

Hour 4

Terrain and Environments

What You'll Learn in This Hour:

- ▶ The fundamentals of terrain
- ▶ How to sculpt terrain
- ▶ How to decorate your terrain with textures
- ▶ How to add trees and grass to your terrain
- ▶ How to move around in your terrain with a character controller

In this hour, you'll learn about terrain generation. You'll learn what terrain is, how to create it, and how to sculpt it. You will also get hands-on experience with texture painting and fine-tuning. In addition, you'll learn to make large, expansive, and realistic-looking terrain pieces for your games and how to use a controller to move around and explore.

Terrain Generation

All 3D game levels exist in some form of a world. These worlds can be highly abstract or realistic. Often, games with expansive “outdoor” levels are said to have a terrain. The term *terrain* refers to any section of land that simulates a world's external landscape. Tall mountains, far plains, and dank swamps are all examples of possible game terrain.

In Unity, terrain is a flat mesh that can be sculpted into many different shapes. It may help to think of terrain as the sand in a sandbox. You can dig into the sand or raise up sections of it. The only thing basic terrain cannot do is overlap. This means you cannot make things like caves or overhangs. Such items have to be

modeled separately. Also, just as with any other object in Unity, terrain has position, rotation, and scale (although they aren't usually changed during gameplay).

Adding Terrain to a Project

Creating a flat terrain in a scene is an easy task with some basic parameters. To add terrain to a scene, just click **GameObject > 3D Object > Terrain**. An asset named New Terrain appears in the project view, and an object called Terrain is added to your scene. If you navigate around in the Scene view, you may also notice that the terrain piece is very large. In fact, the piece is much larger than you could possibly need right now. Therefore, you need to modify some of the properties of this terrain.

To make this terrain more manageable, you need to change the terrain resolution. By modifying the resolution, you can change the length, width, and maximum height of your piece of terrain.

The reason the term *resolution* is used will become more apparent later in this lesson, when you learn about heightmaps. To change the resolution of the terrain piece, follow these steps:

1. Select your terrain in the Hierarchy view. In the Inspector view, locate and click the **Terrain Settings** button (see [Figure 4.1](#)).
2. In the Resolution section, note that currently, Terrain Width and Terrain Length are set to 500. Change them both to **50**, which is a more manageable size.

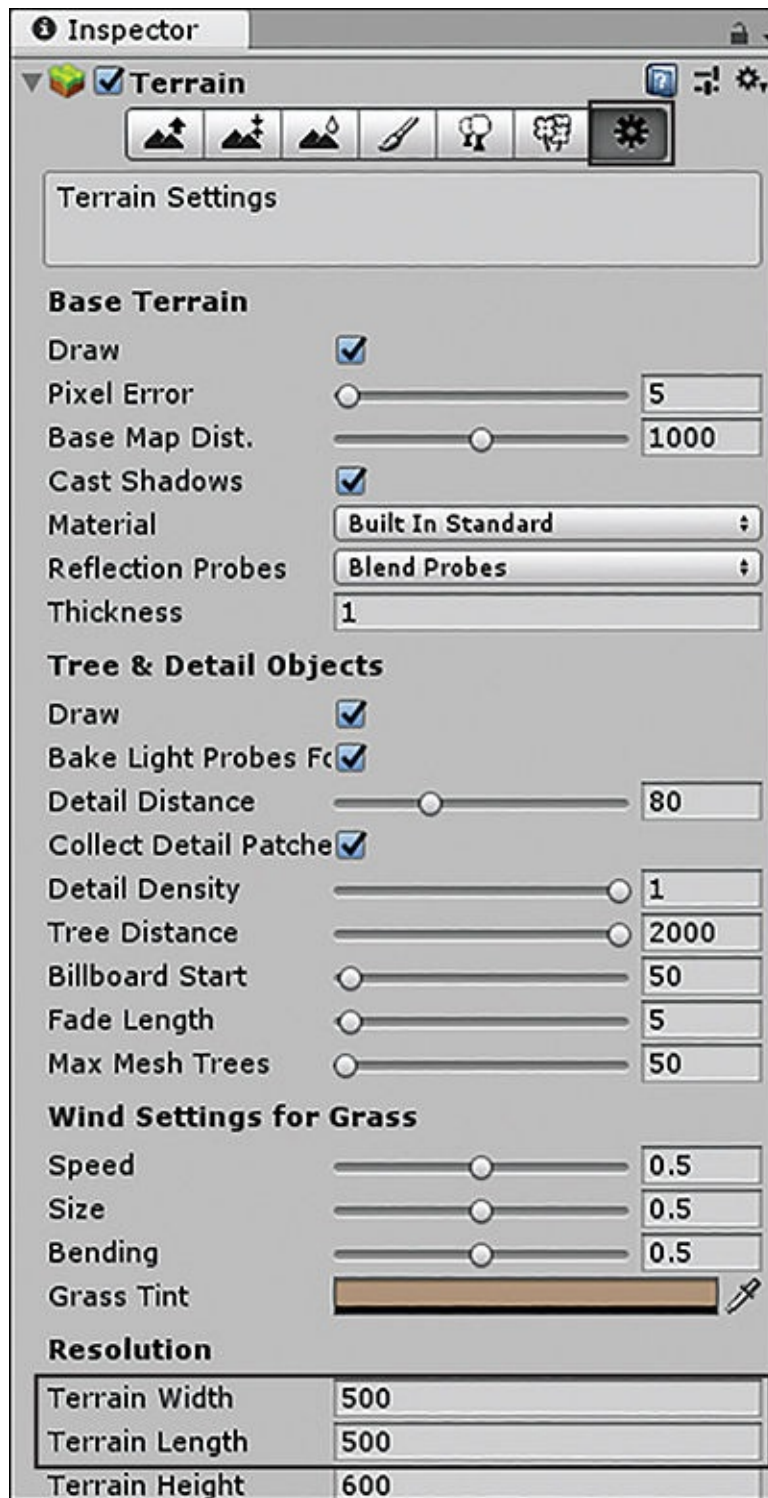


FIGURE 4.1

The Resolution settings.

The other options in the Resolution settings modify the way textures are drawn and the performance of your terrain. Leave these alone for now. After you

change the width and length, you will see that the terrain is much smaller and more manageable. Now it is time to start sculpting.

NOTE

Terrain Size

Currently, you are working with terrain that is 50 units long and wide. This is purely for manageability while you're learning to use the various tools. In a real game, the terrain would probably be a bigger size to fit your needs. It is also worth noting that if you already have a heightmap (covered in the next section), you will want the terrain ratio (the ratio of length and width) to match the ratio of the heightmap.

Heightmap Sculpting

Traditionally, 256 shades of gray are available in 8-bit images. These shades range from 0 (black) to 255 (white). Knowing this, you can use a black-and-white image, often called a *grayscale* image, as something called a *heightmap*. A *heightmap* is a grayscale image that contains elevation information similar to a topographical map. The darker shades can be thought of as low points and the lighter shades as high points. [Figure 4.2](#) shows an example of a heightmap. It might not look like much, but a simple image like this can produce some dynamic scenery.

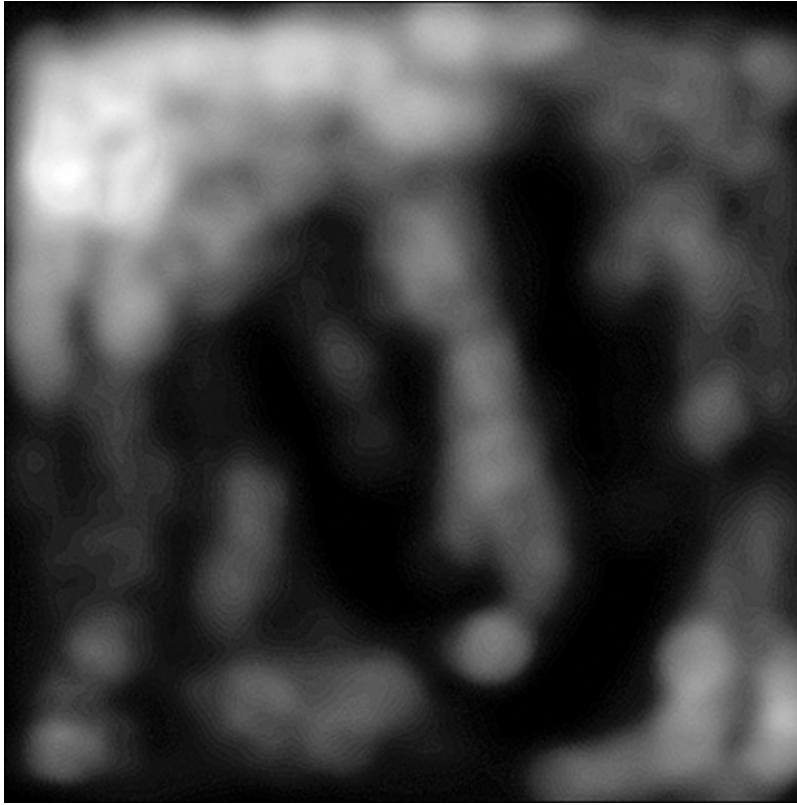


FIGURE 4.2

A simple heightmap.

