Chapter 5. Creating Complex Natural Materials in Cycles

In this chapter, we will cover the following recipes:

- Creating an ocean material using procedural textures
- Creating underwater environment materials
- Creating a snowy mountain landscape with procedurals
- Creating a realistic earth as seen from space

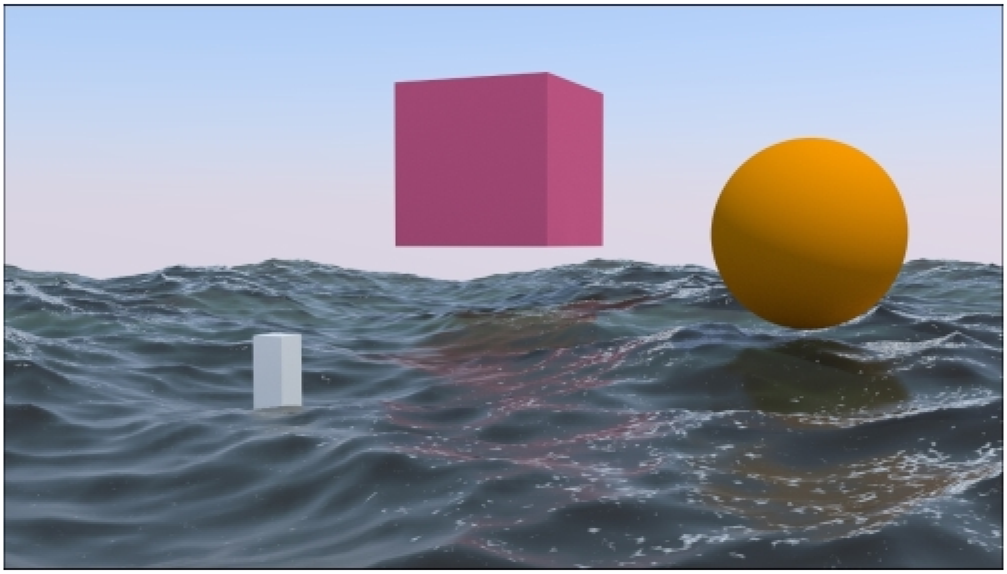
Introduction

In Chapter 3, *Creating Natural Materials in Cycles*, we saw some of the simpler natural materials that are possible to build in Cycles, keeping them out of any landscape context to make them more easily understandable.

Now it's time to deal with more elaborate natural materials. In this chapter, we will examine the way to mix different basic shaders to mimic the look of complex natural objects and their environments (very often, these two things fit together neatly).

Creating an ocean material using procedural textures

In this recipe, we will build an ocean surface material, using the **Ocean** modifier and procedural textures to create the foam, and establish a set of nodes to locate it on the higher parts of the waves:



The final look of the ocean material, with three simple and brightly colored objects to be reflected by the surface

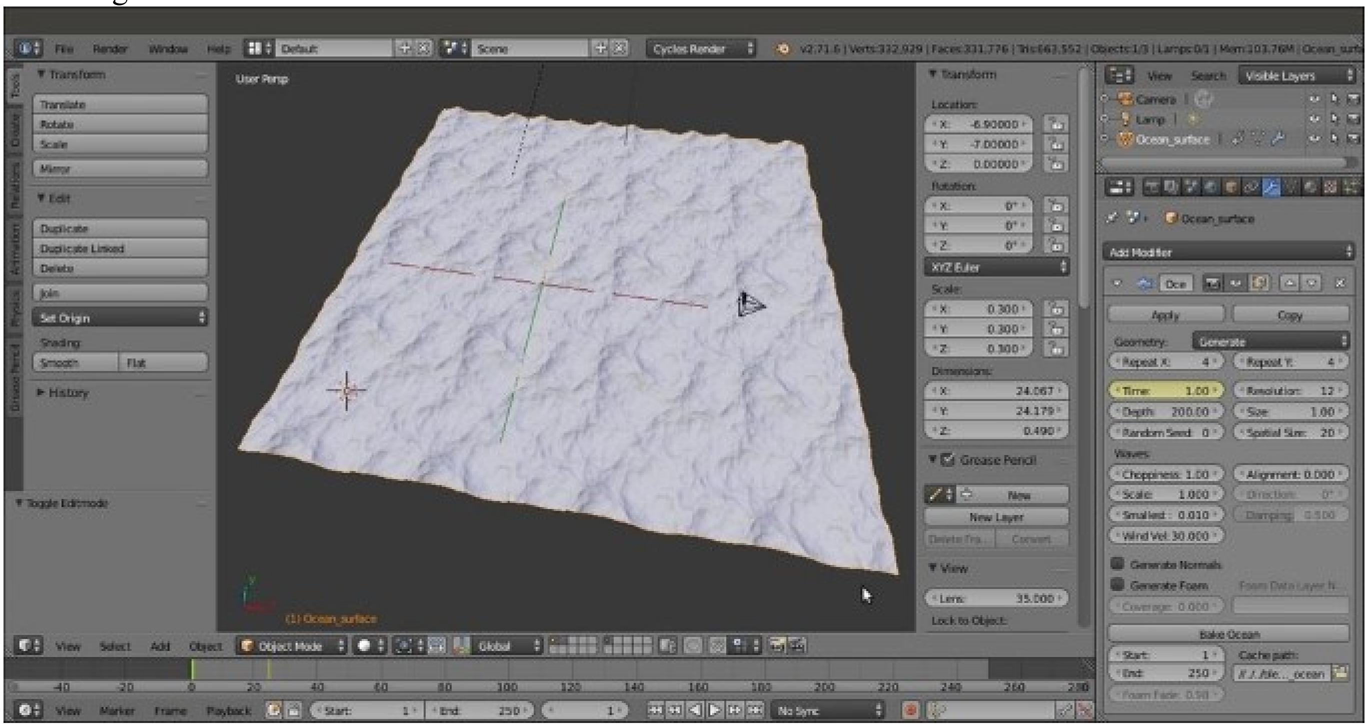
Getting ready

Before we start with creating the shaders, let's prepare the ocean scene:

1. Start Blender and switch to the Cycles rendering engine. Select the default **Cube**, delete it (press *X*), and add a **Plane** (with the mouse arrow in the 3D window, press *Shift* + *A* and navigate to **Mesh** | **Plane**). In **Object Mode**, scale the plane smaller to `0.300`. Don't apply a size.
2. Go to the **Object modifiers** window and assign an **Ocean** modifier. Set these values of **Geometry** to **Generate**, **Repeat X** and **Repeat Y** to `4`, **Spatial Size** to `20`, and **Resolution** to `12`.
3. Press the *N* key, and in the **Transform** panel, set these values for the Plane in **Location** for **X** as `-6.90000`, **Y** as `-7.00000`, and **Z** as `0.00000`.
4. Make sure that you are at frame 1, and with the mouse arrow in the modifier's **Time** slot, press *I* to add a key for the animation. Go to frame 25, change the **Time** value from `1.00` to `2.00`, and press the *I* key again to set a second key.
5. In the **Choose Screen layout** button at the top, switch from **Default** to **Animation**. In the **Graph Editor** window, press *T*. In the **Set Keyframe Interpolation** pop-up menu, select the **Linear** item under **Interpolation**. Then press *Shift* + *E*, and in the **Set Keyframe**

Extrapolation pop-up menu, select the **Linear Extrapolation** item to make the ocean animation constant and continuous.

6. Go back to the **Default** screen and rename the **Plane** as `Ocean_surface`. Have a look at the following screenshot:



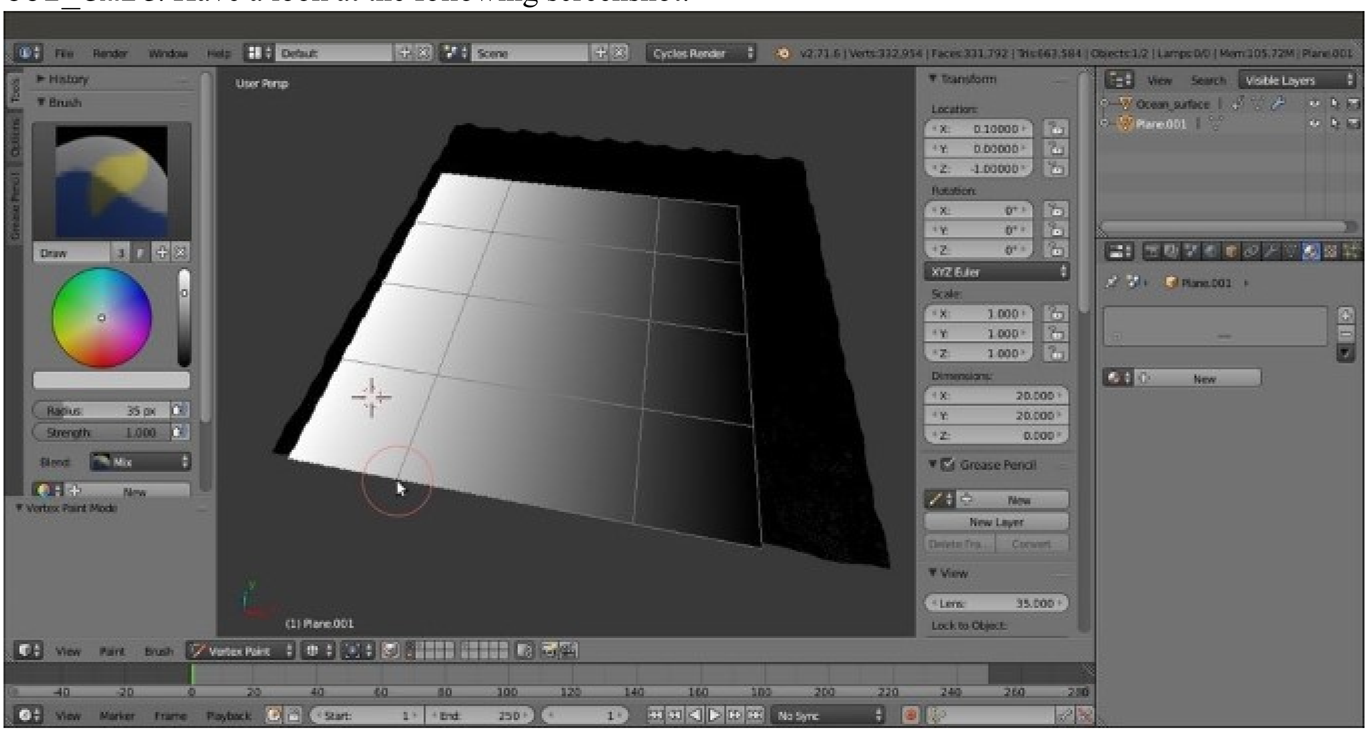
The Plane with the assigned Ocean modifier, and the settings to the right

7. Place the **Camera** to have a nice angle on the ocean, and then go to the **Camera** view (press *0* on the numeric keypad).
8. Add a **Cube** in the middle of the scene and, if you want, a UV Sphere in the foreground. Place these so that they float in the air. Their only purpose is to get reflected by the ocean surface during the shader setup.
9. Go to the **World** window and click on the **Use Nodes** button under the **Surface** subpanel. Then click on the little square with a dot on the right side of the color slot. From the pop-up menu, navigate to **Texture** | **Sky Texture**.
10. Select the **Lamp**, go to the **Object data** window, and click on the **Use Nodes** button under the **Nodes** subpanel. Set a yellowish color for the light (change the value of **R** to `1.000`, **G** to `0.989`, and **B** to `0.700`). Turn it to **Sun**, set the **Size** value to `0.010`, and set the **Strength** value to `2.500`.
11. Go to the **Render** window, and under the **Sampling** subpanel, set both the **Clamp Direct** and **Clamp Indirect** values to `1.00`. Set the samples to `100` for **Render** and `50` for **Preview** (you can obviously change these values according to the power of your machine).

    Now, because the shader we are going to build is largely transparent, we need to simulate the water body as seen from above the surface.

12. Add a new **Plane** in **Edit Mode** and scale it `10` times bigger (20 Blender units per side; press *Tab*, then press *S*, enter digit `10`, and press *Enter*). Exit **Edit Mode** and move the Plane so that it is centered on the ocean Plane location, then move it 1 unit down on the *z* axis. You can do it like this: go to the **Top** view and move the new Plane of 7 Blender units first along the *x* axis and then along the *y* axis. Then press *G*, press *Z*, enter digit `-1`, and press *Enter*.
13. In **Edit Mode**, press *W* to subdivide it by the **Specials** menu. Then press *T* to open the **Tool Shelf** panel on the left, and under **Number of Cuts** in the **Operator** panel at the bottom, and select **3**.
14. Go to the **Vertex Paint** mode and paint a very simple gray-scale gradient, changing from black at the vertices close to the Camera location to a plain white color on the opposite side.

    There are five rows of vertices on the Plane (ideally, all the rows are along the global *x* axis), so you can paint the first row with **RGB** value as `0.000`, second with **RGB** value as `0.250`, third with **RGB** value as `0.500`, fourth with **RGB** value as `0.750`, and fifth with **RGB** value as `1.000` to have a perfect gray-scale gradient.
15. In the **Object data** window, under the **Vertex Colors** tab, rename the Vertex Color layer as `Col_emit`. Have a look at the following screenshot:



The Ocean_Bottom plane with the painted Vertex Colors layer

16. Exit **Vertex Paint** mode and rename this second Plane `Ocean_bottom`.
17. Split the 3D window into two horizontal rows. Change the upper row to a **Node Editor** window.
18. Assign very simple colored materials to the Cube and the UV Sphere; plain **Diffuse BSDF** shaders are enough.

How to do it...

We will be performing this in four parts:

- Creating the water surface and the bottom shaders
- Creating the foam shader
- Creating the stencil material for the location of foam
- Putting everything together

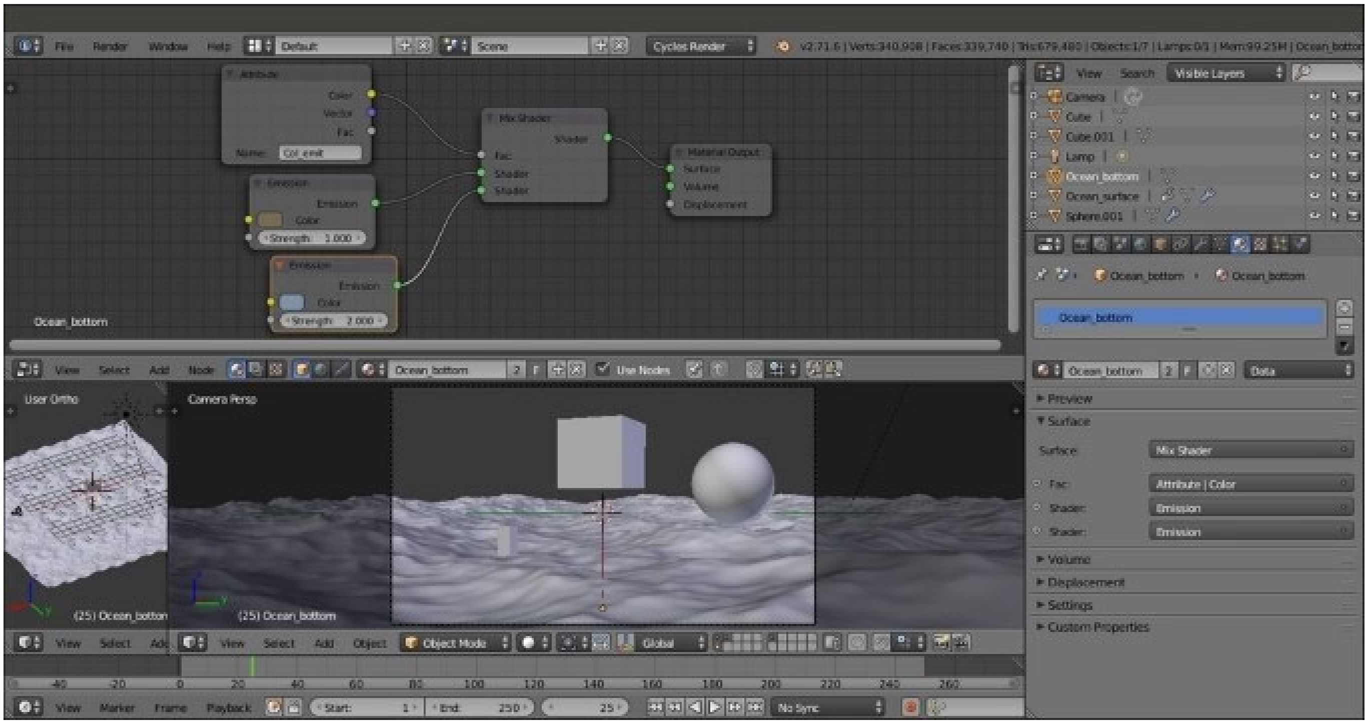
Let's start!

Creating the water surface and the bottom shaders

Let's now create the water surface and the bottom shaders:

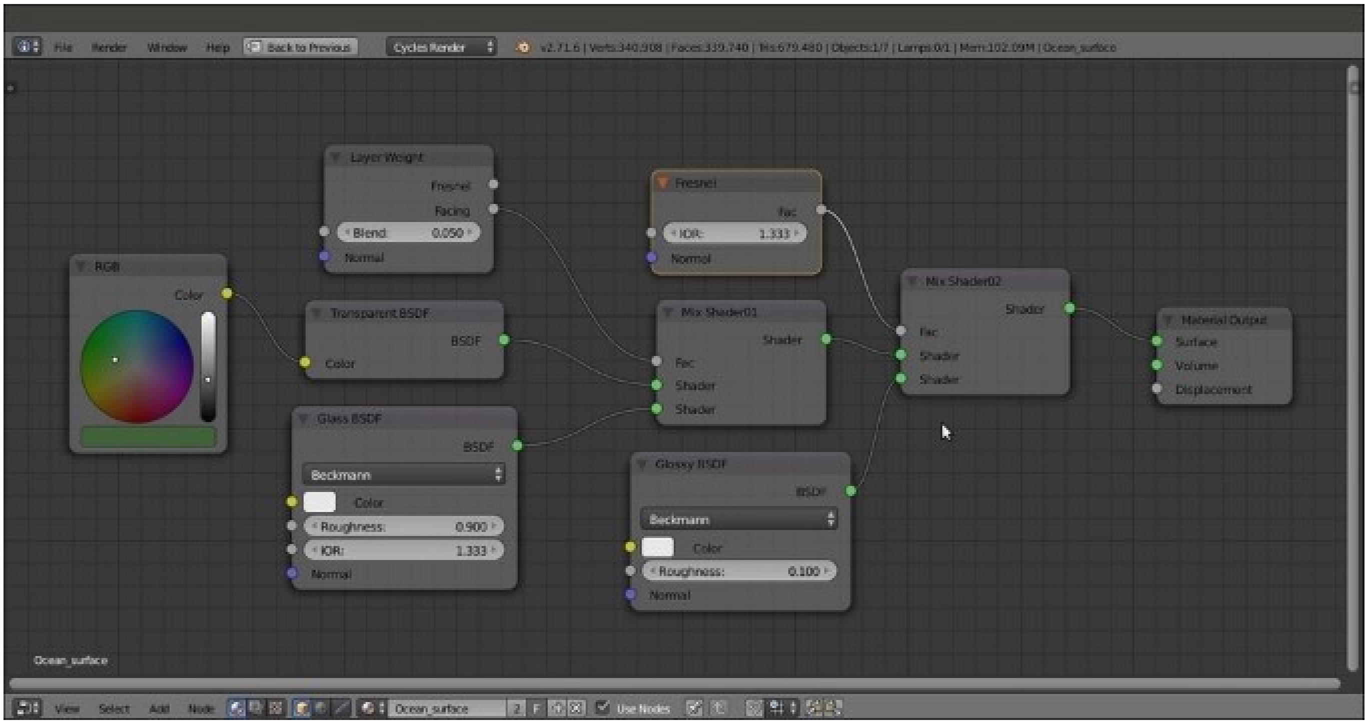
1. Select the **Ocean_bottom** object. Click on the **New** button in the **Material** window under the **Properties** panel or in the **Node Editor** toolbar. Rename the new material as `Ocean_bottom` as well.
2. Switch the **Diffuse BSDF** shader with a **Mix Shader** node. In the first and the second slots, load two **Emission** shaders.
3. Add an **Attribute** node (press *Shift* + *A* and navigate to **Input** | **Attribute**) and connect the **Color** output to the **Fac** input of the **Mix Shader** node. In the **Name** slot of the **Attribute** node, write `Col_emit`, which is the name of the **Vertex Color** layer.
4. Change the color of the first **Emission** node for **R** to `0.178`, **G** to `0.150`, and **B** to `0.085`. Set the **Strength** value to `1.000`.
5. Change the color values of the second **Emission** node for **R** to `0.213`, **G** to `0.284`, and **B** to `0.380`. Set the **Strength** value to `2.000`.

