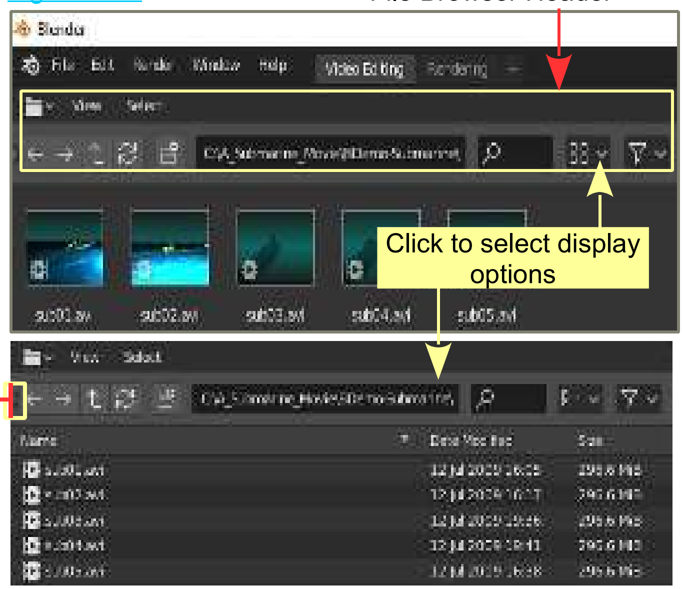
25.6 File Browser Editor

The File Browser Editor was discussed in Chapter 3 – 3.5 but a point to remember is, the Editor will show files in a variety of ways.

The default display in the Video Editing Workspace shows thumbnail images of the first Frame in each video file. You can change this to display the file names if you wish. Click on the button shown in the diagram (Figure 25.6).

Note: You may also expand the File Browser by clicking the expand button. Press **T Key** to cancel.

Figure 25.6



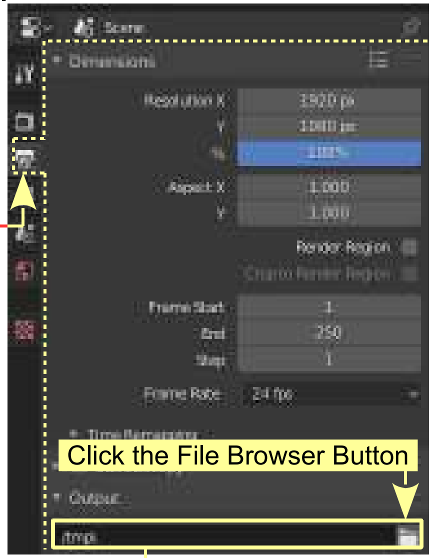
25.7 Preparation

File Definition: In this demonstration the five **.avi files** saved to the hard drive will be referred to as **Video Files**. When combined, the final output will be called, the **Movie File**.

Before attacking the **Video Sequence Editor** some preparation, which is required, must be performed. The first step in the movie making process is to set the file path to the location where you want your **Movie File** saved and to define the **Video Output Format**.

Set the File Path for Saving

Figure 25.7



By default, Blender sets the file path for saving files to the **tmp** (temporary) folder on your hard drive. This can be seen in the **Properties Editor, Output buttons, Output tab** (Figure 25.7).

You change this setting by clicking on the **Browse Folder** button (Figure 25.3) and navigating to a new folder in the **File Browser Editor**. Select the folder then click on the **Accept button** at the bottom right hand side. **Click Accept a second time**.

For convenience and simplicity create a new folder. In this demonstration the folder is named **A_Submarine_Movie** and the file path to the folder is: C:\ **A_Submarine_Movie** (Figure 25.8).

Figure 25.8

Set the Video Format

Set the Movie Video output format (see File Type in Chapter 17 - 17.9 Video Codecs). To demonstrate the movie making process the **AVI Raw** codec (.avi) will be used from the **Movie** list in the **Properties Editor, Output buttons, Output Tab** selection menu (Figure 25.9).

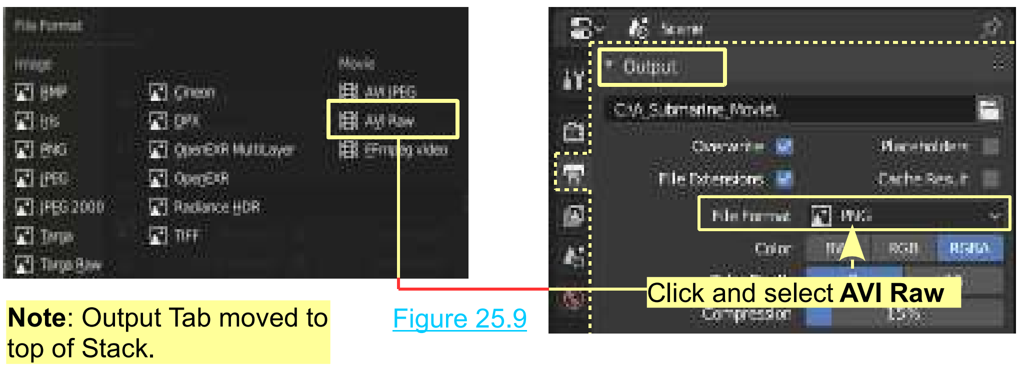


Figure 25.9

Since the **Video Files** (clips) being compiled into a **Movie File** are also **.avi file format** you are, in fact, simply assembling the files into a single file. If you select either the AVI JPEG or FFmpeg video options then the output after assembling would undergo a conversion.

25.8 Video Sequence Editor

VSE Preview superimposed in the **VSE Sequencer**

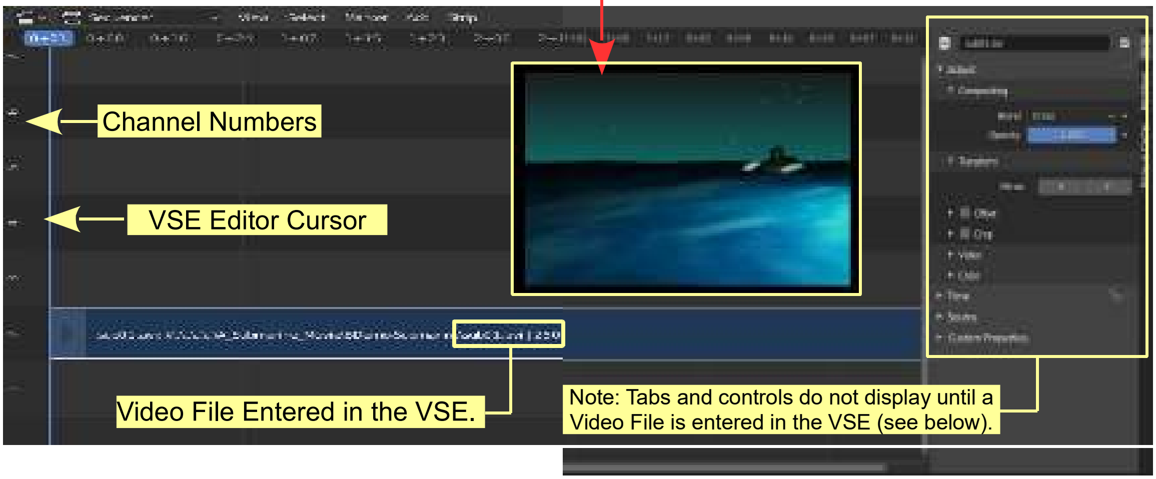


Figure 25.10

The main panel in the **Video Sequence Editor (VSE)** is divided into Channels (horizontal strips), numbered at the left hand side. In Figures 25.10, 25.11 a Video File named **sub01.avi** has been entered in **Channel 1**. A preview panel has been superimposed in the diagram showing the first Frame of the animation. When a Video File is entered in the Video Sequence Editor the first Frame of the animation displays in the Video Sequencer Preview (Not Shown).

Placing Files in the VSE

To enter a Video File in the VSE, click the file thumbnail in the File Browser, hold and drag into the VSE. By default the first file entered is placed in Channel 2.

With the Video File entered in the VSE properties and controls are displayed on the VSE Properties Panel, Strip Tab, at the RHS of the VSE.

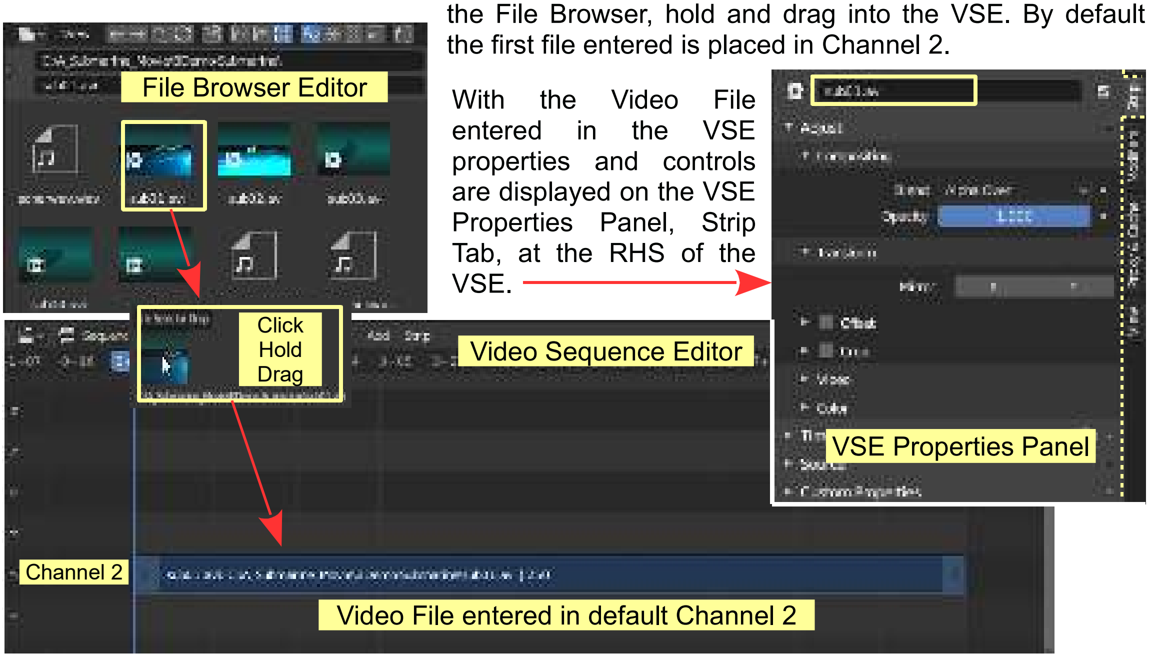
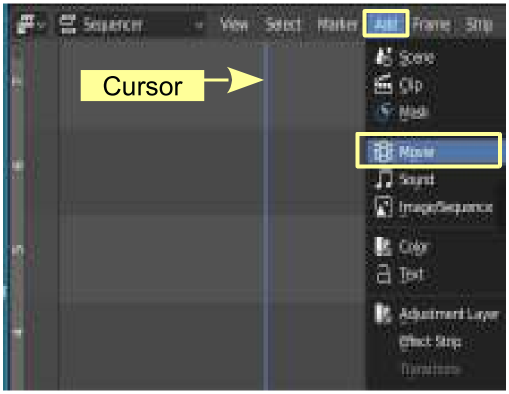


Figure 25.11

Placing Files in the VSE (Alternative Method)

Figure 25.12



Various types of files may be entered in the VSE and combined with video files. Click on **Add** in the VSE Header (Figure 25.12) and select what you wish to enter (the File Browser Editor opens). In this instance you are entering a Video File, therefore, select **Movie**. Navigate to the folder containing your Video Files and select a file. Click Add Movie Strip (lower RH corner). This is an alternative to the method previously described. By default the File is entered in the next **Channel** . Note: By default the VSE Editor Cursor is located at position 0+01 in the **Playback Timeline** along the top of the VSE. When Files are entered in the VSE they are located at the position of the Cursor.

Viewing the Video File

To see Video Files in action click the Play button in the Timeline Editor at the bottom of the Screen. You may also click, hold and drag the VSE Cursor to scrub through the Video Files.

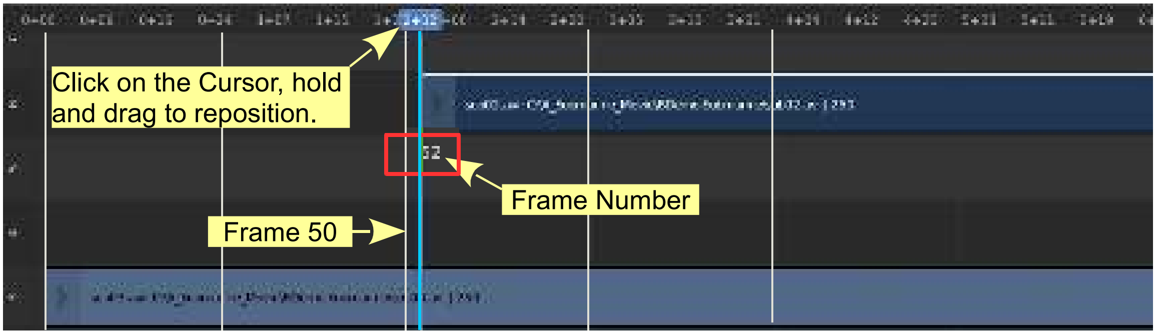
Video Files in upper Channels take precedence and play over lower Channels.