Applying a heightmap to your currently flat terrain is simple. You simply start with a flat terrain and import the heightmap onto it, as shown in the following Try It Yourself.

▼ TRY IT YOURSELF

Applying a Heightmap to Terrain

Follow these steps to import and apply a heightmap:

1. Create a new Unity project or scene. Locate the terrain.raw file in the Hour 4 files and place it somewhere you can easily find it.
2. Create a new terrain using the steps outlined earlier in this hour. Be sure to set its width and height to **50**.
3. With your terrain selected in the Hierarchy view, click the **Terrain Settings** button in the Inspector view. (Refer to [Figure 4.1](#) if needed.) In the Heightmap section, click **Import Raw**.

4. In the Import Raw Heightmap dialog, locate the terrain.raw file from step 1 and click **Open**.
5. In the Import Heightmap dialog, set the options as they appear in [Figure 4.3](#). (Note: The Byte Order property isn't related to the operating system your computer is running. Instead, it relates to the operating system the heightmap was created in.)

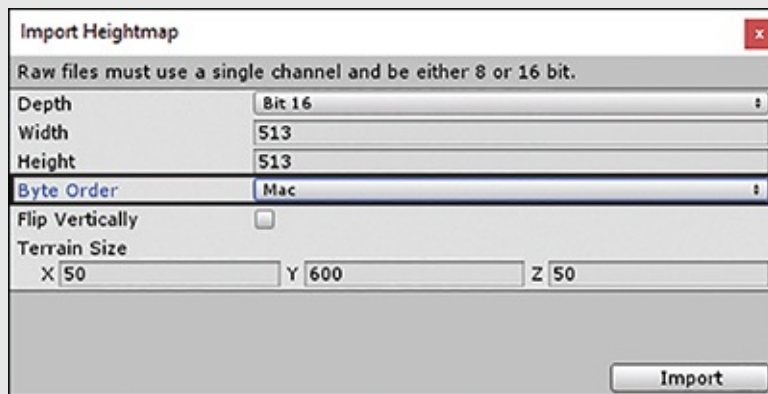


FIGURE 4.3

Import Heightmap dialog.

6. Click **Import**. Right about now, your terrain is looking strange. The problem is that when you set the length and width of your terrain to be more manageable, you left the height at 600. This is obviously much too high for your current needs.
7. Change the terrain resolution by going back to the Resolution section under Terrain Settings in the Inspector view. This time, change the height value to **60**. The result should be something much more pleasant, as shown in [Figure 4.4](#).

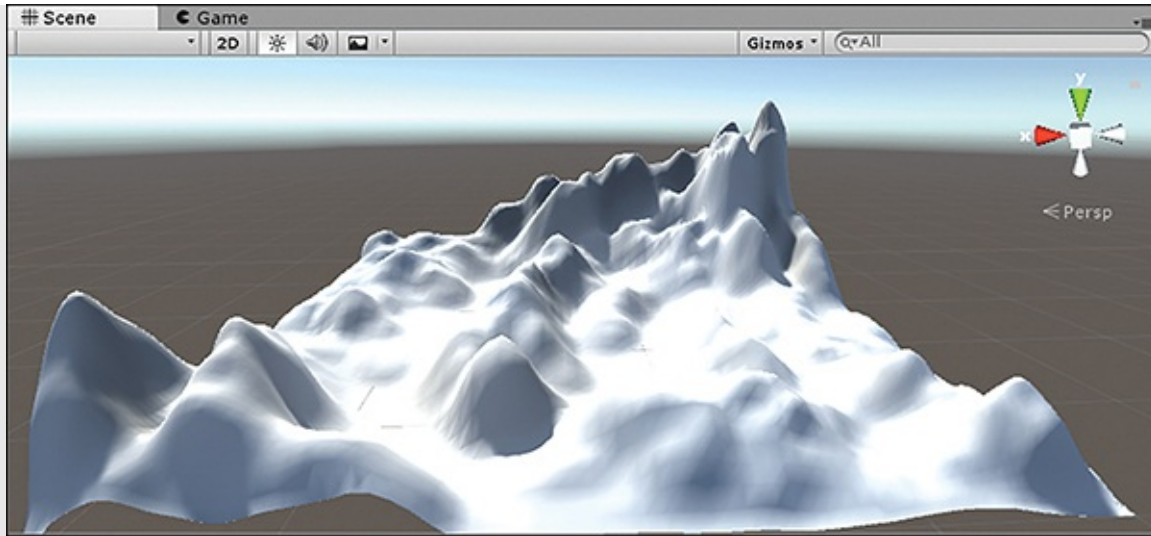


FIGURE 4.4
Terrain after you import a heightmap.

TIP

Calculating Height

So far, the heightmap might seem random, but it is actually quite easy to figure out. Everything is based on a percentage of 255 and the maximum height of the terrain. The max height of the terrain defaults to 600 but is easily changeable. If you apply the formula $(\text{Gray Shade})/255 \times (\text{Max Height})$, you can easily calculate any point on the terrain.

For instance, black has a value of 0, so any spot that is black is 0 units high ($0/255 \times 600 = 0$). White has a value of 255; therefore, it produces spots that are 600 units high ($255/255 \times 600 = 600$). If you have a medium gray with a value of 125, any spots of that color produce terrain that is about 294 units high ($125/255 \times 600 = 294$).

NOTE

Heightmap Formats

In Unity, heightmaps must be grayscale images in the .raw format. There are many ways to generate these types of images; you can use a simple image editor or even Unity itself. If you create a heightmap using an image editor, try to make the map the same length and width ratio as your terrain.

Otherwise, some distortion will be apparent. If you sculpt some terrain using Unity's sculpting tools and want to generate a heightmap for it, you can do so by going to the Heightmap section under Terrain Settings in the Inspector view and clicking **Export Raw**.

Generally for large terrains, or where performance is important, you should export your heightmap and convert your terrain to a mesh in another program. With a 3D mesh, you can then also add caves, overhangs, and so on before importing the mesh for use in Unity. Note, though, that if you import a mesh to use as a terrain, you won't be able to use Unity's terrain texturing and painting tools with it. (However, you can find third-party assets in the Asset Store that can provide this functionality.)

Unity Terrain Sculpting Tools

Unity gives you multiple tools for hand sculpting your terrain. You can see these tools in the Inspector view under the component Terrain. These tools all work basically the same way: You use a brush with a given size and opacity to “paint” terrain. In effect, what you are doing behind the scenes is painting a heightmap that is translated into changes for the 3D terrain. The painting effects are cumulative, which means the more you paint an area, the stronger the effect on that area. [Figure 4.5](#) shows these tools, which you can use to generate nearly any landscape you can imagine.

