Chapter 5- Materials & Textures

As mentioned in the past chapter, materials and textures are what change your model from being gray to brilliant. You can add color, make things glow, become transparent like glass or make them look like brick, grass, stone, metal, fabric, wallpaper, etc. Remember, we are focusing on the classic internal renderer right now.

Basic Material Settings

You must always add a material before you can add a texture. To add a material, first select the object you want to work with. Then go to the Materials panel in the Properties window. Then click the “New” button (unless you are working with the initial cube- that has a material on it by default). You will see more options open up. The material block is used to change some of the physical properties of the object in how it looks. If you plan on using just straight color and no texture, this is where you set the object’s color. The panels can float around so they may not be in this order, but here is what you see with all panels collapsed:

This is just an overview of the basic material panels. On the next page, we will highlight some of the important panels we will be using at this time.

RoboDude Asks: How can I see all the panels on the screen?
Remember panels can be collapsed and opened as needed to streamline your view. You can also scroll with the mouse wheel!
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Material Panels:
Here are some of the basic material panels and settings. Some of this will be a review from the past chapter:

Diffuse:
Diffuse is actually the color that is given off by the object. If you want the object to be red, set it here. You will also see settings for the way the material is calculated (default-Lambert) and the intensity slider. The Ramp button will allow diversity of color.

By clicking on the color sample in diffuse (or in any other block dealing with a color), the color wheel will pop up. You can set the color using the wheel and light/dark slider, setting in manually using RGB, HSV, or Hex numbers. You’ll also see an eyedropper for picking a color elsewhere.

Specular:
Specular settings control the glossiness of the object (is it flat or shiny?) You will see a color sample, calculation model and ramp as in Diffuse. The color sample indicates the color reflected back (usually kept white). Intensity controls the amount of glossiness while the hardness slider controls the hardness and softness of the glow. Check the sample as you change these settings to see how it changes appearance.

Shading:
If you want something to glow, even in low light, adjust the Emit slider. Ambient light allows the object to also react as if indirect light were hitting it. There are also a few other shading settings here as well.

Transparency:
For now, we will only look at using the “Z Transparency” option (Raytrace has it’s own chapter). After checking the Transparency box and “Z Transparency” selected, you can control how transparent an object is using the Alpha slider.

SubSurface Scattering:
Is used to improve rendering for materials where light enters the material and leaves through another point (like skin).

Strands:
Strands are used to represent hair or grass when used with particle systems (discussed in a later chapter). With strand settings, you can control the root and tip width of the strand.

Shadow:
There are time when you do not want an object to be able to cast a shadow and times when it doesn’t receive shadows properly from objects with transparent materials or ray-tracing features. Those options are controlled in this panel.
Transparency Using Z-Transparency:

The easiest way to make something transparent in Blender while still maintaining a fast render speed is to use the Z-Transparency feature and controlling the Alpha setting. In the Material panel, turn on Transparency and select Z-Transparency, then slide the Alpha control down. Press the F12 button to render an image. If you need features like distortion (refraction), then you will need to use Raytrace Transparent. Refraction is the effect you get like looking through a magnifying glass or a crystal. Avoid using Ray features at this time. They are discussed in a later chapter.

Halo Settings

By using Halos on objects, you are basically only making the vertices visible when rendered. Halo effects give you a star-like image on every vertex. Sometimes, it adds a nice effect to take a plane and delete all vertices except for one. This one vertex can be used like a shooting star or a “Tinkerbell” effect in an animation. Tie it to a particle effect (discussed in a later chapter) and you can produce some interesting results. When you press the “Halo” button in the material panel, here are your options:

- Turn ON Halo
- Halo glow only
- Rings only
- Lines only
- Star only
- Rings, Lines and Star

Halos can also be animated to give a variety of effects. Animation basics are discussed in a later chapter. There are also other options with halos not discussed. Halos are also used to control the size and appearance of particles in smoke and fire effects. These will also be discussed in a later chapter. Feel free to experiment!
Chapter 5- Materials & Textures

Basic Textures Settings

After you create a material and would like to add some kind of texture to the object (i.e. brick, carpet, wood grain, etc), you then click on the Texture button beside the Material button. After you click the "New" button, you have some choices in the texture buttons. First, you need to decide if you wish to use one of Blender's preloaded texture generators or provide your own image as a texture. Blender is capable of using almost any image file type whether created in a paint program or is a photographic image. JPEG images are most common. Blender can even place a movie on an object as a material! This is a good effect if you want to add animation within your animation.

Here's what you see in the texture panel:

- **Texture Channels:** You can add multiple textures to an object. For example, lets say you want a marble texture on an object, but also want to add a roughness to the surface. You would add a texture for both effects.

- **Texture Name:** Like materials, it's a good idea to name your textures. In this area, you can also add "+" and delete "X" materials.