Selecting in the VSE

You select a File in a Channel by clicking LMB. Hold and drag R or L to reposition. LMB click on a file, hold and drag up or down to place the file in a different Channel.

Note: When repositioning horizontally, click LMB, hold and drag then you may release MB. When positioning horizontally you will see a Frame Number appear at the beginning and end of the Video File giving you the exact location in the Timeline.

Figure 25.13



Note: The Cursor in Figure 25.13 is positioned at Frame 2 + 02 (see Timeline Graduations / Positions following.

Timeline Graduations / Positions

Example: The start of File named sub02.avi is positioned at Frame 52. In the Timeline the position is given as 2+02. The horizontal divisions (faint vertical lines) are located at:

0+00 = Frame 0.00 1+00 = Frame 25 2+00 = Frame 50

(25 Frames per Division)

Frame 52, is therefore 2 + 02

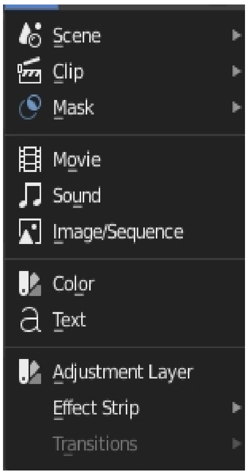
(2 x 25) + 2 = 52

Erasing (Deleting) a File

LMB click on the File in the VSE (border highlights white), press the **X Key** or press Delete or RMB click and select delete. In either cases click **Erase Strips** in the menu that displays.

The Add Button

Figure 25.14



The **Add button** in the VSE window header has several options.

Scene: Adds a strip containing information about a Scene in the Blender file.

Mask: If a mask has been created it can be added to the VSE to hide or alter the appearance of parts of the video.

Image: A still image or a series of images may be inserted into the video much like adding individual frames of an animation or a slide show.

Sound: Sound files can be inserted in the VSE to enhance video.

Effects Strip: Effects to provide enhancement, background and transition

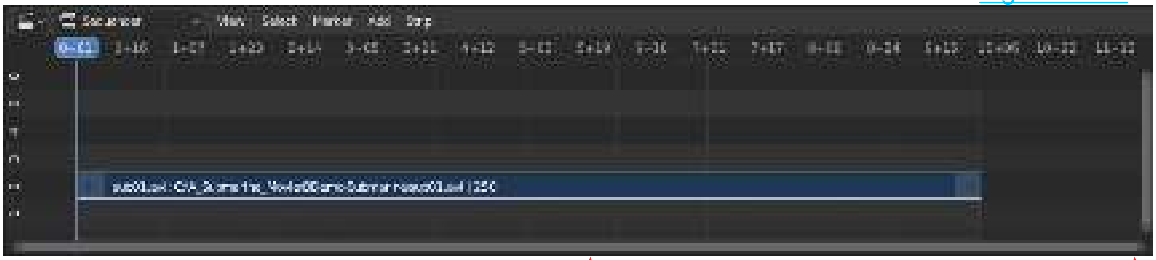
With the forgoing information you are in a position to proceed and compile the Movie File.

Adding Video Files

When adding Video Files it is helpful to scale and pan the VSE Editor. This allows you to get a bigger picture of your assembly. With the Mouse Cursor in the VSE Editor you can zoom in and out by pressing the Plus and Minus keys on the keyboard or by scrolling MMB.

At the bottom of the VSE Sequencer is a gray bar with dots at each end. Lick on the bar, hold and drag left or right to pan the display in the VSE. Click hold and drag the dots at either end to scale the VSE view horizontally. A similar vertical pan and scale bar is at the RHS of the VSE.

Figure 25.15



Click, hold and drag light gray bar. Click, hold and drag the dot.

As you have seen you add Movie Files by clicking, holding and dragging from the File Browser Editor or clicking **Add** in the **VSE Editor header** (Press Add – Movie – navigate in the **File Browser window** – select etc.).

The first file is entered by default in Channel 2 with the VSE cursor located at 0+01. To add a second file, position the cursor where you want it to start and repeat the Add process. A second file is entered in Channel 3. The files can be moved to different channels as you wish and repositioned horizontally.

Note: If the **VSE Cursor** is placed at the end of the first Movie File the second file will be placed in the same Channel as the first, end to end.

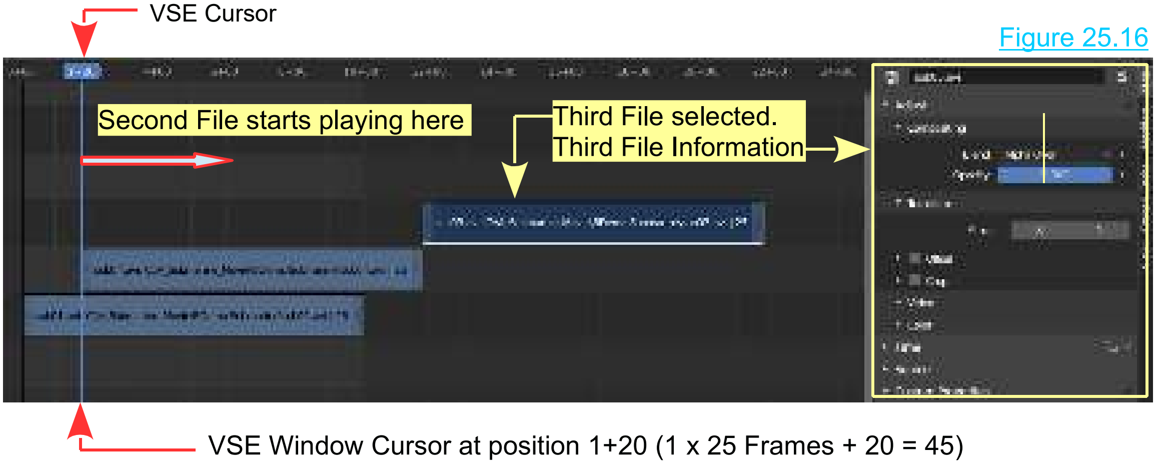
Each successive file addition is entered in the Channel above the preceding Channel except when the VSE Cursor is positioned at the end of the preceding file. To have two Movie Files play end to end as a continuous sequence, position the start of the second file horizontally at the end of the first file (they do not have to be in the same Channel). With the second file selected, press the **G Key** and drag the Mouse. You will see Frame Numbers display at the beginning and end of each file which makes it easy to align exact Frames. You can purposely overlap files since a file in a higher Channel will take precedence over a file in a lower Channel when playing.

Playing the Video File

No matter where the file is located you can view different Frames in the file by dragging the Cursor along the Timeline. You play the file by pressing the **Start button** in the **Timeline Editor**. Press **Esc** to quit or Pause, Fast Forward etc. by using the play controls.

To mention some more obvious information about playing consider this; the Video Files used in the demonstration are 250 Frames long. With the first located with the **Start Frame** at 0+01 it will play in its entirety then repeat until you press **Esc**. This only occurs since, in the **Timeline Editor**, **Start: 1** and **End: 250** are set. If **End: 100** was set the file would only play for 100 Frames then repeat, or if the start Frame of the file was positioned on the VSE Timeline other than at Frame 1 then only part of the file will play. (see Figure 25.16) over.

Figure 25.16

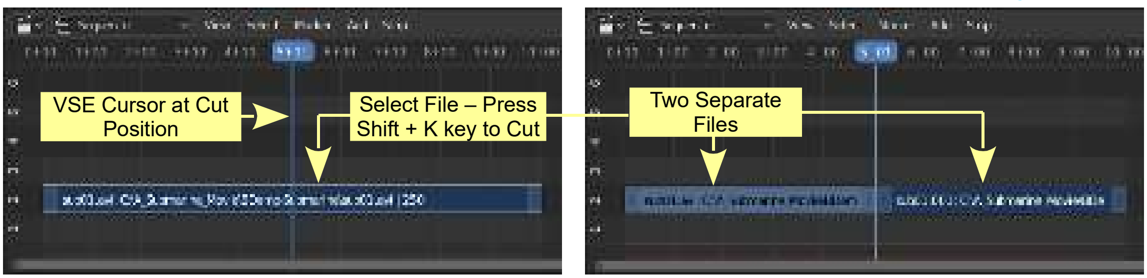


Cutting Video Strips

A Video File in the VSE is also referred to as a **Video Strip**. Another feature of the VSE is the ability to select only part of a video strip for playback. You can cut the strip into segments. There are two ways to do this which are; a **Soft Cut** and a **Hard Cut**. In either case, position the Cursor at the Frame where you wish to make the cut. For a **Soft Cut** press the **K Key**.

For a **Hard Cut** press **Shift + K key**. In either case you finish up with two separate segments of strip which you can reposition or move to a different Channel in the VSE. The difference is, with a **Soft Cut** both segments of the strip retain the data for the other part. With a **Hard Cut** the data is not retained (Figure 25.17).

Figure 25.17



Note: When Cut, File: sub01.avi divides into sub1.ave + sub001.avi

Adding Sound Files

Sound files such as MP3 and WAVE are entered by selecting **Sound** in the **Add button menu** instead of **Movie** and then manipuling the same as a Video File.

With all your strips aligned and edited you can press the **Play button** in the **Timeline Editor** to preview the final movie.

25.9 Rendering the Movie File

When all the specifications have been set for your Movie output File it is time to render the final movie.

In the **Blender Screen Header** click the **Render button** and select **Render Animation**. Be prepared to wait a considerable time. Even a short movie will take awhile depending on the speed of your computer. Long movie sequences are often uploaded to websites called **Render Farms** which will perform the render process for you (at a cost). Once the render is complete you find the file in the output folder and give it a test run in a media player.

25.10 Additional Features

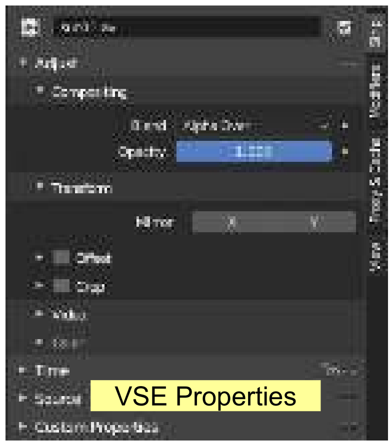
Additional features for enhancing and modifying video strips are accomplished by adding features from the VSE Header Add button menu or by the application of Strip Modifiers in the VSE Properties Panel.

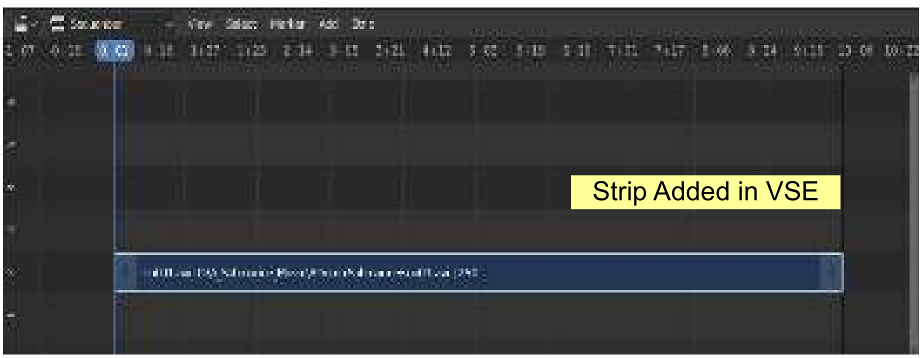
Generally adding a feature from the Header inserts a special Feature Strip in the VSE in addition to the Video Files entered, while the application of a Modifier affects the selected Video Strip in the VSE.