   The **Ocean_bottom** material is ready. Have look at the following screenshot:



The Ocean_bottom material and the scene visible in the Solid viewport shading mode through the Camera view

6. Now select **Ocean_surface** and click on **New** in the **Material** window under the **Properties** panel or in the **Node Editor** toolbar. Rename this material as `Ocean_surface`.
7. Replace the **Diffuse BSDF** node with a **Mix Shader** node, and in the first **Shader** slot, assign a **Transparent BSDF** node. In the second slot, assign a **Glass BSDF** shader. In the **Properties** panel of the **Node Editor** window, label the **Mix Shader** node as `Mix Shader01`.
8. Change the **Transparent BSDF** nodes **Color** values for **R** to `0.055`, **G** to `0.124`, and **B** to `0.042` (you can also do this by connecting an **RGB** node to the **Color** input socket, as shown in the example blend file provided). Set the **Glass BSDF** shader node's **Roughness** value to `0.900` and the **IOR** value to `1.333`.
9. Add a **Layer Weight** node (press *Shift* + *A* and navigate to **Input** | **Layer Weight**), connect the **Facing** output to the **Fac** input of the **Mix Shader01** node, and set the **Blend** value to `0.050`.
10. Select the **Mix Shader01** node and press *Shift* + *D* to duplicate it. Add a **Glossy BSDF** shader (press *Shift* + *A* and navigate to **Shader** | **Glossy BSDF**) and connect it to the second **Shader** input socket of the **Mix Shader02** node. Connect the output of the **Mix Shader01** node to the first **Shader** input socket of the **Mix Shader02** node, and the output of this node to the **Surface** input of the **Material Output** node.
11. Add a **Fresnel** node (press *Shift* + *A* and navigate to **Input** | **Fresnel**). Connect this to the **Fac** input of the **Mix Shader02** node. Set the **IOR** value to `1.333` as shown in the following screenshot:



The Ocean_surface shader network

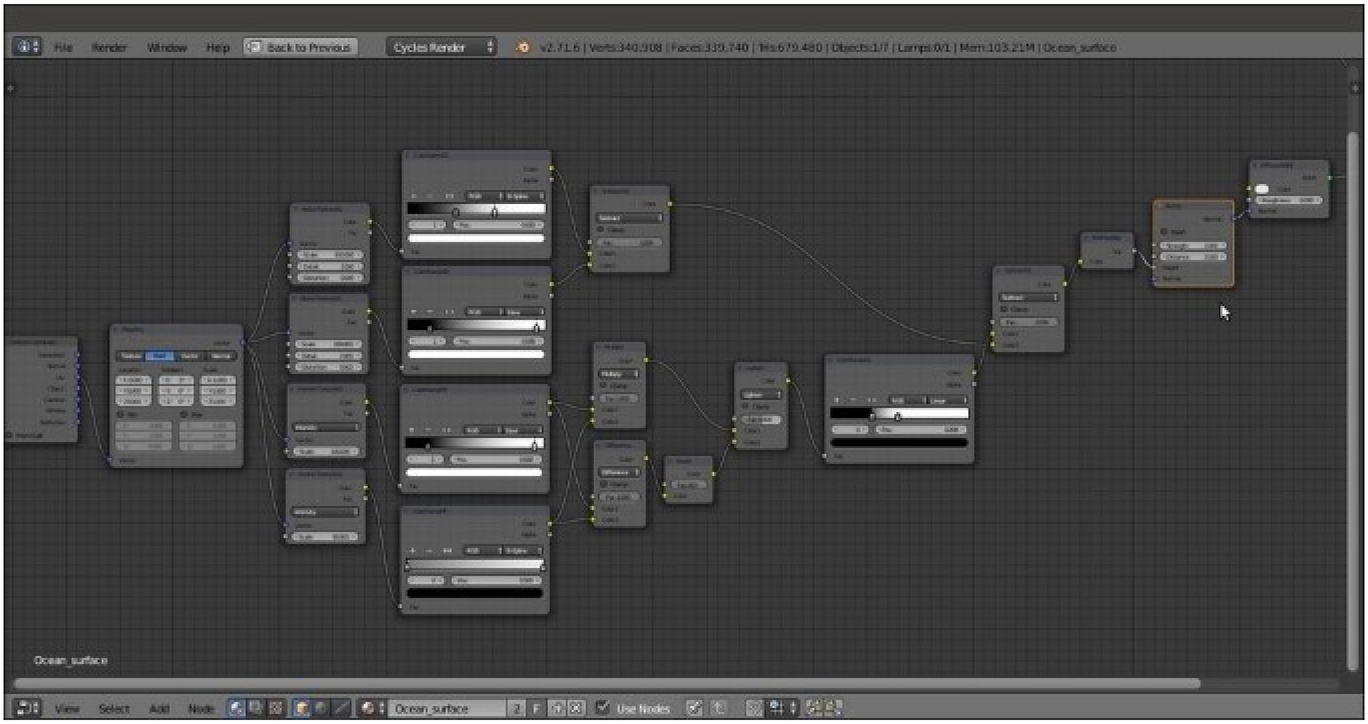
12. Now select all the nodes except the **Material Output** node, and press *Ctrl* + *G* to make a group. Select and delete the **Group Input** node to the left (press the *X* key), and drag the **Mix Shader02** node's output to the empty socket of the **Group Output** node.
13. Press *Tab* to close the node group, and rename it as `Ocean_water`.

Creating the foam shader

Let's now create the shader for the foam:

1. Add a **Noise Texture** node (press *Shift* + *A* and navigate to **Texture** | **Noise Texture**) and a **Voronoi Texture** node (press *Shift* + *A* and navigate to **Texture** | **Voronoi Texture**) nodes. Select them and press *Shift* + *D* to duplicate them. Label them as `Noise Texture01`, `Noise Texture02`, `Voronoi Texture01`, and `Voronoi Texture02`.
2. Add four **ColorRamp** nodes (press *Shift* + *A* and navigate to **Converter** | **ColorRamp**, then press *Shift* + *D* to duplicate them). Label them as `ColorRamp01`, `ColorRamp02`, `ColorRamp03`, and `ColorRamp04`. Place the four texture nodes in a vertical column and arrange the **ColorRamp** nodes to their side. Connect the **Color** output of each texture node to the **Fac** input of the respective **ColorRamp** node.
3. Set **Interpolation** of the **ColorRamp01** node to **B-Spline**, **ColorRamp02** and **ColorRamp03** to **Ease**, and **ColorRamp04** to **B-Spline** again.
4. Go to the **ColorRamp01** node. Move the black color stop to position `0.345` and the white color stop to position `0.633`.

5. Go to the **ColorRamp02** and **ColorRamp03** nodes. Move the black color stop to position `0.159` and the white color stop to position `0.938` for both nodes. Leave the **ColorRamp04** color stops as they are.
6. Set the **Scale** value of the **Noise Texture01** node to `500.000`, the **Noise Texture02** node to `100.000`, the **Voronoi Texture01** node to `100.000`, and the **Voronoi Texture02** node to `90.000`.
7. Add a **Texture Coordinate** node (press *Shift* + *A* and navigate to **Input** | **Texture Coordinate**) and a **Mapping** node (press *Shift* + *A* and navigate to **Vector** | **Mapping**). Connect the **UV** output of the **Texture Coordinate** node to the **Vector** input socket of the **Mapping** node. Then connect the **Vector** output of this node to the **Vector** input sockets of the four texture nodes.
8. Add a **MixRGB** node (press *Shift* + *A* and navigate to **Color** | **MixRGB**), set the **Blend Type** to **Subtract**, and label it as `Subtract01`. Set the **Fac** value to `1.000`. Connect the **Color** outputs of the **ColorRamp01** and **ColorRamp02** nodes to the **Color1** and **Color2** input sockets of the **Subtract01** node.
9. Select the **Subtract01** node, press *Shift* + *D* to duplicate it, and set the **Blend Type** to **Multiply**. Label it as `Multiply` and connect the **Color** outputs of the **ColorRamp03** and **ColorRamp04** nodes to its **Color1** and **Color2** input sockets.
10. Duplicate a **MixRGB** node again, set the **Blend Type** to **Difference**, and name it `Difference` as well. Then connect the **Color** outputs of the **ColorRamp03** and **ColorRamp04** nodes to the **Color1** and **Color2** input sockets of this **Difference** node.
11. Duplicate one of the **MixRGB** nodes one more time. Set the **Blend Type** to **Lighten** and label it as `Lighten`. Lower the **Fac** value to `0.500`. Connect the **Color** output of the **Multiply** node to the **Color1** input of the **Lighten** node, and the **Color** output of the **Difference** node to the **Color2** input socket.
12. Add an **Invert** node (press *Shift* + *A* and navigate to **Color** | **Invert**) and move it on the link connecting the **Difference** and the **Lighten** nodes to be automatically pasted in between.
13. Add a new **ColorRamp** node, label it as `ColorRamp05`, and connect the **Lighten** node output to its **Fac** input. Then move the black color stop to position `0.298` and the white color stop to position `0.486`.
14. Add a new **MixRGB** node (press *Shift* + *A* and navigate to **Color** | **MixRGB**), set the **Blend Type** to **Subtract**, and label it as `Subtract02`. Set the **Fac** value to `1.000`. Connect the **ColorRamp05** node's **Color** output to the **Color1** input of **Subtract02** node and the output of the **Subtract01** node to the **Color2** input socket.
15. Add an **RGB to BW** node (press *Shift* + *A* and navigate to **Converter** | **RGB to BW**), a **Bump** node (press *Shift* + *A* and navigate to **Vector** | **Bump**), and a **Diffuse BSDF** shader (press *Shift* + *A* and navigate to **Shader** | **Diffuse BSDF**).
16. Connect the **Subtract02** node's output to the **RGB to BW** node, the output of this node to the **Height** input socket of the **Bump** node, and the **Normal** output of the **Bump** node to the **Normal** input of the **Diffuse BSDF** shader. Set the **Bump** node's **Strength** value to `1.000` as shown in the following screenshot:



The network for the foam shader

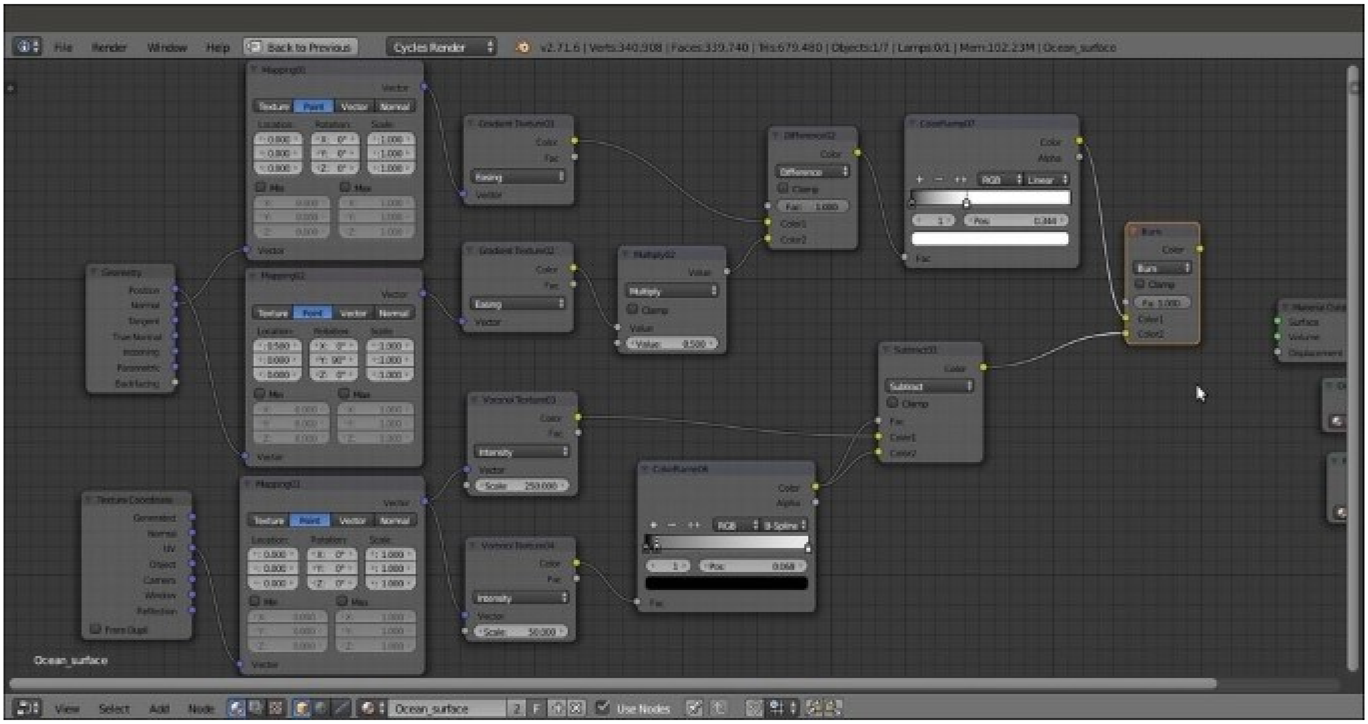
17. Select all of these nodes and press *Ctrl* + *G*. Delete the **Group Input** node on the left.
18. Drag the **BSDF** output of the **Diffuse BSDF** shader onto the right side, to the empty socket of the **Group Output** node. Repeat this for the **Color** output of the **Subtract02** node.
19. Press *Tab* to close the group. Rename it as `Foam`.

Creating the stencil material for the foam location

What we need now is a way to limit both the amount and the presence of the foam in the upper parts of the waves:

1. Add **Gradient** (press *Shift* + *A* and navigate to **Texture** | **Gradient Texture**) and **Voronoi Texture** (press *Shift* + *A* and navigate to **Texture** | **Voronoi Texture**) texture nodes, select them, and press *Shift* + *D* to duplicate them. Label them as `Gradient Texture01`, `Gradient Texture02`, `Voronoi Texture03`, and `Voronoi Texture04`.
2. Set the **Gradient Types** to **Easing** for both the nodes, the **Scale** value of the **Voronoi Texture03** node to `250.000`, and the Scale value of the **Voronoi Texture04** node to `50.000`.
3. Add three **Mapping** nodes (press *Shift* + *A* and navigate to **Vector** | **Mapping**, then press *Shift* + *D* to duplicate them). Label them as `Mapping01`, `Mapping02`, and `Mapping03`.
4. Add a **Texture Coordinate** node (press *Shift* + *A* and navigate to **Input** | **Texture Coordinate**) and a **Geometry** node (press *Shift* + *A* and navigate to **Input** | **Geometry**).
5. Connect the **Normal** output of the **Geometry** node to the **Vector** input of the **Mapping01** node. Next, connect the **Position** output of the **Geometry** node to the **Vector** input of the **Mapping02** node. Then connect the **UV** output of the **Texture Coordinate** node to the **Vector** input of the **Mapping03** node.

6. In the **Mapping02** node, change the **Location** value of **X** to `0.500` and the **Rotation** value of **Y** to `90°`.
7. Connect the output of the **Mapping01** to the input of the **Gradient Texture01**, the output of the **Mapping02** to the input of the **Gradient Texture02**, and the output of the **Mapping03** to both the **Vector** inputs of the last two **Voronoi Texture** nodes.
8. Add a **ColorRamp** node (press *Shift* + *A* and navigate to **Converter** | **ColorRamp**), label it as `ColorRamp06`, and connect the **Color** output of the **Voronoi Texture04** node to its **Fac** input. Set **Interpolation** to **B-Spline**. On the **ColorRamp06** node, click on the little **+** icon to add a new color stop (medium gray) in the middle of the slider. Change its color to total black and move it to position `0.068`.
9. Add a **Math** node (press *Shift* + *A* and navigate to **Converter** | **Math**), set the **Operation** to **Multiply**, and label it as `Multiply02`. Connect the **Color** output of the **Gradient Texture02** node to the first **Value** input socket of the **Multiply02** node.
10. Add a **MixRGB** node (press *Shift* + *A* and navigate to **Color** | **MixRGB**), set the **Blend Type** to **Difference**, and label it as `Difference02`. Set the **Fac** value to `1.000`. Connect the **Color** output of the **Gradient Texture01** to the **Color1** input socket, and the **Value** output of the **Multiply02** node to the **Color2** input socket of the **Difference02** node.
11. Press *Shift* + *D* to duplicate the **MixRGB** node, set the **Blend Type** to **Subtract**, and label it as `Subtract03`. Connect the **ColorRamp06** node's **Color** output to both the **Color2** and to the **Fac** input sockets. Then connect the **Color** output of the **Voronoi Texture03** node to the **Color1** input socket.
12. Add a new **ColorRamp** node (press *Shift* + *A* and navigate to **Converter** | **ColorRamp**), label it as `ColorRamp07`, and connect the output of the **Difference02** node to the **Fac** input. Then move the white color stop to position `0.344`.
13. Duplicate one of the **MixRGB** nodes, set the **Blend Type** to **Burn**, and label it as `Burn` as well. Connect the **Color** output of the **ColorRamp07** node to the Color1 input of the **Burn** node. Then connect the output of the **Subtract03** node to the **Color2** input socket of the **Burn** node as shown in the following screenshot:



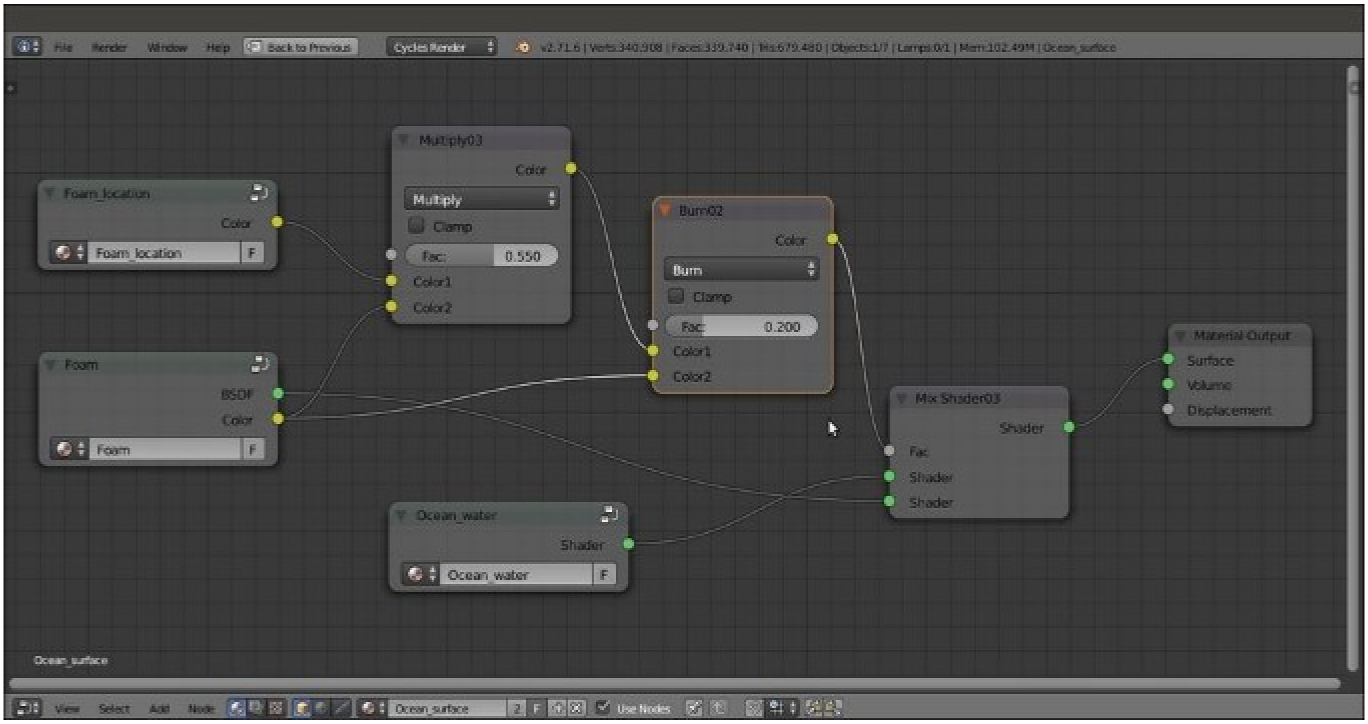
The stencil network

14. Now select all of these nodes, press *Ctrl* + *G*, and drag the **Burn** node output on the right to connect it to the empty socket of the **Group Output** node. Press *Tab* to close the group. Rename it as `Foam_location`.

Putting everything together

What is left now is just to connect these three groups to build the final shader:

1. Add a **Mix Shader** node (press *Shift* + *A* and navigate to **Shader** | **Mix Shader**). Label it as `Mix Shader03` and connect its output to the **Surface** input socket of the **Material Output** node.
2. Connect the **Shader** output of the **Ocean_water** group to the first **Shader** input of the **Mix Shader03**. Then connect the **BSDF** output of the **Foam** group to the second **Shader** input.
3. Add two **MixRGB** nodes (press *Shift* + *A* and navigate to **Color** | **MixRGB**). Set the **Blend Type** of the first node to **Multiply** and the **Fac** value to `0.550`. Then label it as `Multiply03`. Set the second node **Blend Type** to **Burn** and the **Fac** to `0.200`. Then label it as `Burn02`.
4. Connect the **Color** output of the **Foam_location** group to the **Color1** input of the **Multiply03** node, and the **Color** output of the **Foam** group to the two **Color2** inputs of both the **Multiply03** and **Burn02** nodes.
5. Connect the **Multiply03** node's output to the **Color1** input of the **Burn02** node. Connect the output of the **Burn02** node to the **Fac** input of the **Mix Shader03** node as shown in the following screenshot:

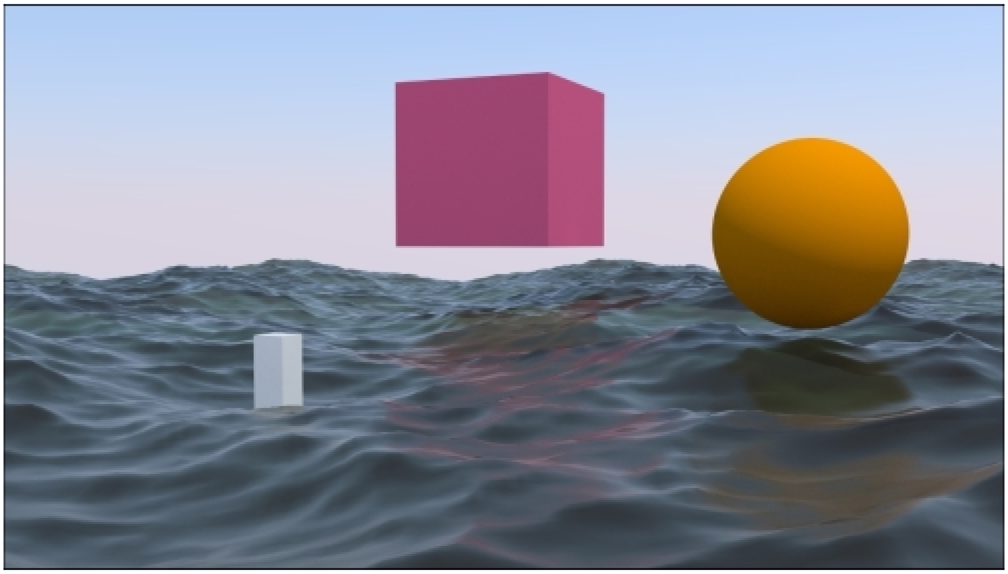


The overall view of the network with the connected node groups

How it works...