- **Texture Type:** Choose between built-in texture generators for wood, marble, stucci, etc or select an image or movie.

- **Mapping:** Setting that control how the texture is mapped onto the object. Also control the size and offset of the texture on the object. **Mapping used to always be set to "Generated", but is now set to "UV" by default. Change it to "Generated".**

- **Influence:** Settings that control appearance such as brightness, transparency, glossiness and roughness. S are also affected by the Material setting. Materials and textures work together. Many textures use a secondary color in their generation. That is also controlled in this panel.

*RoboDude Says:* You can’t add a texture unless you’ve already added a material. Material and Texture properties work together!
Blender’s Built-In Textures:

Let’s say you want to use one of Blender’s built-in textures (under the “Type” option). For now, we just want to look at Clouds, Stucci, Magic, Marble and Wood. These can produce some interesting effects with a little practice. When you select one, setting options will open for that effect. Each texture has different tools available to work with, but some similarities are present in most:

Most of Blender’s texture options deal with turbulence and noise (randomness of the pattern). The wood texture also has some features dealing with the pattern of the wood grain (bands and rings). After you place the texture, you still need to go back to the Materials Buttons to fine tune the look on your object. The Stucci texture involves a little more work and will be discussed later in this chapter.

Many textures have a Noise Basis for different texture effects.
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For an example of using textures, we will apply a wood texture to a cube. We'll start with a basic cube that has a material applied to it. Since wood is usually various shades of brown, we'll make the Diffuse color brown. We'll also take Specular Intensity down a bit.

We'll now go over to the texture buttons and add a new texture. Make the texture type “Wood”. In the wood texture panel you will see some different ways to represent the wood grain. “Sine-Saw-Tri” will give you a different stripe while “Bands-Rings-Band Noise-Ring Noise” will give you a different pattern. For my example, I will select “Ring Noise” and hit “F12” to render a picture. For these exercises, remember to switch “UV” to “Generated” in the “Mapping” Panel!

If you look at your render, you should see your wood grain, but you have a secondary color that needs to be corrected! To fix this, scroll down through your texture panels to find the color swatch to change this to a better color. I will choose a darker brown.

You can also adjust the Size (X,Y,Z) of the texture and the Noise Basis for more effects. Feel free to experiment with the various other settings.

The Stucci Texture:
The Stucci texture provides interesting effect on the surface of your object. In the Texture Buttons, select it as you do for any of the other texture generators and adjust the settings. In the Stucci panel, I will adjust the size to 0.15. Next, go down to the Influence panel and turn on “Nor” (for Normal) under Geometry for normal. Adjusting the “Normal” slider to adjust the amount of the effect. Play with the setting to get a bumpy effect. Turning the size setting way down can also give you a grainy effect.

Below are some samples of different Noise Basis patterns.
Using Images and Movies as Textures

The basic texture generators are nice, but not complete. Most of the time you need to place textures like grass, brick, metal, fabrics and such into your model. **Anything that can be saved as a JPEG image can be used as a texture in Blender.** Most other image type files can be used as well (png, targa, TIFF, bmp). If you want to put a picture of your face on an object- you can! Movie files can also be placed on an object as a material. To use a JPEG as a texture, add a Material as before, go to the Texture buttons and select the “**Image or Movie**” option under “Type”. When you select this, here is what you see for options:

- **Texture Type:** Changed to “Image or Movie”
- **Preview Window:** Can be set to display Texture or Material or Both
- **Colors Panel:** An image can be adjusted if colors are not quite what you want (i.e. a wood grain that you may want more red in it)
- **Mapping Panel:** Textures can be projected Flat, Cube, Tube, or Sphere onto an object. Important block! Here, you can also adjust the offset and size of an image on your object.
- **Coordinate Mapping:** New default settings have this set to **UV**, which will be discussed in a later chapter. Change this to “**Generated**” for these lessons.
- **Image Panel:** This is actually where you open the image or movie you wish to use for your texture. If you don’t see thumbnails of your images, you can change the window’s viewing type (see page 1-4 for details).
- **Image Sampling Panel:** Make adjustments to your image such as Alpha (transparent images). For example, you have a tree image made in a graphics program with a transparent background. Set alpha here to remove that background.
- **Image Mapping Panel:** If you would like to have the texture repeat (i.e. a brick pattern where you need to use the image several times on a surface), set it here. You also have mirror options in case the image you’re using doesn’t appear seamless.

**Remember to switch “UV” to “Generated” in the “Mapping” Panel! UV Mapping will be discussed in a future chapter.**
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For an example of using images, here is a cube and sphere rendered using a brick image. You will notice that, by default, the image is mapped onto the top and stretched down the sides of the object. This is called “Flat” mapping. This can be adjusted in the “Mapping” panel. Your other options are shown below:

Let's say I want to use the “Cube” mapping, but the bricks are too large. I can control this in the “Image Mapping” panel under the “Repeat” option. The image I used tiles well, but if it does not you can press the Mirror- X and Y buttons.