Example 1: No Features Applied

Figure 25.18

Preview with Strip in VSE and default settings in the VSE Properties. **No additional features.**



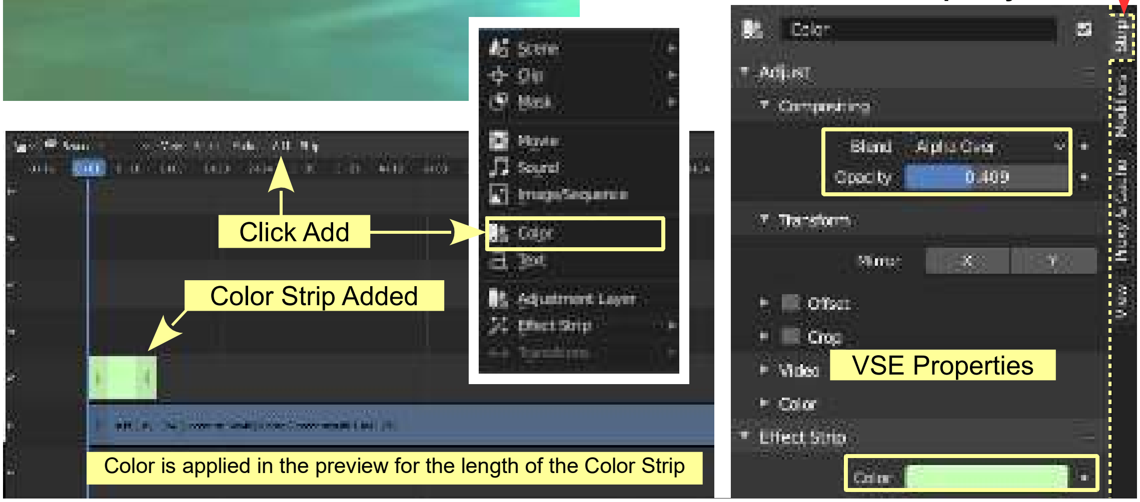


Example 2: Add Color Feature

Figure 25.19

Click **Add** in the VSE Header and select **Color** in the menu. A Color Strip is added in the VSE Editor and controls display in the VSE Properties Panel in the Strip Tab. (individual Tabs may be moved up/down)

Select a Color and reduce **Opacity**.



Example 3: Apply Color Modifier

Figure 25.20

Select a Strip in the VSE. In the VSE Properties, Modifiers Tab click Add Strip Modifier. In this case select Color Balance. Alter the values in the tri color pickers to adjust the preview display. Color is applied permantly for the whole Strip.

Note: The Strip must be selected in the VSE.

Example 4: Inserting Text Captions

Examples 2 and 3 were concerned with affecting the Preview Color Tones.

Captions may be inserted in a Strip to display a Title, credits etc.

Select a Strip in the VSE. In the VSE Sequencer Header click on **Add** and select **Text** from the menu that displays.

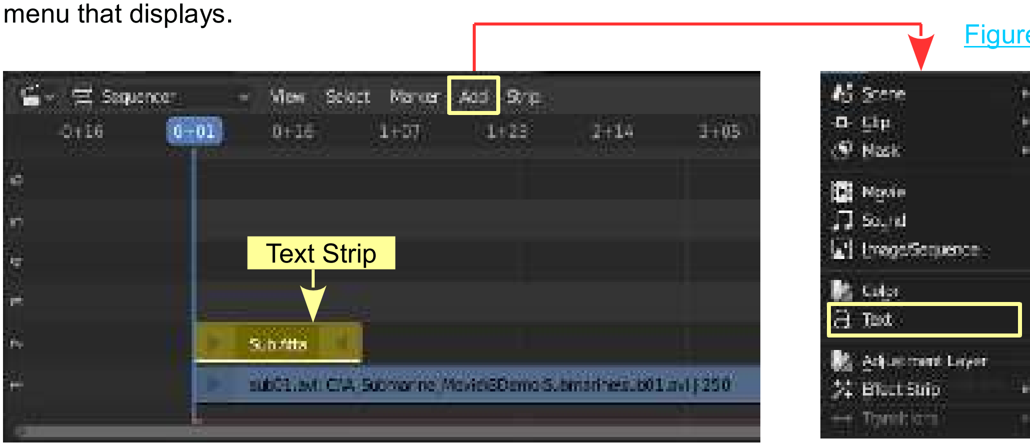


Figure 25.21

Selecting **Text** in the menu inserts the small white word **Text** at the bottom of the video display in the VSE Preview. A **Text Strip** is added in a Strip at the position of the VSE Cursor. In the **VSE Properties Panel** at the RHS of the VSE is the **Strip Tab** with controls for modifying the Text.

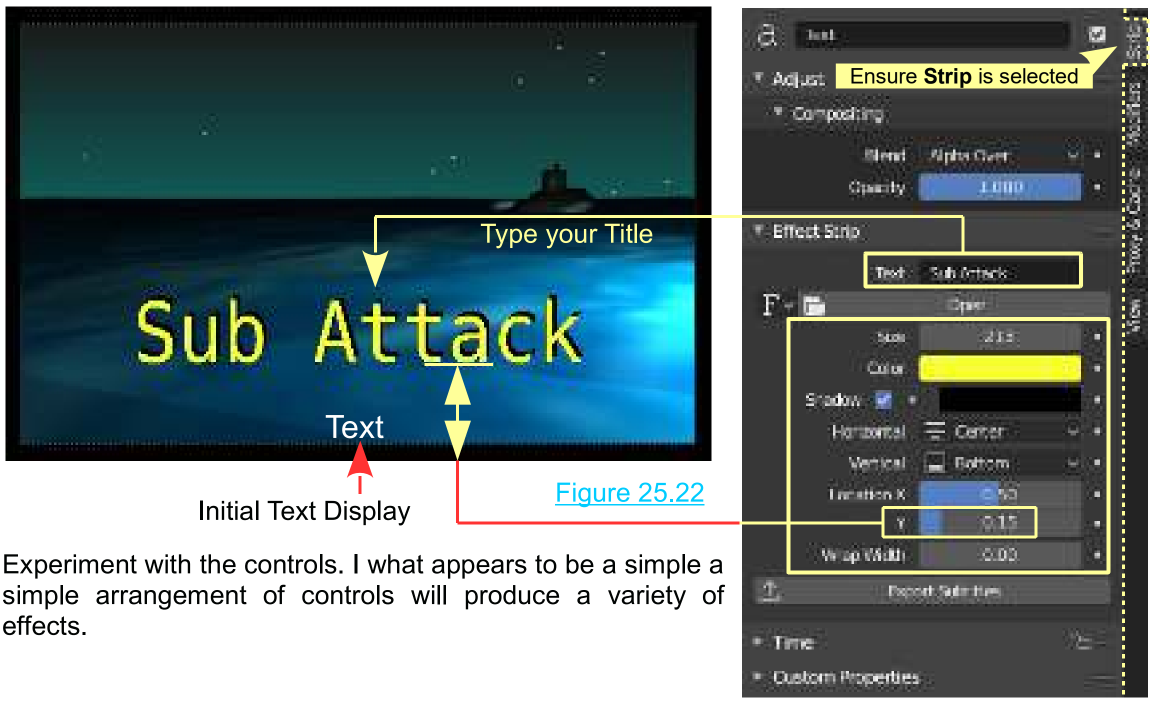


Figure 25.22

Experiment with the controls. I what appears to be a simple a simple arrangement of controls will produce a variety of effects.

Example 5: Annotation

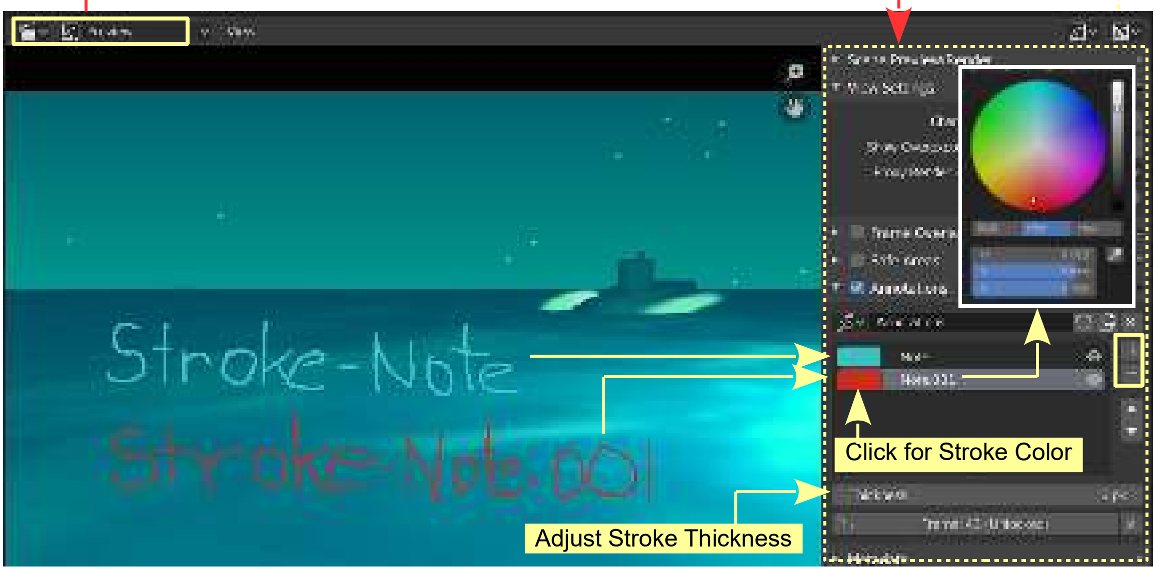
The previous examples of Additional Features have demonstrated how to affect the Preview and ultimately how the Video displays when it is Rendered.

In the course of compilation it may be advantageous to insert temporary notes as reminders. These can be hand written over the Preview in the **VSE Preview Mode**. The notations are termed **Annotation**.

With a Video File added in the VSE Sequencer open the **View Tab** in the VSE Preview (Figure 25.23). in the **VSE Properties Panel** check **Show Annotations.** With the Mouse Cursor in the VSE Preview Panel press the **N Key** to display the **VSE Preview Properties Panel.** Check Anotations.

With the Mouse Cursor in the VSE Preview Editor hold the **D Key**, **LMB click** and drag the Mouse to draw freehand notation, sketches etc. **D Key**, **RMB click**, hold and Drag to erase.

VSE - Preview Figure 25.23 Properties Panel (N Key to display)



Note: Annotations are drawn on Layers i.e Note (blue), Note.001 (red). Click **+** to add a new Layer. Click – to delete a selected Layer.

25.11 Summary

The Blender Video Sequence Editor allows you to introduce transitional effects between video clips, to render a Video File into a series of Image Files so that you can manipulate images (Frames) within any one clip, then render the reconstructed Frame back to a Video File. Video Files can be cut and edited and combined to produce the most sophisticated animated Movies.

26

Cycles & Workbench Render

29.1 Cycles Render
29.2 How to Start Cycles
29.3 Create an Object Light Source
29.4 Cycles in Practice
29.5 Workbench Render

The Render Engines

There are three Render Engines built into Blender, **Eevee, Cycles** and **Workbench**.

Eevee is the default Engine which provides several Viewport display options one of which is a Real Time display showing what is produced in a final Render.

The Cycles Rendering system, built into Blender, is designed to produce photo realistic images and to provide an interactive workspace where you see a rendered view as a Scene is created.

Photo realism and high definition in images, including animation frames comes with a demand on computer power and render time.

The Eevee Render Engine gives an excellent result but there are situations where Cycles will provide added benefit.

All the Blender tools and controls for generating a Scene are applicable to both Render processes although there is a difference in the Node Systems.

Workbench Render provides a simplified process for previewing Scenes in the construction process before implementing a final Render.

Creating Scenes and Rendering, possibly, demands a dedicated publication, therefore, this chapter is limited to how to start the Engines, obtain the best results from your computer and provide a brief example of applications.

26.1 Cycles Render

Cycles Rendering simulates many effects that have to be specifically added to other methods of rendering such as soft shadows, depth of field, motion blur, caustics, ambient occlusion and indirect lighting.

The **Cycles Render Engine** is described as being a raytracing based engine with support for interactive rendering. Being interactive means you see a rendered view of your work as it progresses in the 3D Viewport Editor in **Rendered Viewport Shading Mode**. Cycles incorporates a Shading Node system, a different material and texture work flow and it utilises **GPU** acceleration.

Computer Specifications for Cycles

Before using Cycles, be aware that you will require a reasonable computer processor and a graphics card which meets the specifications to handle this advanced process (refer to the Blender Wiki – Hardware Requirements).

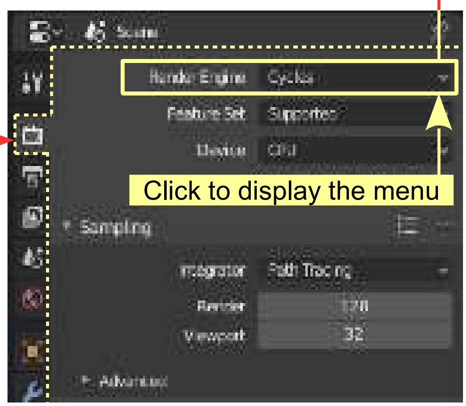
In essence, to fully utilise **Cycles** you need a fast processor, heaps of memory (RAM) and a graphics card with **Open GL** (graphics card with built in memory **GPU** and **CUDA** enabled).