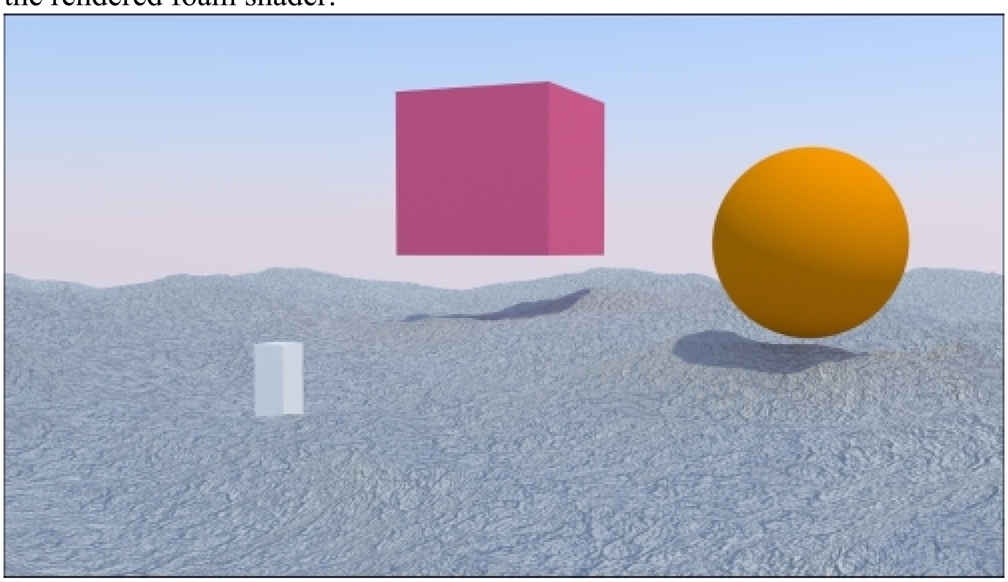
This material, which looks quite complex, is actually easily understandable by splitting the entire process in three stages corresponding to the three group nodes:

- In the first stage, we created the basic ocean water shader by mixing a **Glass** node with a **Transparent BSDF** shader on the ground of the **Facing** value of the **Layer Weight** node and then also with a **Glossy BSDF** shader driven by the index of refraction of water (the **IOR** value of the **Fresnel** node, which is `1.333` for water at 20°C). In other words, the ocean surface nicely reflects the environment but for the faces looking towards the Camera (the **Facing** factor), it is transparent. Very important is the **Bottom_ocean** Plane, which is used to mimic the volume of the water and the underwater perspective and also emitting light to enhance the effect of the sun bouncing from the ocean surface to any floating object. The result of this first stage is shown in the following rendering:



Only the water shader rendered

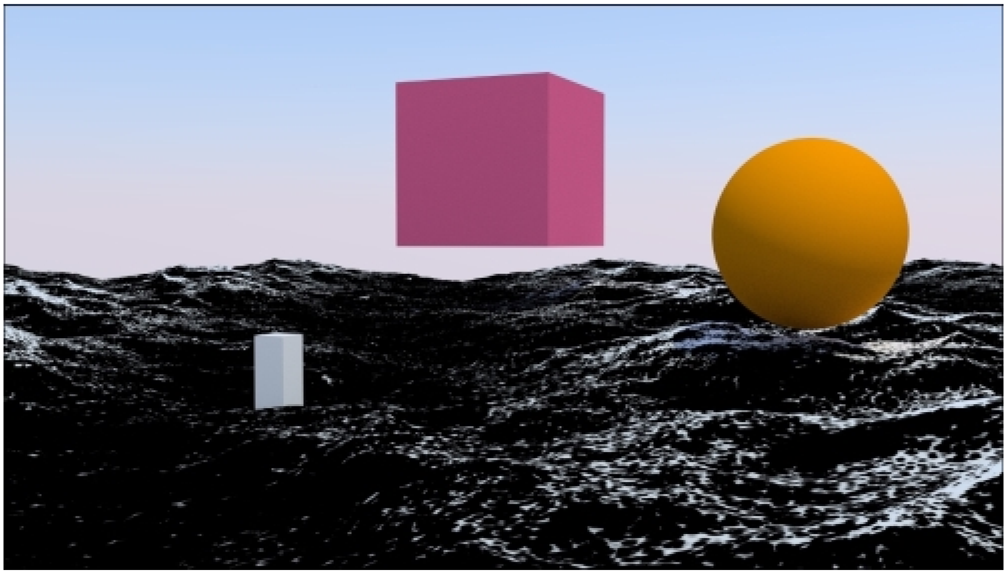
- In the second stage, we created the material for the foam—a simple, white **Diffuse BSDF** shader. In fact, the peculiarity of the foam shader is mostly in the frothy bumpiness (and in the lacy-shaped outline cut by the procedural textures of the **Foam_location** shader). Have a look at the rendered foam shader:



Only the foam shader rendered

- In the third stage, this group of nodes establishes the location of the foam that is mainly formed in the higher parts of waves in the real world, behaving as a gray-scale stencil map. Basically, a gradient texture is mapped on the **Position** (vertices) and multiplied for the **Normal** coordinates of the ocean mesh that, being created by the **Ocean** modifier, is constantly changing. So, only as the waves rise do they show foam at the top. This effect has been lessened and made a bit random to show some foam scattered around the rest of the surface as well. This works not only for stills but also in animation.

In the following screenshot, you can see the rendering of the resulting black-and-white mask that we used as a stencil for foam location (the image obtained by simply connecting the mask output to an **Emission** shader node to get a quick rendering and preview):



The only stencil material rendered

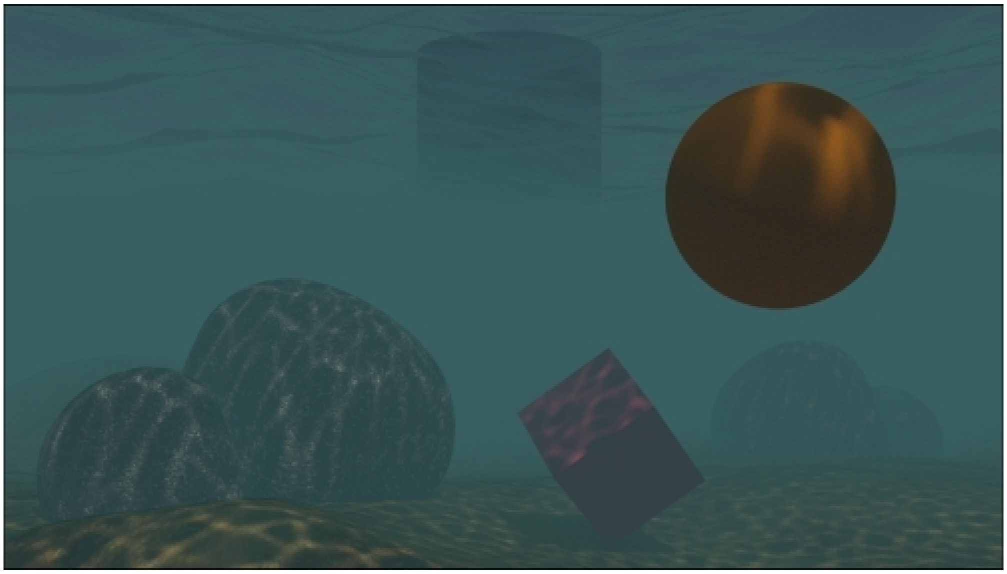
See also

The Blender **Ocean** modifier is able to create its own foam effect, generated as Vertex Colors and baked to a series of images (frames) saved in a directory. These images are then automatically mapped on the surface. They can be used as stencil masks instead of the **Foam_location** group node.

To know more about the **Ocean** modifier, you can take a look at the wiki documentation at http://wiki.blender.org/index.php/Doc:2.6/Manual/Modifiers/Simulate/Ocean.

Creating underwater environment materials

In this recipe, we will create an underwater environment as shown in the following screenshot, looking especially at a fake caustic effect projected by the water's wavy surface and from an atmospheric perspective, obtained by a per material dedicated node group:



The underwater environment in the final rendering

Note

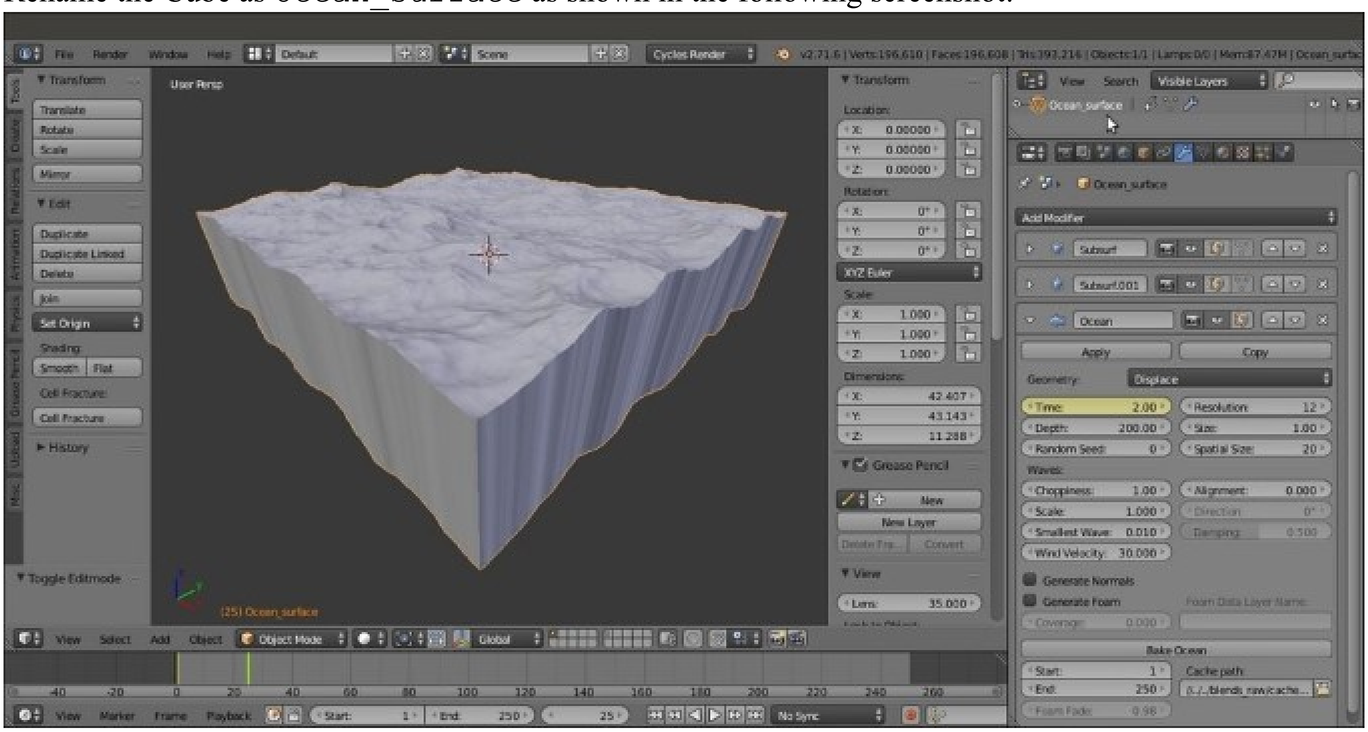
Note that this atmospheric perspective effect is actually a fake and it is not obtained by a volume material. Volumetric shaders will be explained in Chapter 9, *Special Materials*, of this Cookbook.

Getting ready

Let's start by preparing the scene:

1. Start Blender and switch to the Cycles rendering engine. Select the **Cube** and go to **Edit Mode**. Scale it 21 times bigger (Press *A* to select all the vertices, then press *S*, enter digit *21*, and finally press *Enter*). Then scale it on the *z* axis of `0.230` (press *S*, then press *Z*, enter `.23`, and press *Enter*).
2. Go to the **Top** view (press *7* on the numeric keypad) and press *Ctrl* + *R* to add three edge loops along the global *x* axis. Then press *Ctrl* + *R* again to add three edge loops along the *y* global axis. The Cube is now subdivided into 16 equal parts.
3. Select all the faces, go to the **Shading** tab under the **Tool Shelf** panel to the left, and click on the **Flip Direction** button to invert the normals (which must look inwards).
4. Exit **Edit Mode**, switch to the **Objects modifiers** window, and assign a **Subdivision Surface** modifier. Set the type of subdivision to **Simple** and the **Subdivisions** to `4` both for the **View** and the **Render** levels.

5. Assign a second **Subdivision Surface** modifier. Again, set the type of subdivision to **Simple** but the **Subdivisions** to `2` for both the **View** and the **Render** levels.
6. Now assign an **Ocean** modifier. Set the values of **Geometry** to **Displace**, **Spatial Size** to `20`, and **Resolution** to `12`.
7. Go to the **Tool Shelf** again, and in the **Edit** subpanel under the **Tools** tab, click on the **Smooth** button below the **Shading** item.
8. Go to the **Object data** window and click on the **+** icon under the **UV Maps** subpanel to add a set of UV coordinates. There is no need to unwrap the Cube. Check the **Double Sided** item in the **Normals** subpanel at the top.
9. Make sure you are at frame **1**, go to the **Object modifiers** window, and move the mouse over the **Ocean** modifier **Time** slot. Press the *I* key to add a key for the animation. Go to frame **25**, change the **Time** value from `1.00` to `2.00`, and press *I* again to set a second key.
10. In the **Choose Screen** layout button at the top, switch from **Default** to **Animation**. In the **Graph Editor** window, press *T*, and in the **Set Keyframe Interpolation** pop-up menu, select the **Linear** item under **Interpolation**. Then press *Shift* + *E*, and in the **Set Keyframe Extrapolation** pop-up menu, select the **Linear Extrapolation** item to make the ocean animation constant and continuous.
11. Rename the Cube as `Ocean_surface` as shown in the following screenshot:



The Cube with the assigned Ocean modifier

12. Move the Camera to a place below the ocean surface Set the **Location** value of **X** to `16.80000`, **Y** to `-2.64000`, and **Z** to `0.95000`. Then set the **Rotation** value of **X** to `92°`, **Y** to `0°`, and **Z** to `90°`. Next, go to the **Camera** view (press *0* on the numeric keypad).
13. Add a **Cube**, a **UV Sphere,** and whatever other objects you want to add floating under the ocean surface. Assign them very simple and colored **Diffuse BSDF** materials. Add a big **Cylinder** to

the background, close to the far side of the **Ocean_surface** object. Immerse half of it in water (and half will be in the air). Assign a simple **Diffuse BSDF** material to this item too. Smooth the Cylinder and the UV Sphere. If you wish, assign a **Subdivision Surface** modifier to the UV Sphere.

14. Now add a **Plane**. Place it at **Location** values of **X** as `-3.22600`, **Y** as `-2.79600`, and **Z** as `-2.24463`. Enter **Edit Mode** and scale it 30 times bigger (press *A* to select all of the geometry, then press *S*, enter *30* and press *Enter*). Using the **Specials** menu (press *W*) divide the Plane five or six times. Activate the **PET** (**Proportional Editing Tool**), randomly select vertices, and move them up to model the dunes of the ocean bed. Exit **Edit Mode**, smooth it by the **Tools** tab under the **Tool Shelf** panel, and assign a **Subdivision Surface** modifier at level `2`. Disable the modifier visibility in the viewport by clicking on the eye icon. Rename it as `Ocean_bed`.
15. Add a **Cube**. In **Edit Mode**, divide it a couple of times (press *W*, and **Subdivide Smooth**), in **Proportional Editing** mode and by selecting vertices quickly model a big round rock. Replicate it three or four times by rotating and scaling the copies. Place them in a scattered manner on the **Ocean_bed**. Smooth it and assign a **Subdivision Surface** modifier. Disable the modifier visibility in the viewport.
16. Go to the **World** window and click on **Use Nodes**. Then click on the little square with a dot on the right side of the color slot. From the menu, select **Sky Texture**. Click on the **Sky Type** button above the little window and switch to the **Preetham** type.
17. Select the **Lamp**. In the **Object data** window, click on the **Use Nodes** button and set a yellowish color for the light (set the values for **R** to `1.000`, **G** to `0.989`, and **B** to `0.700`). Change it to a **Sun**. Set the **Size** value to `0.010` and the **Strength** value to `2.500`. Then set the **Rotation** values of **X** to `22°`, **Y** to `-7°`, and **Z** to `144°`. You might know that for a Sun Lamp, the location doesn't matter.
18. Go to the **Render** window. Under the **Sampling** subpanel, set the **Clamp Direct** and the **Clamp Indirect** values to `1.00`. Then set the **Samples** to `25` for both **Preview** and **Render**. Under the **Light Paths** subpanel, disable both the **Reflective Caustics** and **Refractive Caustics** items.

As an alternative, just open the `9931OS_05_underwater_start.blend` file and use the prepared scene.

How to do it...

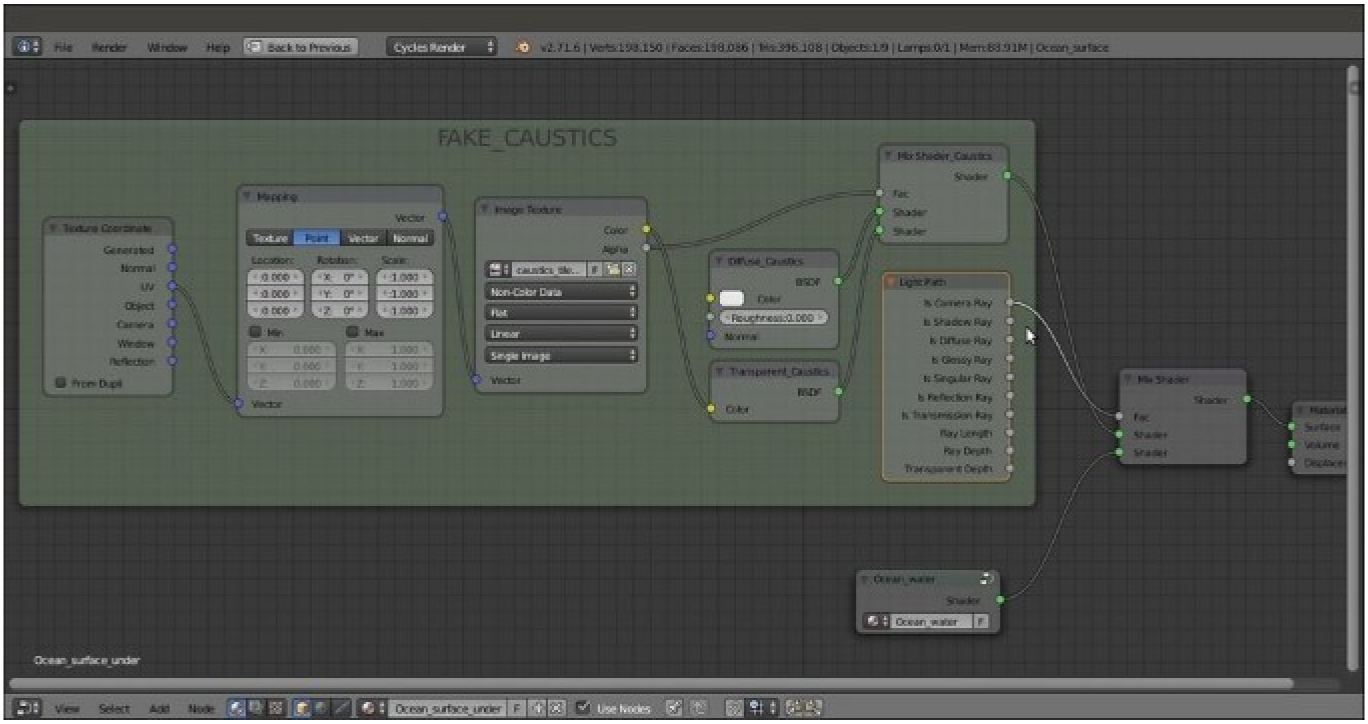
First, let's perform the easy steps by appending the materials that are already made so that we can reuse them:

1. From the `9931OS_03_Rock_procedurals.blend` file, append the `Rock_proc01` material. Select the **Rocks** object and assign the newly appended material.
2. From the `9931OS_03_Ground.blend` file, append the `Ground_01` material. Select the **Ocean_bed** object and assign the material.

Now let's move on to the more complex steps:

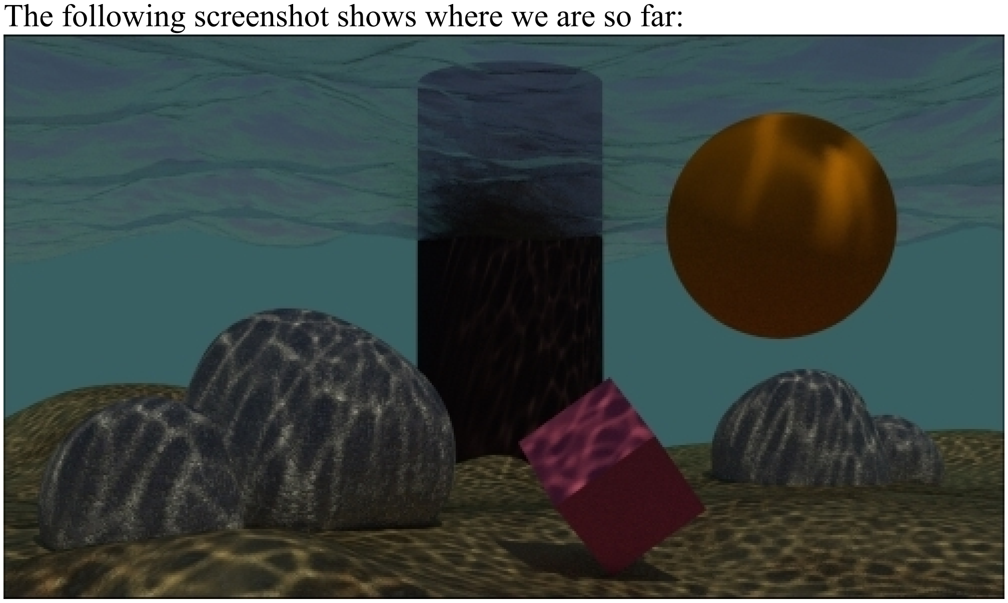
1. From the `9931OS_05_Ocean.blend` file, append the `Ocean_surface` object, material. Select the **Ocean_surface** object and assign the material. Rename it as `Ocean_surface_under`.

