



UNREAL  
ENGINE

## HOUR 6

Materials:  
Learning the Material Editor

# INTRODUCTION

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In this lecture, you will learn what Materials are and how to use them. You will be introduced to the Material Editor and how to create a basic Material. You will learn about common Material nodes and the role they play in affecting the surface of a Static Mesh.



# LECTURE GOALS AND OUTCOMES

## Goals

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The goals of this lecture are to

- Become familiar with the Material Editor
- Understand what Materials are and how they are used
- Learn to create a new Material
- Learn how to import Textures and use them in the Material Editor
- Learn about mipmaps
- Learn what image formats you can use

## Outcomes

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By the end of this lecture you will be able to

- Create a new Material asset
- Use the Material Editor
- Import and use Textures in the Material Editor

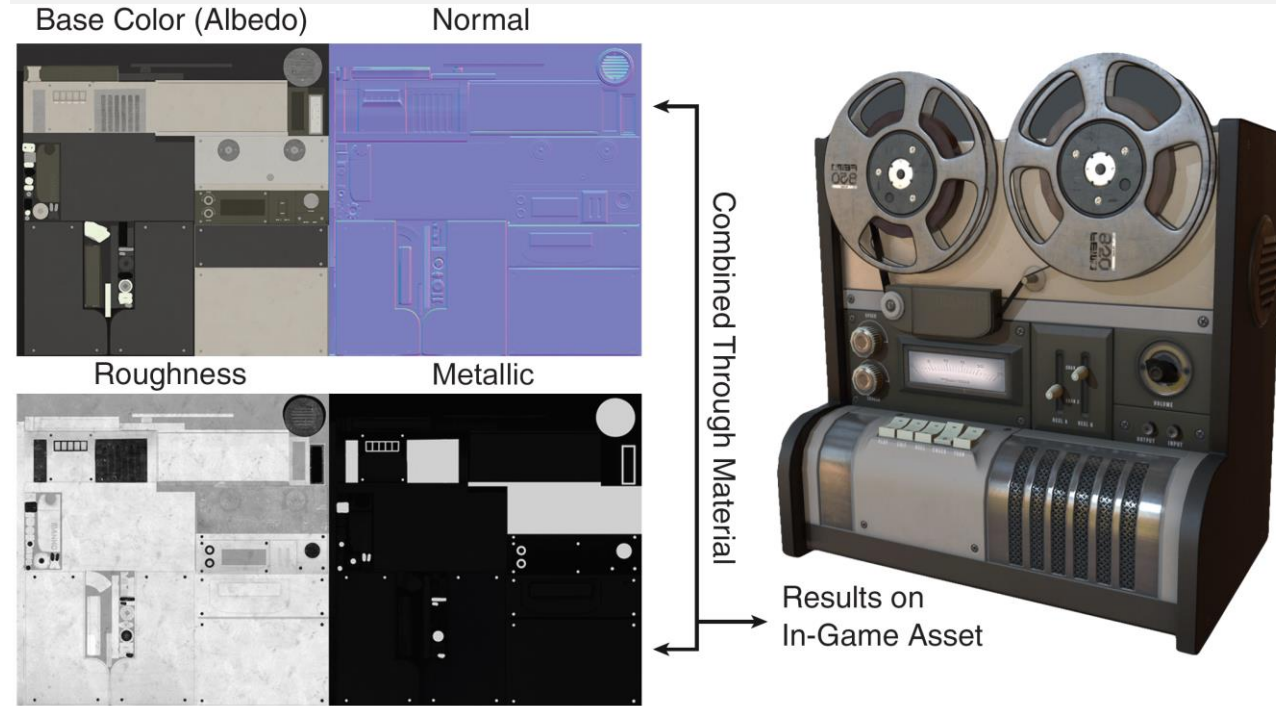




# UNDERSTANDING MATERIALS

A Material is a combination of Textures and mathematical calculations that work together to define how light reacts with a surface.

Materials establish the visual style of an asset. When you are viewing an asset in-game, such as a rock, a tree, or a concrete wall, that asset has a particular Material assigned to it that defines the surface properties and gives it a unique appearance.



# PHYSICALLY BASED RENDERING (PBR)

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UE4's Material rendering system uses physically based rendering (PBR) for real-time rendering. PBR is a relatively new concept in the world of authoring Textures and Materials for games.

UE4 utilizes a physically based shading model. This means that rather than defining a Material using arbitrary properties (such as diffuse color and specular power), you use properties more easily relatable to the real world. These include base color, metallic, specular, and roughness.



# COLOR RANGES

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If you are coming from Photoshop, you may be familiar with values that range from 0 to 255 when dealing with color channels.

For example, a gray in Photoshop would be R: 128, G: 128, B: 128. The UE4 Material Editor uses a normalized value system that ranges from 0 to 1; 0 is 0% and 1 is 100%, so a gray would be R: 0.5, G: 0.5, B: 0.5.



# MATERIAL EDITOR

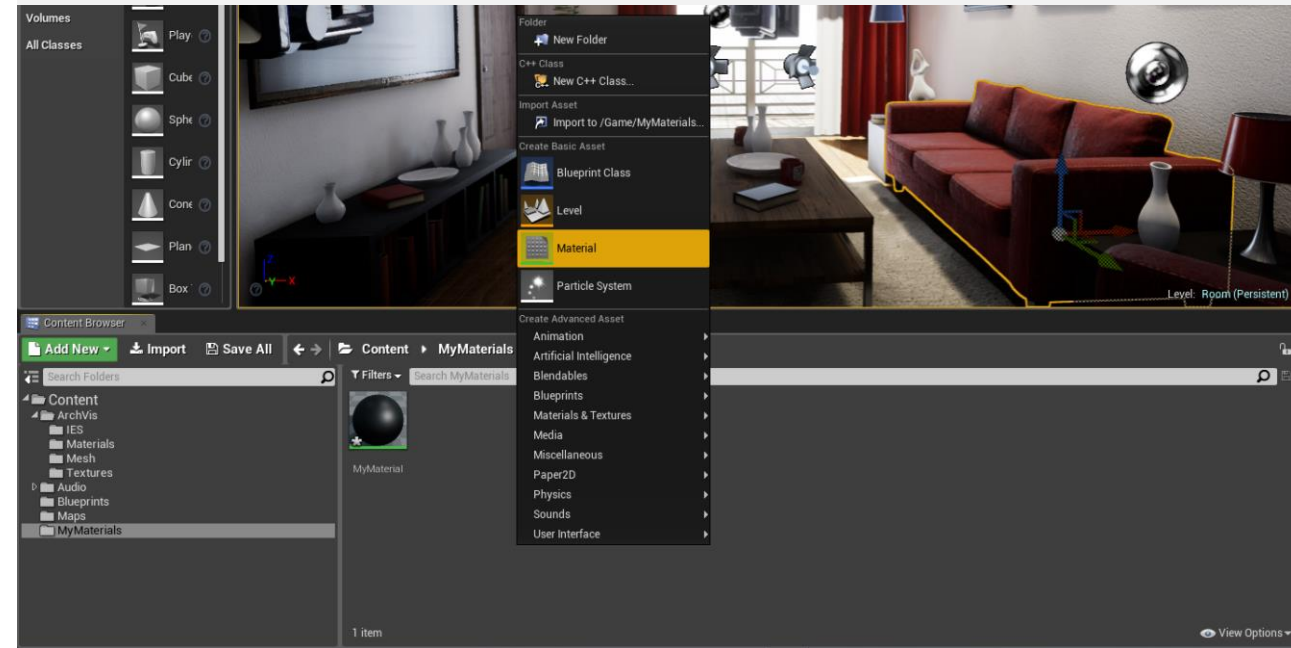
Interface



# CREATING MATERIALS

To create a new Material:

- Right-click in the Content Browser's asset view and select Material.
- Give the new Material a name.
- Double-click on the new Material to open the Material Editor.