> **Note:** Cycles Rendering is activated from the main Blender interface but CUDA and GPU acceleration require a secondary activation similar to an Add-on.

If you are new to Blender these terminologies and specifications may be slightly on the technical side but just be aware that, to utilise the full effects of **Cycles** you computer has to meet the requirements. The following will show you how to activate Cycles and discover if your system is up to speed.

26.2 How To Start Cycles

Figure 26.1



To activate Cycles change **Eevee** to **Cycles** in the Properties Editor, **Render buttons** (Figure 26.1).

To demonstrate Cycles Rendering set up a Scene in the 3D Viewport Editor as shown in Figure 26.2.

Figure 26.2 shows a UV Sphere positioned just above a Plane (ground plane). A second Plane (Plane.001) is placed above and behind the UV Sphere opposite the Camera. The ground plane is scaled to fill the Camera aperture as shown in the Camera View inset, while Plane.001 is positioned outside Camera View. The UV Sphere is scaled up and set to Smooth. There is a single Point Lamp in the Scene.

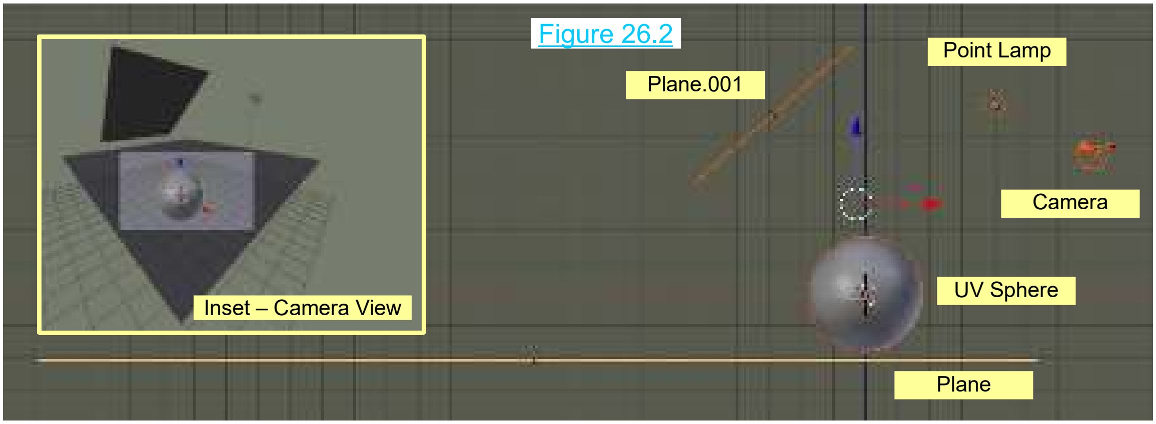
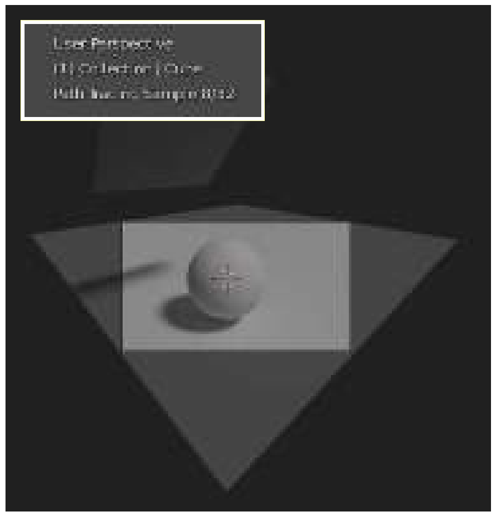


Figure 26.2

To activate the **Cycles Render Engine** click on the selection button in the Properties Editor, Render buttons as shown in Figure 26.1. From the menu select **Cycles Render**. With the 3D Viewport Editor in **Rendered Viewport Shading Mode** you see a rendered view of the Scene.

You will note that some of the options in the **Properties Editor** change. Leave all the settings just as they are for this demonstration.

Figure 26.3



The 3D Viewport Editor will change showing the Objects with a dark gray background (Figure 26.3). If you rotate the Scene you will see the Objects being re-rendered as you rotate.

Unless you have a reasonably fast processor the render will be very blocky and grainy and can take a considerable time. With Rendered Viewport Shading the 3D Viewport Editor re-renders at each change made to the Scene. The longer you wait the clearer the render becomes, **up to a point**. You wouldn't want your computer stuck in an infinite rendering loop so Blender incorporates a time-out setting to limit the render.

1. When the Scene is altered e.g. rotated, the **Render** process is activated. In the upper LH corner of the 3D Viewport Editor you will see a progress display giving the number of Render Samples. When a Render is completed this displays, **Rendering Done**.

In the **Properties Editor, Render buttons, Sampling Tab** see **Render 128 – Viewport 32**. These are the default Render Pass settings. The render it limited to 32 Passes for the view in the viewport and 128 Passes for a Rendered View when you press F12.

Increasing the Pass settings produces a better result, bearing in mind that an increase in Samples incurs an increase in time to perform the Render.

The content of the Scene also affects the Render time. For example, on a machine, with the **Default Blender Scene** containing the single **Cube** Object the elapsed time for the 32 Sample preview is 00.02.20 seconds. The full image Render, pressing F12 with 128 samples takes 00.09.51 seconds. Scaling the **Cube** X 2 increases the preview time to 00.03.43 seconds and a full render is 00.24.89 seconds. **Note:** These Render Times are on my PC. Yours will be different.

The 3D Viewport Editor view is very dark since the default Lamp provides only a limited illumination. Changing the Lamp type or providing additional Lamps will improve the illumination, but in Cycles you can use Objects as a light source. More on that later.

What to expect from Cycles will depend on your computer and operating system, your display adaptor (Graphics Card) and the drivers (Software) that have been installed for the card.

Before proceeding it will help to understand some terms.

NVIDIA graphics: NVIDIA is one of many suppliers of graphics chipsets used in graphics cards. At the time of writing Blender is configured to use NVIDIA with Open GL and CUDA enabled for GPU rendering.

Open GL is a set of graphics standards used world wide which is designed to give maximum performance on the GPU.

GPU (Graphics Processing Unit) is the processing device built into the graphics card which performs computations in parallel with the computer's central processing unit (CPU).

CUDA™ (Computer Unified Devise Architecture) is a parallel computing platform and programming model that enables dramatic increases in computing performance by harnessing the power of the graphics processing unit (GPU).

To summarize, the GPU performs computations in conjunction with the CPU which significantly speeds up the changing graphics display that is required for **On the Fly** graphics rendering. BUT! whether the GPU is faster than the CPU depends on your computer configuration. It could be your CPU is faster for some aspects of the process.

Another factor in this technicality is the **Compute Capability** rating of your graphics card. Cards are rated through a range something like 1.1 to 3.5. At the time of writing, Blender only supports graphics cards rated at 1.3 and above for GPU processing (Rendering), so again, unless your system meets the requirements you will not realize the full capability of **Cycles**.

OK! Cycles has been turned on and there is a display on the Screen but at this point the CUDA architecture and GPU processor are not activated. As previously stated CUDA and GPU require a secondary activation.

Also be aware that what you see in the Blender controls will depend on your system configuration. Blender takes a look at your system and displays controls accordingly.

To activate CUDA, in the **Blender Screen Header** click on **Edit** and open the **Preferences Editor**. Select **System** in the LH column to see **Cycles Render Device** (Figure 26.4).

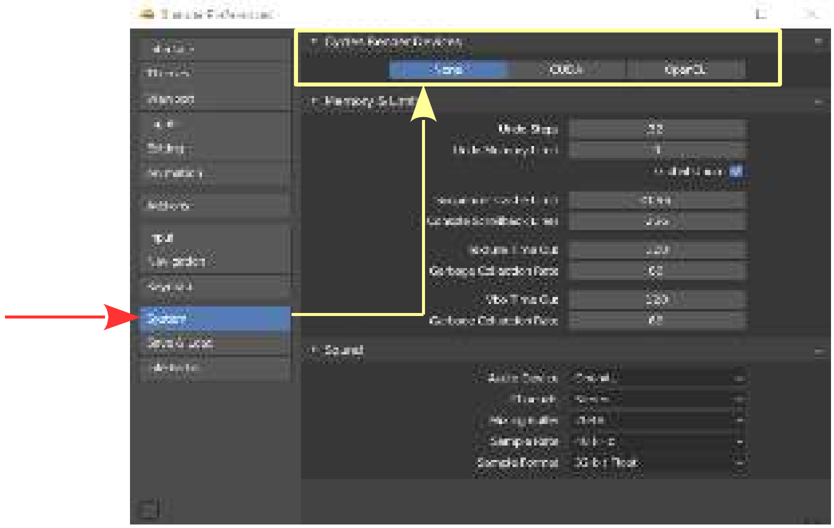


Figure 26.4

If you do not have a NVIDIA graphics chipset or your drivers for the card are outdated then you will see a message stating **No compatible GPUs** found and, therefore, the Cycles rendering process will be performed entirely by the CPU.

Providing you have the correct graphics chipset you may click on CUDA and the Cycles Render Devices Tab will show the name of your graphics card (Figure 26.5).

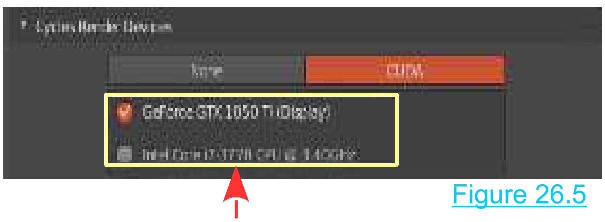


Figure 26.5

This display is specific to your PC

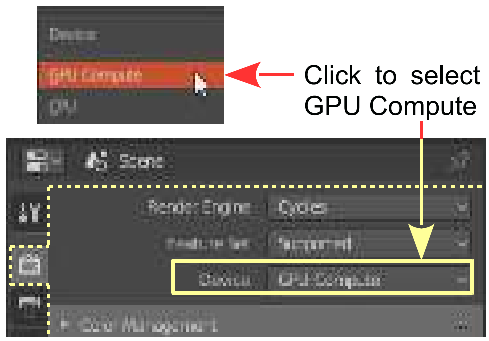


Figure 26.6

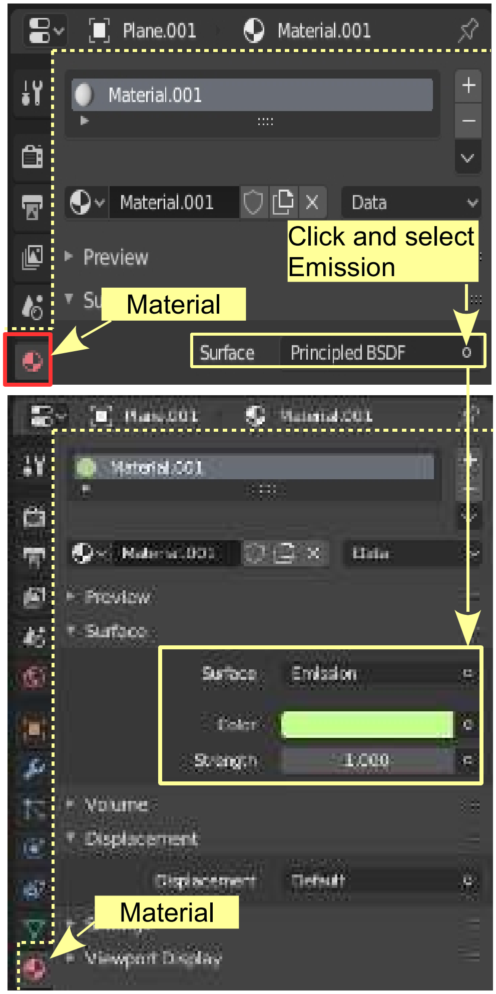
In the **Properties Editor, Render buttons** you will have the option to select **GPU Rendering** (Figure 26.6).

With Cycles activated it's time to see what it can do.

26.3 Create an Object Light Source

With the demonstration Scene previously created (Figure 26.2) select the elevated Plane Object (Plane.001).