2. With the **Ocean_surface** object still selected, enter **Edit Mode**. Go to the **Face** selection mode and select only the upper faces. Then press *Ctrl* + *I* to invert the selection. In the **Material** window under the **Properties** panel, click on the **+** icon on the right (Add a new material slot), rename the new material as `Null`, and click on the **Assign** button. Now the **Ocean_surface** object has two different materials: the transparent water surface and the opaque sides and bottom (a simple white **Diffuse BSDF** material). Exit **Edit Mode**.
3. In the **Material** window, click on the **Ocean_surface_under** material to select it. In the **Node Editor** window, delete the **Foam** and the **Foam_location** node groups. Also delete the two **MixRGB** nodes. Just leave the **Ocean_water** node group connected to the second **Shader** input socket of the **Mix Shader** node, which in turn is connected to the **Material Output** node.
4. Add a **Texture Coordinate** node (press *Shift* + *A* and navigate to **Input** | **Texture Coordinate**), a **Mapping** node (press *Shift* + *A* and navigate **Vector** | **Mapping**), and an **Image Texture** node (press *Shift* + *A* and navigate to **Texture** | **Image Texture**). Connect the **UV** output of the **Texture Coordinate** node to the **Vector** input of the **Mapping** node, and the **Vector** output of this node to the **Vector** input socket of the **Image Texture** node.
5. In the **Image Texture** node, load the `caustics_tileable_low.png` texture and set the **Color Space** to **Non-Color Data**.
6. Add a **Diffuse BSDF**, a **Transparent BSDF**, and a **Mix Shader** node (press *Shift* + *A* and navigate to **Shader** | **Diffuse BSDF**, and repeat the same for the other two nodes). Label them as `Diffuse_Caustics`, `Transparent_Caustics`, and `Mix Shader_Caustics`.
7. Connect the **Diffuse_Caustics** node's output to the first **Shader** input socket of the **Mix Shader_Caustics** node, and the **Transparent_Caustics** output to the second **Shader** input socket. Then connect the **Color** output of the **Image Texture** node to the **Color** input socket of the **Transparent_Caustics** shader node, and the **Alpha** output of the **Image Texture** node to the **Fac** input of the **Mix Shader_Caustics** node.
8. Now connect the output of the **Mix Shader_Caustics** node to the first (and still empty) **Shader** input socket of the first **Mix Shader** node.
9. Add a **Light Path** node (press *Shift* + *A* and navigate to **Input** | **Light Path**). Connect the **Is Camera Ray** output to the **Fac** input of the first **Mix Shader** node. Add **Frame** (press *Shift* + *A* and navigate to **Layout** | **Frame**) and parent these last nodes to it. Then label it as `FAKE_CAUSTICS` as shown in the following screenshot:



The FAKE_CAUSTICS frame mixed with the Ocean_Water node group on the ground of the Is Camera Ray output of the Light Path node

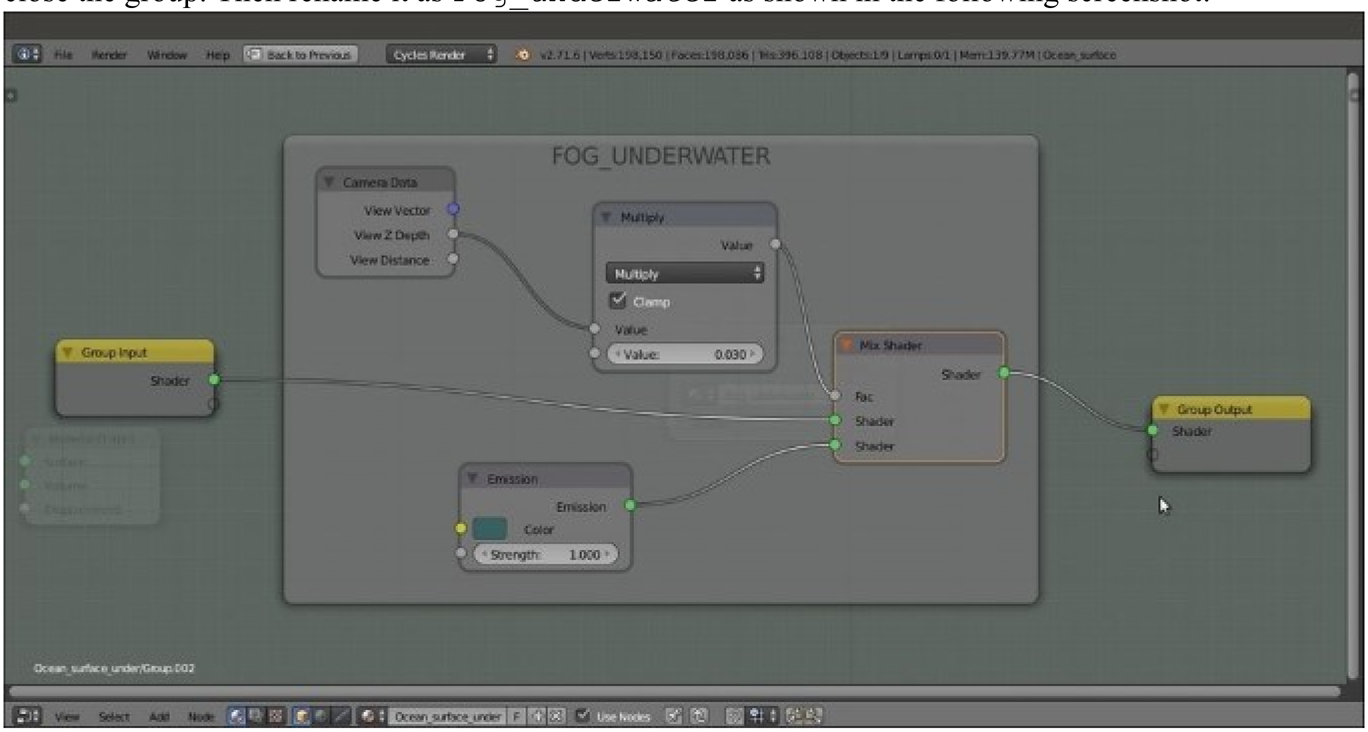
The following screenshot shows where we are so far:



The point where we are so far

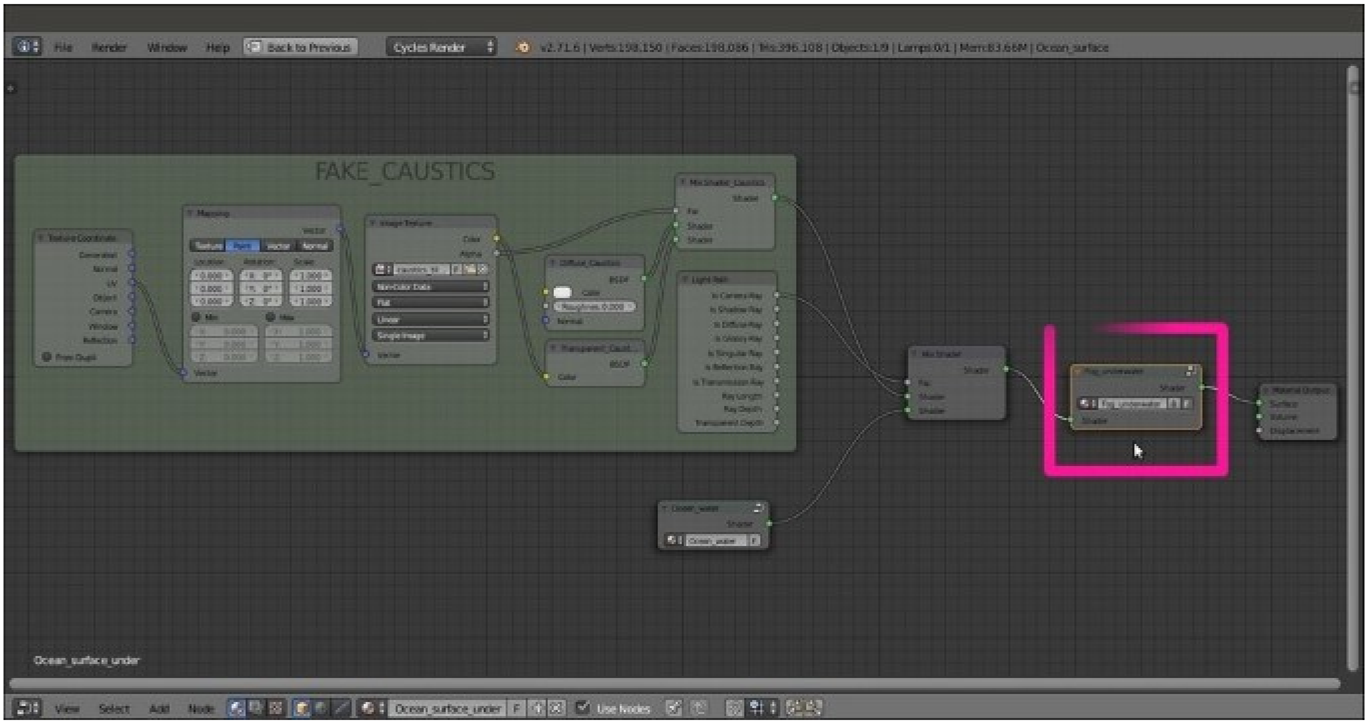
What is missing now is the underwater atmospheric perspective effect. There are several ways to obtain this, for example, by compositing a Mist pass rendered in Blender Internal or by using a volumetric shader. However, we are going to do this with a simple node group added to every one of the different materials.

10. Add a **Camera Data** node (press *Shift* + *A* and navigate to **Input** | **Camera Data**), a **Math** node (press *Shift* + *A* and navigate to **Converter** | **Math**), an **Emission** node (press *Shift* + *A* and navigate to **Shader** | **Emission**), and a **Mix Shader** node (press *Shift* + *A* and navigate to **Shader** | **Mix Shader**). Label the **Mix Shader** node as `Mix Shader_Fog`.
11. Connect the **View Z Depth** output of the **Camera Data** node to the first **Value** input of the **Math** node. Set the **Math** node's **Operation** to **Multiply** and the second **Value** to `0.030`. Check the **Clamp** option. Connect the **Multiply** node output to the **Fac** input socket of the **Mix Shader_Fog** node.
12. Connect the **Emission** output to the second **Shader** input of the **Mix Shader_Fog** node. Set the **Color** values for **R** to `0.040`, **G** to `0.117`, and **B** to `0.124`.
13. Select all the new nodes and press *Ctrl* + *G* to make a group. Click and drag the first **Shader** input socket of the **Mix Shader_Fog** node into the empty socket of the **Group Input** node on the left and repeat this step by connecting the **Shader** output socket on the right. Press *Tab* to close the group. Then rename it as `Fog_underwater` as shown in the following screenshot:



The FOG_UNDERWATER node group in Edit Mode

14. Add and paste the **Fog_underwater** node (press *Shift* + *A* and navigate to **Group** | **Fog_underwater**) just before the **Material Output** node of every material (in our scene, the **Fog_underwater** node will show eight users if the *fake user* button is selected) as shown in the following screenshot:



The Fog_underwater node group pasted at the end of the shader

How it works...

First of all, why should we choose a Cube for the ocean surface instead of the simpler Plane?

The reason is very simple: in Cycles, the World emits light, and the only way to avoid this is to set the color to pitch black (or by a combination of a **Light Path** node with the **World** materials, but this is another story). In our scene, the World is set to a bright blue sky color, and with a Plane, the underwater objects and the ocean bed would have been lit too much from the sides and the bottom the result look natural. A Cube, on the other hand, envelops all the underwater elements, limiting the lighting to the Sun Lamp passing through the surface, and projecting the image textured caustics. This gives a more natural-looking result.

The image texture we assigned to the water material is used to obtain a textured transparency effect. Right now, the water surface is actually opaque and transparent according to the black and white values of the textures, so as to allow the Sun Lamp light to pass through and project the caustics.

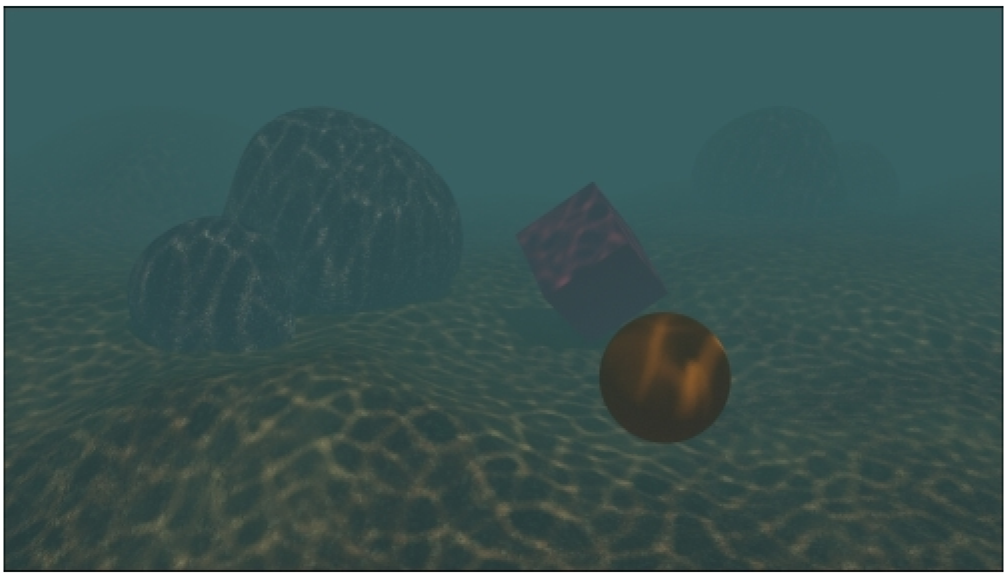
Thanks to the **Is Camera Ray** output of the **Light Path** node, the caustics image texture is not directly renderable on the ocean surface, but it nevertheless has some effect on the other materials. Because the value of **Is Camera Ray** is `1`, the rays starting from the Camera and directly hitting the ocean surface can render only the clean water material plugged into the second input socket of the **Mix Shader** node, while the transmitted caustics (plugged in the first **Shader** socket = 0) get rendered.

The **Fog_underwater** node group is simply an emitter material serving as the background (deep green in this case) and mapped on every underwater material according to the *z* depth of the Camera (it also works with the Camera frame, in the viewport). The density of the fog is set by the **Multiply** node's second **Value**. For the ocean body, a value of `0.030` is good enough.

Note

The Camera *z* axis must not be confused with the global coordinate *z* axis, which is the vertical blue line visible in the 3D view. The Camera *z* axis, on the other hand, is the ideal line connecting the starting point of view to any visible element in the scene.

Note that we didn't expose the values of the nodes in the **Fog_underwater** group. This is because in **Edit Mode**, we can tweak the internal values of just one node to automatically update all the fog group instances assigned to the other materials. Besides, we know that the values exposed on the group interface would overwrite the internal settings and work only for that single node instance.



The final underwater environment rendered from a different point of view

Creating a snowy mountain landscape with procedurals

In this recipe, we will make a snowy mountain landscape by reusing existing shaders—the `Rock_procedural` and the `Snow materials`. We will improve these materials by grouping them and exposing the useful values. Then we will create a new group node that will work as a stencil to depict snow in a more customizable and natural way on the rocks as shown in the following screenshot:

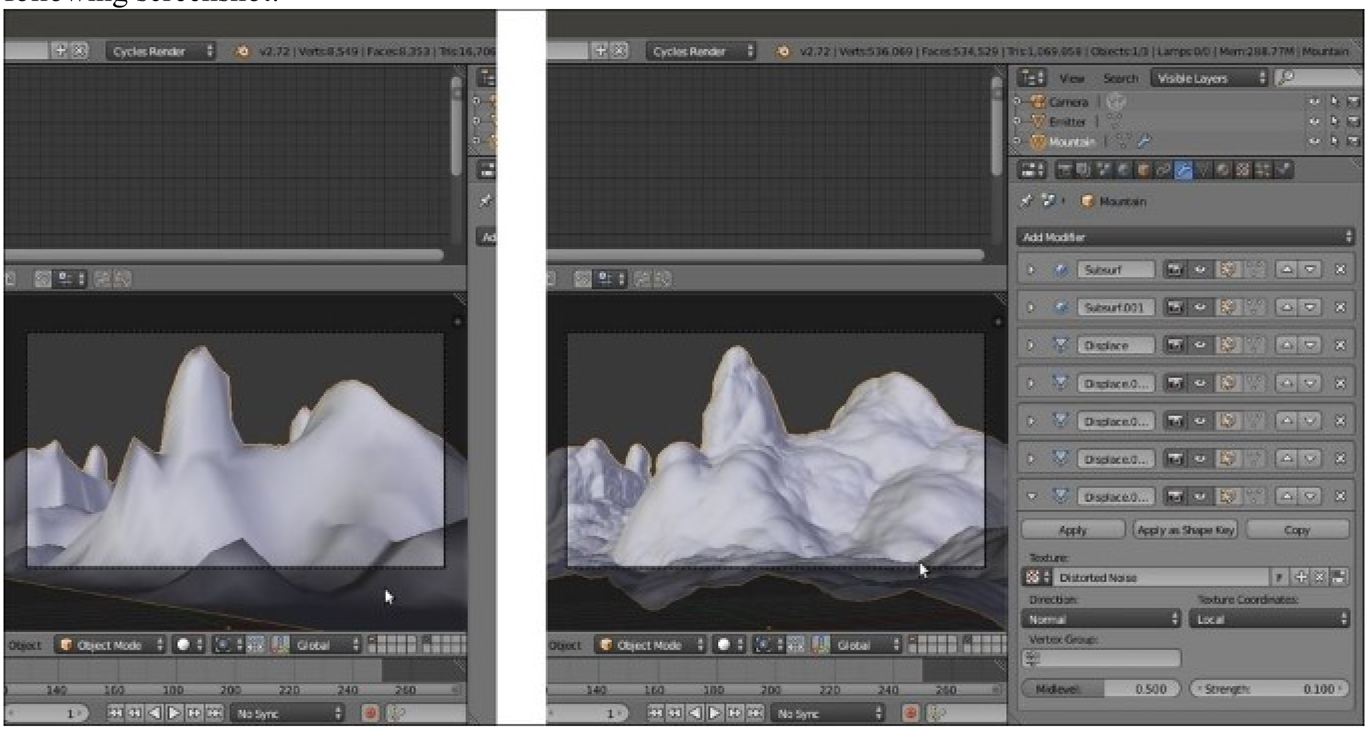
The snowy mountain landscape as it appears in the final rendering

Getting ready

As usual, let's start with the preparation of the scene. In this case, we start with an almost ready blend file:

1. Start Blender and open the `9931OS_05_RockSnow_start.blend` file, where there is a scene with a placed Camera—a simply modeled **Mountain** object and a **Plane** set as **Emitter**.
2. Select the **Mountain** object, go to the **Object modifiers** window, and assign a **Subdivision Surface** modifier. Set the levels to `2` for both **View** and **Render**.
3. Assign a second **Subdivision Surface** modifier. Set the levels to `1` for both **View** and **Render**.
4. Assign a **Displace** modifier. Click on the **Show texture in texture** tab to the extreme right of the **Texture** name slot to go to the **Textures** window. Assign a **Voronoi** procedural texture. Set the **Size** to `1.00`. Go back to the **Displace** modifier and set the **Strength** to `-0.200`.
5. Assign a second **Displace** modifier. In the **Texture** window, assign a new **Voronoi Texture** and set **Distance Metric** to **Manhattan** and **Size** to `0.50`. Back in the **Displace** modifier panel, set the **Strength** to `-0.050`.

6. Assign a third **Displace** modifier, select a **Clouds** texture, and set **Noise** to **Hard** and the **Displace** modifier's **Strength** to 0.040.
7. Assign a fourth **Displace** modifier. In the **Texture** window, assign a **Musgrave** procedural texture. Set the **Type** to **Hetero Terrain**, **Dimension** to 0.650, **Lacunarity** to 2.000, **Octaves** to 0.500, **Offset** to 0.250, **Basis** to **Voronoi F1**, and **Size** to 2.00. Back in the **Displace** modifier panel, set the **Strength** to 0.300.
8. Assign a fifth **Displace** modifier. In the **Texture** window, assign a **Distorted Noise** texture. Set the **Noise Distortion** to **Voronoi F1**, Basis to **Improved Perlin**, **Distortion** to 2.000, and **Size** to 3.30. Back in the **Displace** modifier panel, set the **Strength** to 0.100 as shown in the following screenshot:

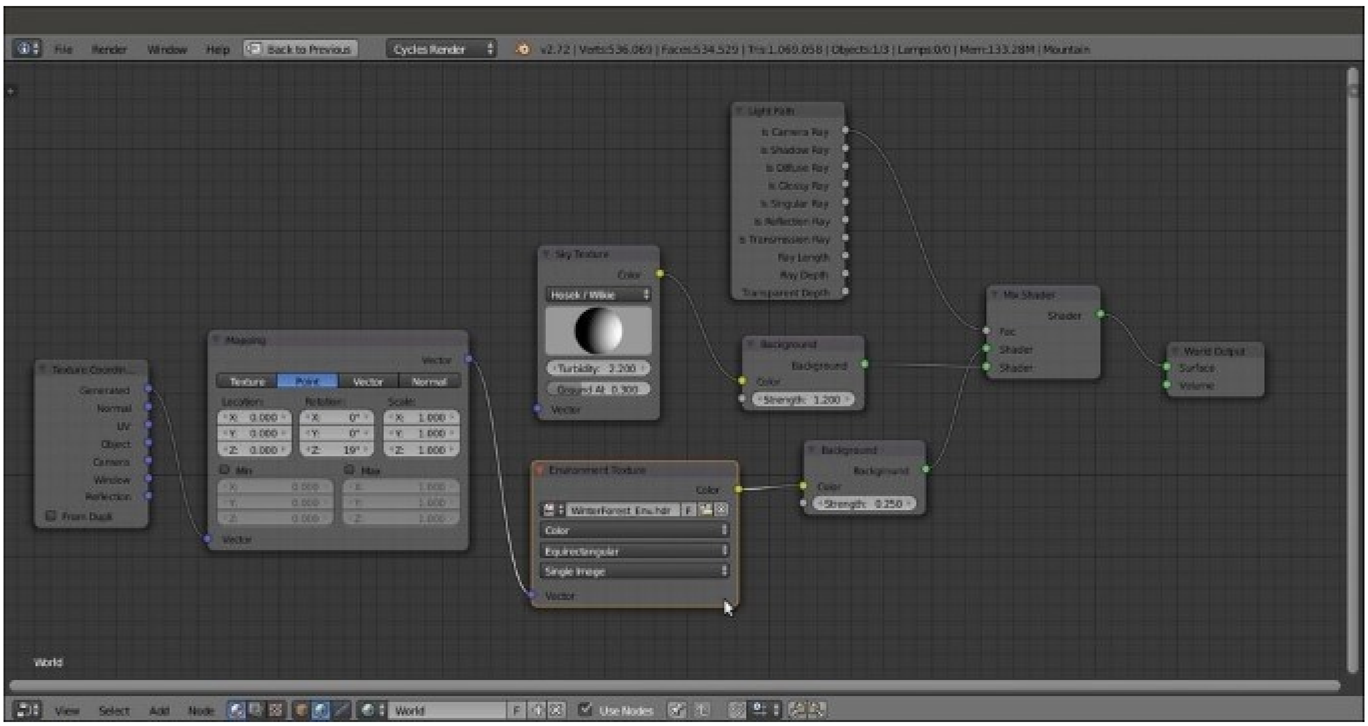


The mountain object obtained using different settings—without and with the several modifiers

9. Now disable the **Display** modifier in viewport button (the eye icon) of each modifier.
10. Go to the **World** window and click on the **Use Nodes** button. Then click on the little square with a dot on the right side of the **Color** slot. From the pop-up menu, select **Sky Texture**. On the **Background** node, set the **Strength** value to 1.200.
11. Add a **Mix Shader** node (press *Shift* + *A* and navigate to **Shader** | **Mix Shader**) and paste it between the **Background** and the **World Output** nodes. Switch the link of the **Background** node with the second input socket.
12. Add a **Texture Coordinate** node (press *Shift* + *A* and navigate to **Input** | **Texture Coordinate**), a **Mapping** node (press *Shift* + *A* and navigate to **Vector** | **Mapping**), an **Environment Texture** node (press *Shift* + *A* and navigate to **Texture** | **Environment Texture**), and a new **Background** node (press *Shift* + *A* and navigate to **Shader** | **Background**).
13. Connect the **Generated** output of the **Texture Coordinate** node to the **Vector** input socket of the **Mapping** node, and the output of this node to the **Vector** input socket of the **Environment**

Texture node. Connect the **Color** output of this node to the **Color** input socket of the second **Background** node.