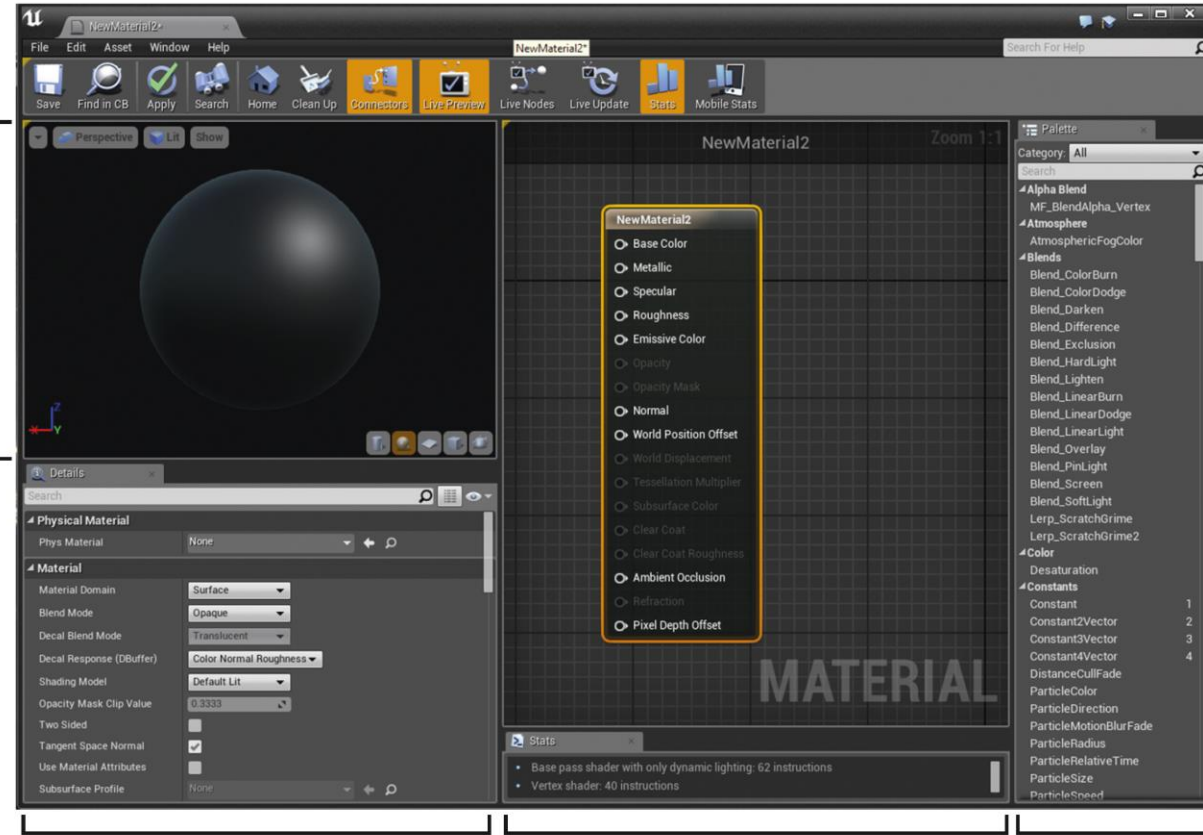
# MATERIAL EDITOR INTERFACE

In UE4, Materials are edited in the Material Editor.

The Material Editor is a node-based system that uses expressions and functions to manipulate the output to create the desired end result.

**Note:** While learning the Material Editor interface is simple, the complexity of the surface you create will ultimately be limited by your creativity and understanding of mathematics.

Viewport panel



Details panel

Graph panel

Palette panel



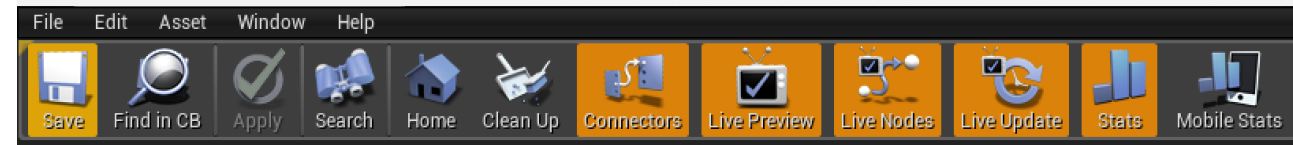
## TOOLBAR

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At the top of the Material Editor is a toolbar, where you can save and compile your Material by clicking Save or Apply.

You also have search tools such as Find in CB, which locates the current Material in the Content Browser, and Search, which can help you locate a node within the Material graph.

Live Preview, Live Nodes, Live Update, and Stats all allow you to visualize the Material node graph in real time and update the Viewport panel. It is a good idea to turn these on while working in the Material Editor.



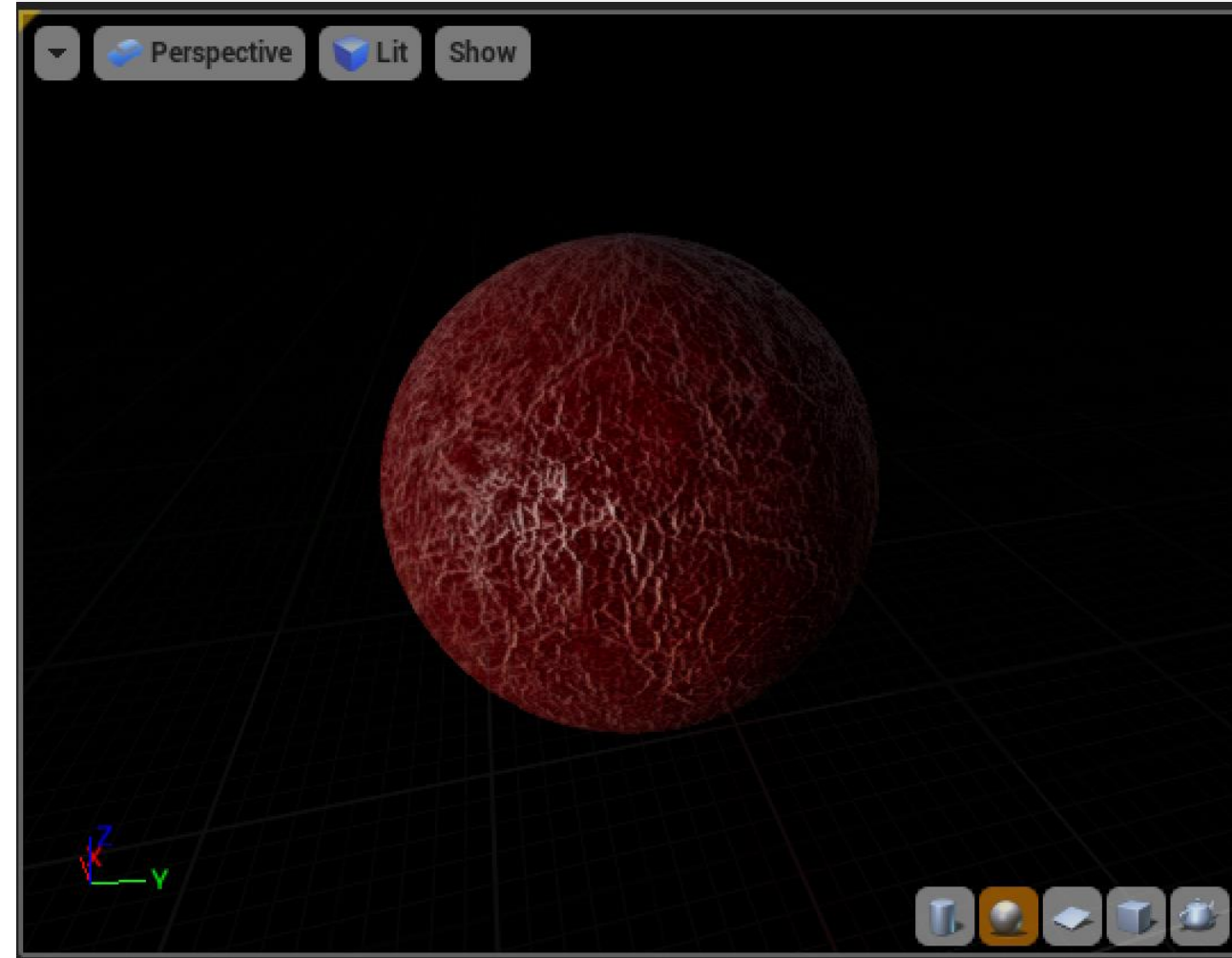


## VIEWPORT PANEL

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The Viewport panel displays a real-time preview of the Material. It shows the final result of the Material being compiled.