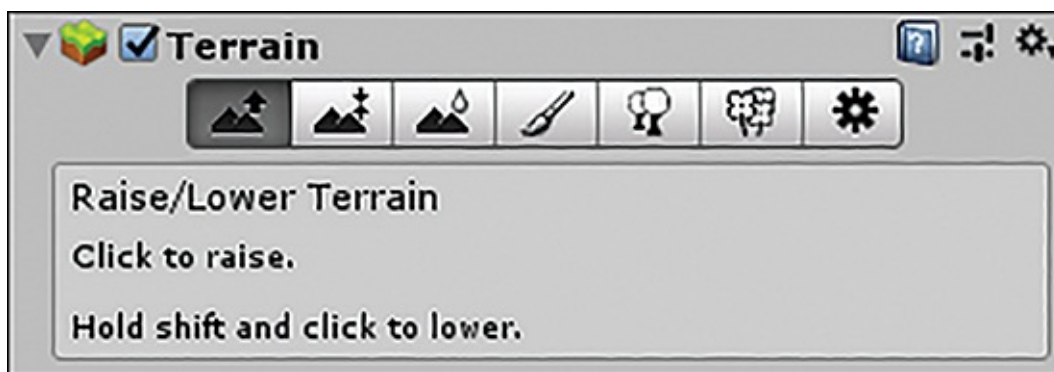


FIGURE 4.5

The terrain sculpting tools.

The first tool you will learn to use is the Raise/Lower tool. This tool, just as it sounds, enables you to raise or lower the terrain wherever you paint. To sculpt with this tool, follow these steps:

1. Select a brush. (The brush determines the size and shape of the sculpting effect.)
2. Choose a brush size and opacity. (The opacity determines how strong the sculpting effect is.)
3. Click and drag over the terrain in the Scene view to raise the terrain.
Holding **Shift** when you click and drag instead lowers the terrain.

Figure 4.6 illustrates some good starting options for sculpting given the terrain size 50×50 with a height of 60.

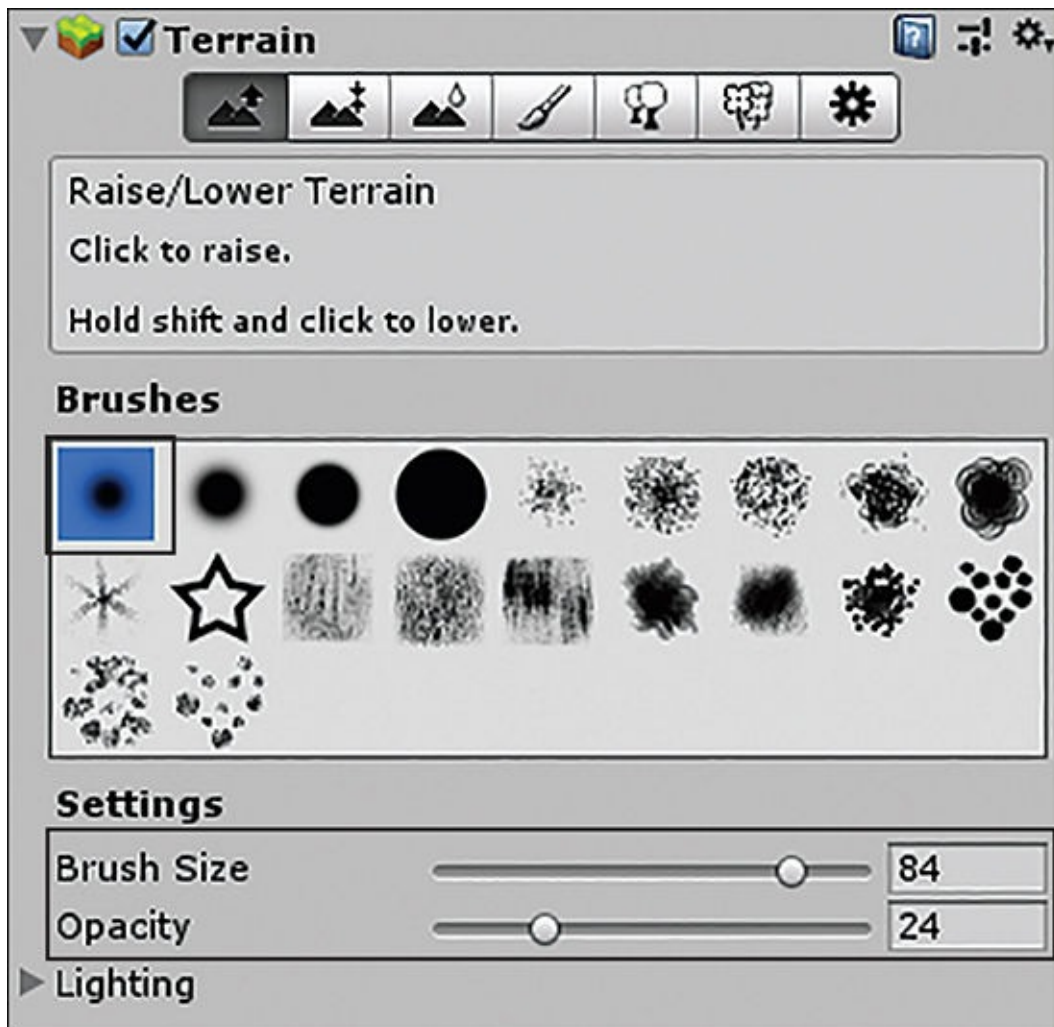


FIGURE 4.6

Good starting properties for sculpting.

The next tool is the Paint Height tool. This tool works almost exactly the same way as the Raise/Lower tool except that it paints your terrain to a specified height. If the specified height is higher than the current terrain, painting raises

height. If the specified height is higher than the current terrain, painting raises the terrain. If the specified height is lower than the current terrain, however, the terrain is lowered. This is useful for creating mesas and other flat structures in your landscape. Go ahead and try it out!

TIP

Flattening Terrain

If, at any time, you want to reset your terrain back to being flat, you can do so by going to the Paint Height tool and clicking **Flatten**. One benefit of doing this is that you can flatten the terrain to a height other than its default 0. If your maximum height is 60 and you flatten your heightmap to 30, you have the ability to raise the terrain by 30 units, but you can also lower it by 30 units. This makes it easy to sculpt valleys into your otherwise flat terrain.

The final tool you will use is the Smooth Height tool. This tool doesn't alter the terrain in highly noticeable ways. Instead, it removes a lot of the jagged lines that appear when sculpting terrain. Think of this tool as a polisher. You will use it only to make minor tweaks after your major sculpting is done.

▼ TRY IT YOURSELF

Sculpting Terrain

Now that you have learned about the sculpting tools, it's time to practice using them. In this exercise, you attempt to sculpt a specific piece of terrain:

1. Create a new project or scene and add a terrain. Set the resolution of the terrain to 50×50 and give it a height of 60.
2. Flatten the terrain to a height of 20 by clicking the **Paint Height** tool, changing the height to **20**, and clicking **Flatten**. (*Note: If the terrain appears to disappear, it just moved up 20 units.*)
3. Using the sculpting tools, attempt to create a landscape similar to that shown in [Figure 4.7](#). (*Note: The lighting in the image has been changed to make it easier to see.*)
4. Continue to experiment with the tools and try to add unique features to your terrain.