14. Connect the output of the second **Background** node to the first input socket of the **Mix Shader** node, and set its **Strength** to `0.250`. Add a **Light Path** node (press *Shift* + *A* and navigate to **Input** | **Light Path**). Connect the **Is Camera Ray** output to the **Fac** input socket of the **Mix Shader** node.
15. Go to the **Environment Texture** node and click on the **Open** button. Browse to the `texture` folder and load the `WinterForest_Env.hdr` image (it's a free, high-dynamic-range image downloaded from the sIBL Archive at http://www.hdrlabs.com/sibl/archive.html, and licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License).
16. Go to the **Mapping** node and set the **Rotation** value of Z to `19°` as shown in the following screenshot:



The World network setting

17. Go to the **Render** window, and under the **Sampling** subpanel, set both the **Clamp Direct** and **Clamp Indirect** values to `1.00`. Set the **Samples** to `10` for **Preview** and `25` for **Render**. Under the **Light Paths** subpanel, disable both the **Reflective Caustics** and **Refractive Caustics** items and set the **Filter Glossy** to `1.00`.

How to do it...

We are going to create the scene and materials by dividing the process into four stages:

- Appending and grouping rock and snow shaders
- Mixing the material groups

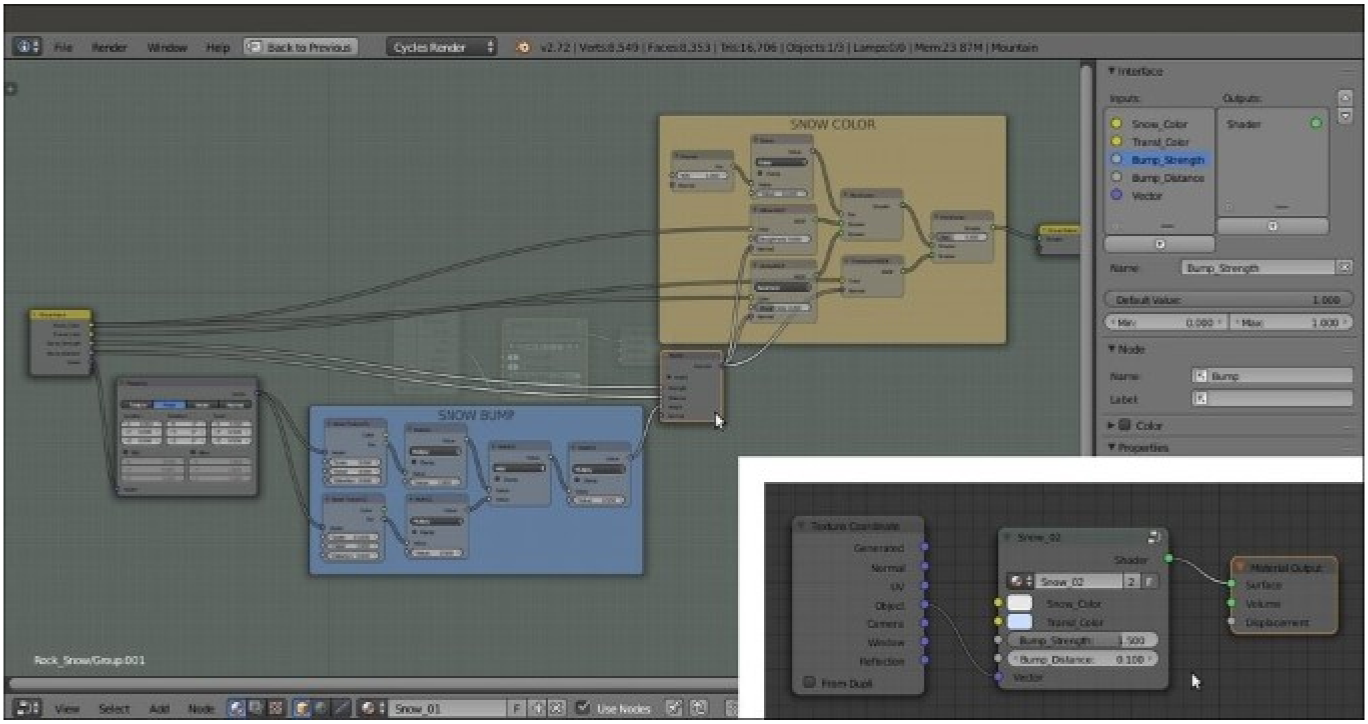
- Creating a stencil shader
- Adding an atmospheric perspective

So, let's start with the first stage.

Appending and grouping the rock and the snow shader

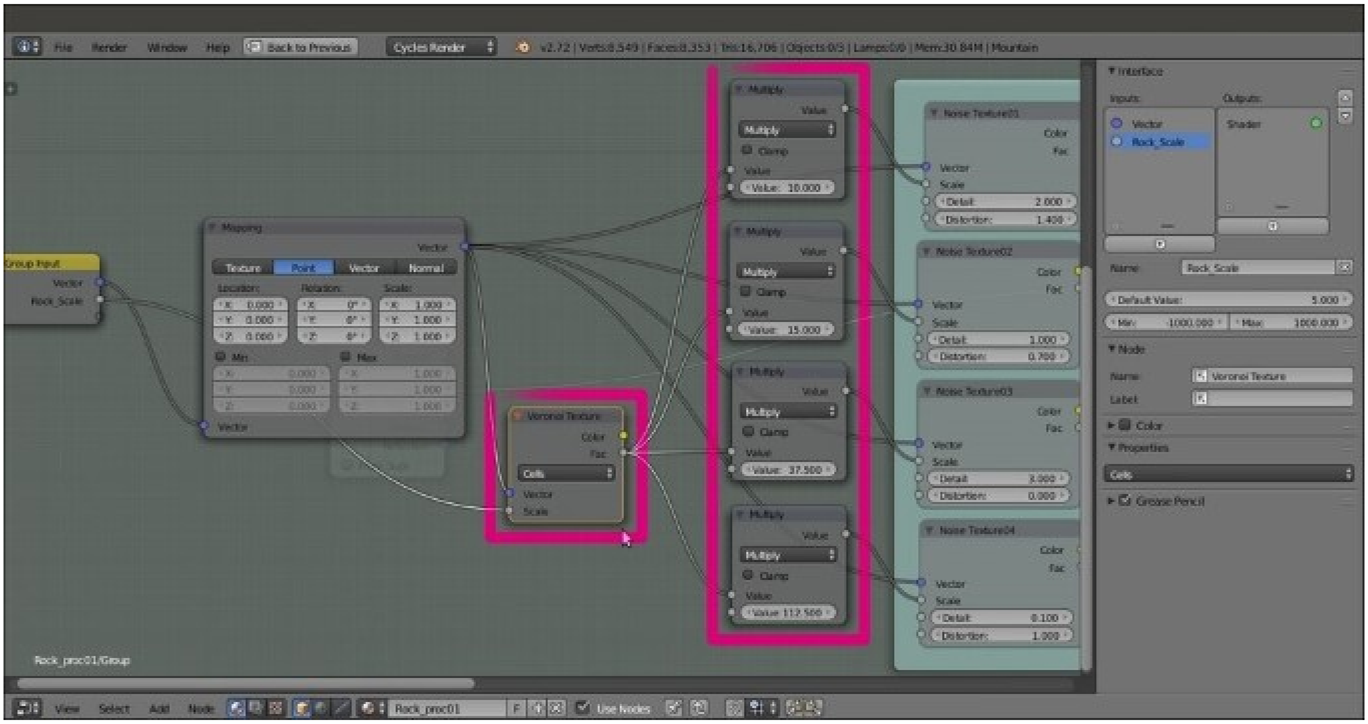
Let's append the required (and previously made) materials, and group them for convenience:

1. From the `9931OS_03_snow.blend` file, append the `Snow_01` material, and for now, assign it to the **Mountain** object.
2. In the **Node Editor** window, select all the nodes except **Texture Coordinates** and **Material Output**, and press *Ctrl* + *G* to group them.
3. Place the **SNOW_COLOR** frame to the right of the **SNOW_BUMP** frame. Select the **Group Output** node, and in the (press *N*) **Properties** panel of the **Node Editor** window, delete the **Value** output.
4. Add a **Bump** node (press *Shift* + *A* and navigate to **Vector** | **Bump**). Connect the **Value** output of the **Math04** node inside the **SNOW_BUMP** frame to the **Height** input socket of the **Bump** node. Then connect the **Normal** output of the **Bump** node to the **Normal** input sockets of the **Diffuse BSDF**, **Glossy BSDF**, and **Translucent BSDF** shaders inside the **SNOW_COLOR** frame.
5. Click on the **Strength** socket of the **Bump** node and drag it into the empty socket on the **Group Input** node. Rename the socket (automatically named Strength) as `Bump_Strength`. Repeat this step for the **Distance** socket and rename it as `Bump_Distance`.
6. Drag the **Color** input socket of the **Diffuse BSDF** node into the empty socket of the **Group Input** node. Move the new socket to the top of the list and rename it as `Snow_Color`. Drag the **Color** input of the **Glossy BSDF** shader node and connect it to the same **Snow_Color** socket.
7. Drag the **Color** input socket of the **Translucent BSDF** node into the empty socket of the **Group Input** node. Move the new socket upwards, just below the **Snow_Color** socket, and rename it as `Transl_Color`.
8. Move the **Vector** socket on the **Group Input** node to the bottom of the list, and close the group. Rename it as `Snow_02` and check the *fake user* option. Click on the **Bump_Strength** slider and type `1.500` as shown in the following screenshot:



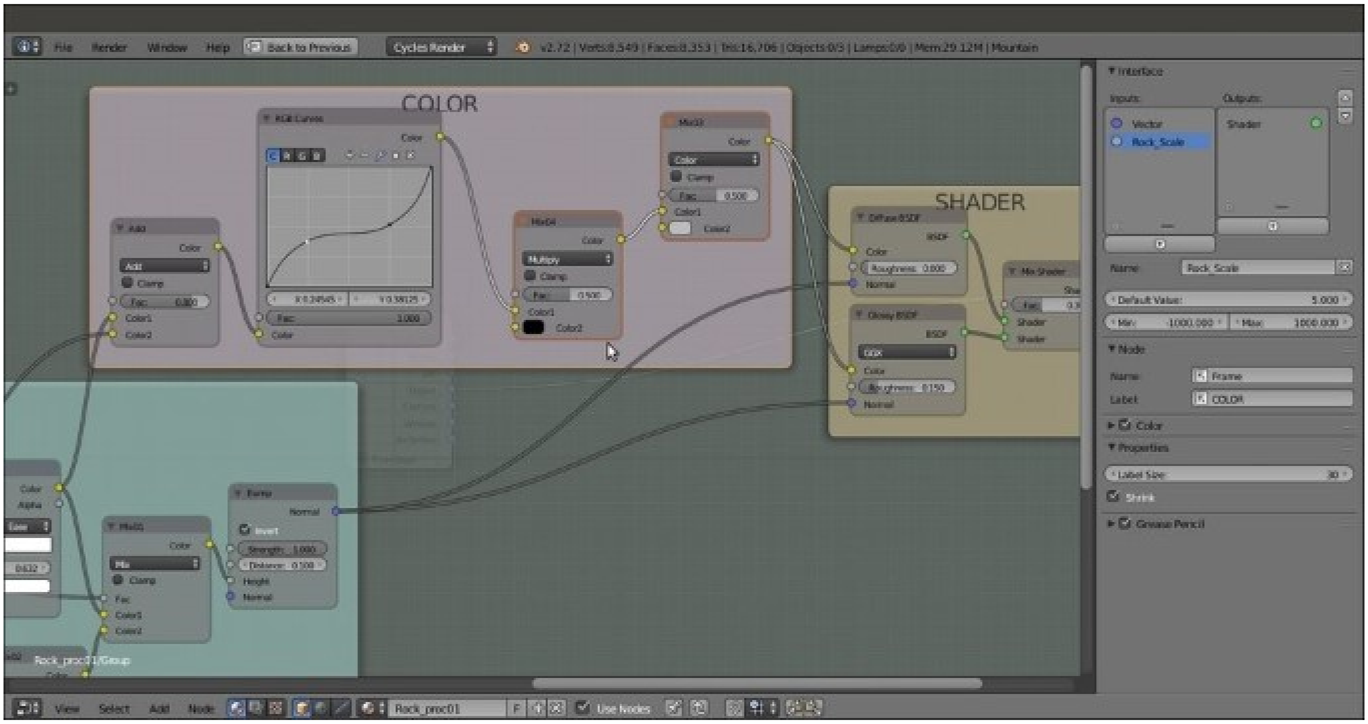
Making a node group of the appended snow material

9. From the `9931OS_03_Rock_procedurals.blend` file, append the `Rock_proc01` material. Go to the **Material** datablock button on the **Node Editor** toolbar and assign it to the **Mountain** object.
10. In the **Node Editor** window, select all the nodes except the **Texture Coordinates** and the **Material Output** nodes. Press *Ctrl* + *G* to group them. Set the **Location** values in the **Mapping** node to `0.000` for all the three axes.
11. Add a **Math** node (press *Shift* + *A* and navigate to **Converter** | **Math**). Set the **Operation** to **Multiply** and the first **Value** to `1.000`. Press *Shift* + *D* to duplicate it, and do this three times. Connect the **Value** outputs of each of the four **Multiply-Math** nodes to the **Scale** input sockets of the four **Noise Texture** nodes inside the **BUMP** frame.
12. Now, in the second **Value** slot of each **Multiply-Math** node, set `10.000` for **Noise Texture01**, `15.000` for **Noise Texture02**, `37.500` for **Noise Texture03**, and `112.500` for **Noise Texture04**.
13. Add a **Voronoi Texture** node (press *Shift* + *A* and navigate to **Texture** | **Voronoi Texture**), switch the **Coloring** to **Cells**, and connect its **Fac** output to the first **Value** input socket (the socket with value of `1.000`) of each of the four **Multiply-Math** nodes.
14. Connect the **Voronoi Texture** node's **Vector** input socket to the **Vector** output of the **Mapping** node and drag the link from its **Scale** input socket to the empty socket of the **Group Input** node. Rename the new socket as `Rock_Scale` as shown in the following screenshot:



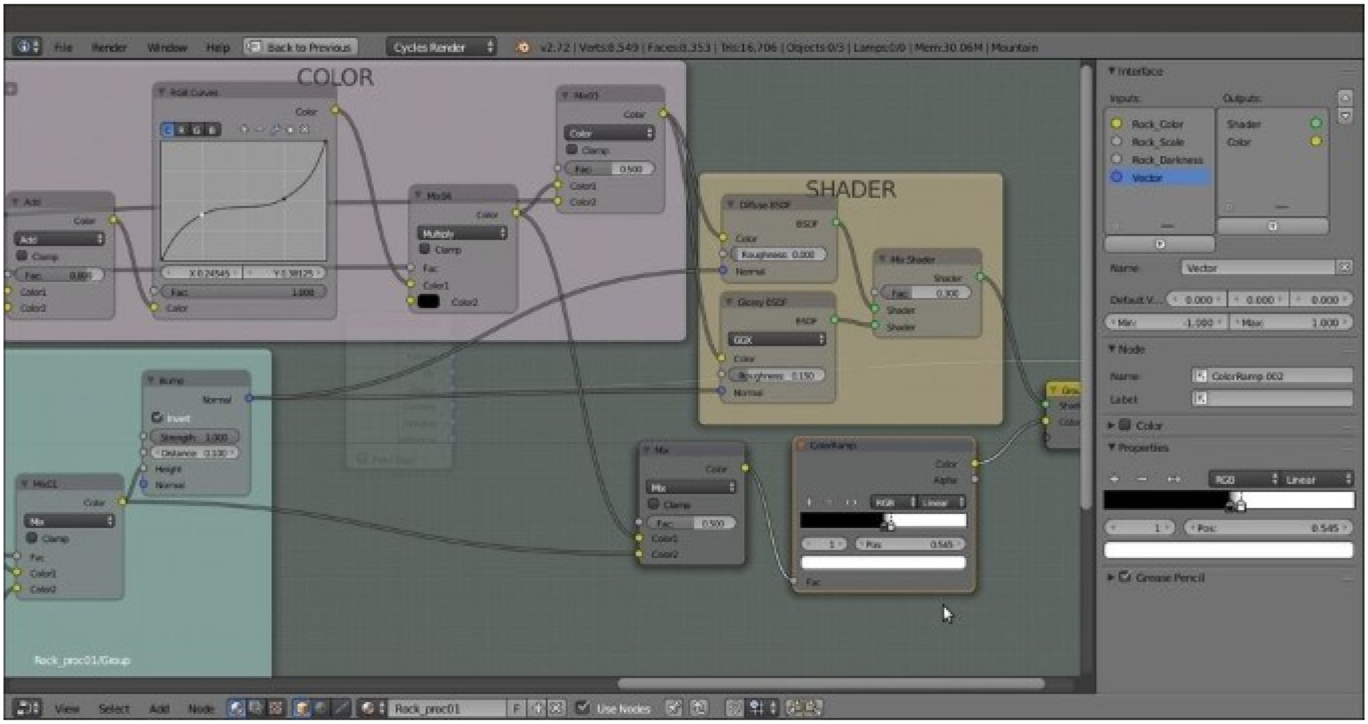
Adding Math nodes to tweak the exposed scale values of the textures for the procedural rock material

15. Now go to the **COLOR** frame and delete the **RGB** node. Then select the **Mix03** node and press *Ctrl* + *X* to delete it, maintaining the connection of the **Darken** node to the **Color2** socket of the **Add** node.
16. Add a **MixRGB** node (press *Shift* + *A* and navigate to **Color** | **MixRGB**), label it as `Mix03` again, and paste it between the **RGB Curves** node and the **Diffuse BSDF** shader. Set the **Blend Type** to **Color** and connect its output to the **Color** input socket of the **Glossy BSDF** shader.
17. Press *Shift* + *D* to duplicate the **Mix03** node. Label the duplicate as `Mix04` and paste it between the **RGB Curves** and the **Mix03** nodes. Set its **Blend Type** to **Multiply** and the **Color2** to pure black. Then select both the **Mix03** and **Mix04** nodes and parent them to the **COLOR** frame as shown in the following screenshot:



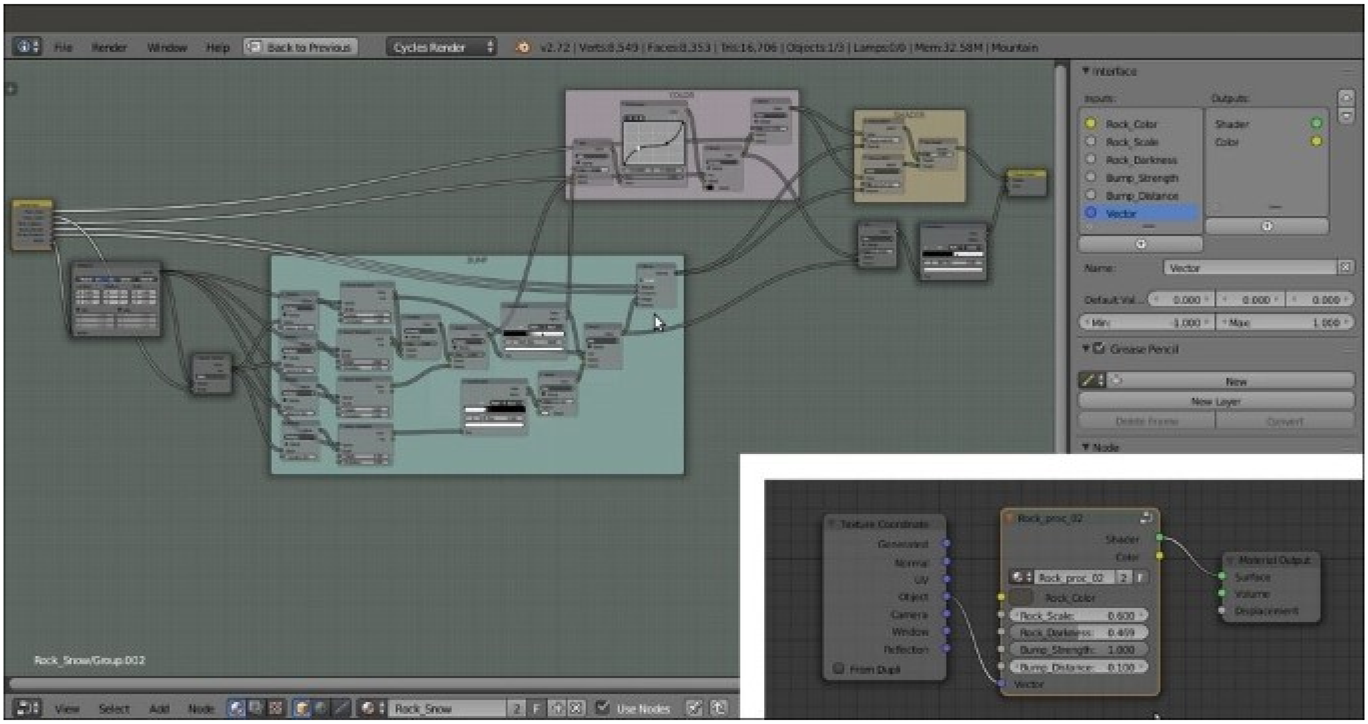
Adding color variations to the rock material