Remember that the Material and Texture panels work together. The bricks look good, but a bit too glossy and flat. You can make adjustments to Specular in Materials (glossiness) and add a “Normal” to the brick texture in the Texture panel under the “Influence” panel. This will simulate depth and add a nice effect to the brick.

Movies as Textures:

You load a movie just as you would load an image, except that you have a few other options. You can control which frames of the movie to use, when it starts (offset) and if the movie cycles through your animation. This can be a great option for animated backgrounds, and motion on objects. Remember that all movie formats may not be supported.
Displacement Mapping

Displacement Mapping is using a texture effect to deform the mesh. Basically, you can make a cube, sphere, etc. look wrinkled or deformed without having to move vertices around to do it. To start, create a cube or sphere. If you start with a cube, go into Edit Mode (tab) and select all vertices, press the Subdivide button a few times in the Tool Shelf. Displacement works off of vertices so if you don’t have it subdivided a few times, you won’t get a good effect. Next, put a material and a texture on the object. I used the Cloud texture in Blender. Here’s what we have by pressing F12:

Nothing that we haven’t already experienced in this chapter so far. Now, go to the “Influence” panel and find the “Displacement” button to turn on Displacement and adjust the slider. Re-render (F12). Displacement basically works by pushing vertices with the varying colors in the texture. This is also controllable.

For our next test, I will create a simple image in a graphics program using only simple gray, white, and black shapes. Gray is considered the base color.

Here are the effects of the image on the object mapped with the Cube wrap. Notice that the white shape was pushed out while the black shapes went in. The quality of the cuts and extrudes is determined by the subdivision (vertices) on the mesh.

To the right, the shape has been subdivided a few more times for a better edge. While Normal gives the illusion of depth, Displacement will actually deform, but it makes the shape more complicated and slower to render.
Materials & Textures in Cycles
We will now discuss Cycles materials and textures in more detail. Switch your render engine from “Blender Render” to “Cycles Render”. Remember to set your processor and samples as discussed in the previous chapter.

Basic Material Settings in Cycles:
We have already discussed the Diffuse, Glossy, Emission, and Mix Shader nodes in the last chapter. Surface shaders can be applied in the Materials properties panel, but can also be applied in the Node Editor window through the Tool Shelf or from the “Add” button at the bottom of the window. Here are some of the other shaders:

- **Ambient Occlusion**: can be used to add darker shading to recessed areas and corners.
- **Anisotropic**: can act like the glossy shader, but will distort the reflection in a direction.
- **Diffuse**: just like diffuse in the classic render engine, the color for the object with no reflection at all, like flat paint.
- **Emission**: used to light your scene. Can be mixed with other shaders.
- **Glass**: makes an object look like glass. You can control distortion using the IOR (index of refraction) setting.
- **Glossy**: add a chrome or mirror look or mixed with other shaders to control the amount of gloss.
- **Hair**: Used with particle strands for hair or a fur look.
- **Holdout**: create holes in your render, good for creating overlays.
- **Mix Shader**: used to combine shaders for blended effects.
- **Refraction**: acts like glass, but distortion only and no reflection.
- **Subsurface Scattering**: scatters light beneath the surface, like in a wax candle.
- **Toon**: used to simulate cartoon-type material shading.
- **Translucent**: lets light pass through it, like paper or stained glass.
- **Transparent**: completely transparent or tinted or combined.
- **Velvet**: great for cloth. Gives a velvet effect.
- **Volume Absorption**: affects the volume, not the surface. Gets darker the deeper it goes.
- **Volume Scatter**: scatters the light that passes through it. Good for clouds and smoke.

RoboDude Says:
The Blender Guru website has a nice page dedicated to the different Cycles shaders and can be found here: 
Basic Texture Settings in Cycles:
In the classic render engine, textures are applied after materials in the properties panel. *Cycles does not use the textures panel at all.* Textures in Cycles are applied to a Diffuse shader node, with other nodes being used for more control. Like textures in the classic render engine, there are several built-in texture generators in Cycles.

To start using textures, apply a Diffuse shader to an object, then click on the small button on the “Color” setting option. When you click the button, you will see a column of texture options, like the image displayed to the left.