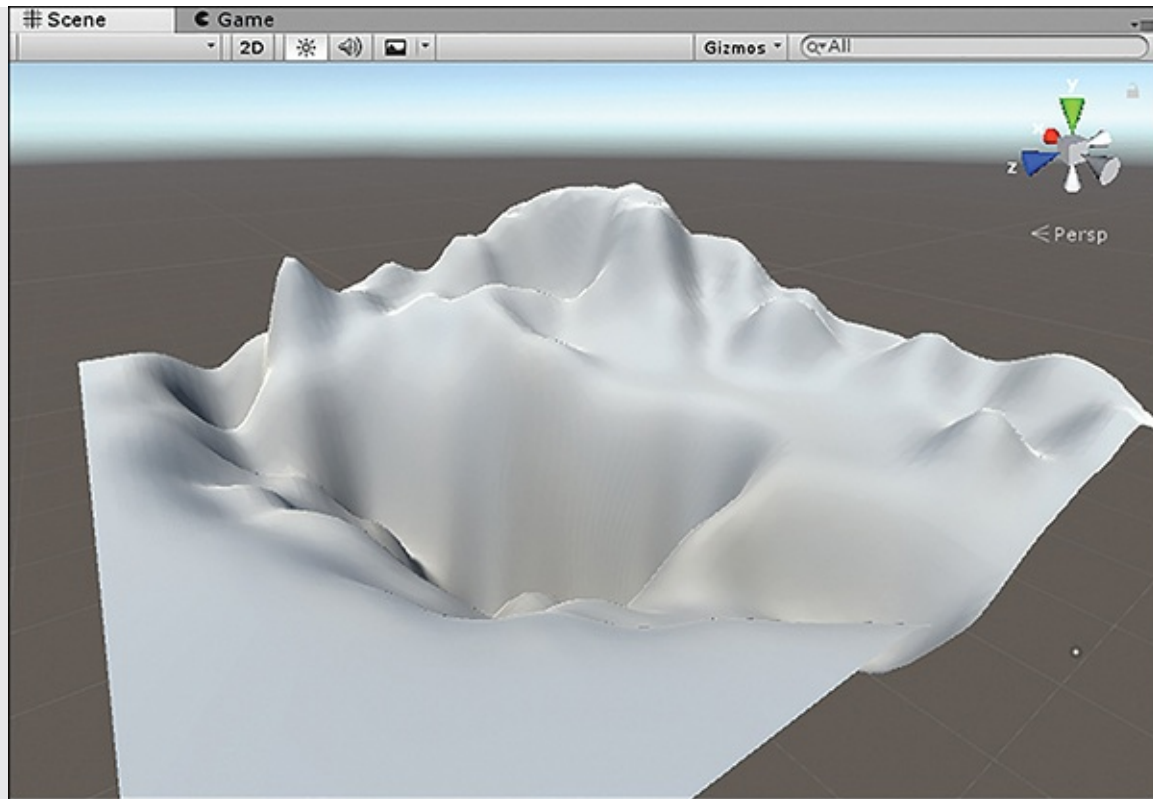


FIGURE 4.7
A sample terrain.

TIP

Practice, Practice, Practice

Developing strong, compelling levels is an art form in itself. Much thought has to be given to the placement of hills, valleys, mountains, and lakes in games. Not only do the elements need to be visually satisfying, they also need to be placed in such a way as to make a level playable. Level-building skills don't develop overnight. Be sure to practice and refine your level-building skills to make exciting and memorable levels.

Terrain Textures

You now know how to make the physical dimensions of a 3D world. Even though there may be a lot of features to your landscape, it is still bland, shiny (due to the default material), and difficult to navigate. It is time to add some character to your level. In this section, you'll learn how to texture your terrain to

give it an engaging look. Like sculpting terrain, texturing terrain works a lot like painting. You select a brush and a texture and paint it onto your world.

Importing Terrain Assets

Before you can begin painting the world with textures, you need some textures to work with. Unity has some terrain assets available to you, but you need to import them in order to use them. To load these assets, select **Assets > Import Package > Environment**. The Import Unity Package dialog appears (see [Figure 4.8](#)). You use this dialog to specify which assets you want to import. Deselecting unneeded items is a good idea if you want to keep your project size down. For now, though, just leave all options checked and click **Import**. You should now have a new folder under Assets in the Project view called Standard Assets. This folder contains all the terrain assets you will be using in the rest of this hour.

NOTE

Missing Packages

If you are missing the Environment asset package when you go to **Assets > Import Package**, that means that you did not select the Standard Assets option when installing Unity. If you would like these assets (and many more that will be used throughout this book), you can run the installer again and select to install the standard assets.

Texturing Terrain

In order to begin painting terrain, you need to load a texture. [Figure 4.9](#) illustrates the Paint Texture tool in the Inspector, which you access after selecting the terrain in your Hierarchy. Pay attention to the three numeric properties: brush size, opacity, and target strength. You should be familiar with the first two properties, but the last one is new. The target strength is the maximum opacity that is achievable through constant painting. Its value is a percentage, with 1 being 100%. Use this as a control to avoid painting your textures too strongly.

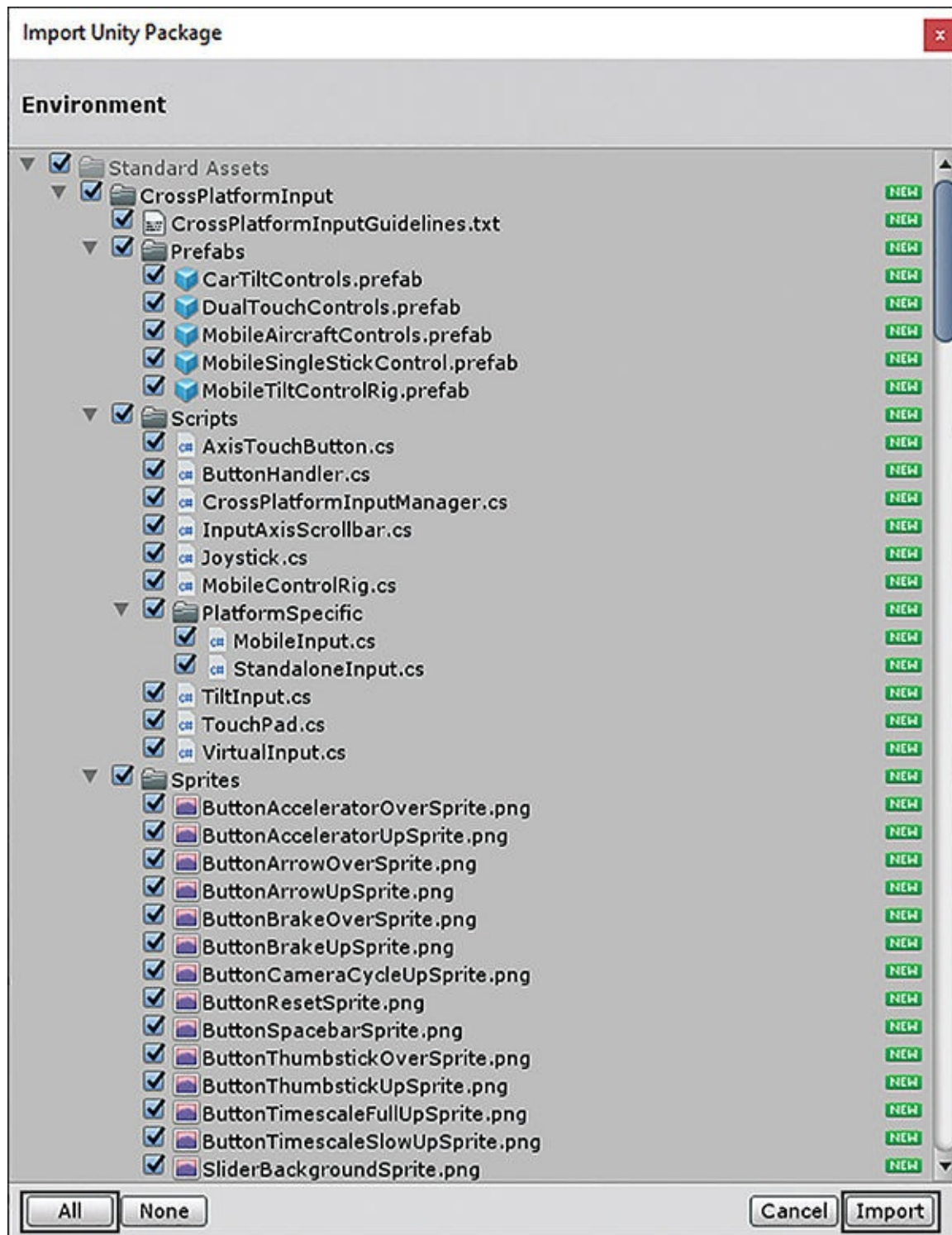


FIGURE 4.8

The Import Unity Package dialog.