18. Click on the **Color2** input socket of the **Mix03** node. Drag it to the empty socket of the **Group Input** node. Move the new socket to the top of the list and rename it as `Rock_Color`.
19. Repeat the preceding step with the **Fac** socket of the **Mix04** node, and rename the new socket as `Rock_Darkness`. Move the **Vector** socket on the **Group Input** node to the bottom of the list.
20. Add a new **MixRGB** node (press *Shift* + *A* and navigate to **Color** | **MixRGB**) and a **ColorRamp** node (press *Shift* + *A* and navigate to **Converter** | **ColorRamp**). Connect the **Color** output of the **Mix03** node to the **Color1** input socket of the new **MixRGB** node, and the **Color** output of **Mix01** to the **Color2** input socket.
21. Connect the **Color** output of the new **MixRGB** node to the **Fac** input socket of the **ColorRamp** node. Then connect the **Color** output of this node to the empty socket of the **Group Output** node. Go to **ColorRamp** and set the position of the black color stop to `0.500` and the position of the white color stop to `0.545` as shown in the following screenshot:



Creating a Color output in the node group to be used later to detail the stencil effect

22. Drag the **Strength** and the **Distance** sockets of the **Bump** node to the **Group Input** node, and rename them as `Bump_Strength` and `Bump_Distance`, respectively. Move the **Vector** socket to the bottom. Press *Tab* to exit **Edit Mode**.
23. Rename the group as `Rock_proc_02`, and enable the *fake user*. Set the **Rock_Color** values for **R** `0.078`, **G** to `0.067`, and **B** to `0.056`; the **Rock_Scale** to `0.600`; and the **Rock_Darkness** to `0.469` as shown in the following screenshot:

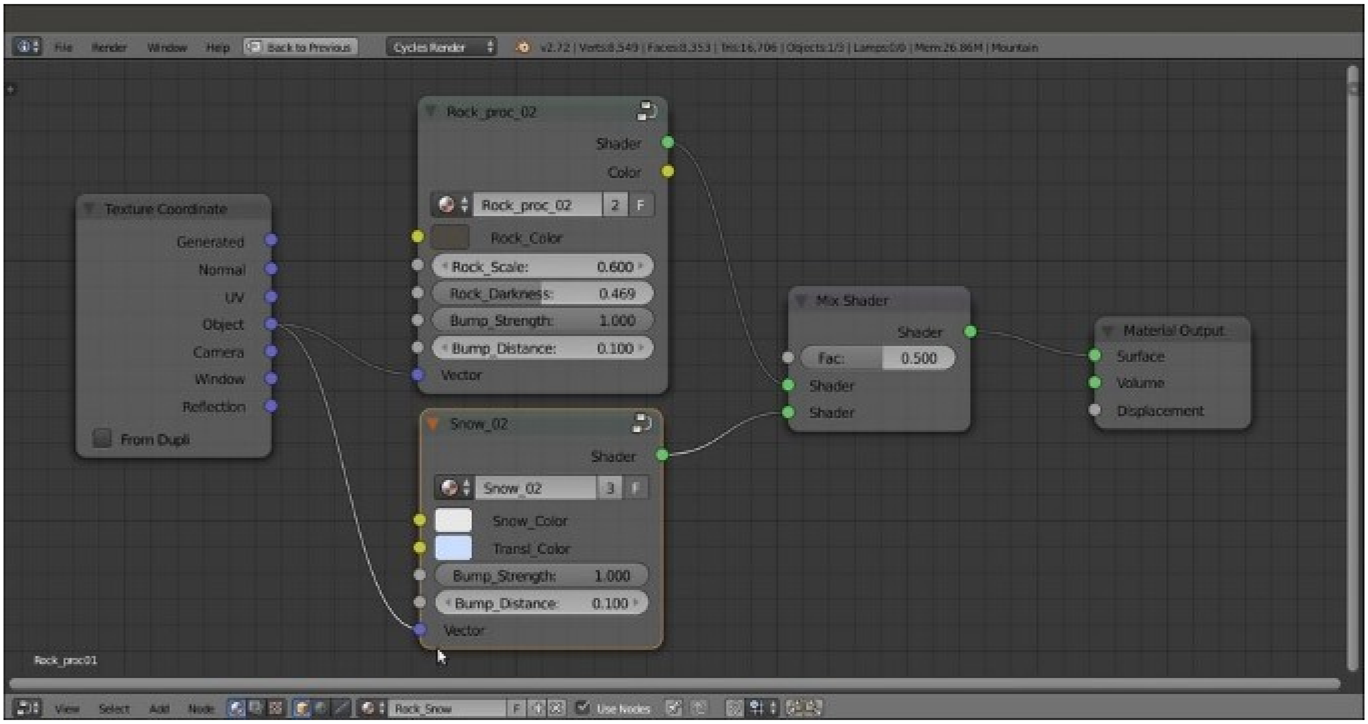


The overall view of the procedural rock node group in Edit Mode

Mixing the material groups

Now we can start to build the real shader by mixing the procedural rock and snow materials:

1. Press *Shift* + *A* with the mouse in the **Node Editor** window and add the **Snow_02** group node (press *Shift* + *A* and navigate to **Group** | **Snow_02**). Then rename the material as `Rock_Snow` in the **Node Editor** toolbar.
2. Add a **Mix Shader** node (press *Shift* + *A* and navigate to **Shader** | **Mix Shader**) and paste it between the **Rock_proc_02** group node and the **Material Output** node. Connect the **Shader** output of the **Snow_02** group node to the second **Shader** input socket of the **Mix Shader** node.
3. Connect the **Object** output of the **Texture Coordinate** node to the **Vector** input socket of the **Snow_02** group node as shown in the following screenshot:



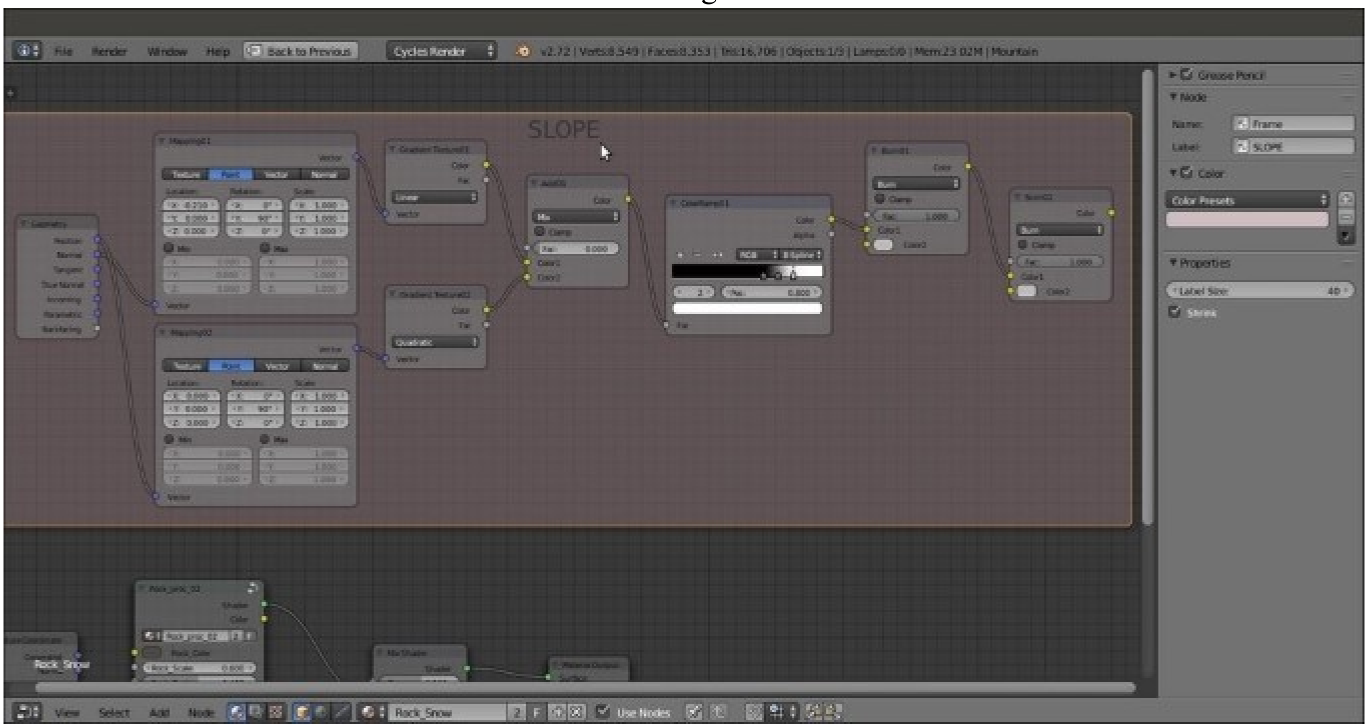
Starting to build the snowy rock mountain material

Creating the stencil shader

At this point, both the materials are assigned to the **Mountain** object, but if you render the preview now, they will appear on the whole mesh surface as a mixture of rock and snow. We must build a separator to establish where the surface will show only the rock and where it will show only the snow:

1. Add a **Geometry** node (press *Shift* + *A* and navigate to **Input** | **Geometry**), two **Mapping** nodes (press *Shift* + *A* and navigate to **Vector** | **Mapping**), two **Gradient Texture** nodes (press *Shift* + *A* and navigate to **Texture** | **Gradient Texture**), and a **ColorRamp** node (press *Shift* + *A* and navigate to **Converter** | **ColorRamp**).
2. In the **Properties** panel of the **Node Editor**, label these four nodes as follows: `Mapping01`, `Mapping02`, `Gradient Texture01`, `Gradient Texture02`, and `ColorRamp01`. Connect the **Normal** output of the **Geometry** node to the **Vector** input socket of the **Mapping01** node and the **Position** output to the **Mapping02** node. Then connect the **Mapping01** node to the **Gradient Texture01** node and the **Mapping02** node to the **Gradient Texture02** node.
3. Leave the **Gradient Type** of the **Gradient Texture01** node as **Linear** and set the **Gradient Type** of the **Gradient Texture02** to **Quadratic**. In the **Mapping01** node, set the **Location** value of **X** as `-0.210` and the **Rotation** value of **Y** as `90°`. In the **Mapping02** node, set only the **Rotation** value of **Y** as `90°`.
4. Add three **MixRGB** nodes (press *Shift* + *A* and navigate to **Color** | **MixRGB**). Set the **Fac** of the first one to `0.000` and label it as `Add01`. Then connect the **Color** outputs of both the **Gradient Texture** nodes to the **Color1** and to the **Color2** input sockets.

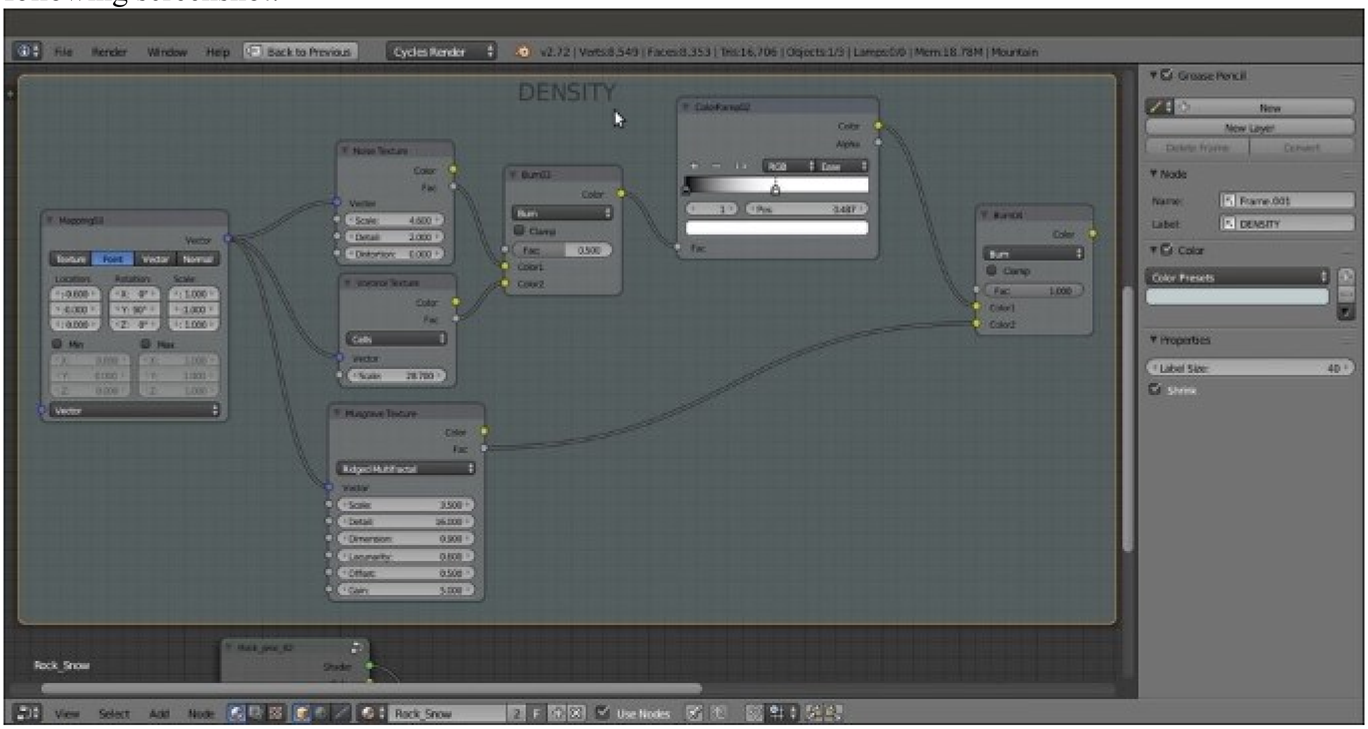
5. Connect the output of the **Add01** node to the **Fac** input socket of the **ColorRamp01** node. Then set its **Interpolation** to **B-Spline** and move the black color stop to `0.600` position. Add a new color stop, set the color to pure black, and move it to the `0.700` position. Then move the position of the white color stop to `0.800`.
6. Label the other two **MixRGB** nodes as **Burn01** and **Burn02**. Connect the **Color** output of the **ColorRamp01** node to the **Color1** input socket of the **Burn01** node, and the **Color** output of this node to the **Color1** input of the **Burn02** node. Set the **Blend Type** for both the nodes to **Burn**.
7. Add a **Frame** (press *Shift* + *A* and navigate to **Layout** | **Frame**) and parent all of these nodes to it. Label the frame as `SLOPE` as shown in the following screenshot:



The SLOPE frame

8. Now press *Shift* + *D* to duplicate one of the **Mapping** nodes (press *Alt* + *P* to unparent it from the frame), and move it to under the **SLOPE** frame. Label it as `Mapping03` and change the **Location** value of **X** to `-0.600`.
9. Add a **Noise Texture**, a **Voronoi Texture**, and a **Musgrave Texture** node (press *Shift* + *A* and navigate to **Texture** | **Noise Texture**, repeat the same for all other nodes) and place them in a column next to the **Mapping03** node. Set the **Noise Texture** node's **Scale** value to `4.600`. Set the **Voronoi Texture** node's **Coloring** to **Cell** and the **Scale** to `28.700`. Set the **Musgrave Texture** node's type to **Ridged Multifractal**, the **Scale** to `3.500`, **Detail** to `16.000`, **Dimension** to `0.900`, **Lacunarity** to `0.600`, **Offset** to `0.500`, and **Gain** to `5.000`.
10. Connect the **Vector** output of the **Mapping03** node to the **Vector** inputs of the three textures. Then add a **MixRGB** node (press *Shift* + *A* and navigate to **Color** | **MixRGB**), set the **Blend Type** to **Burn**, and label it as `Burn03`.

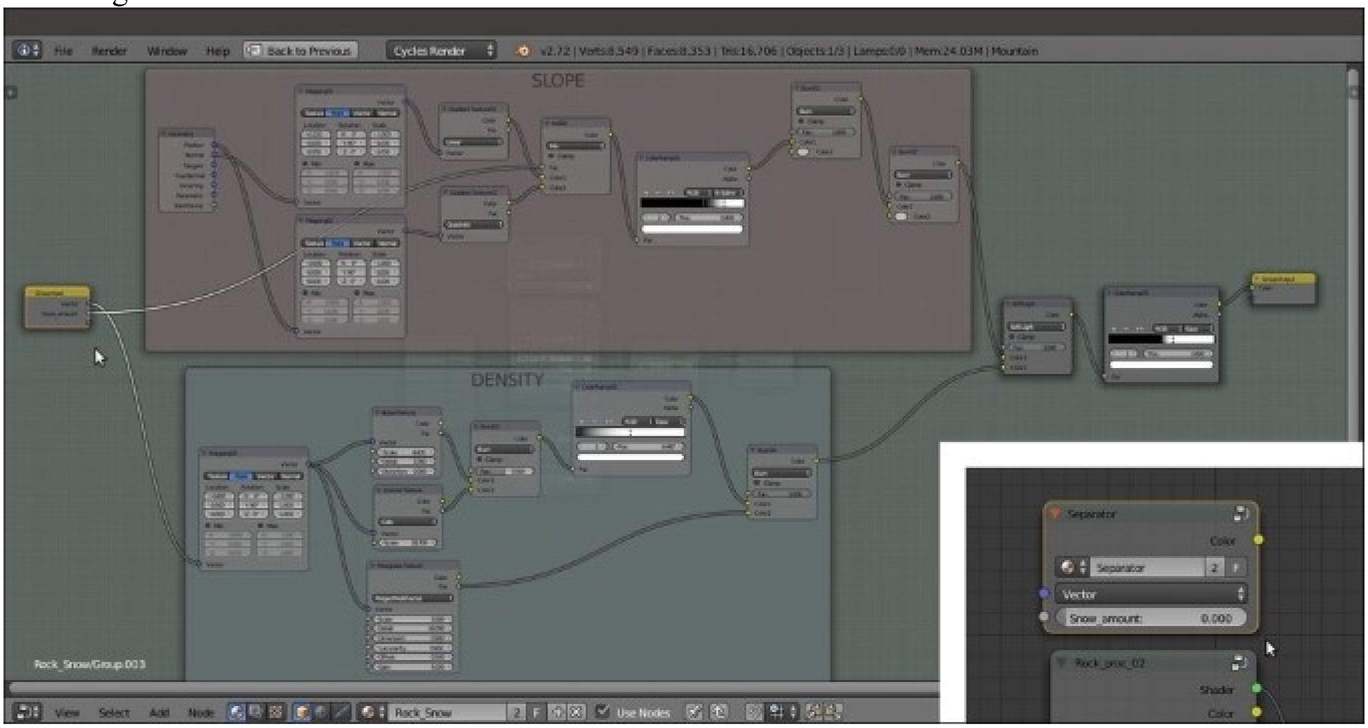
11. Connect the **Fac** outputs of the **Noise Texture** and **Voronoi Texture** nodes to the **Color1** and **Color2** input sockets of the **Burn03** node. Press *Shift* + *D* to duplicate the **Burn03** node, label it as `Burn04`, and set its **Fac** value to `1.000`. Connect the **Color** output of the **Burn03** node to the **Color1** input socket of the **Burn04** node. Then connect the **Fac** output of the **Musgrave Texture** node to its **Color2** input socket.
12. Add a **ColorRamp** node (press *Shift* + *A* and navigate to **Converter** | **ColorRamp**), label it as `ColorRamp02`, and paste it between the **Burn03** and the **Burn04** nodes. Set **Interpolation** to **Ease** and move the white color marker to the `0.487` position.
13. Add a **Frame** (press *Shift* + *A* and navigate to **Layout** | **Frame**), select all of these nodes and then the frame, and press *Ctrl* + *P* to parent them. Label the frame as `DENSITY` as shown in the following screenshot:



The DENSITY frame

14. Box-select the two frames (with all the nodes inside) and press *Ctrl* + *G* to create a group. Add a **MixRGB** node (press *Shift* + *A* and navigate to **Color** | **MixRGB**), set the **Blend Type** to **Soft Light**, and set the **Fac** value to `1.000`. Connect the **Color** output of the **Burn02** node inside the **SLOPE** frame to the **Color1** input socket. Then connect the **Color** output of the last **Burn04** node inside the **DENSITY** frame to the **Color2** input socket.
15. Drag the **Color** output of the **Soft Light** node into the empty socket of the **Group Output** node to create a new **Color** output on the interface. Then add a new **ColorRamp** (press *Shift* + *A* and navigate to **Converter** | **ColorRamp**), label it as `ColorRamp04`, and paste it between the **Soft Light** and the **Group Output** nodes. Set **Interpolation** to **Ease**, the black color stop to the `0.500` position, and the white color stop to the `0.600` position.
16. Go to the **SLOPE** frame. Click and drag the **Fac** socket of the **Add01** node to the empty socket of the **Input Group** node. Rename the new input as `Snow_amount`.