Like the material shaders, texture shaders can be accessed from the Node Editor window Tool Shelf as well. Here are the basic texture nodes available:

- **Brick** - can be used to simulate a brick texture on an object. Settings for colors, size, motor joints, etc.
- **Checker** - creates a checkerboard effect on your object.
- **Environment** - used to project background images in the world.
- **Gradient** - used to generate a gradient fade across your object.
- **Image** - uses an image file to project on your object.
- **Magic** - creates a colorful “tie died” look.
- **Musgrave** - can create a very “organic” pattern, like stucci in the classic render engine.
- **Noise** - a random TV-like static pattern. Different for every frame.
- **Point Density** - Used for particles and volume.
- **Sky** - used in the world setting to generate sky effect.
- **Voronoi** - cells, skin, hammered metal look.
- **Wave** - takes the place of wood and marble textures.

Create a simple scene and experiment with the various texture nodes and settings to get a feel for how they work. Some of these nodes are designed to work with the world, or background, settings and will be discussed in more detail in the world chapter.

So How Real Do You Want It To Look?

So far, we have only been applying materials and textures in the materials property panel, but the strength of Cycles is in the *Nodes Editor* window. Understanding how to connect the various nodes and which ones to use can be a difficult learning process that few people have mastered. 3D modelers are always trying different things and posting their results on the internet to share with others, so make use of that wealth of knowledge. 3D modeling, animation and texturing is a process in the study of nature. How realistic do you want your model to look? Many people have gone to great lengths to use material shading nodes to achieve realistic effects. The following examples will help you in the journey into understanding Cycles shading.
Chapter 1 - The Blender Interface

Basic Color with Gloss:
The next several examples will work with various shader nodes for the plane. This scene is using simple Mix, Diffuse, and Glossy nodes on the plane. You will notice that nodes have multiple input (left side) and output (right side) connection points. Nodes can also be collapsed by clicking the small triangle in the top of the block. Nodes are connected and disconnected by dragging lines to and from connection points. You will notice some of the same terms used in the materials property panel, like Roughness to control surface smoothness, Factor for the amount and balance of the nodes, and Color to control the color settings. You will also notice that other nodes can be connected to many of these settings to control them.

Basic Image and Gloss with Roughness:
While most of these settings can be handles in the materials properties panel, some need to added in the Node Editor.

Map the texture Flat, Cube, Tube, or Sphere, as we did on page 5-8

Notice we have a few more nodes in this sequence. A “Mix” shader was used that combines a “Diffuse” shader set to an “Image Texture” and “Glossy” shader. We have added a “Mapping” node from the Vector node menu. This is used to scale the image we used to make it look like there are more stones. The “Texture Coordinate” node (from the Input node menu) is set to “Generated”, like we have used before, and is tied to the “Mapping” vector input. In order to make the stones look like they are three-dimensional with mortar joints, we have added a “MixRGB” node from the Color node menu and set it to “Multiply”, setting the factor to a higher number to adjust the depth appearance. This node is tied between “Image Texture” and “Material Output” nodes on the Displacement connection. Displacement simulates texture depth.
Basic Glass:
While you can use just the “Glass” shader alone, it often works better when mixed with a “Transparent” shader. The IOR (index of refraction for distortion), Color, and the mix Factor can all be adjusted for the desired look.

Texture Displacement and Polished Metal:
This example demonstrates two shading examples. The monkey on the left uses a wood image texture, mapped flat using generated texture coordinates on the vector and using displacement. The monkey on the right uses a simple mix shader. The Glossy node color was set to a light yellow color from white to better complement the Diffuse color. Notice the reflection on the yellow monkey from the floor.

What do the different node connection points mean?
Even the people most experienced with Cycles on the web seem to ask this question from time-to-time. Nodes are basically a data processing pipeline with inputs and outputs. Experimenting with them is the best way to learn them. Some of the term you need to know are:

- **Image**: The basic connections that pass the image results through the block.
- **Factor**: Controls the amount of influence in the node. Mix nodes balance the 2 inputs.
- **Vector**: Basically determine how your texture will be mapped on your object.
- **Displacement**: Like “normal” in Blender internal renderer. Simulates texture depth.
- **BSDF and Shader**: Connect like the Image connections to blend and mix results.
Chapter 5- Materials & Textures

Stone Materials:
Creating stone textures in Cycles can also be a challenge with very realistic results possible. Here are some basic setup options to get you started:

The monkey on the left uses a Noise texture and a Voronoi texture, set to Cells to create a rough, cracked material. Both are run through Color Ramps (found in the Converter nodes menu) to control the color effect. We use 2 Mix nodes (from the Color nodes menu) with one set to “Value”. It is finally mixed with the Noise texture and connect to the Displacement output. Adjust all values to get the effect you desire.

The monkey on the right also uses a Noise texture with a Color Ramp node that is mixed with a Glossy shader. The Wave texture and Color Ramp are connected to an Mix node set to Multiply to control the Displacement roughness. Experiment with the wave settings to get the effect you desire.

Simple Brushed Aluminum:
The Anisotropic shader can simulate a texture with distortion set to a direction.