Figure 26.7

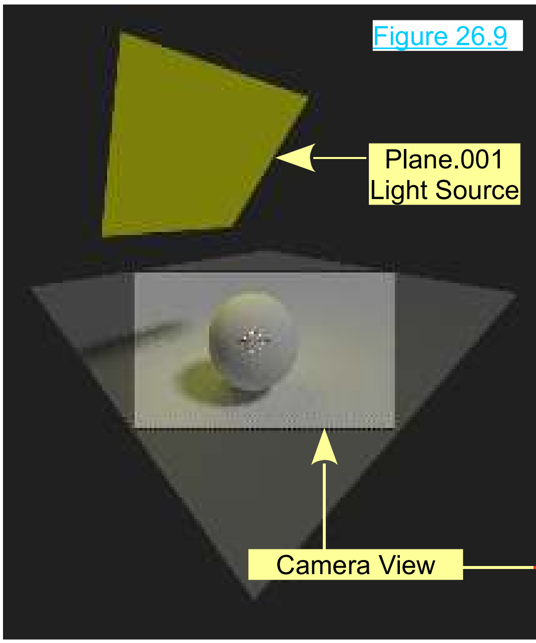


Go to **Properties Editor, Material buttons**. **Note:** When the **New button** has been pressed the Materials buttons will show the **Surface Material** (color) being controlled by the **Principled BSDF Node**. You may verify this by opening the Shader Editor where you will see the Principled BSDF Node connected to the Material Output Node.

In **Surface bar** where you see **Diffuse BSDF** click and select **Emission** from the menu that displays. This changes the plane into a light source (Figure 26.9). Note the **Strength** value is 1.000 (alter to increase the light intensity).

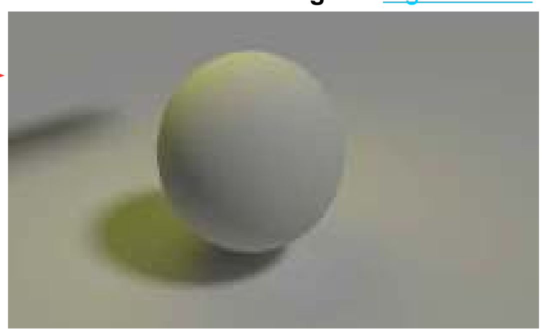
Figure 26.8

In the **Surface Tab** click on the **Color bar** and in the color picker that displays, select a bright color (green).



Plane.001 Light Source – Green Light

Rendered Image Figure 26.10



Plane.001 emits light casting it in the Scene where it reflects off the UV Sphere and ground Plane (Figure 26.10).

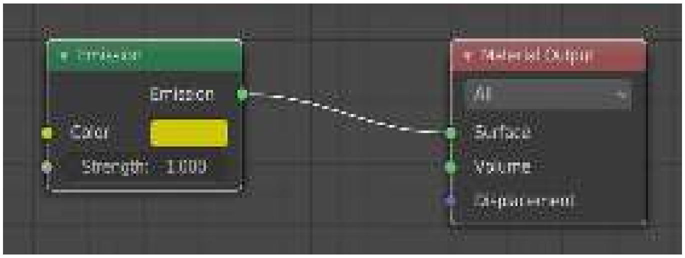


Figure 26.11

Figure 26.11 shows that the Principled BSDF Node has been replaced by an Emission Shader Node in the Shader Editor.

Note: Bear in mind that **The Node system in Cycles is different from that used with Eevee Render.**

If you care to compare the Nodes available in the Add Menu you will find Cycles has a larger selection.

To demonstrate the Node system, start a new Blender file and place the **3D Viewport** in **Cycles Render** mode with **Viewport Shading – Rendered**. Change the **Timeline Editor** to the **Shader Editor**. Click on the **Material buttons** in the **Properties Editor**.

At this point you will have the gray Cube in the 3D Viewport Editor and the Principled BSDF Node connected to a Material Output Node in the Shader Editor.

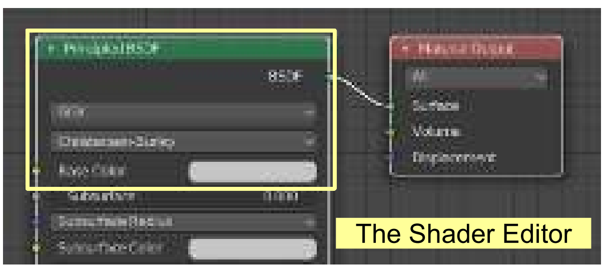
The Shader Editor Header has Material Nodes activated by default with Use Nodes checked.

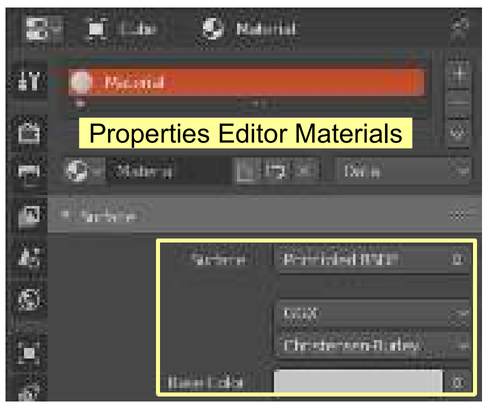
Note: You are working with the **Material buttons** in the **Properties Editor,** therefore, the **Material Node button** in the **Shader Editor** is active.

The Nodes displayed are a Principled BSDF Node and a Material Output Node (Figure 26.12).

The Principled BSDF Node is a replica of the **Surface Tab** in the Properties Editor and note, this node is connected to the **Surface** input socket on the **Material Output** Node. In other words the Base Color is being mapped to the surface of the selected Object.

Clicking on the Base Color bar in the **Diffuse BSDF Node** displays a color picker where a new color may be selected, the same as the Base Color bar in the **Properties Editor** (Figure 26.12). Figure 26.12



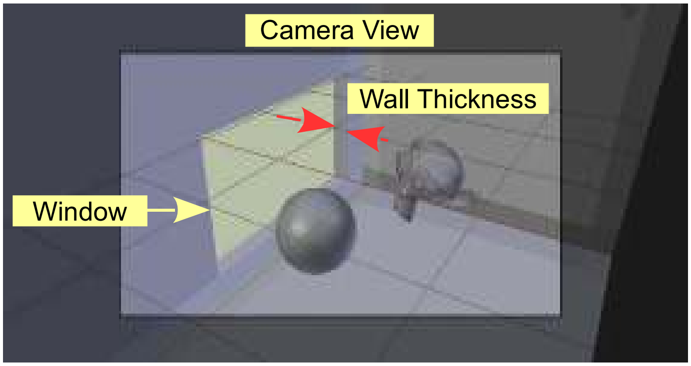


26.4 Cycles in Practice

To demonstrate the practical application of **Cycles Render**, work through the following demonstration which will show you how to create and illuminate a Scene.

Set up the Scene

Arrange a UV Sphere and a Monkey **inside** the default Cube in a new Blender Scene as shown (Figure 26.13 and 26.14). The UV Sphere and the Monkey have smooth shading applied and the Cube has been scaled up and elongated and subdivided with several faces deleted on the back side creating a window. A **Solidify Modifer** has been applied to the modified Cube to create wall thickness.



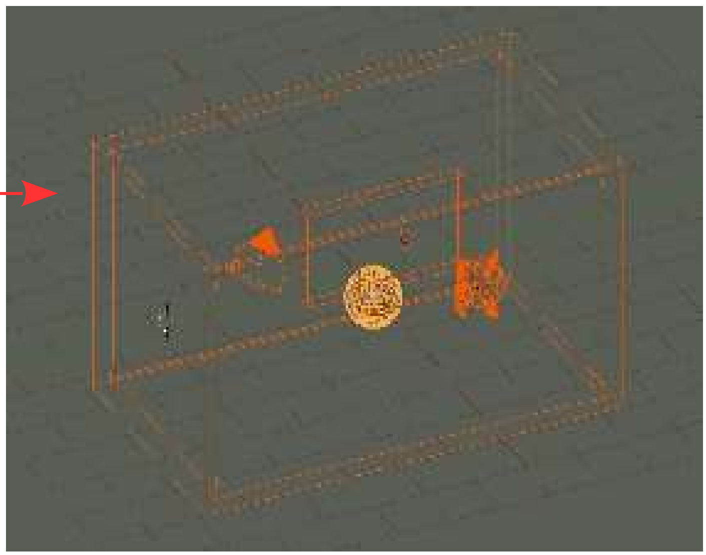
The objective is to place the Sphere and Monkey inside a room next to a window.

The Camera and single Point Lamp are also inside the room.

The Sphere, the Monkey and the window are positioned in Camera View.

Figure 26.13

With the 3D Viewport Editor in **Solid Viewport Shading** mode all you see is the Cube. To see Objects inside the room change the 3D Viewport Editor to **Wireframe Viewport Shading**.



At this stage the scene is illuminated by the default point lamp which is inside the room. Pressing F12 renders (Cycles Render – Rendered Viewport Shading) an image of the Camera view in Figure 26.15. The Render may take a while.

Figure 26.14

More Set Up Stuff

You may hide an Object temporarily to unclutter a Scene. In Solid Viewport Shading mode select the Cube (the room). Press the **H key**. To reinstate the Cube press **Alt + H key**. This is not particularly useful in this instance but is worth remembering.

In the Properties Editor, Render button, change **Eevee Render** to **Cycles Render.** Have the 3D Viewport Editor in Camera Perspective View and change to Rendered Viewport Shading Mode. This will allow you to see rendered results as you progress.

If you have GPU rendering available and it is faster than CPU rendering it's time to turn it on.

Warning: Turning GPU may or may not be beneficial depending on your PC. Rendering in Cycles may stall or crash the program. You will have to experiment.

You may go to the **Properties window, Render buttons, Sampling tab** and change the Preview Samples value. The default is 32 which doesn't allow a fantastic result (Figure 26.15). Remember: Increasing the value will increase the render time.

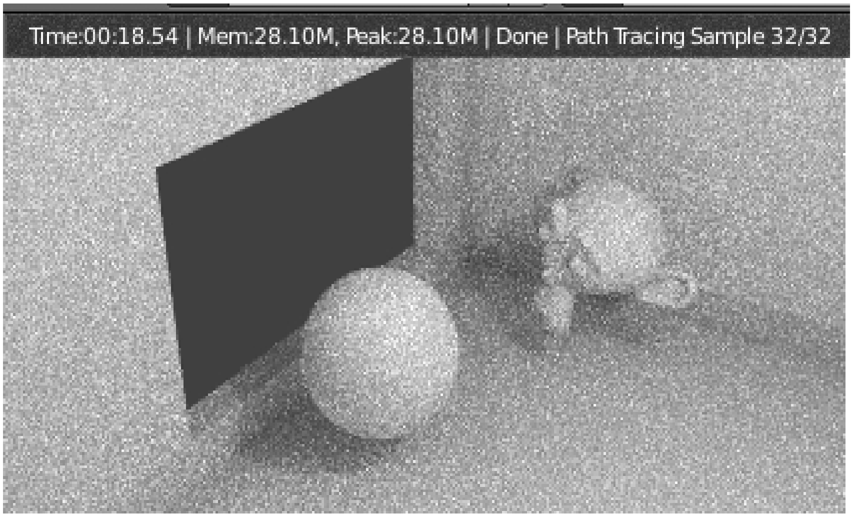


Figure 26.15

By comparison a full render (F12) at 128 Samples is shown in Figure 26.16.

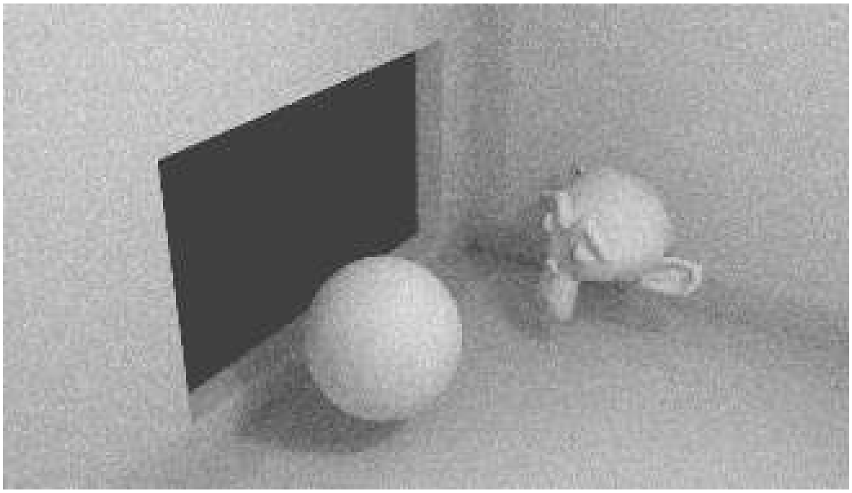
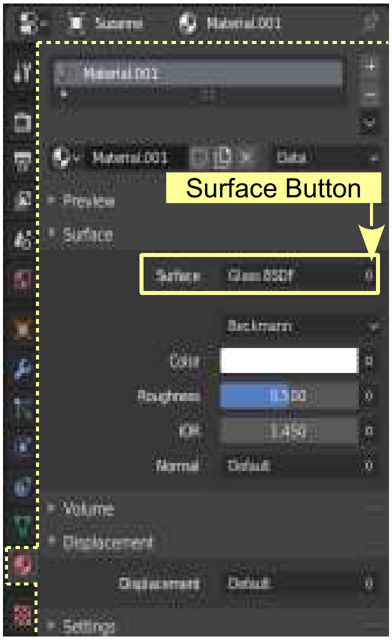


Figure 26.16

Materials in the Properties Editor

Figure 26.17



Select the Monkey in the 3D View Editor. Remember: The monkey is named **Suzanne** as you can see in the upper left hand corner of the **3D View Editor** and in the **Outliner Editor**.