17. Go to the **DENSITY** frame and attach the **Vector** input of the **Mapping03** node to the empty socket of the **Input Group** node. Move it up by clicking on the little arrow icon in the **Properties** panel, and press *Tab* to close the group. Rename it as `Separator` as shown in the following screenshot:

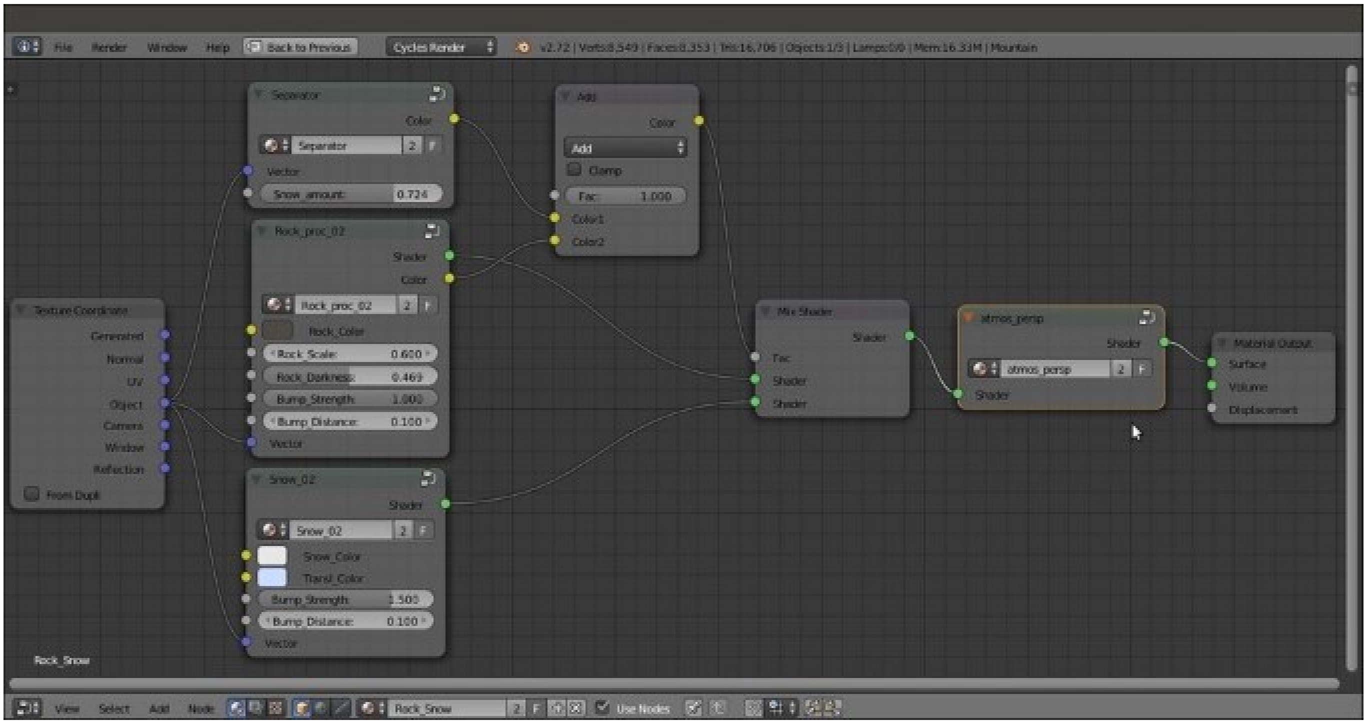


The outputs of the SLOPE and DENSITY frames added inside the Separator node group

18. Connect the **Object** output of the **Texture Coordinate** node to the **Vector** input socket of the **Separator** node group. For the rendering of the image at the beginning of this recipe, I've set the **Snow_amount** value to `0.724`.
19. Add one more **MixRGB** node (press *Shift* + *A* and navigate to **Color** | **MixRGB**), set the **Blend Type** to **Add**, and connect the **Color** output of the **Separator** group node to the **Color1** input socket. Then connect the **Color** output of the **Rock_proc_02** group node to the **Color2** input socket. Set the **Fac** value to `1.000` and connect the **Color** output to the **Fac** input socket of the **Mix Shader** node.

Adding the atmospheric perspective

The final step we can do to improve our material is to append the **Fog_underwater** node group, from the `9931OS_05_underwater_final.blend` file located in **Nodetree**. Rename this node `Atmos_persp` and paste it just before the **Material Output** node. Then press *Tab* to open the group by entering **Edit Mode**. Set the **Multiply** node value to `0.010` and the color values of the **Emission** shader for **R** to `0.078`, **G** to `0.133`, and **B** to `0.250` as shown in the following screenshot:



The overall network and the atmospheric perspective node group added at the end of the shader. Note the Color output of the Rock material added to the output of the Separator to work as stencil or blending factor.

How it works...

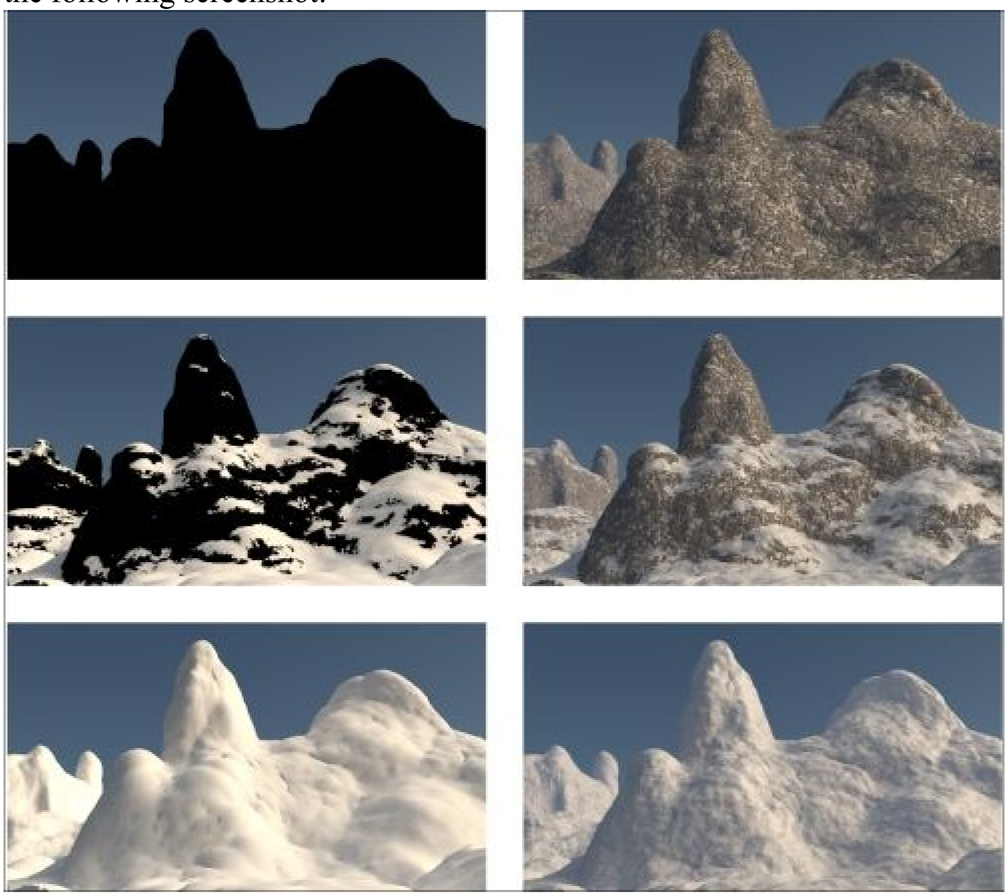
Now let's see how this material actually works, by dividing the creation's process into three parts:

- Firstly, we appended the `Snow` material and made a group, exposing the required properties and changing the way the bump works. In other words, we deleted the output to the **Displacement** input of the **Material Output** node and implemented a per shader bump.

  This doesn't really make a big difference in the final rendering. Just be aware that a bump piped in the **Displacement** socket can react to Ambient Occlusion (which we didn't use in the scene, by the way), but this is not true with the per shader bump.
- Secondly, we appended the `Rock_procedural` material and made a group of it as well. Again, all the necessary values were exposed, and although we kept the material unaltered in this scene, the group could now be easily reused for different kinds of rock in other projects or on different objects.

  We added a **Math** node set to **Multiply** for every texture **Scale** value that needed to be driven by one single exposed input. The first **Value** of the **Math** node, set to the original scale value, gets multiplied by the driven second **Value**, thus increasing or decreasing (for values smaller than `1.000`) the final scale value.

- Thirdly, we built `Separator`, a node group outputting gray-scale values that are connected to the **Fac** input of the **Mix Shader** node, which works as a stencil map, separating the two different materials on the mesh surface accordingly to black and white values. The two gradient textures in the **SLOPE** frame, mapped on the position and the normals of the mesh and then blended together by the **Burn** nodes, make the snow material (the white color value of the stencil map) appear more on the mesh's faces that have more a horizontal trend than a vertical one. Thanks to the **Add01** node, mixing the gradients driven by the exposed input **Snow_amount** and influencing the gradient of the **ColorRamp01** node, it's also possible to set the quantity of snow (the white color in the stencil) on the whole object. The mixed textures in the **DENSITY** frame make the separation line between black and white more frayed and realistic, and so also the **Color** output of the **Separator** group that is added to a **Color** output of the **Rock** shader just before being connected to the **Fac** input of the **Mix Shader**. Have a look at the following screenshot:



The only mask and the Rendered versions of three different values of the Snow_amount slider

In the preceding set of screenshots, you can see the different effects of the `0.000`, `0.700`, and `1.000` values of the **Snow_amount** slider. The black-and-white mask works as a separator between the rock and the snow materials.

Creating a realistic Earth as seen from space

In this recipe, we will create a realistic Earth as shown in the following screenshot, using both image textures from the Web and some procedurals:

The Earth as it appears in the final rendering

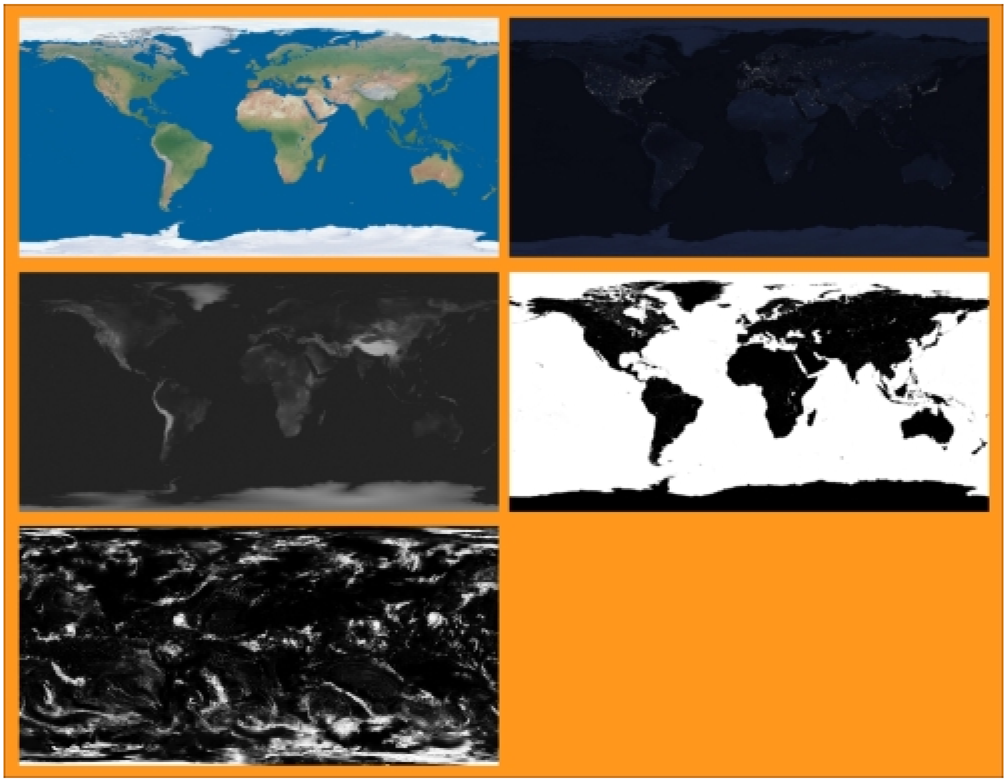
Getting ready

The image textures provided with this Cookbook have generally been heavily down-scaled and are good for demonstration purposes only (in this case, for a very distant Earth render). For better results with this recipe, replace these low-resolution images with high-resolution versions that you can find at these addresses:

- http://www.shadedrelief.com/natural3/pages/textures.html
- http://www.shadedrelief.com/natural3/pages/clouds.html
- http://celestia.h-schmidt.net/earth-vt/
- http://www.celestiamotherlode.net/catalog/earth.php

Before you download anything, always take a look at the license of the images provided by any site you can find to ensure that they are released as freely usable, especially if you are going to use them for commercial work. All the preceding links should be okay, but on the Internet, things can change quite quickly, so double-check!

You will need at least five image maps for this recipe: Earth-color, the color of the land or sea in daylight; Earth-night, the color of the land or sea at night (usually provided with superimposed city lights); Earth-bump, a gray-scale, high map of the continents; Earth-spec, an outline with the continents in black and the water masses perfectly white; and Clouds, a gray-scale map of the clouds as shown in the following screenshot:



The five image textures

Actually, Cycles can handle very big textures pretty well, even 16 K images (that is, images made by 16.000 pixels for the longest side), so you can use them at the best resolution you can find. Be aware that the bigger the resolution of the textures, the longer the rendering times, especially if they are used as bump maps.

Now perform the following steps:

1. Start Blender and switch to the Cycles Render engine.
2. Delete the default **Cube** and add a **UV Sphere** (with the mouse arrow in the 3D view, press *Shift* + *A* and navigate to **Mesh** | **UV Sphere**). In the **Outliner**, rename it as `Earth_Surface`.
3. With the mouse arrow in the **Camera** view, press the *1* key on the numeric keypad to go to the **Front** view. Then press the *5* key to switch to **Orthogonal**. Next, press *Tab* to enter **Edit Mode**, followed by *A* to select all the vertices. Finally, press *U*. In the **UV Mapping** pop-up menu, select **Sphere Projection**. Then exit **Edit Mode**.
4. Make sure you place the 3D Cursor at the center of the **UV Sphere**. Then add an **Empty** (press *Shift* + *A* and navigate to **Empty** | **Arrows**). In the **Object data** window, set its **Size** to `2.00` and rename it as `Empty_terminator`. Go to the **Object Constraints** window and assign a **Damped Track** constraint to the **Empty_terminator**. In the **Target** field, select the **Sun** item (the Lamp), and in the **To** field, click on the **X** button.

5. Reselect the **UV Sphere** and go to the **UV Maps** subpanel under the **Object data** window. Click on the + icon button to add a new UV coordinates layer. Rename it as `UVMap_terminator`.
6. Go to the **Object modifiers** window and assign a **Subdivision Surface** modifier first, followed by a **UVProject** modifier. For this modifier, in the **UV Map** field, select the **UVMap_terminator** item. In the **Object to use as projector transform** field, select the **Empty_terminator**.
7. Press *Shift* + *D* and press *Enter* to duplicate the **Earth_Surface** object. In the **Transform** subpanel under the **Properties** panel to the right (press *N* if this is not activated), set the **Scale** value for **X**, **Y**, and **Z** to `1.001`. Rename it as `Earth_Clouds`.
8. Duplicate it again, set the **Scale** value to `1.002`, and rename it as `Earth_Atmosphere`.
9. Add a new **Empty** (press *Shift* + *A* and navigate to **Empty** | **Plain Axes**) and rename it as `Empty_Earth`. In the **Object data** window, set its **Size** to `2.00`. Press *Shift* and select the **Earth_Surface**, **Earth_Clouds**, **Earth_Atmosphere**, and the **Empty_Earth** objects. Press *Ctrl* + *P* and click on **Object** to parent the three UV Spheres to **Empty_Earth**.
10. Select **Empty_Earth**, and in the **Transform** panel, set the **Rotation** values of **X** to `18.387°`, **Y** to `0.925°`, and **Z** to `-4.122°` (you can obviously rotate the **Empty_Earth** as you wish, but this helps provide a nice point of view on the specular effect showing on the oceans).
11. Select the **Camera**, and in the **Transform** panel, set the **Location** values of **X** to `-0.64000`, **Y** to `-4.70000`, and **Z** to `0.12000`. Then set the **Rotation** values of **X** to `89°`, **Y** to `0°`, and **Z** to `-9°`. Go to the **Object data** window and change the **Focal Length** to `60.000` (millimeters). Press the *0* key on the numeric keypad to go to the **Camera** view.
12. Go to the **World** window and change the background **Color** to pure black.
13. Select the **Lamp** and change it to a **Sun**. Set the **Size** to `0.050` and the **Strength** to `10.000`. Set the **Color** values for **R** to `1.000`, **G** to `0.902`, and **B** to `0.679`. In the **Transform** panel, set the **Location** values of **X** to `158.00000`, **Y** to `-27.00000`, and **Z** to `107.00000`. For **Rotation**, set **X** to `1.5°`, **Y** to `56°`, and **Z** to `-8°` (Sun lamps don't need a location, but in this case, we need it to establish a target for a later-to-come day/night terminator trick).
14. Go to the **Render** window. Under the **Sampling** subpanel, set the **Clamp Direct** and **Clamp Indirect** values to `1.00`, the **Preview** samples to `20`, and the **Render** samples to `50`.
15. Go to the **Scene** window. In the **Color Management** subpanel, click on the **Use Curves** item. Set the **Exposure** value to `1.000`. Then click inside the curve window to add a new point, and place it at position **X** as `0.61149` and **Y** as `0.71250`. Then set the value of the **B** channel for the **White Level** between `0.800` and `0.850`.

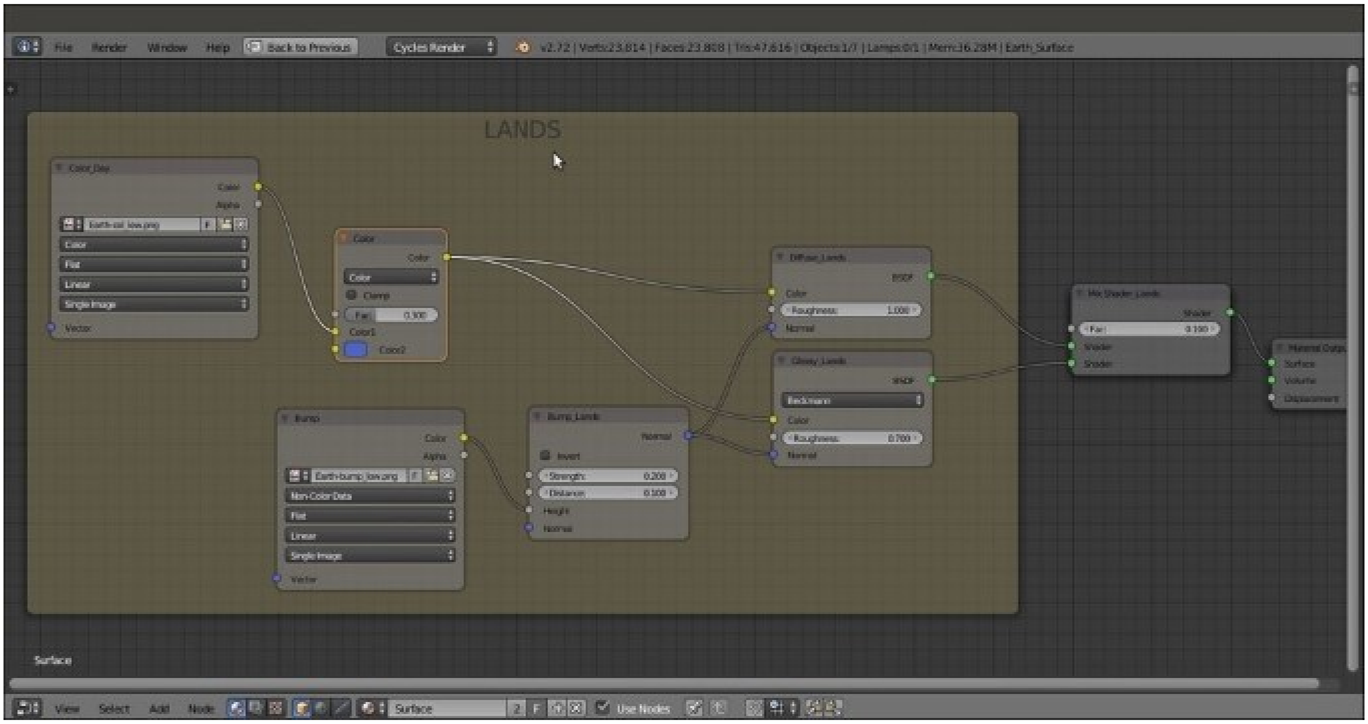
How to do it...

After the creation of the 3D scene and the setting of the lighting, let's go for the materials, starting with the planet's surface.