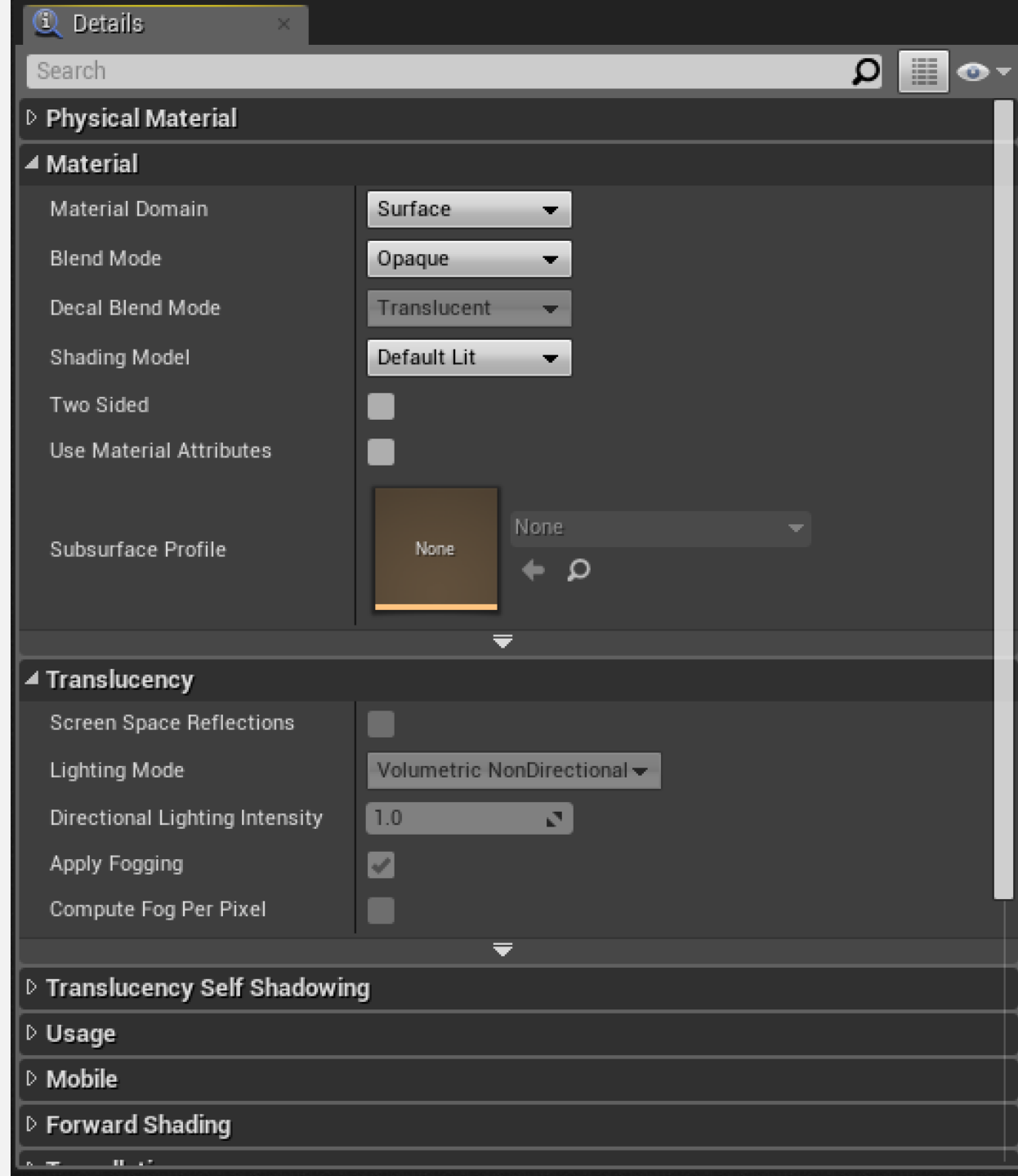
- You can change the object on which the Material is displayed by using the shape options on the bottom right.
- You can change the Material's visual or perspective attributes by using the options in the upper left corner of the panel.





## DETAILS PANEL

The Details panel is where you can change overall Material properties and rendering methods that the Material uses in gameplay space, such as opacity options, subsurface options, and shading models.



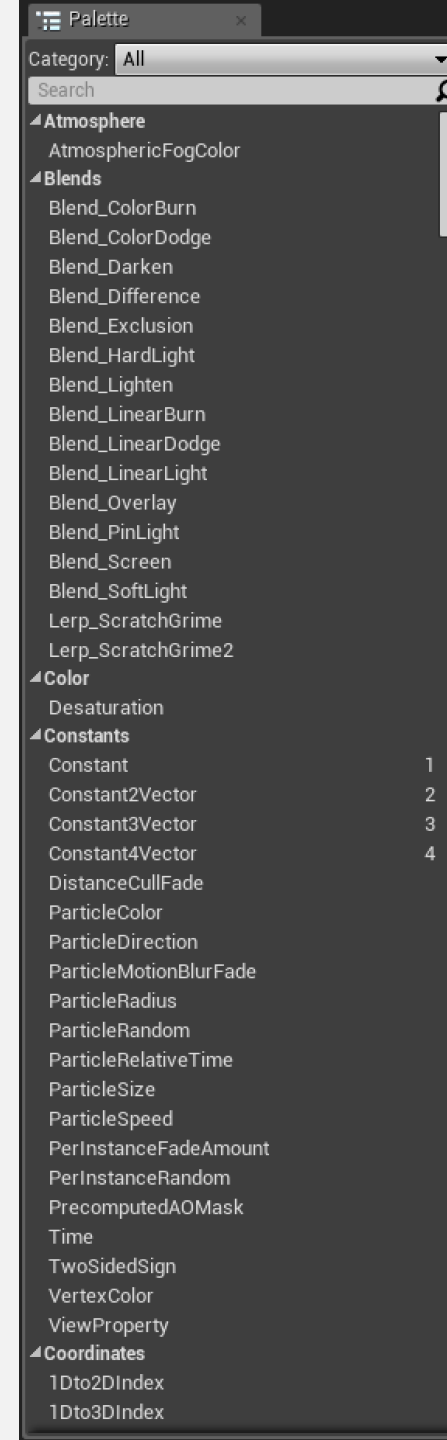


## PALETTE PANEL

The Palette panel is located farthest to the right. It houses all the functions and expressions for creating specific effects within a Material.

There are three ways to add function and expression nodes to the Graph panel:

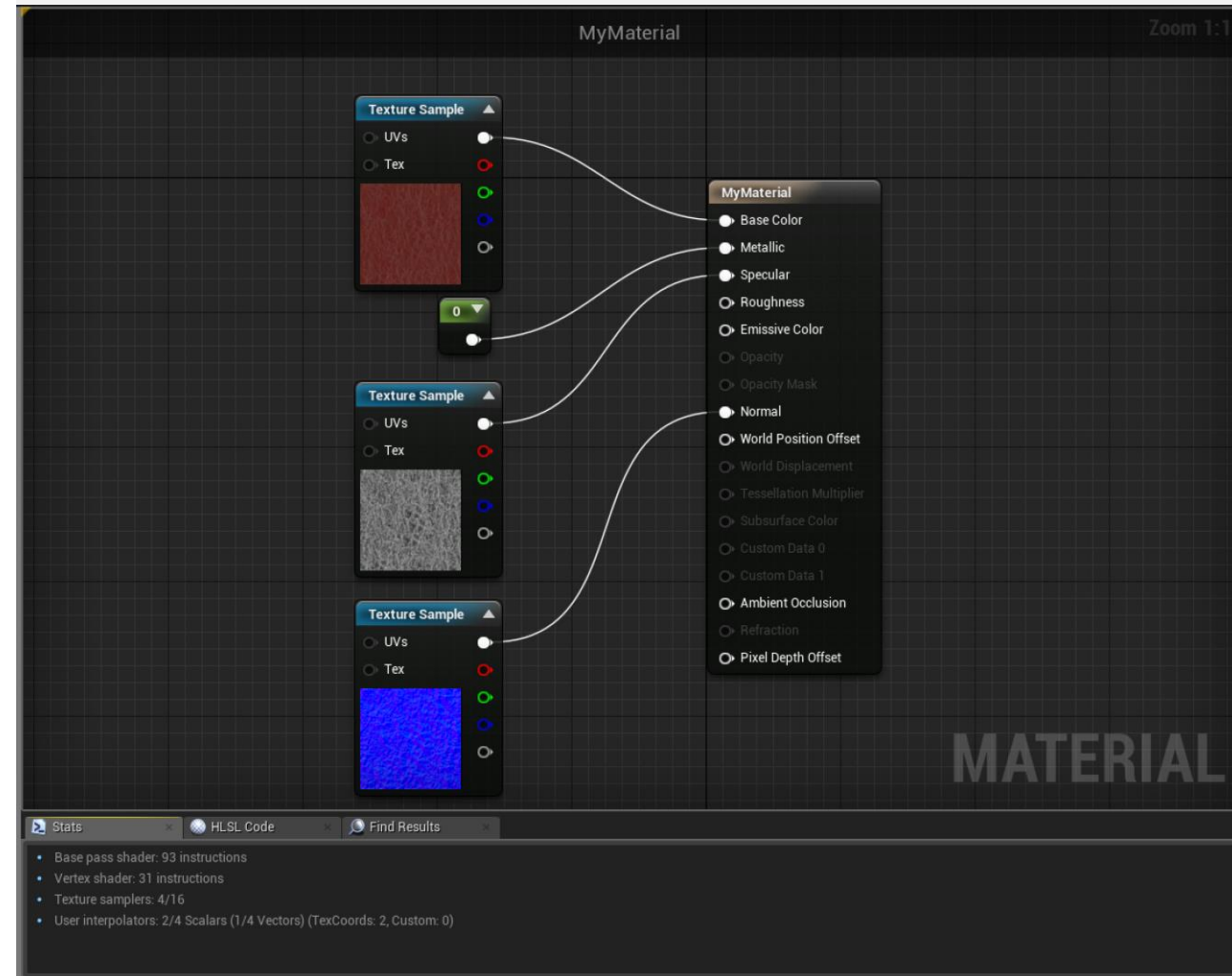
- Click and drag the node from the Palette panel.
- Press the assigned shortcut key for the node and left-click in the Graph panel.
- Right-click in the Graph panel and select a node from the pop-up list.





## GRAPH PANEL

The Graph panel is where most of the work is done. It is where you place function and expression nodes from the Palette panel and link data wires to input and output pins to create your desired end result for each of the Material inputs found on the base Material node.



# MATERIAL EDITOR

Base Material Node



## BASE MATERIAL NODE

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In the Material Editor Graph panel, you will see a node that represents the output of the Material.

This is called the base Material node.