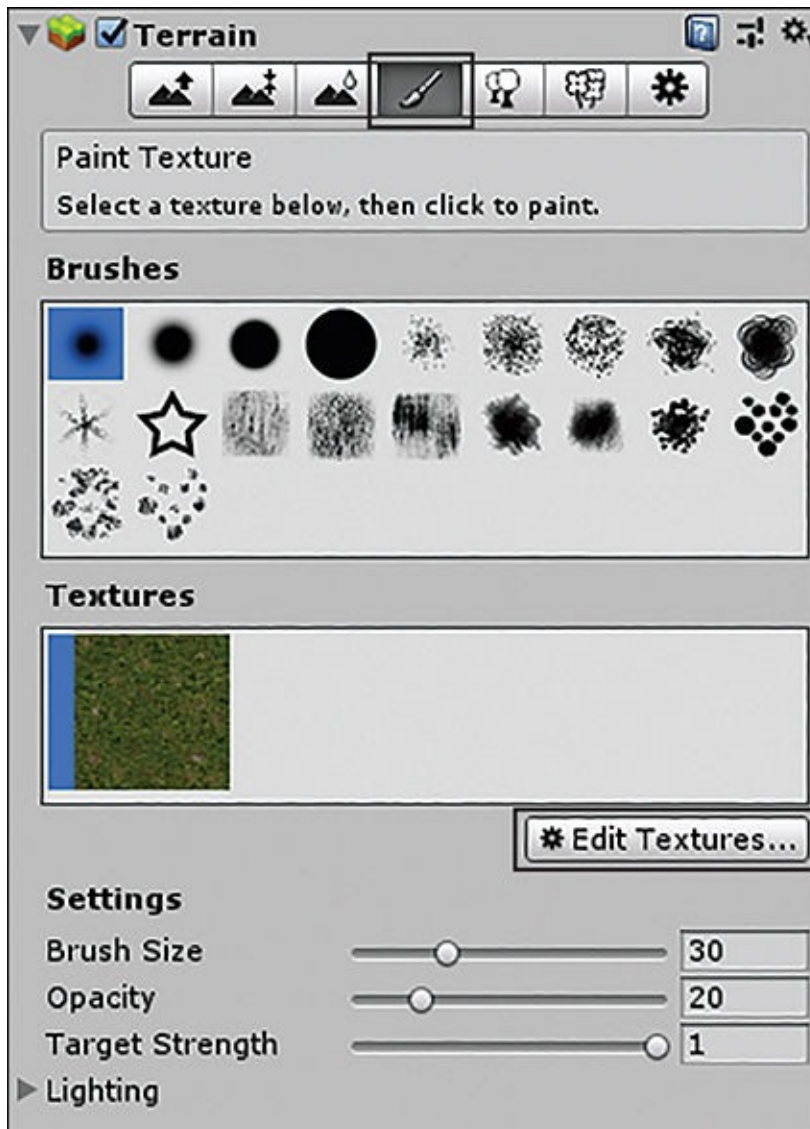


FIGURE 4.9

Paint Texture tool and properties.

To load a texture, follow these steps:

1. Select **Edit Textures > Add Texture** in the Inspector (not from the Unity menus).
2. In the Edit Terrain Texture dialog, click **Select** in the texture box (see [Figure 4.10](#)) and select the **GrassHillAlbedo** texture.
3. Click **Add**. There is no need to add a normal map, but you can if you have a texture with some bumpiness to it.

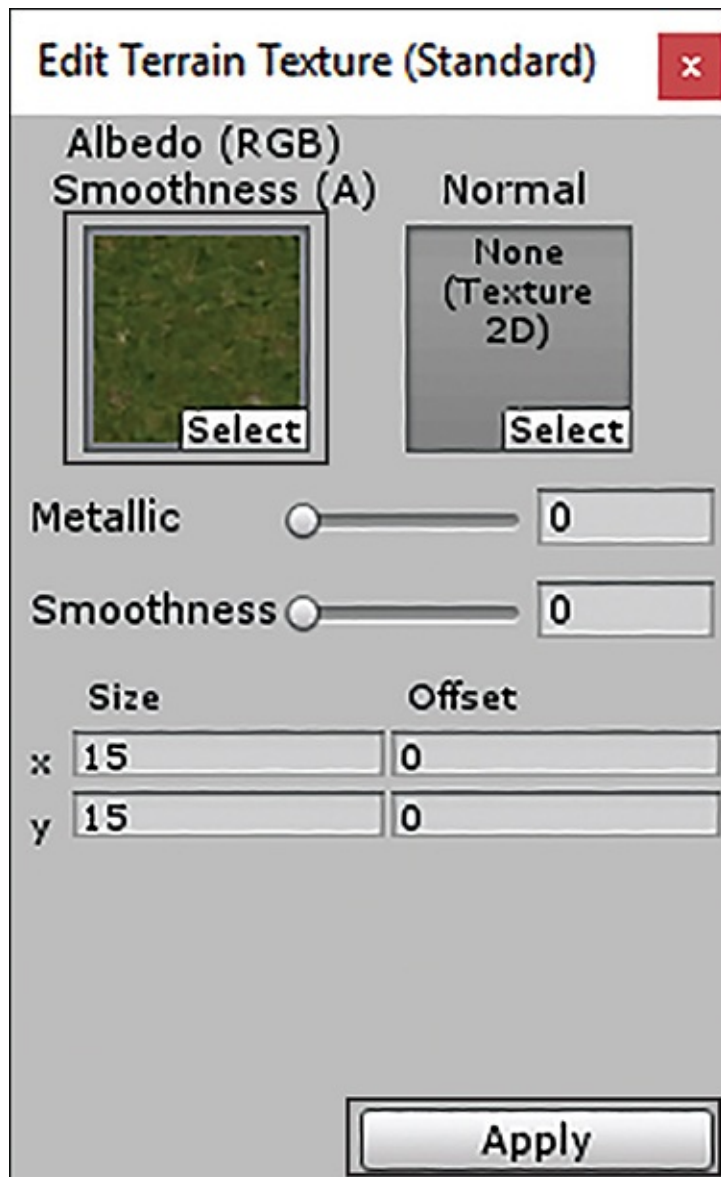


FIGURE 4.10

The Edit Terrain Texture dialog.

At this point, your entire terrain should be covered in patchy grass. This looks better than the white terrain you had before, but it is still far from realistic. Next, you will actually begin painting and making your terrain look better.

▼ TRY IT YOURSELF

Painting Textures onto Terrain

Follow these steps to apply a new texture to your terrain to give it a more realistic two-tone effect:

Realistic Two-Tone Effect

1. Using the steps listed earlier in this hour, add a new texture. This time, load the **GrassRockyAlbedo** texture. Once you have loaded it, be sure to select it by clicking it. (Note: A blue bar appears next to it if it is selected.)
2. Set the brush size to **30**, the opacity to **20**, and the target strength to **0.6**.
3. Sparingly paint (by clicking and dragging) on the steep parts and crevices of your terrain. This gives the impression that grass isn't growing on the sides of steep grades and in between hills (see [Figure 4.11](#)).
4. Continue experimenting with texture painting. Try loading the texture **CliffAlbedoSpecular** and applying it to steeper parts or the texture **SandAlbedo** and making a path.