In the **Properties Editor, Material buttons**, click on the **New** button. As previously explained the Material Nodes for Cycles Render are different to Eevee Render.

The default settings show the **Principled BSDF** Node active. The Color (the white color bar/picker) is showing Blender's default gray, RGB 0.800. Click on the **Surface** button where you see Principled BSDF and select **Glass BSDF** (Figure 26.17).

This gives Suzanne a gray glass like effect. Change the color and reduce the Roughness value to 0.000. The effects of the Surface Shader and color are immediately seen in the Camera view (Figure 26.18 – **Note:** Render Sample 200 and Time taken to complete the render 2 minutes, 8.68 seconds).

You will have to decide if the wait is worth it.

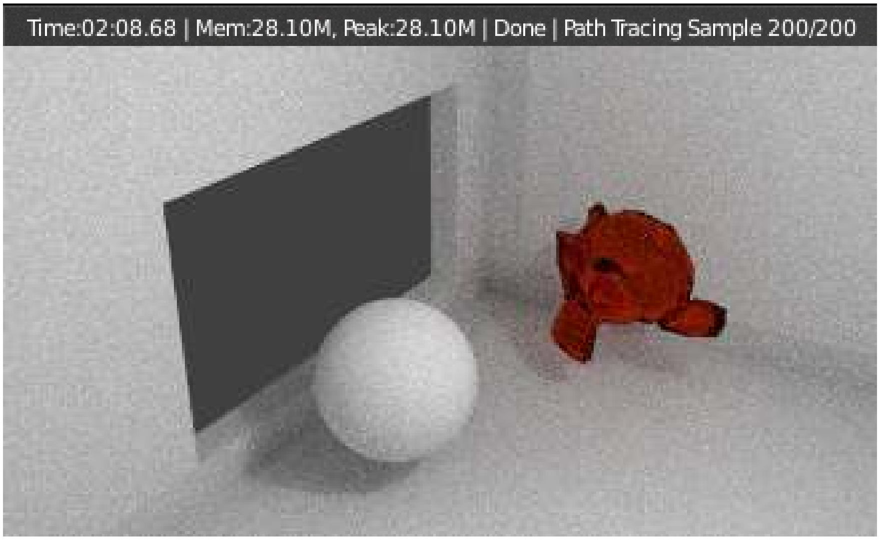


Figure 26.18

This procedure has applied a **Material** to the Monkey by using the **Properties Editor, Materials buttons**.

Remember: The application of Materials using Cycles Render is using the **Cycles Node System**. You may use the Properties Editor or the Shader Editor to apply Materials.

Note: Adding, manipulating and connecting nodes when using **Cycles Render** is the same as when using Eeveer Render. The difference is, in Cycles Render there are more Node options to choose.

Note: Node Groups created when using **Eevee** and **Appended** into a file using **Cycles** will not work unless they have been specifically designed to do so.

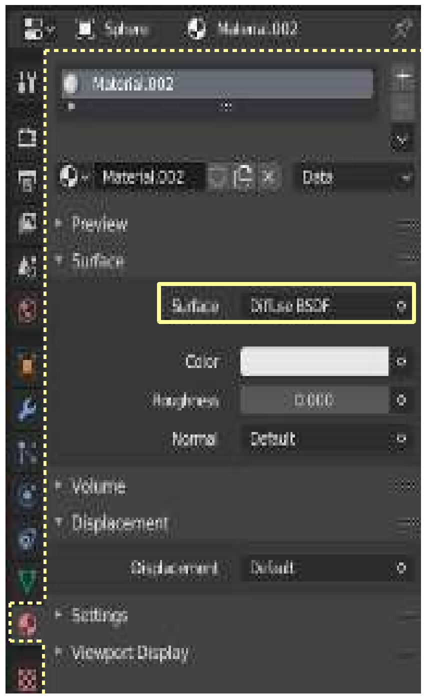
Materials in the Shader Editor

Deselect Suzanne and select the **UV Sphere**. Change the Timeline Editor at the bottom of the Screen to the Shader Editor and drag the top edge up. Place the 3D View Editor at the top of the Screen in Rendered Viewport Shading mode.

In the Rendered View the UV Sphere displays with Blender's default gray Material color even though a Material has not been applied. With the UV Sphere selected the Shader Editor is empty. By default Blender applies the default gray color to the UV Sphere. Click on the New button in the Shader Editor Header to activate the Node System. In the Shader Editor the Principled BSDF Node displays connected to the Material Output Node. The Properties Editor, Material buttons show Principled BSDF in the Surface Tab.

With the Mouse Cursor in the **Shader Editor** click LMB to deselect all Nodes then LMB click on the Principled BSDF Node to select. Press the X Key to delete the Principled BSDF Node. The UV Sphere displays black in the 3D View Editor.

Figure 26.18



Click Add in the Shader Editor Header and select Shader – Diffuse BSDF to enter a Node. Connect the Diffuse BSDF Node output socket to the Surface input socket of the Material Output Node.

In the **Shader Editor** the **Diffuse BSDF**. This Node is the graphical representation of the data in the **Properties Editor**. The **Material Output** Node is the graphical representation of data sending the Diffuse material color to the surface of the UV Sphere.

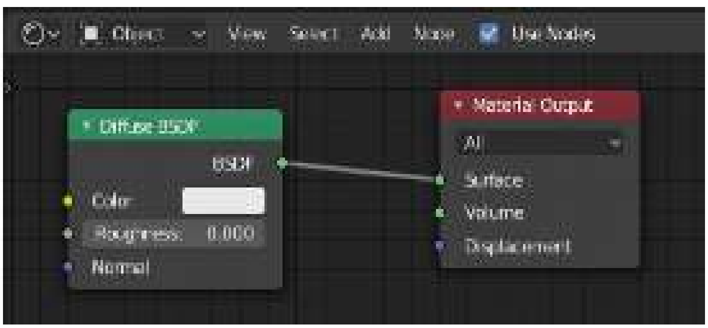


Figure 26.19

The display in the 3D Viewport Editor, Rendered Viewport Shading, Camera view is as shown previously in Figure 26.15.

The Power of Nodes

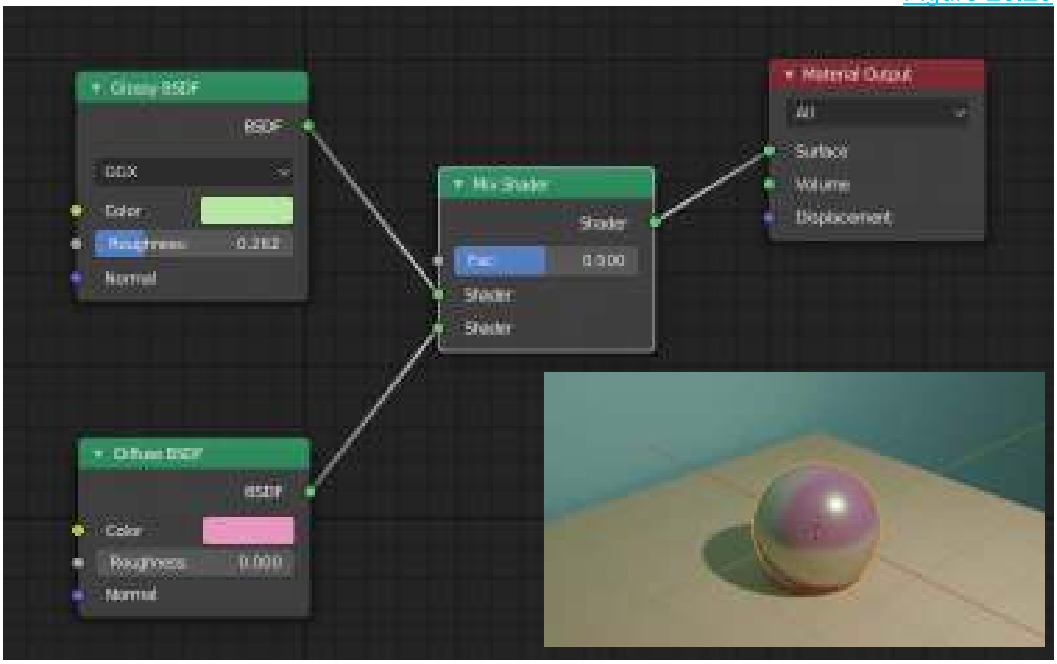
To discover the power of using Nodes in Cycles Render, have a UV Sphere positioned above a Plane in a new blender Scene (inset Figure 26.20) and perform the following:

With the UV Sphere selected add a Glossy BSDF Node (click Add in the header – Shader - Glossy BSDF). Add a Mix Shader Node (click Add in the header – Shader – Mix Shader). Arrange and connect the Nodes as shown in Figure 26.20.

In the Glossy BSDF Node click on the Color button to display the color picker and select a soft pastel color. The UV Sphere in the 3D Viewport Editor will immediately render showing a glossy surface.

In the Diffuse BSDF Node select a bright vivid color. The 3D Viewport Editor re-renders, mixing the two Shaders together. The Roughness sliders in the Shader Nodes vary the intensity of the colors while the Fac: slider in the Mix Shader Node adjusts the ratio of the mix.

Figure 26.20



There are numerous combinations of Nodes available and it is impossible to cover everything but this simple demonstration shows the potential of one aspect of Nodes in Cycles.

What you see in the rendered view has been reliant on the default single point lamp for illumination. This can be vastly improved in Cycles.

Sky Lighting

The effect of Sky Lighting is to create an ambient light which is the overall lighting from the sky in the natural world. In the Scene inside the room the Camera is positioned inside. Camera View would only show this through the window.

To have a better understanding of the effect, use the Scene with the UV Sphere above the Plane.

In the **Properties Editor, World buttons, Surface tab**, click at the end of the **Color bar**, click on the button and select **Sky Texture** from the menu (Figure 29.22). Voila! you have blue sky in the window background. In the **Color bar** you will see **Sky Texture**.

Click, hold and drag the mouse on the **Sky Ball** to adjust shadow effect in the Scene. You may also adjust the **Turbidity** value between 1.00 and 10.00 for a variation. The Strength value also changes the sky effect. Sky Lighting sets the lighting for outdoors.

Figure 26.21 shows Sky Lighting with the values in Figure 26.22.

Figure 26.21

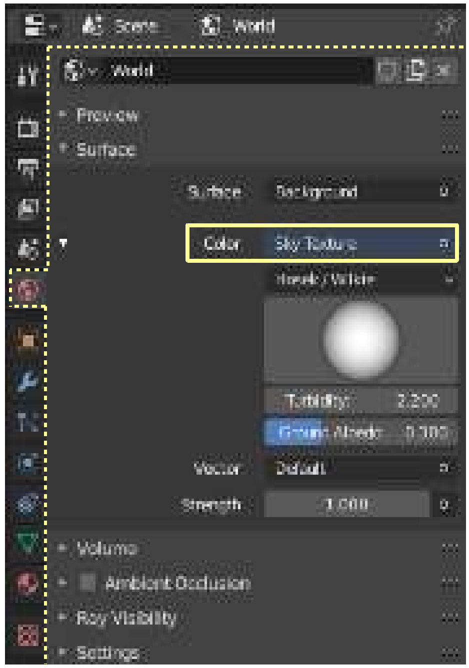


Figure 26.22

You see the Node Arrangement for the Sky effect produced by the values set in Figure 26.22 in the Shader Editor with World Shader Nodes active (Figure 26.22 – Editor Header only).

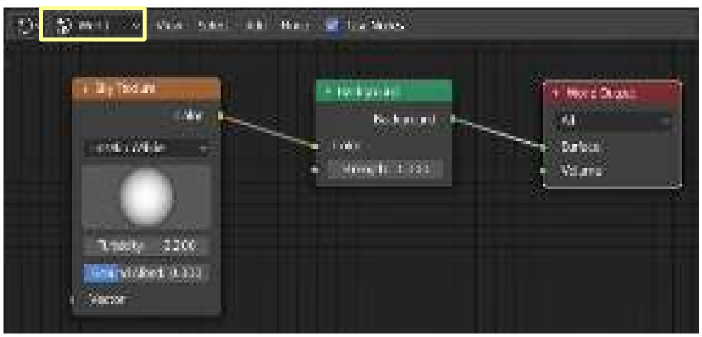


Figure 26.23

Its time to back indoors.