### MyMaterial

- Base Color
- Metallic
- Specular
- Roughness
- Emissive Color
- Opacity
- Opacity Mask
- Normal
- World Position Offset
- World Displacement
- Tessellation Multiplier
- Subsurface Color
- Custom Data 0
- Custom Data 1
- Ambient Occlusion
- Refraction
- Pixel Depth Offset

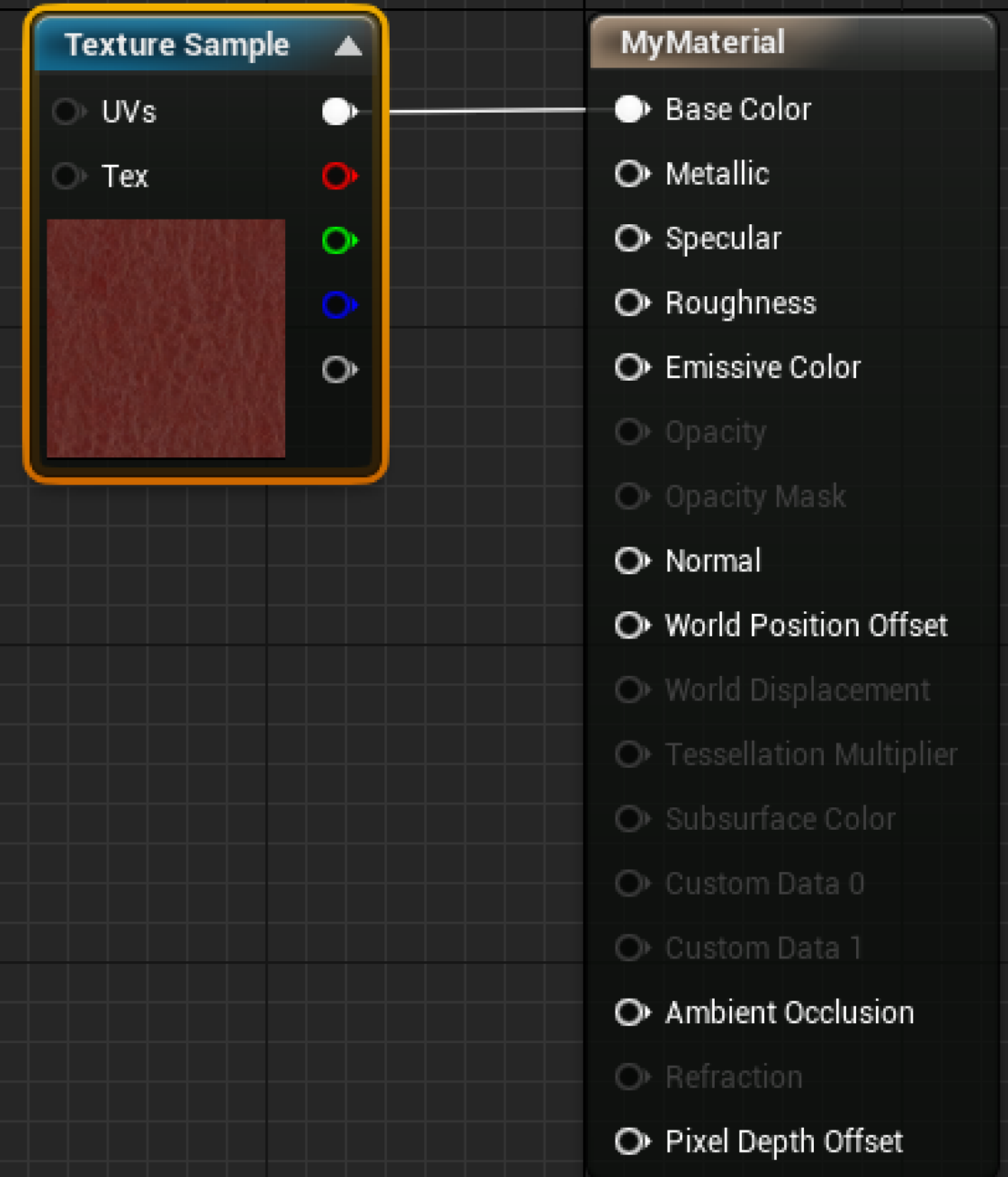




## BASE COLOR

Also referred to as *albedo* or *diffuse*, base color is the core color description of the surface in a Material minus shadow and lighting detail. Essentially, the Base Color input uses the pure color value of the Material you are creating.

- It should be void of shadow and lighting information and show only the color that you wish to represent in the Material.
- It can use a Texture input or even a simple constant vector, which is simply a number representing a uniform color.

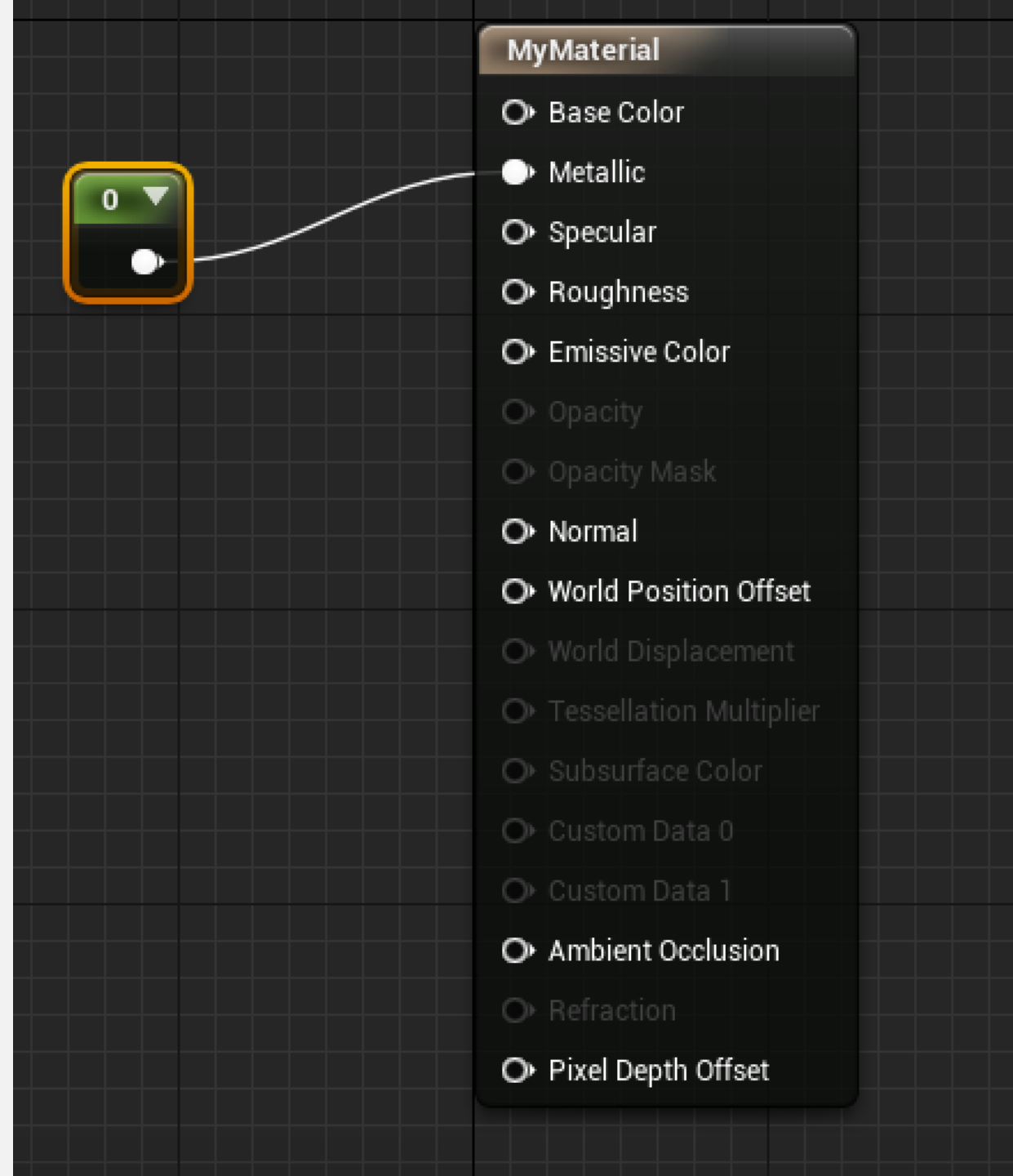




## METALLIC

The Metallic input is used to determine if a Material looks like metal. A value of 0 or black is off, meaning it is not metallic. A value of 1 or white is on, meaning it is metallic.

- The Metallic input affects the reflective properties of the surface.
- If a Material is metallic, you most likely will not use the Specular category, but if a Material is not metallic, you will need to use the Specular category.
- If a surface is metal, use value ranges of .5 to 1 to control variation.