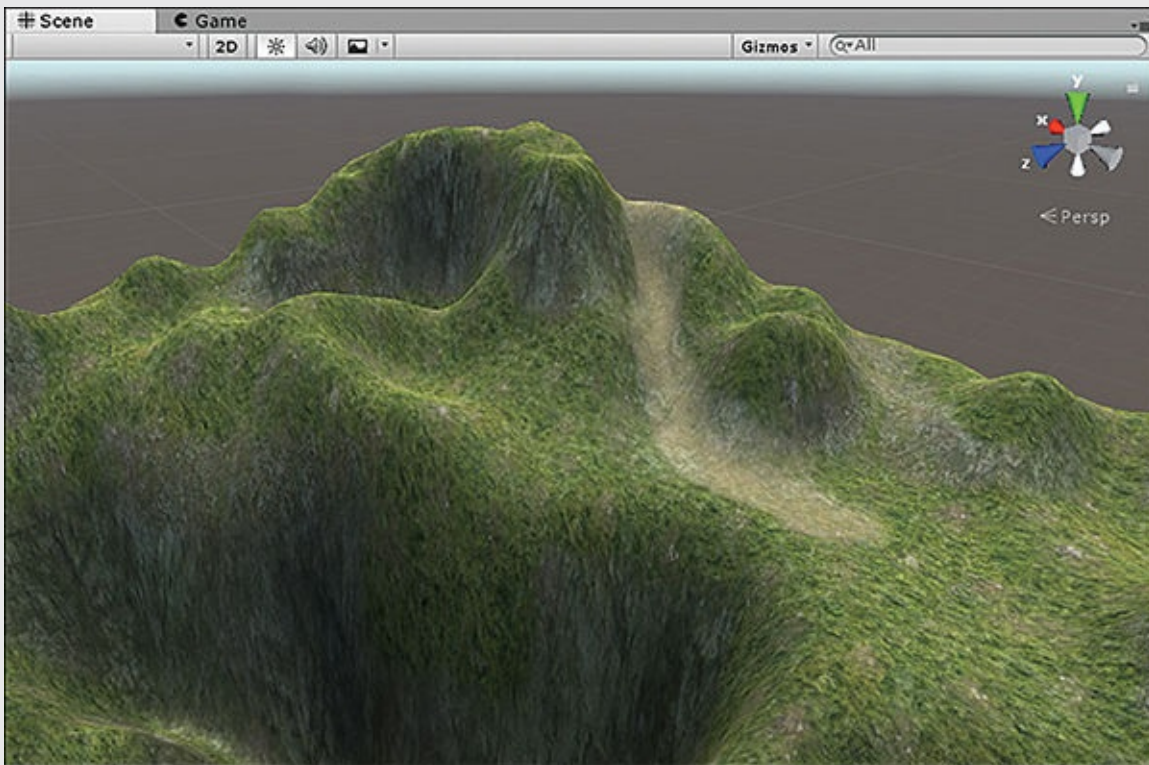


FIGURE 4.11

Example of a two-toned textured cliff with a sand path.

You can load as many textures as you want in this fashion and achieve some realistic effects. Be sure to practice texturing to determine the best-looking

realistic effects. Be sure to practice texturing to determine the best looking patterns.

NOTE

Creating Terrain Textures

Game worlds are often unique and require custom textures to fit within the context of the games they are created for. You can follow some general guidelines when making your own textures for terrain. The first is to always try to make the pattern repeatable. This means the textures can be tiled seamlessly. The larger the texture, the less obvious a repeating pattern is. The second guideline is to make the texture square. Finally, try to make the texture dimension a power of 2 (32, 64, 128, 512, and so on). The last two guidelines affect the compression of the texture and the texture's efficiency. With a little practice, you will be making brilliant terrain textures in no time.

TIP

Subtlety Is the Best Policy

When texturing, remember to keep your effects subtle. In nature, one element tends to fade to another without many harsh transitions. Your texturing efforts should reflect that. If you can zoom out away from a piece of terrain and tell the exact point where one texture starts, your effect is not subtle enough. It is often better to work in many small and subtle applications of a texture rather than with one broad application.

CAUTION

TerrainData Errors...What?

Depending on your project settings and the version of Unity you are using, you may get errors when you run your scene. One error says something like "TerrainData is missing splat texture...make sure it is marked for read/write in the importer." This error tells you that you are having runtime texture access issues. Luckily, the fix is very simple. All you need to do is click on the offending texture in the Project view, which causes the Inspector to show its Import settings. Then, in the Inspector view, expand **Advanced** and check the box next to **Read/Write Enabled**. Problem solved!

Generating Trees and Grass

A world with only flat textures would be boring. Almost every natural landscape has some form of plant life. In this section, you'll learn how to add and customize trees and grass to give your terrain an organic look and feel.

Painting Trees

Adding trees to your terrain works very much like sculpting and texturing; the whole process is very similar to painting. The basic premise is to load a tree model, set the properties for the trees, and then paint the area where you want the trees to appear. Based on the options you choose, Unity will spread out the trees and vary them to give a more natural and organic look.

You use the Paint Trees tool to spread out trees over the terrain. Once the terrain has been selected in the scene, select the **Paint Trees** tool in the Inspector view for the Terrain (Script) component. [Figure 4.12](#) shows the Paint Trees tool and its standard properties.

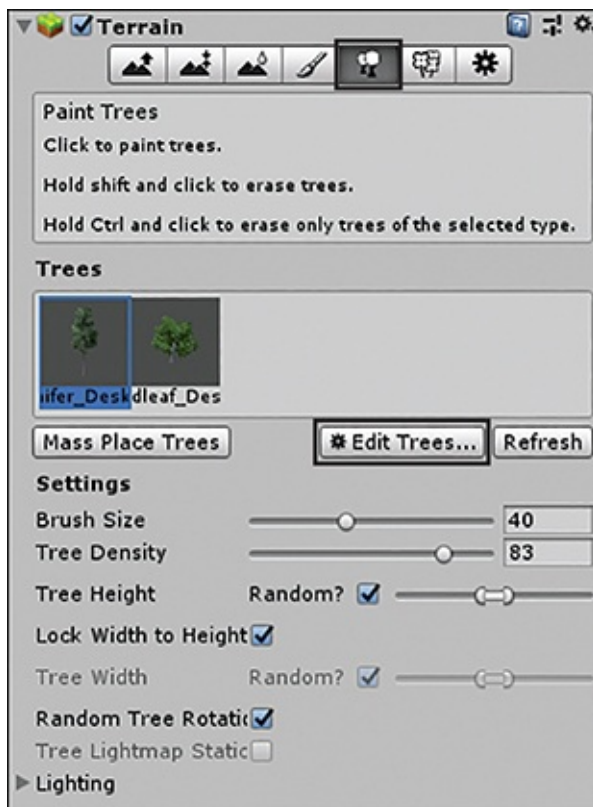


FIGURE 4.12

The Paint Trees tool.

Table 4.1 describes the Paint Trees tool's properties.

TABLE 4.1 The Paint Trees Tool's Properties

Property	Description
Brush Size	The size of the area to which trees are added when painting.
Tree Density	How densely the trees can be packed.
Tree Height/Width, Rotation, and so on	How all the trees differ from each other. Using these properties allows you to give the impression of many different trees instead of the same tree repeated.

▼ TRY IT YOURSELF

Placing Trees on a Terrain

Let's walk through the steps involved in placing trees onto terrain by using the Paint Trees tool. This exercise assumes that you have created a new scene and have already added a terrain. The terrain should be set to a length and width of 100. It will look better if the terrain has some sculpting and texturing done already. Follow these steps:

1. Click **Edit Trees > Add Tree** to pull up the Add Tree dialog (see Figure 4.13).
2. Clicking the **circle** icon to the right of the Tree Prefab text box on the Add Tree dialog pulls up the Tree Selector dialog.

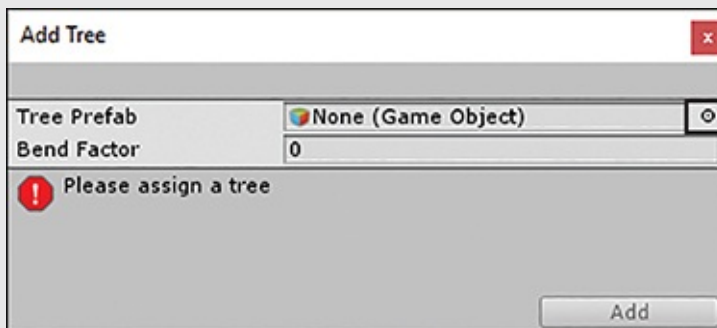


FIGURE 4.13

The Add Tree dialog.

3. Select **Conifer_Desktop** and click **Add**.
4. Set your brush size to **2** and your tree density to **10**. Leave the tree height/width set to **Random** but reduce the overall size.
5. Paint trees on the terrain by clicking and dragging over the areas where you want trees. Hold the **Shift** key while click-dragging to remove trees. If you can't paint, go to **Terrain Settings > Tree & Detail Objects** and ensure that the **Draw** check box is selected.
6. Continue to experiment with different brush sizes, densities, and trees.

Painting Grass

Now that you have learned how to paint trees, you'll learn how to apply grass and other small plant life to your world. Grass and other small plants are called *details* in Unity. Therefore, the tool used to paint grass is the Paint Details tool. Unlike trees, which are 3D models, details are billboards (see the note "Billboards"). Just as you have done over and over in this hour, you apply details to a terrain by using a brush and a painting motion. [Figure 4.14](#) illustrates the Paint Details tool and some of its properties.