Reinstate the Room:

With Sky Lighting created delete the Point Lamp. There will be no light inside the room but light will come through the window from outside (Figure 26.24).

Figure 26.24

Object Lighting

The Point Lamp will be replaced by an Object acting as a light source.

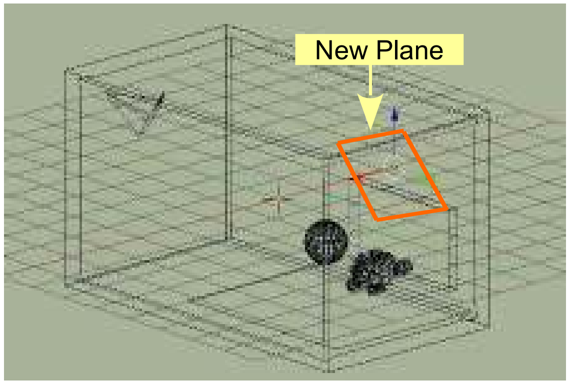


Figure 26.25

Add a Plane and position as shown in Figure 29.25. You want the Plane above and angled towards the Objects. Think of it as a mirror which will reflect light onto the Objects.

Make sure the Plane, when in Camera view, is not in the aperture.

In the **Properties Editor, Material buttons**, click **New** to add a Material. Select **Surface, Shader** type, **Emission**. This makes the plane a light source (Figure 26.26).

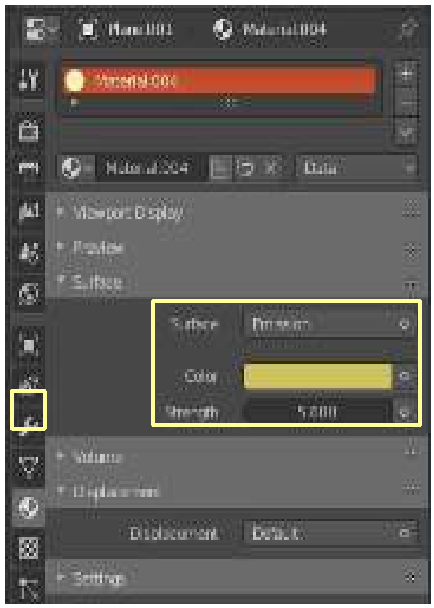


Figure 26.26

With the **Camera View** in **Rendered mode** you see the inside of the room illuminated (Figure 26.27). The light Color can be changed and the Strength value adjusted. The position and scale of the light source affects the rendered view. You may add more than one light source.

Figure 26.27

26.5 Workbench Render

This introduction to the Workbench Render Engine is intended to make you aware of its existence and to point out a few of its features. The following description is taken from the Blender Wiki.

General Description

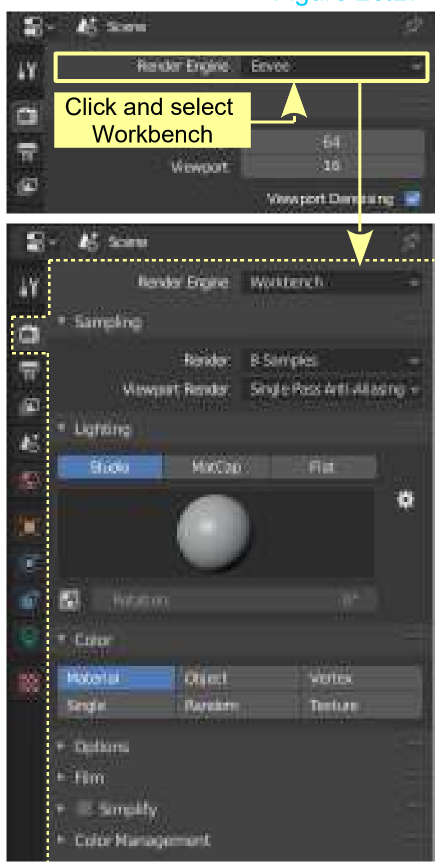
The Workbench Engine is a render engine optimized for fast rendering during modeling and animation preview. It is not intended to be a render engine that will render final images for a project. Its primary task is to display a scene in the 3D Viewport when it is being worked on.

Workbench also has an X-ray mode to see through objects, along with cavity and shadow shading to help display details in objects. Workbench supports several lighting mechanisms including studio lighting and MatCaps.

Lighting

The Workbench engine does not use the lights of the scene. The lighting conditions that will be used can be set in the Lighting panel (Tab).

Figure 26.27

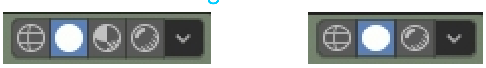


Workbench Render is accessed in the Properties Editor, Render buttons (Figure 26.27).

With Workbench opened the Render buttons display with the Sampling Tab, the Lighting Tab and the Color Tab open. Settings in these tabs will directly control the display in the 3D Viewport Editor and supersede normal controls.

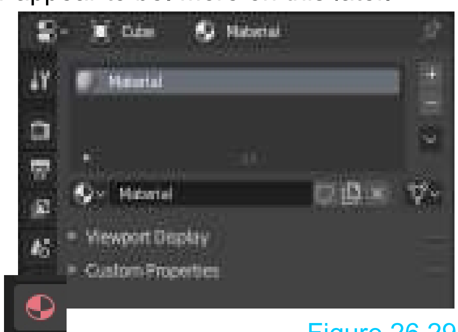
For example: With Workbench active the Viewport Display Modes are limited.

Figure 26.28



Eevee **Workbench**

You will also find the Materials buttons in the Properties Editor limited or appear to be. More on this later.



Material button

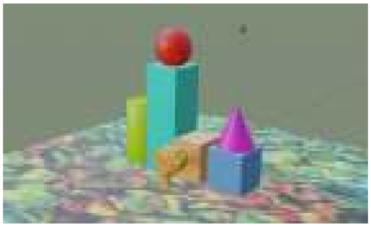
Figure 26.29

The display in the 3D Viewport Editor is controlled from the Properties Editor Render buttons. To use Materials as an example, a Material applied to the default Cube in the default Scene with Eevee Render active does not display in the Viewport when you switch to Workbench Render.

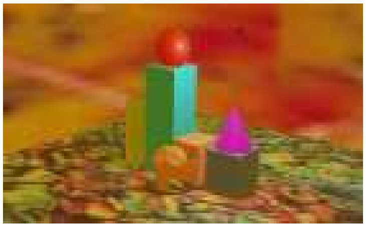
Workbench is designed to present a complicated Scene in a simplified display for modeling, and at the same time provide previews of color and lighting effects as previews of a final Render.

The Scene shown in Figure 26.30 is far from being complicated but it will serve to demonstrate Workbench controls.

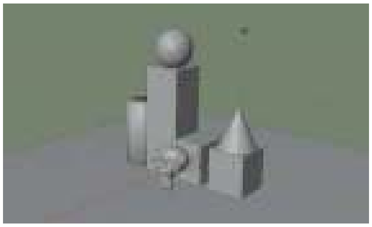
Figure 26.30



Eevee
Material Preview
Mode



Eevee
Rendered Mode



Workbench
Solid Mode

With Materials added to the Objects the colors display in Eevee Render in LookDev and Rendered display Modes. Changing to Workbench Render sees the Objects in the default Gray. In Figure 26.30 the Workbench Solid Mode shows a green Screen background. Changing to Workbench Render with Rendered Viewport Shading shows a gray World background (Figure 26.31). This is the starting point for exploring the Properties Editor, Render buttons for Workbench Render.

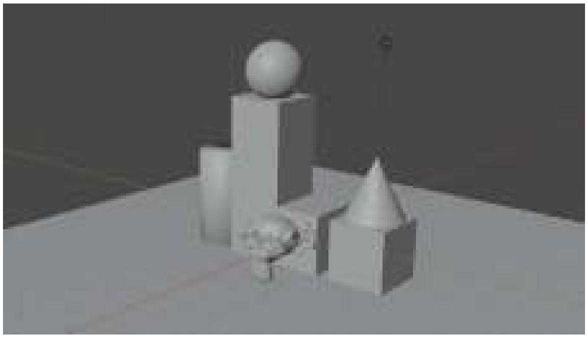


Figure 26.31

Sampling

The first thing to note is the **Sampling** setting in the Sampling Tab. The default value is **8 Samples**. Click to display options. Higher values improve the display. Lower values reduce the resolution.

Click for Options

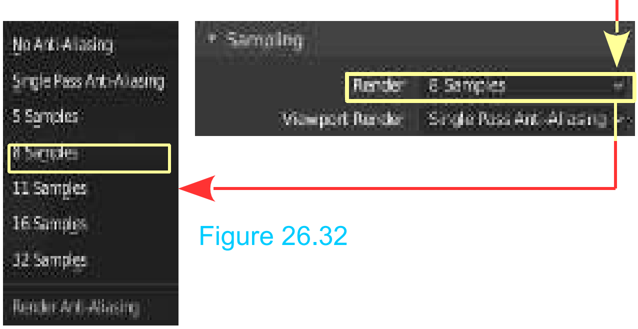
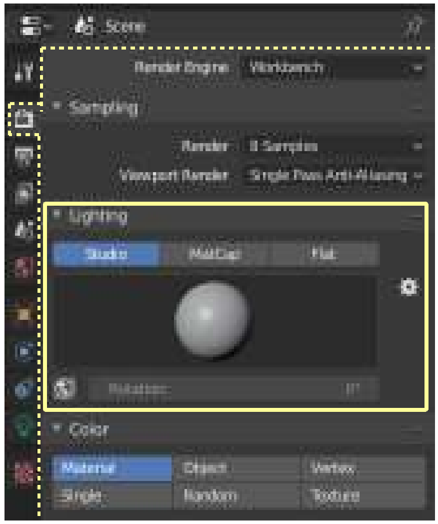


Figure 26.32

Lighting

Figure 26.33



Note: In Workbench Render the default Point Lamp in the Scene or any Lamps placed in the Scene have no effect on lighting. The lighting is controlled by the settings in the Workbench Properties Editor, Render buttons (Figure 26.33).

Studio Lighting: The default Lighting display.

Flat Lighting: Shows all Objects without color in a flat gray.

MatCap Lighting: Provides a variety of options which show the Scene with an overall lighting effect. It should be remembered that the effects are a preview only to allow you to see how the Scene will look after you set the lighting effects in Eevee or Cycles render.

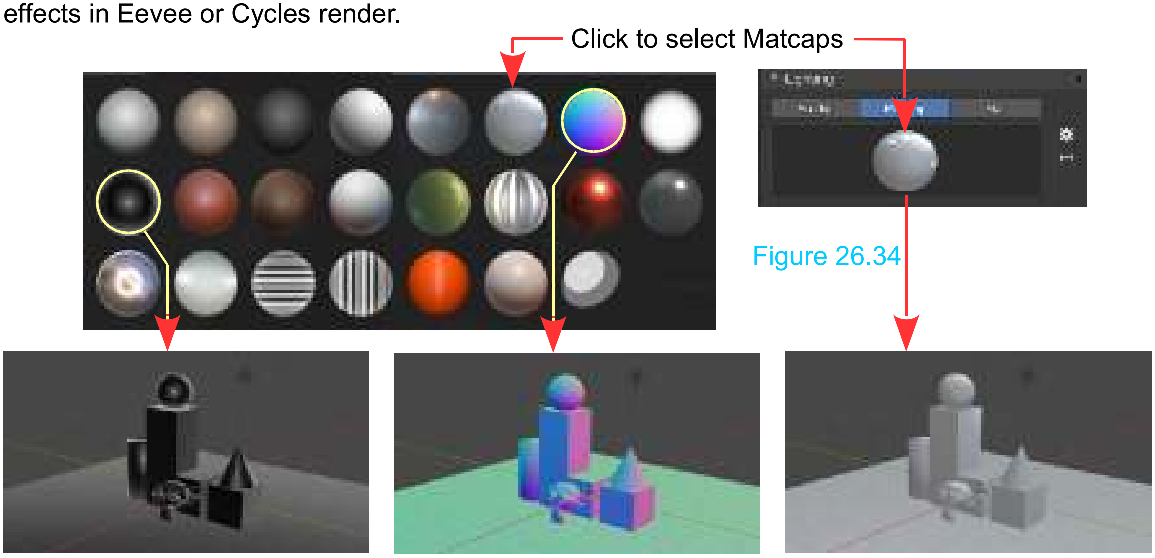


Figure 26.34

Color:

The Color Tab allows you to preview Materials and Textures applied to Objects.

Figure 26.35

The default Color option is **Material** (Figure 26.35). This is perhaps the trickiest option to explain since it relates to the Material applied to an Object and at the beginning of the chapter it was stated that the Material buttons in the Properties Editor were limited.