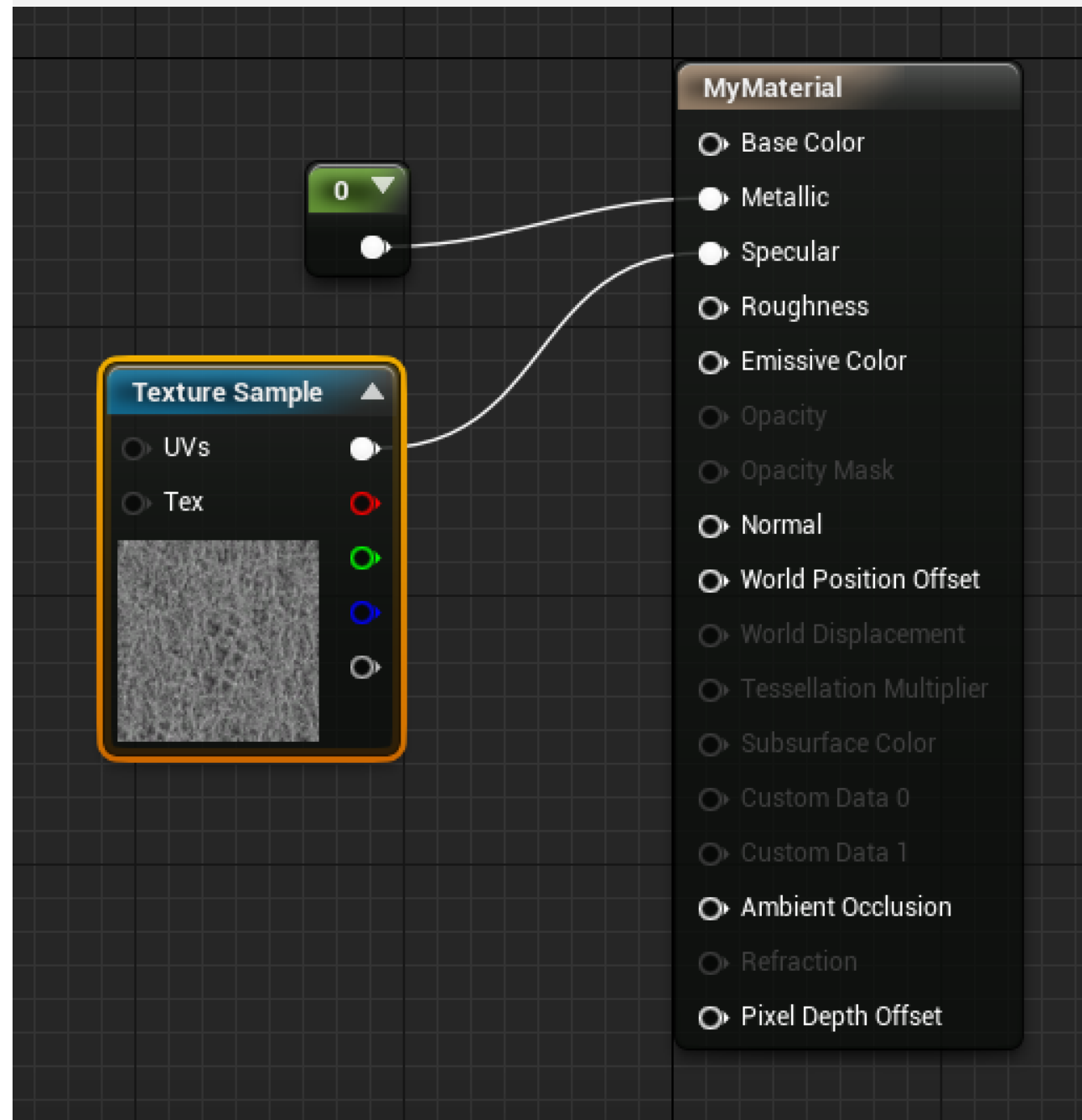




## SPECULAR

The Specular input determines the overall reflectivity of a surface. A value of 0 will not reflect anything, while a value of 1 will effectively eliminate attenuation of surface reflections.

- The Specular input should almost always be left as its default (0.5), except to simulate nonphysically correct effects like microfacets—tiny surface roughness that creates microshadowing that reduces the amount of reflected light. Certain fabrics or rough surfaces might require this.
- The Specular input does not affect metallic Materials.



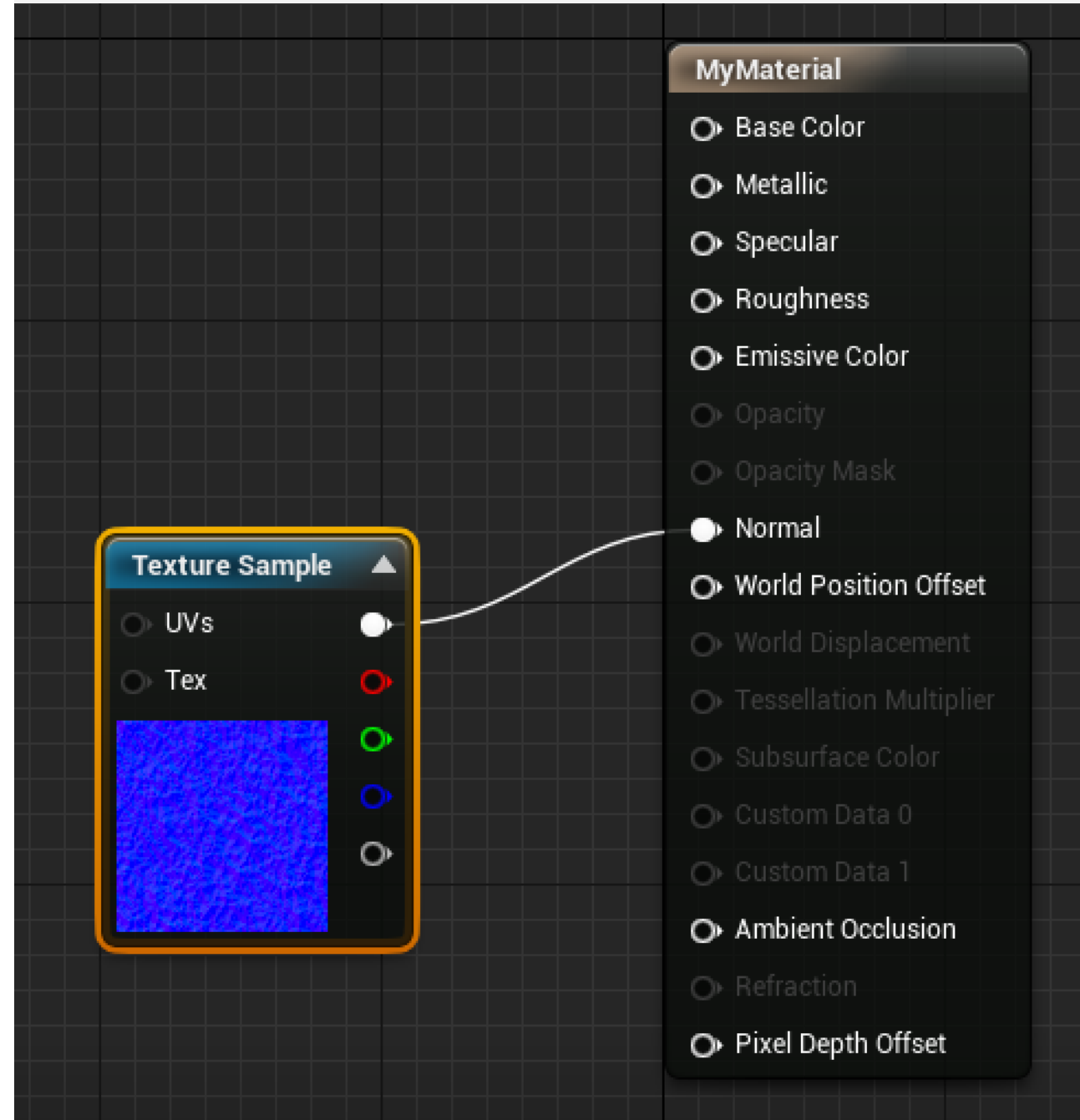


## NORMAL

The Normal input controls the direction in which light should react with a surface. Normal maps add high-definition surface detail and shape to a Material by modifying the underlying surface's world normal direction.

Each channel of a Texture map (red, green, and blue) is composited to represent a different surface direction angle per color.

- Red represents the x axis, or the front-to-back direction of light hitting the surface.
- Green represents the y axis, or the left-to-right direction.
- Blue represents the z axis, or the top-to-bottom direction.