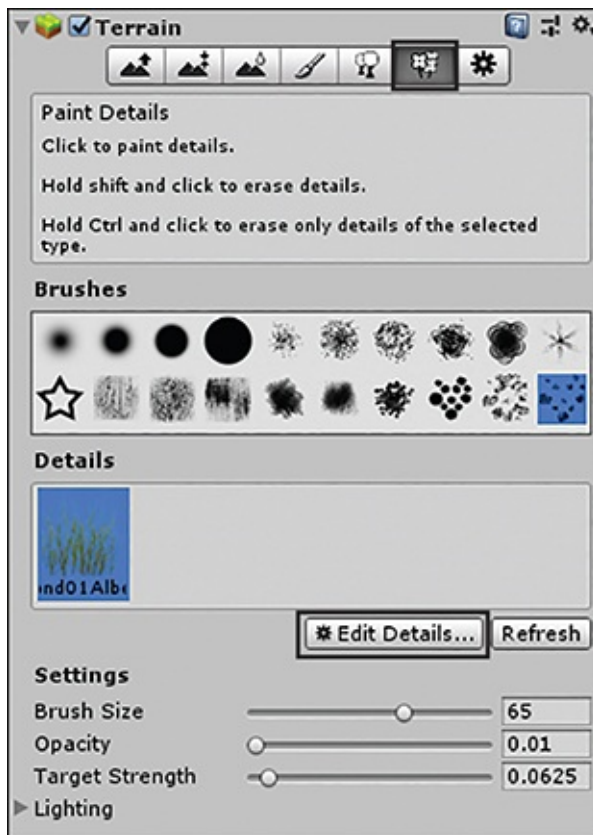


FIGURE 4.14

The Paint Details tool.

NOTE

Billboards

Billboards are a special type of visual component in a 3D world that give the effect of a 3D model without actually being a 3D model. Models exist in all three dimensions. Therefore, when moving around one, you can see the different sides. Billboards, however, are flat images that always face the camera. When you attempt to go around a billboard, the billboard turns to face your new position. Common uses for billboards are grass details, particles, and onscreen effects.

Applying grass to your terrain is a fairly straightforward process. You first need to add a grass texture:

1. Click **Edit Details** in the Inspector view and select **Add Grass Texture**.
2. In the Edit Grass Texture dialog, click the **circle** icon next to the Texture text box (see [Figure 4.15](#)). Select the **GrassFrond01AlbedoAlpha**

texture. You can search for “grass” to help find it.

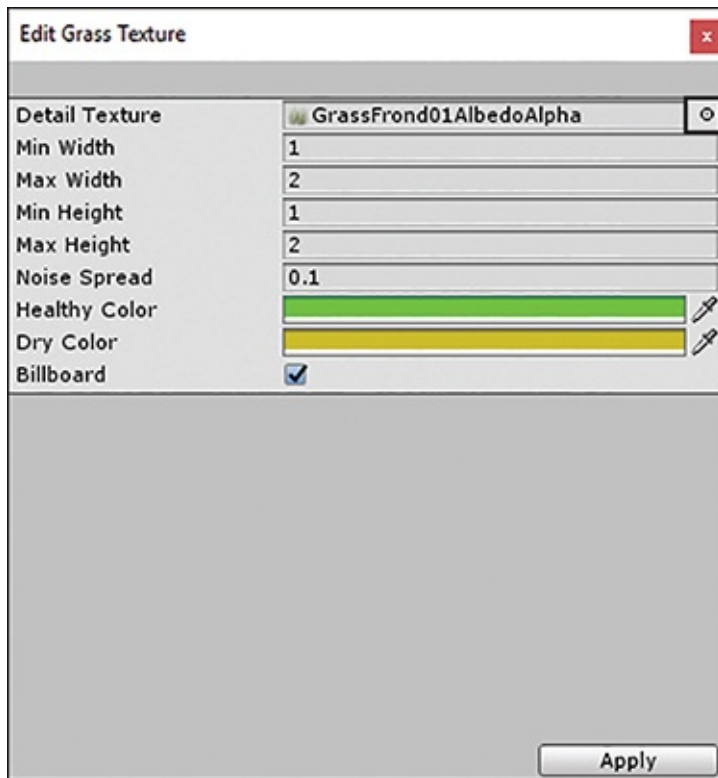


FIGURE 4.15

The Edit Grass Texture dialog.

3. Set your texture properties to whatever values you want. Pay special attention to the color properties because they establish the range of natural colors for your grass.
4. When you're finished changing settings, click **Apply**.

When you have your grass loaded, you just need to choose a brush and brush properties, and you are ready to begin painting grass.

TIP

Realistic Grass

You may notice that when you begin painting grass, it does not look realistic. You need to focus on a few things when adding grass to your terrain. The first is to pay attention to the colors you set for the grass texture. Try to keep them darker and earth toned. The next thing you need to do is choose a nongeometric brush shape to help break up hard edges. (Refer to [Figure 4.14](#)

for a good brush to use.) Finally, keep the opacity and target strength properties very low. Good settings to start with are .01 for opacity and .0625 for target strength. If you need more grass, you can just keep painting over the same area. You can also go back to Edit Details and change the grass texture properties.

CAUTION

Vegetation and Performance

The more trees and grass you have in a scene, the more processing is required to render it. If you are concerned about performance, keep the amount of vegetation low. Some of the properties you'll look at later in this hour can help you manage this, but as an easy rule, try to add trees and grass only to areas where they are really needed.

TIP

Disappearing Grass

As with trees, grass is affected by its distance from the viewer. Whereas trees revert to a lower quality when the viewer is far away, grass is just not rendered. The result is a ring around the viewer beyond which no grass is visible. Again, you can modify this distance by using properties discussed later in this hour.

Terrain Settings

The last of the terrain tools in the Inspector view is the Terrain Settings tool. This tool's settings control how the terrain, texture, trees, and details look and function overall. [Figure 4.16](#) shows the Terrain Settings tool.

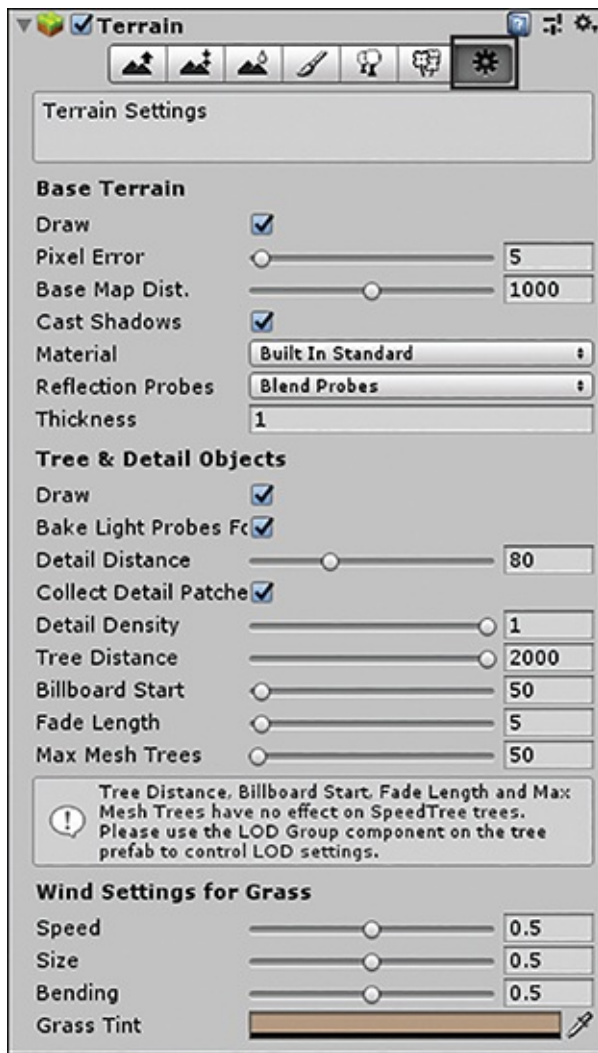


FIGURE 4.16

The Terrain Settings tool.

The first group of settings is for the overall terrain. [Table 4.2](#) describes some of these settings.