Material: Assume that you would like to see how Suzanne (Monkey) would look with a different Material, in the Scene, before actually making a change.

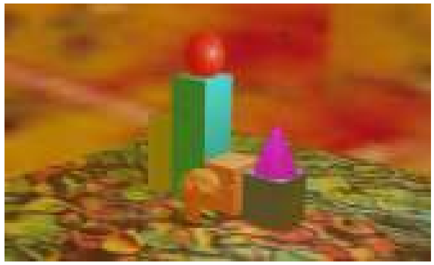


Figure 26.36

The Scene is displayed in Eevee, in Rendered Viewport Shading Mode (Figure 26.36).

Switch to Workbench Render in Rendered Viewport Shading Mode and select Suzanne in the Viewort.

At this point everything in the Scene displays gray. With the limited display in the Material buttons(Figure 26.37), open the Viewport Display Tab and click the Color bar to display the Color Picker Circle. Select a color and adjust the Metallic and Roughness settings (Figure 26.38). When satisfied switch back to Eevee and make the changes.

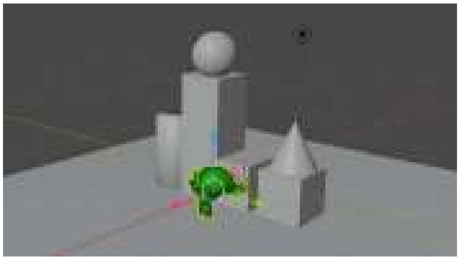


Figure 26.37

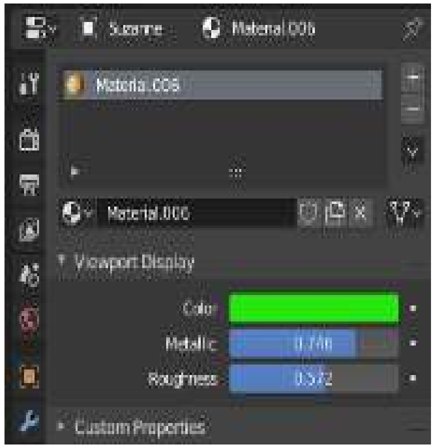


Figure 26.38

Object:

The Object Color option is similar to the Material option. Select an Object in the Viewport then in the Properties Editor, Object buttons Viewport Display tab, select a Color for preview.

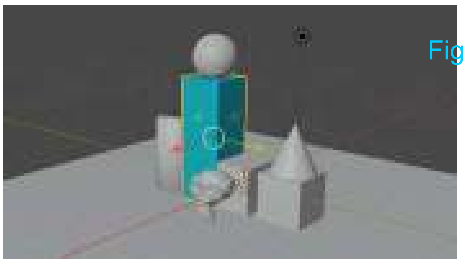
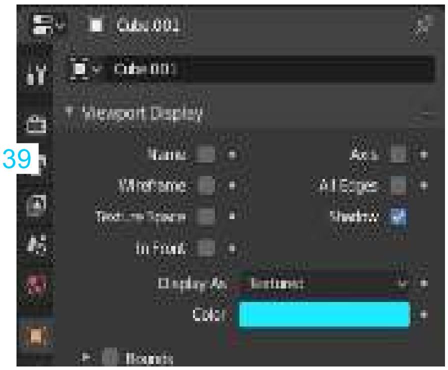


Figure 26.39



Single: The **Single** Color option displays all Objects with the same color.

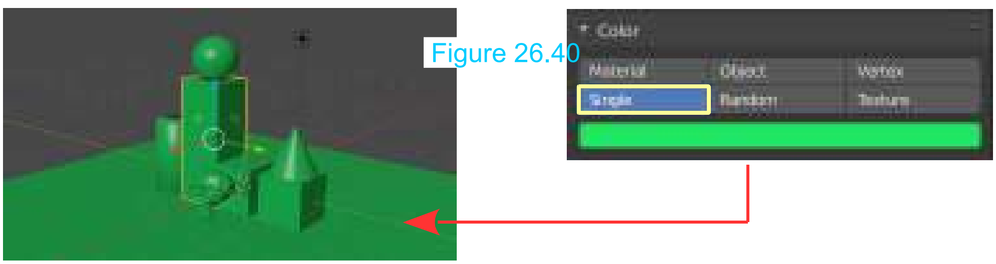


Figure 26.40

Random: **Random** applies a different color to each Object in the Scene making it easier to distinguish one object from another when the scene becomes really congested.

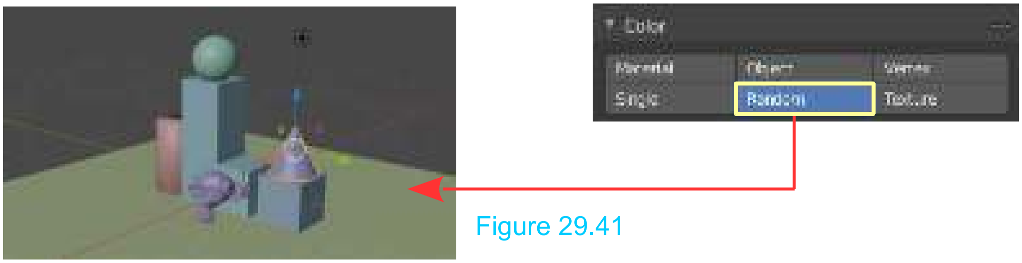


Figure 29.41

Texture: Displays textures which have been applied to Objects in a Scene.

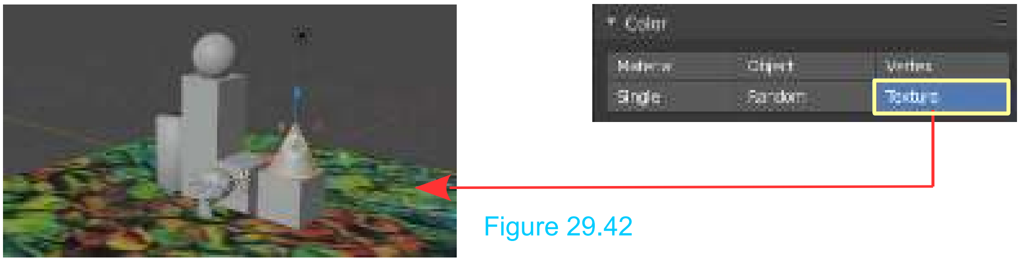


Figure 29.42

Vertex:

Vertex allows you to **Vertex Paint** Objects as a preview before making changes to a Scene. Have the Vertex option selected. Select an Object in the 3D Viewport. Change the 3D Viewport (in Rendered Display Mode) from Object Mode to **Vertex Paint Mode**. RMB click in the Viewport foe the Color Picker. Select a color. The Mouse Cursor is a circle which you click , hold and drag over the Object to paint color.

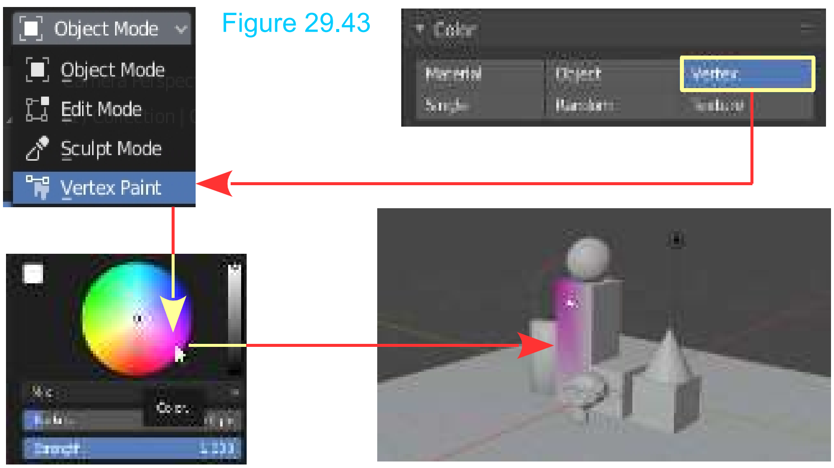
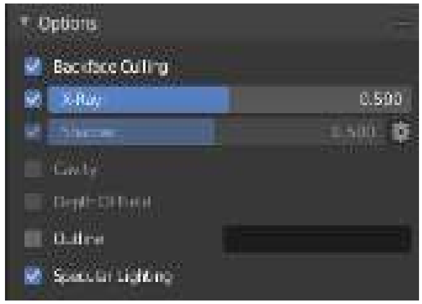


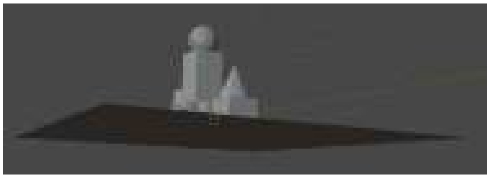
Figure 29.43

The Options Tab

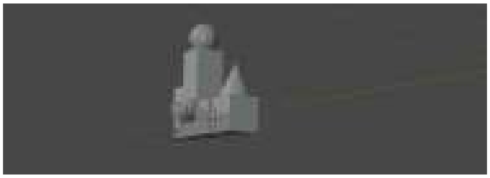
Finally a few of the settings in the **Options Tab**. Figure 29.44



Backface Culling: Allows you to see through the rear Face of Objects.



Scene Rotated



Backface Culled

Shadows:

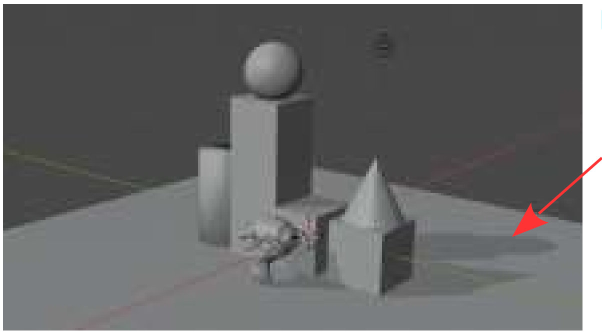


Figure 29.45

Shadow

X-Ray: Displays Objects in the Scene transparent **IN A RENDERED VIEW** when you press **F12.**

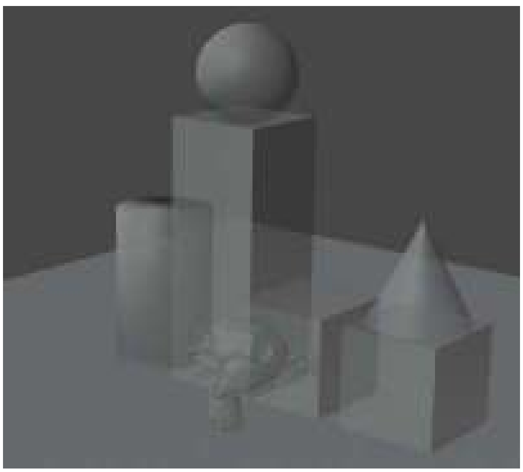


Figure 29.46

27

Internet Resources

The following resources are a sample of the information freely available on the internet. New material is continually being released and recognition and appreciation is given to the authors of these publications.

It is practically impossible to cover all aspects of **Blender** in a single publication, therefore, researching information from the internet is integral to becoming proficient in the operation of the program.

In providing the following there is no order of precedence.

Blender 2.81 Reference Manual

https://docs.blender.org/manual/en/latest/

Wikipedia Blender (software)

https://en.wikipedia.org/wiki/Blender

Tutorials — blender.org

https://www.blender.org/support/tutorials/ Blender Fundamentals 2.8

CGMasters

https://cgmasters.net/free-tutorials/blender-2-8-tutorial-overview-eevee-more/

CGCookie.com Blender 2.8 Tutorial | Overview, Eevee & More

https://cgcookie.com/learn-blender

Blender Nation

https://www.blendernation.com/category/education/tutorials/videotutorials/

Blenderartists.org

https://blenderartists.org/t/list-of-the-best-training-for-blender-2-8-beta-for-a-complete-newbie/1148435

CGPRESS

https://cgpress.org/archives/cgtutorials/blender-2-8-beginner-tutorials

Blender Guru

https://www.blenderguru.com/

3D Printing.com

https://3dprinting.com/blender-tutorials/

Sardi' Blender Tutorials

https://www.youtube.com/playlist?list=PLCtL34Gw96S87jqFtVVkZV1FHQyZV4cmn

Blender.Today (Forums)

https://blender.community/c/today

All Blender Tutorials

https://stylizedstation.com/tutorials/blender-tutorials/

The Authors Website

The authors website has supplements to **The Complete Guide to Blender Graphics**.

Supplements:

01 Reflection
02 Background Image
03 Irradience Volume
04 Reflective Plane
05 Background Image
06 Grease Pencil 2D Animation (ZIP)
07 Grase Pencil 2D Animation (PDF)
08 Installing Add-ons
09 Drivers
10 Textures in Cycles

https://www.tamarindcreativegraphics.com

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