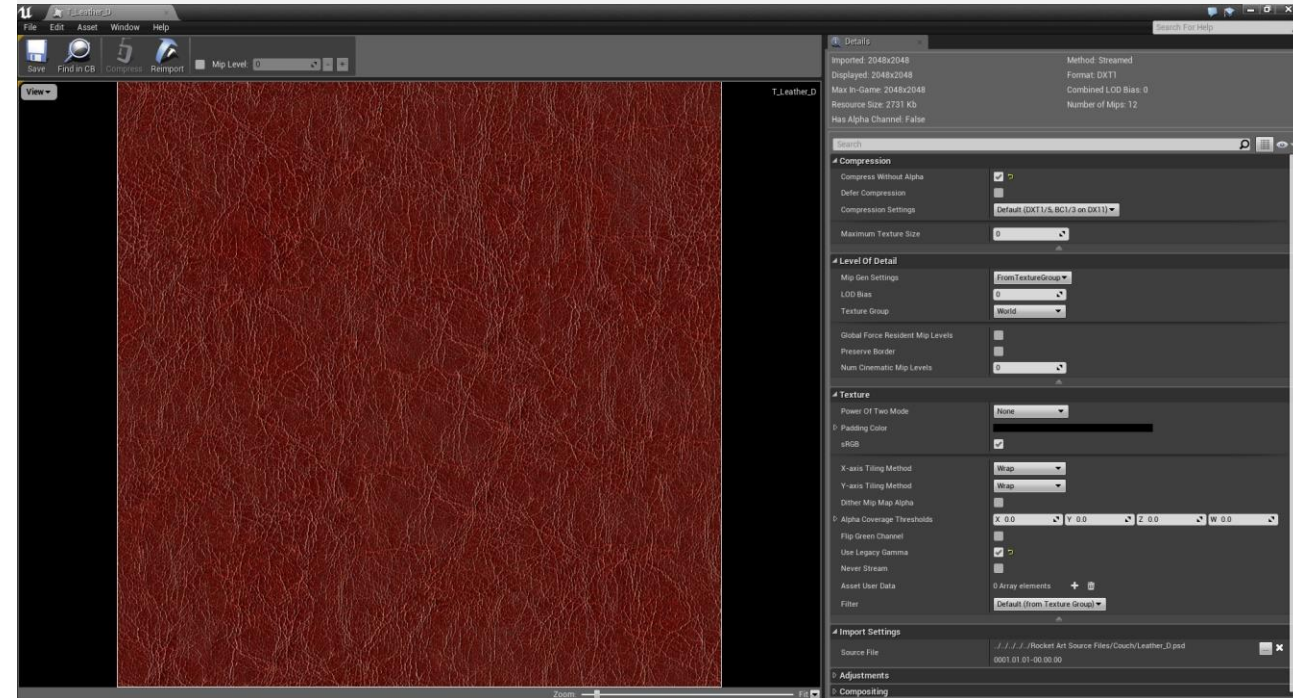
# WORKING WITH TEXTURES

Texture Editor



# TEXTURE EDITOR

Once a Texture has been imported, double-clicking on the Texture asset in the Content Browser will open the Texture viewer and display the Texture. Here you can change the default preference for the Texture.





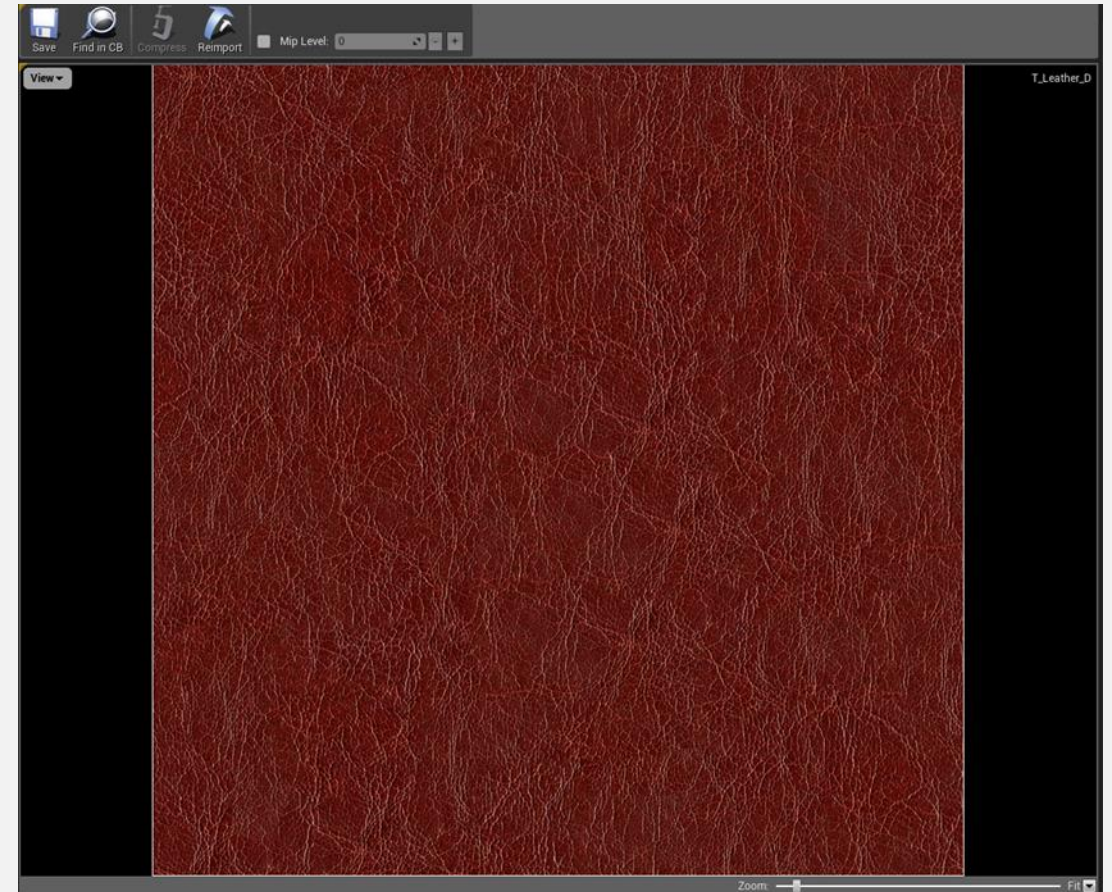


# TEXTURE EDITOR

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Textures are the foundation for controlling surface properties in a Material. Textures are 2D images created in external applications such as Photoshop.

- Textures should adhere to the “power of 2” rule.
- Textures don’t have to be square, but each dimension should be a power of 2.
- By default, the smallest Texture you can import is 16x16 pixels.
- The largest Texture you can import is 8192x8192.



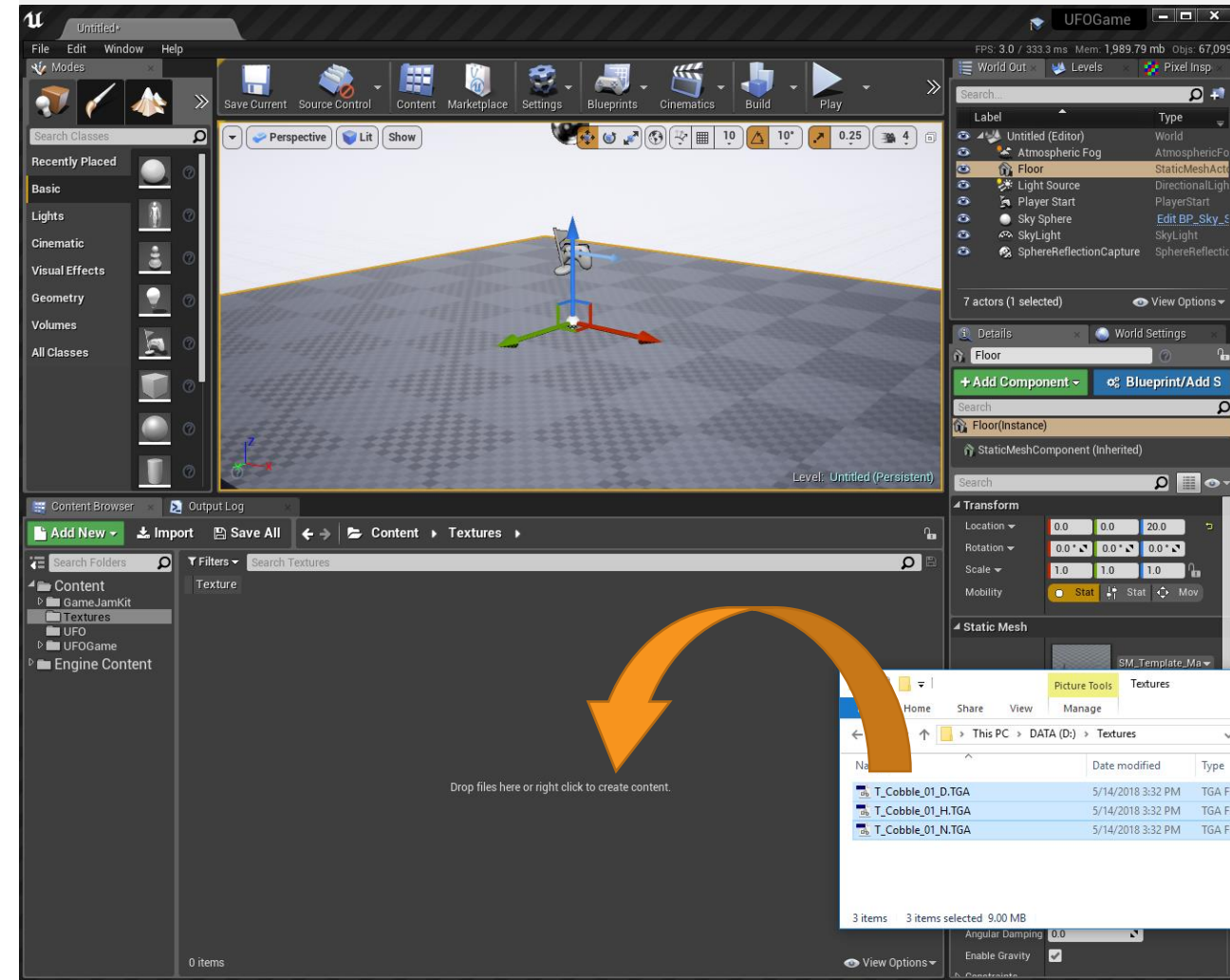


# TEXTURE FORMATS

To import a Texture into the Editor, simply drag the Texture file into the Content Browser.