TABLE 4.2 [Base Terrain Settings](#)

Setting	Description
Draw	Determines whether the terrain should be drawn.
Pixel Error	Specifies the number of allowable errors when displaying terrain geometry. The higher the value, the lower the detail of the terrain.
Base Map Dist.	Specifies the maximum distance from which high-resolution textures are displayed. When the viewer is farther than the distance

set, textures degrade to a lower resolution.

Cast Shadows	Determines whether terrain geometry casts shadows.
Material	This slot is for assigning a custom material capable of rendering terrain. The material must contain a shader that can render terrain.
Reflection Probes	Specifies how reflection probes are used on terrain. This is effective only when using built-in standard material or a custom material that supports rendering with reflection. It is an advanced setting that is not covered in this text.
Thickness	Specifies how much the terrain collision volume should extend along the negative y axis. Objects are considered colliding with the terrain from the surface to a depth equal to the thickness. This helps prevent high-speed moving objects from penetrating into the terrain without the use of expensive continuous collision detection.

In addition, some settings directly affect the way trees and details (like grass) behave in a terrain. [Table 4.3](#) describes these settings.

TABLE 4.3 Tree and Detail Object Settings

Setting	Description
Draw	Determines whether trees and details are rendered in the scene.
Bake Light Probes For	Makes real-time lighting more realistic and efficient. This is an advanced performance setting.
Detail Distance	Specifies the distance from the camera at which details are no longer drawn to the screen.
Collect Detail Patches	Preloads the terrain details to prevent hiccups when moving around terrain, at the cost of memory usage.
Detail Density	Specifies the number of detail/grass objects in a given unit of area. The value can be set lower to reduce rendering overhead.
Tree Distance	Specifies the distance from the camera at which trees are no longer drawn to the screen.
Billboard Start	Specifies the distance from the camera at which 3D tree models begin to transition into lower-quality billboards.

Fade Length	Specifies the distance over which trees transition between billboards to higher-quality 3D models. The higher the setting, the smoother the transition.
Max Mesh Trees	Specifies the total number of trees able to be drawn simultaneously as 3D meshes and not billboards.

The next settings are for wind. Because you haven't had a chance to actually run around inside your world yet (although you will later in this hour), you might be wondering how wind works. Basically, Unity simulates a light wind over your terrain, and this light wind causes the grass to bend and sway and liven up the world. [Table 4.4](#) describes the wind settings. (The Resolution settings are discussed earlier in this hour in the section “Adding Terrain to a Project”).

TABLE 4.4 [Wind Settings](#)

Setting	Description
Speed	Specifies the speed, and therefore the strength, of the wind effect.
Size	Specifies the size of the area of grass affected by the wind at one time.
Bending	Specifies the amount of sway the grass has due to wind.
Grass Tint	Controls the overall coloration of all grass in a level. (This is not really a wind setting, but it is related.)

Character Controllers

At this point, you have finished your terrain. You have sculpted it, textured it, and covered it in trees and grass. It is now time to get into your level and see what it's like to play it. Unity provides two basic character controllers that allow you to easily get right into your scene without a lot of work on your end. Basically, you drop a controller into a scene and then move around with the control scheme common to most first-person games.

Adding a Character Controller

To add a character controller to your scene, you first need to import the asset by selecting **Assets > Import Package > Characters**. In the Import Package

dialog, leave everything checked and click **Import**. A new folder named Characters is added to your Project view, under the Standard Assets folder. Because you don't have a 3D model to use as the player, in this case you are going to use the first-person controller. Locate the **FPSController** asset in the Character Controllers folder (see [Figure 4.17](#)) and drag it onto your terrain in the Scene view.

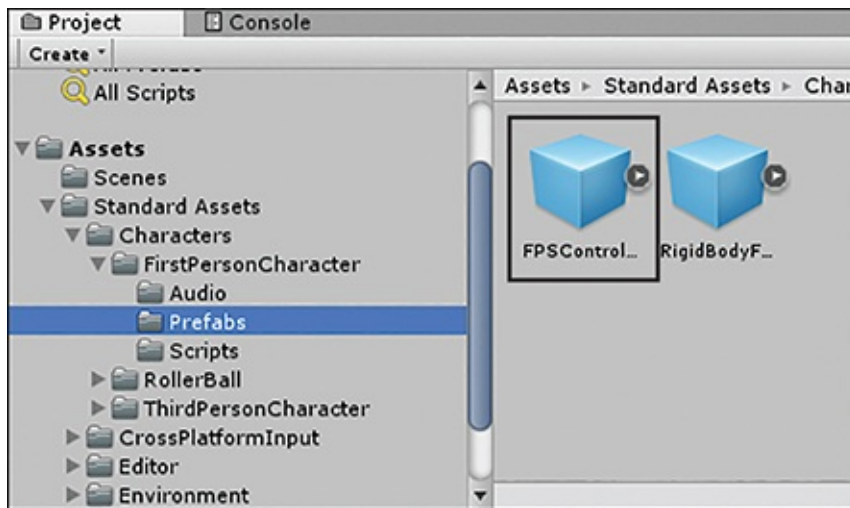


FIGURE 4.17

The **FPSController** character controller.

Now that the character controller has been added to your scene, you can move around in the terrain you created. When you play your scene, notice that you can now see from where the controller was placed. You can use the WASD keys to move around, the mouse to look around, and the spacebar to jump. Play around with the controls if they feel a bit unusual to you, and enjoy experiencing your world!

TIP

“2 Audio Listeners” Message

When you added the character controller to the scene, you might have noticed a message at the bottom of the editor that said, “There are 2 audio listeners in the scene.” This is because the Main Camera (the camera that exists by default) has an audio listener component, and so does the character controller that you added. Because the cameras represent the player's perspective, only one of them can listen for audio. You can change this by removing the audio listener component from the Main Camera. You can even delete the Main Camera game object altogether if you wish. as FPSController

...the main camera game object and generally you want to use the camera that has its own camera.

TIP

Falling Through the World

If you find the camera falling through the world whenever you run your scene, chances are that your character controller is stuck partially in the ground. Try raising your character controller up slightly above the ground. When the scene starts, the camera should fall just a little bit until it hits the ground and stops.

Summary

In this hour, you have learned all about terrains in Unity. You started by learning what terrains are and how to add them to a scene. From there, you looked at sculpting the terrain with both a heightmap and Unity's built-in sculpting tools. You learned how to make your terrains look more appealing by applying textures in a realistic fashion. Finally, you learned to add trees and grass to your terrain and explore it with a character controller.

Q&A

Q. Does my game have to have terrain?

A. Not at all. Many games take place entirely inside modeled rooms, in abstract spaces, or with meshes for exterior terrain.

Q. My terrain doesn't look very good. Is that normal?

A. It takes a while to gain proficiency with the sculpting tools. With some practice, your levels will begin looking much better. True quality comes from patience working on a level.

Workshop

Take some time to work through the questions here to ensure that you have a firm grasp of the material.

Quiz

1. True or False: You can make caves out of the Unity terrain.
2. What is a grayscale image containing terrain elevation information called?
3. True or False: Sculpting terrain in Unity is a lot like painting.
4. How do you access Unity's available terrain textures?

Answers

1. False. Unity's terrain cannot overlap.
2. A heightmap
3. True
4. You import the terrain assets by going to **Assets > Import Package > Environment**.

Exercise

Practice terrain sculpting and texturing. Sculpt a terrain that contains the following elements:

- ▶ Beach
- ▶ Mountain range
- ▶ Flat plains

You may need a slightly larger terrain to fit in everything you'd like to have. Once you have sculpted these elements, apply textures to your terrain in the following manner. You can find all textures listed here in the Terrain Assets package:

- ▶ The beach should use the texture SandAlbedo and should fade into GrassRockyAlbedo.
- ▶ Plains and all flat areas should be textured with GrassHillAlbedo.
- ▶ The texture GrassHillAlbedo should smoothly transition into GlassRockyAlbedo as the terrain gets steeper.
- ▶ The texture GlassRockyAlbedo should transition into Cliff at its steepest and highest points.

Finally, finish the terrain by adding trees and grass. Be as creative as you want with this exercise. Build a world that makes you proud.