The following file types currently work in UE4:

- .tga
- .psd
- .tiff
- .bmp
- .float
- .pcx
- .png
- .jpg
- .dds

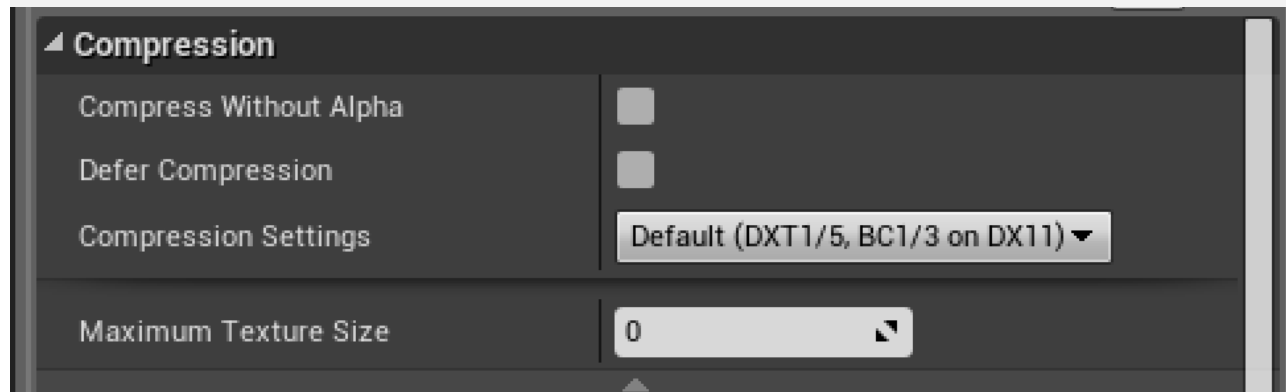






## TEXTURE FORMATS

When Textures are imported, the Editor automatically assigns compression to the image based on the image's properties.





# MIPMAPS

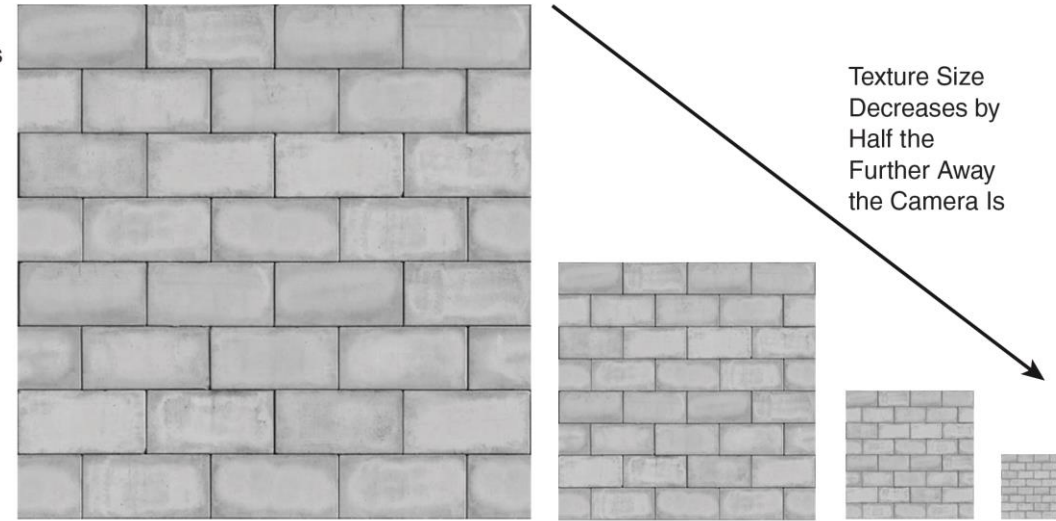
Mipmapping is the process of generating a sequence of lower-resolution images from a larger one.

The “mip” in *mipmap* stands for “multum in parvo” (a great deal in a small space). Mipmapping is an efficiency technique. As an Actor moves farther and farther away from the camera, its resolution becomes smaller and smaller, and therefore the Actor can use lower Texture resolutions.

Mipmaps help eliminate aliasing and shimmer on distant surfaces.

Texture Map Sizes

4096  
2048  
1024  
512  
256  
128  
64  
32  
16  
8  
4  
2



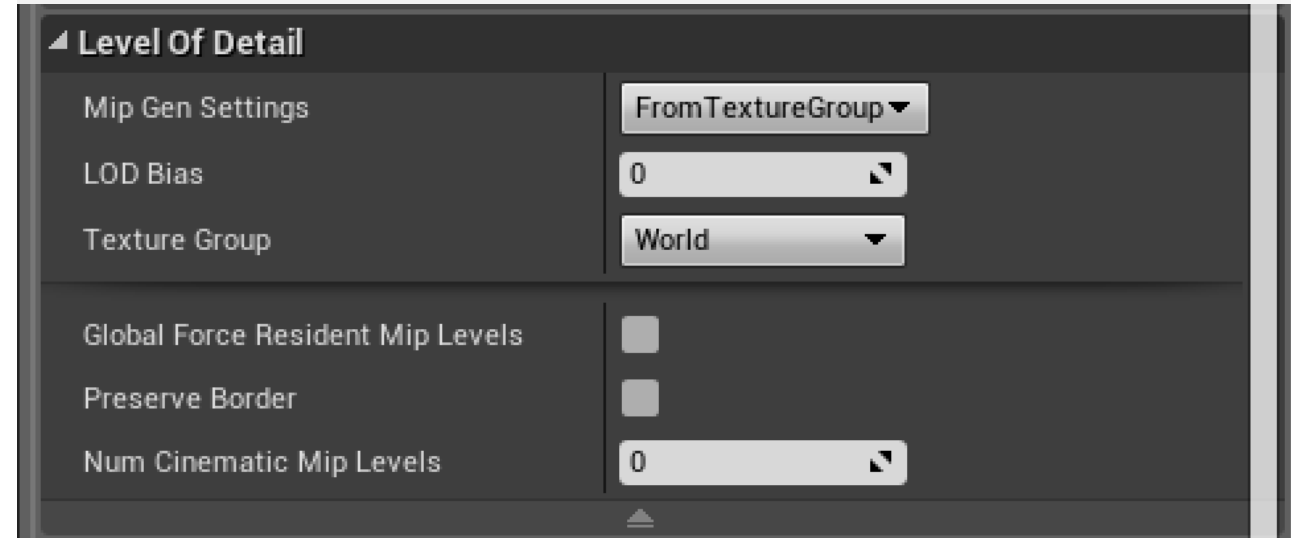


## TEXTURE GROUPS

Images can be assigned to Texture groups, which tells the engine how they are going to be used.

Groups of Textures can be modified using system scalability settings to force lower-resolution images on lower-spec hardware.

Groups can also be used to apply group-wide settings such as number of mipmaps to generate.

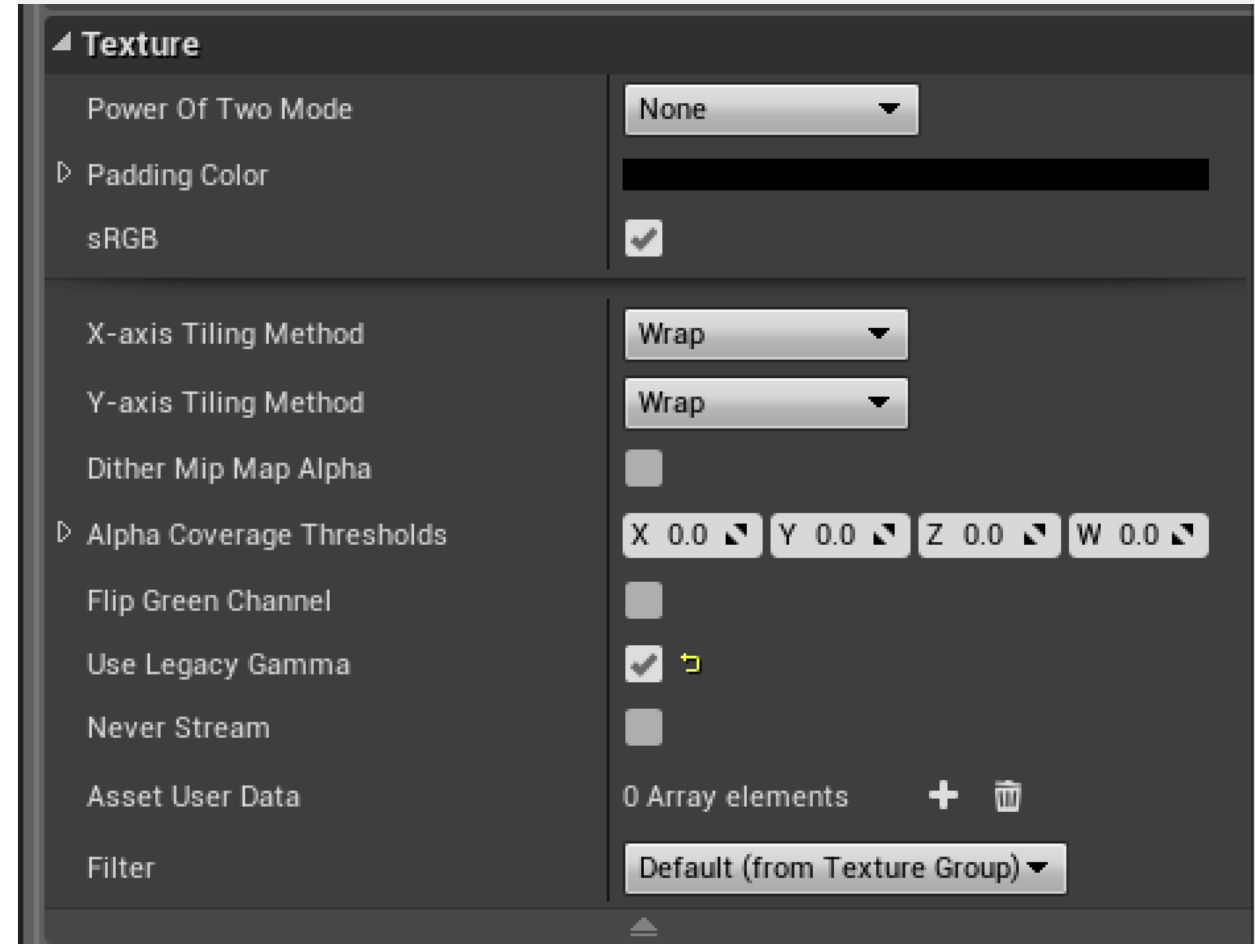




## TEXTURE PROPERTIES

Under Texture categories, you can control properties such as tiling of Textures when used in the Material Editor or whether the Texture can be streamed.

**Note:** While UV tiling is controlled in the Material Editor using the Texture Coordinate node, the tiling of a Texture is controlled in the Texture properties.



# MATERIAL EDITOR NODES

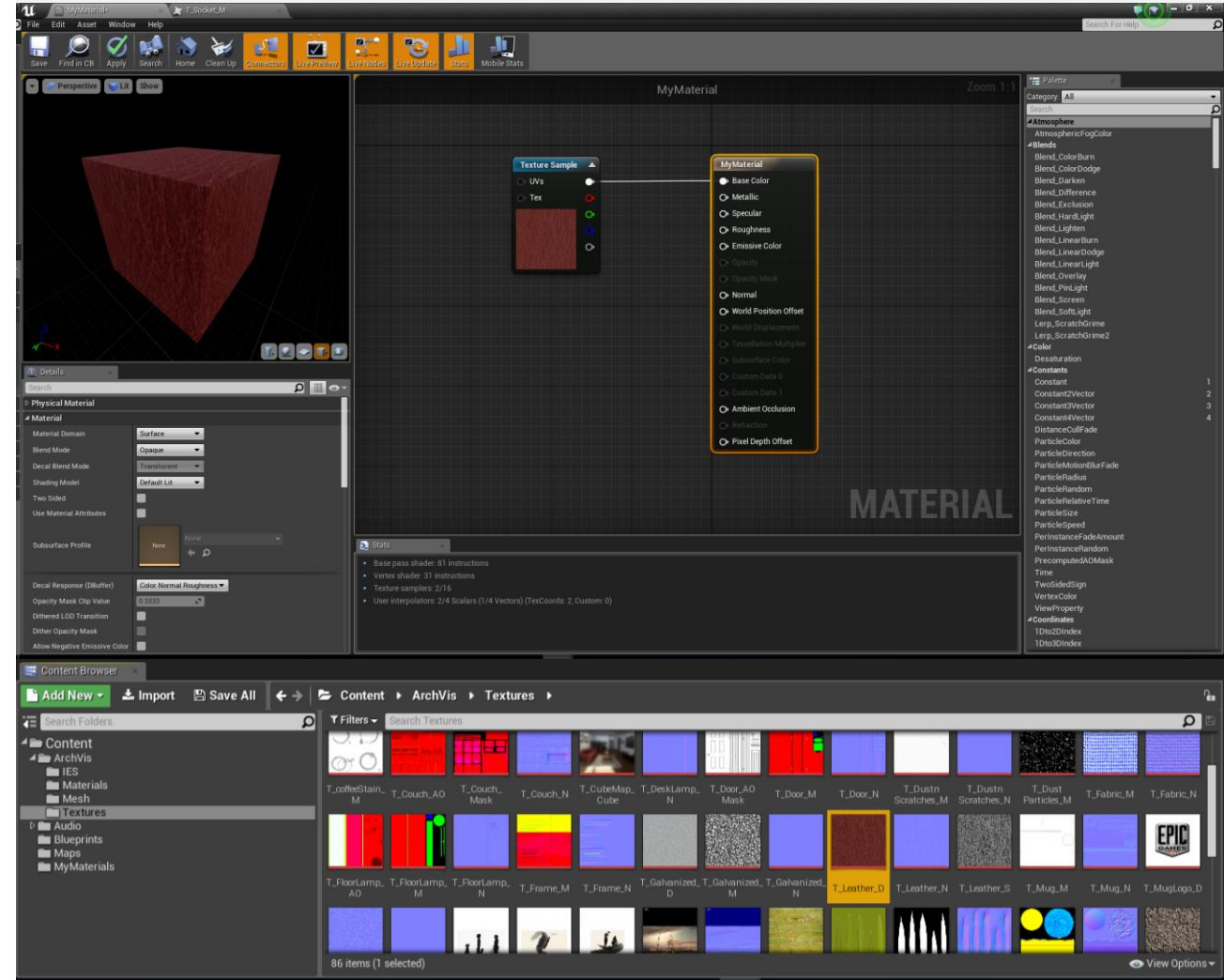
Texture Samples and Constant Vectors



# TEXTURE SAMPLES

Textures can be added to the Material Editor by dragging them from the Content Browser to the Graph panel.

This will add a Texture Sample node that references the Texture asset.





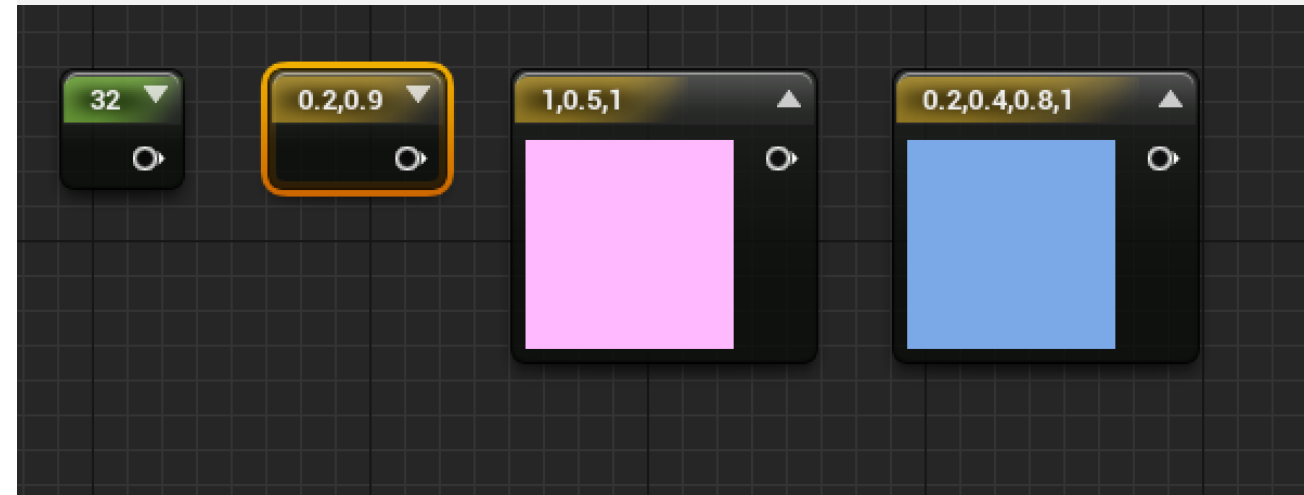
## CONSTANT VECTORS

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Constant vector nodes hold static values.

They can be added to the Graph panel in the following ways:

- Hold the 1, 2, 3, or 4 key and left-click in the Graph panel.
- Right-click in the Graph panel and search for them in the pop-up list.
- Drag them out from the Palette panel.





## SHORT CUTS

Most of the commonly used nodes in the Material Editor have corresponding shortcut keys so you can place them quickly.

- To place a Constant vector node, press the 1 key and right-click in the Graph panel area.
- To create a Constant3Vector, press the 3 key and right-click in the Graph panel area.
- To add a Texture Sample, hold down “T” and left-click in the Graph panel area.

You can see the assigned shortcuts in the Palette panel.