The planet surface

In the **Outliner** (just temporarily), hide the **Earth_Clouds** and **Earth_Atmosphere** objects by clicking on the little eye icons to the right side of the names. This is to see only the **Earth_Surface** in the viewport, rendered and updated in real time as we work on the material:

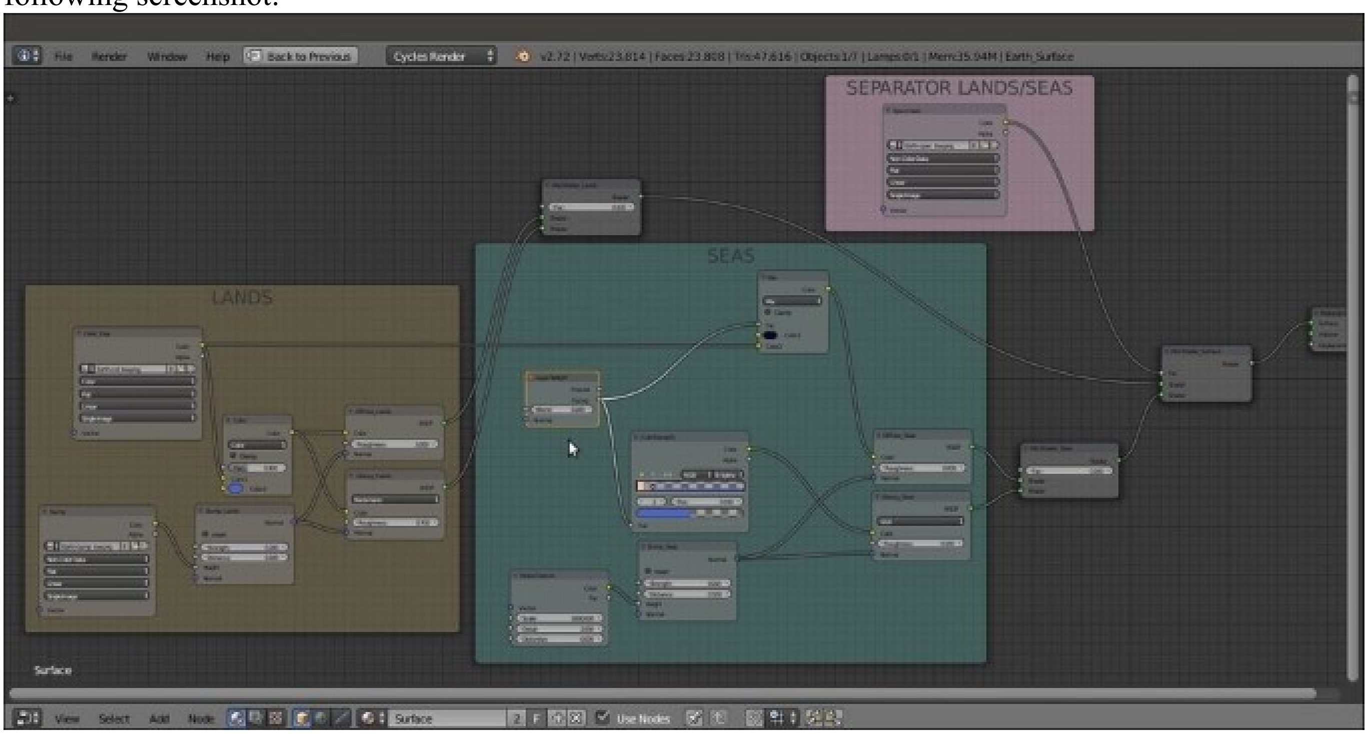
1. Select the **Earth_Surface** object. Click on the **New** button in the **Material** window under the **Properties** panel or in the **Node Editor** toolbar. Rename the material as `Surface`.
2. In the **Material** window under the main **Properties** panel, switch the **Diffuse BSDF** shader with a **Mix Shader** node. In the first **Shader** slot, load a new **Diffuse BSDF** shader and set its **Roughness** value to `1.000`. In the second **Shader** slot, load a **Glossy BSDF** node. Then set its **Roughness** value to `0.700` and **Distribution** to **Beckmann**. Set the **Fac** value of the **Mix Shader** to `0.100`.
3. Press *N* in the **Node Editor** window to open the **Active Node** panel. Label the shaders as `Diffuse_Lands` and `Glossy_Lands` and the **Mix Shader** as `Mix Shader_Lands`.
4. Add an **Image Texture** node (press *Shift* + *A* and navigate to **Texture** | **Image Texture**) and connect its **Color** output to both the **Color** input sockets of the **Diffuse_Lands** and **Glossy_Lands** shaders. Click on the **Open** button on the **Image Texture** node, browse to your `textures` directory, and load the `Earth-col_low.png` image (or a high-resolution version, if available). Label the image node as `Color_Day`.
5. Add a new **Image Texture** node (press *Shift* + *A* and navigate to **Texture** | **Image Texture**) and a **Bump** node (press *Shift* + *A* and navigate to **Vector** | **Bump**). Connect the **Color** output of this **Image Texture** node to the **Height** input socket of the **Bump** node. Then connect the **Normal** output of the **Bump** node to the **Normal** input sockets of both the **Diffuse_Lands** and the **Glossy_Lands** nodes.
6. Label the second **Image Texture** node as `Bump`. Then click on its **Open** button and load the `Earth-bump_low.png` image. Set the **Color Space** to **Non-Color Data**. Label the **Bump** node as `Bump_Lands` and set the **Strength** value to `0.020`.
7. Add a **MixRGB** node (press *Shift* + *A* and navigate to **Color** | **MixRGB**) and paste it between the **Color_Day** and the **Diffuse_Lands** nodes. Set the **Blend Type** to **Color**, the **Fac** value to `0.300`, and the **Color2** value for **R** to `0.072`, **G** to `0.127`, and **B** to `0.578`.
8. Add a **Frame** (press *Shift* + *A* and navigate to **Layout** | **Frame**). Press *Shift* and select the two image texture nodes (**Color_Day** and **Bump**), the **Color** node, **Bump_Lands** node, **Diffuse_Lands** and **Glossy_Lands** shaders, and then the **Frame**. Press *Ctrl* + *P* to parent them. Label the **Frame** as `LANDS` as shown in the following screenshot:



The LANDS frame

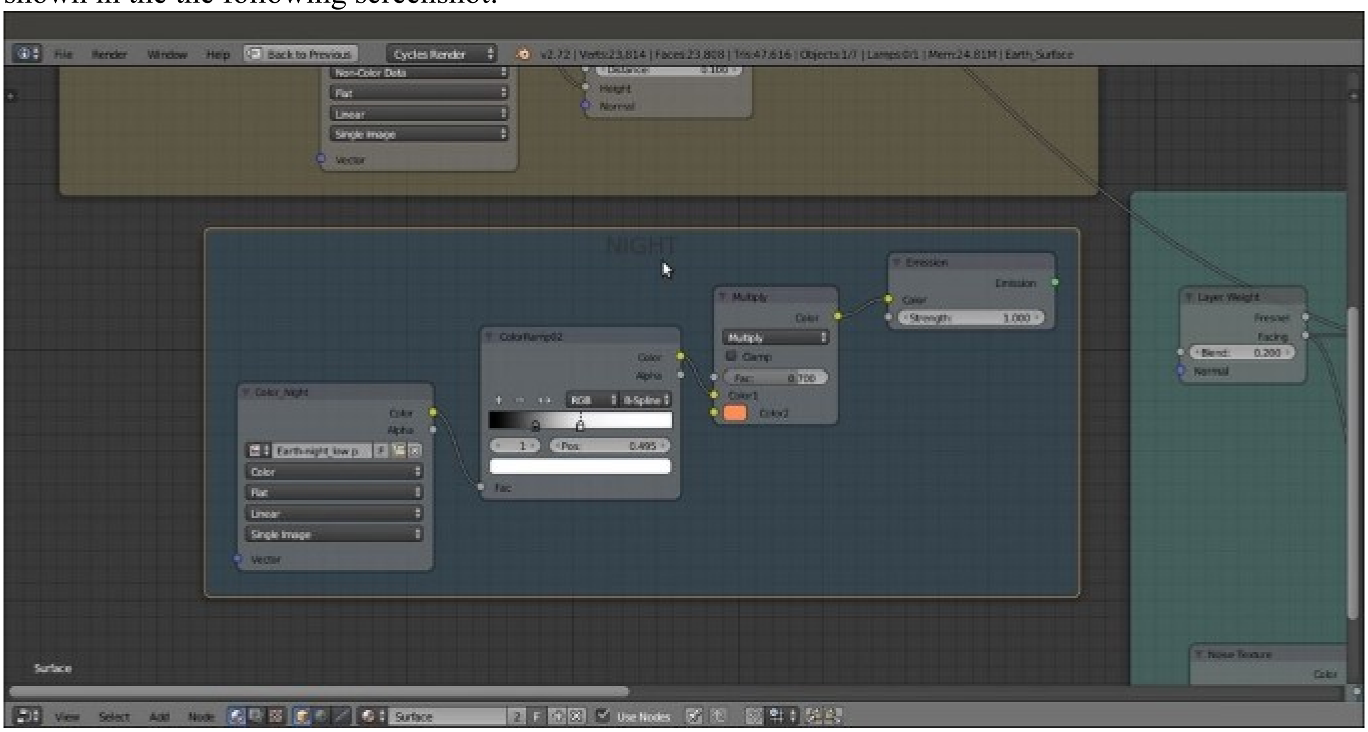
9. Now add a **Noise Texture** node (press *Shift* + *A* and navigate to **Texture** | **Noise Texture**), a **Bump** node (press *Shift* + *A* and navigate to **Vector** | **Bump**), a **Diffuse BSDF** shader (press *Shift* + *A* and navigate to **Shader** | **Diffuse BSDF**), and a **Glossy BSDF** shader (press *Shift* + *A* and navigate to **Shader** | **Glossy BSDF**).
10. Set the **Noise Texture** node's **Scale** value to `1000.000` and connect its **Color** output to the **Height** input socket of the **Bump** node. Label this node as `Bump_Seas`, set the **Strength** value to `0.015`, and connect its **Normal** output to the **Normal** input sockets of the new **Diffuse BSDF** and **Glossy BSDF** shaders. Label them as `Diffuse_Seas` and `Glossy_Seas` and set the **Glossy BSDF** node's **Roughness** value to `0.150`.
11. Add a **Frame** (press *Shift* + *A* and navigate to **Layout** | **Frame**). Press *Shift* and select the new nodes and then the **Frame**. Press *Ctrl* + *P* to parent them. Rename the frame as `SEAS`.
12. Add a **Mix Shader** node (press *Shift* + *A* and navigate to **Shader** | **Mix Shader**), label it as `Mix Shader_Seas`, and place it just under the **Mix Shader_Lands** node. Set the **Fac** value to `0.100`. Connect the output of the **Diffuse_Seas** node to the first **Shader** input, and the output of the **Glossy_Seas** node to the second **Shader** input socket.
13. Press *Shift* + *D* to duplicate the **Mix Shader_Seas** node and paste it between the **Mix Shader_Lands** and the **Material Output** nodes. Label it as `Mix Shader_Surface`. Connect the output of the **Mix Shader_Seas** node to its second **Shader** input socket.
14. Add a new **Image Texture** node (press *Shift* + *A* and navigate to **Texture** | **Image Texture**) and rename it as `Spec/mask`. Connect its **Color** output to the **Fac** input socket of the **Mix Shader_Surface** node. Click on the **Open** button to load the `Earth-spec_low.png` image. Set the **Color Space** to **Non-Color Data**.

15. Add a **Frame** (press *Shift* + *A* and navigate to **Layout** | **Frame**). Press *Shift* and select the **Spec/mask** node and then the **Frame**. Press *Ctrl* + *P* to parent them. Rename the frame as `SEPARATOR LANDS/SEAS`.
16. Now click on the **Color** output of the **Color_Day** image texture inside the **LANDS** frame, and drag it so that it is connected to the **Color** input of the **Diffuse_Seas shader** node inside the **SEAS** frame.
17. Add a **MixRGB** node (press *Shift* + *A* and navigate to **Color** | **MixRGB**) to the **SEAS** frame (just add it and parent it to the frame). Paste it just before the **Diffuse_Seas** shader. Switch the **Color1** connection to the **Color2** input socket. Then set the **Color1** values for **R** to `0.002`, **G** to `0.002`, and **B** to `0.022`.
18. Add a **ColorRamp** node (press *Shift* + *A* and navigate to **Converter** | **ColorRamp**) to the **SEAS** frame and label it as `ColorRamp01`. Connect the **Color** output to the **Color** input of the **Glossy_Seas** shader. Set **Interpolation** to **B-Spline**. Change the black color stop (index **0**) to pure white and the white color stop values (index **1**) for **R** to `0.072`, **G** to `0.127`, and **B** to `0.578`, with **Alpha** value set to `0.000`. Move it to `0.150` position. Click on the **+** icon button to add a new color stop. Change its **Color** values for **R** to `0.965`, **G** to `0.462`, **B** to `0.223`, and **Alpha** to `1.000`. Move it to `0.075` position.
19. Add a **Layer Weight** node (press *Shift* + *A* and navigate to **Input** | **Layer Weight**) to the **SEAS** frame. Connect the **Facing** output to the **Fac** input socket of the **ColorRamp01** node and the **Fac** input socket of the **MixRGB** node. Set the **Blend** factor to `0.200` as shown in the following screenshot:



The LANDS and the SEAS frames connected and separated by the simple SEPARATOR LANDS/SEAS

20. Add an **Image Texture** node (press *Shift* + *A* and navigate to **Texture** | **Image Texture**), a **ColorRamp** node (press *Shift* + *A* and navigate to **Converter** | **ColorRamp**), a **MixRGB** node (press *Shift* + *A* and navigate to **Color** | **MixRGB**), and an **Emission** shader (press *Shift* + *A* and navigate to **Shader** | **Emission**). Label the **Image Texture** node as `Color_Night` and the **ColorRamp** as `ColorRamp02`.
21. Connect the **Color_Night** node's **Color** output to the **Fac** input socket of the **ColorRamp02** node, and the **Color** output of this node to the **Color1** input socket of the **MixRGB** node. Then connect the **MixRGB** node's output to the **Color** input of the **Emission** node.
22. In the **Color_Night** image texture node, load the `Earth-night_low.png` image. Set the **ColorRamp02** node's **Interpolation** to **B-Spline** and move the black color stop to `0.250` position. Then move the white color stop to the `0.495` position. Set the **MixRGB** node's **Blend Type** to **Multiply**, the **Fac** value to `0.700` and the **Color2** values for **R** to `1.000`, **G** to `0.257`, and **B** to `0.090`. Set the **Emission** node's **Strength** value to `1.000`.
23. Add a **Frame** (press *Shift* + *A* and navigate to **Layout** | **Frame**). Press *Shift* to select these new nodes and then the **Frame**. Press *Ctrl* + *P* to parent them. Rename the frame as `NIGHT`. This is shown in the the following screenshot:

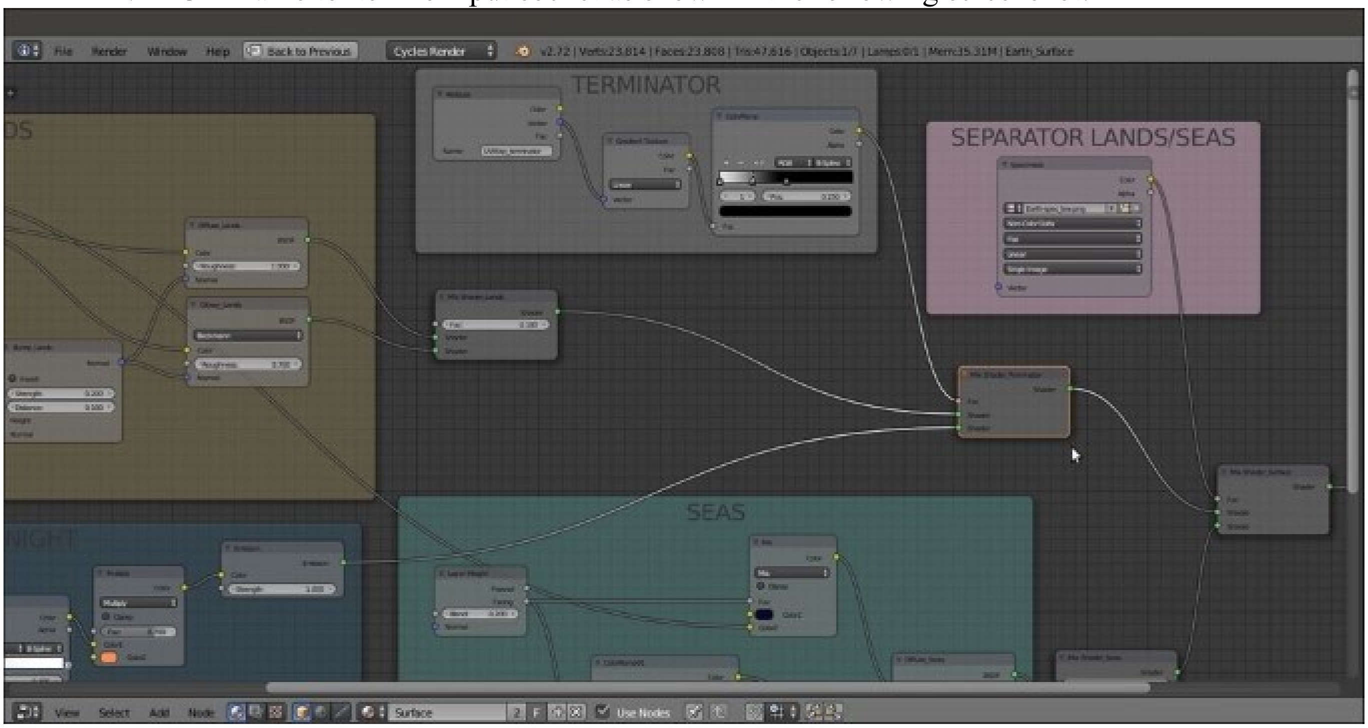


The NIGHT frame

24. Add an **Attribute** node (press *Shift* + *A* and navigate to **Input** | **Attribute**), a **Gradient Texture** node (press *Shift* + *A* and navigate to **Texture** | **Gradient Texture**) and a **ColorRamp** node (press *Shift* + *A* and navigate to **Converter** | **ColorRamp**). Connect the **Vector** output socket of the **Attribute** node to the **Vector** input socket of the **Gradient Texture** node, and the **Color** output of this node to the **Fac** input socket of the **ColorRamp** node.
25. In the **Name** slot of the **Attribute** node, write `UVMap_terminator`. Set the **ColorRamp** node's **Interpolation** to **B-Spline**. Then move the black color stop to `0.500` and the white

color stop to the `0.000` position. Click on the **+** icon button to add a new color stop. Set its color to pure black as well.

26. Add a **Frame** (press *Shift* + *A* and navigate to **Layout** | **Frame**). Press *Shift* to select these three nodes and then the frame. Press *Ctrl* + *P* to parent them. Rename the frame as `TERMINATOR`.
27. Add a **Mix Shader** node (press *Shift* + *A* and navigate to **Shader** | **Mix Shader**), label it as `Mix Shader_Terminator`, and paste it just between the **Mix Shader_Lands** and the **Mix Shader_Surface** nodes. Connect the output of the **Emission** node inside the **NIGHT** frame to its second **Shader** input socket, and the **Color** output of the **ColorRamp** inside the **TERMINATOR** frame to its **Fac** input socket as shown in the following screenshot:



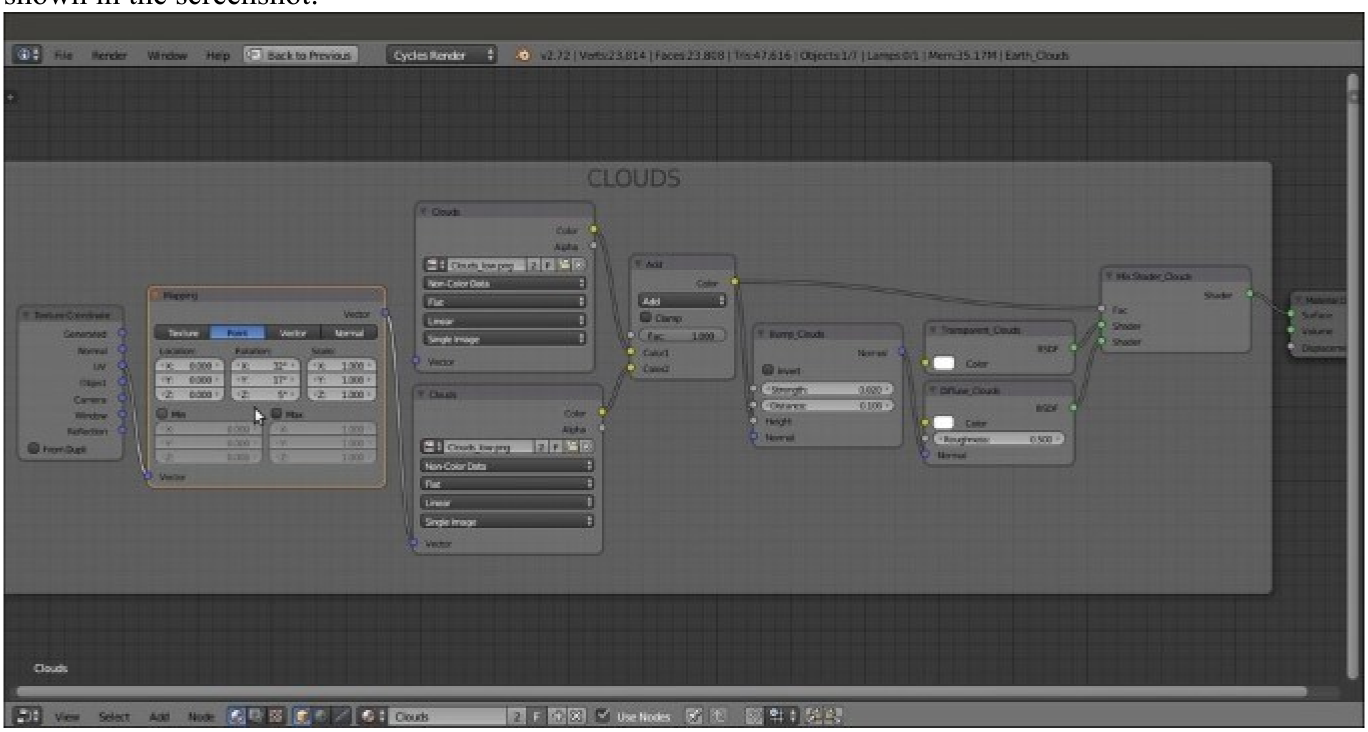
The TERMINATOR frame added to the surface material network

The clouds

As second planet material, let's go with the clouds by performing the following steps:

1. Now go to **Outliner**, unhide the **Earth_Clouds** sphere, and select it. Click on **New** in the **Material** window under the main **Properties** panel or in the **Node Editor** toolbar. Rename the material as `Clouds`.
2. In the **Material** window under the main **Properties** panel, switch the **Diffuse BSDF** shader with a **Mix Shader** node. Label it as `Mix Shader_Clouds`, and in the first **Shader** slot, load a **Transparent BSDF** shader. In the second **Shader** slot, load a new **Diffuse BSDF** shader. Set the color of both the shaders to pure white.
3. Add an **Image Texture** node (press *Shift* + *A* and navigate to **Texture** | **Image Texture**) and a **Bump** node (press *Shift* + *A* and navigate to **Vector** | **Bump**).

4. Label the **Image Texture** node as `Clouds` and the **Bump** node as `Bump_Clouds`. Connect the **Bump** node's output to the **Normal** input of the **Diffuse_Clouds** node. Set the **Strength** value to `0.020`.
5. Click on the **Open** button of the **Clouds** image texture node and load the `Clouds_low.png` image. Set the **Color Space** to **Non-Color Data**.
6. Press *Shift* + *D* to duplicate the **Clouds** image node. Then add a **Texture Coordinate** node (press *Shift* + *A* and navigate to **Input** | **Texture Coordinate**) and a **Mapping** node (press *Shift* + *A* and navigate to **Vector** | **Mapping**). Connect the **UV** output of the **Texture Coordinate** node to the **Mapping** node, and the output of this node to the **Vector** input socket of the duplicated **Clouds** image texture node.
7. Add a **MixRGB** node (press *Shift* + *A* and navigate to **Color** | **MixRGB**) and connect the output of both the two **Clouds** image texture nodes to the **Color1** and **Color2** input sockets. Set the **Blend Type** to **Add** and the **Fac** value to `1.000`. Connect the **Color** output to the **Height** input socket of the **Bump_Clouds** node and to the **Fac** input socket of the **Mix Shader_Clouds** node.
8. In the **Mapping** node, set the **Rotation** values of **X** to `32°`, **Y** to `17°`, and **Z** to `5°`.
9. Add a **Frame** (press *Shift* + *A* and navigate to **Layout** | **Frame**). Press *Shift* to select the nodes and then the **Frame**. Then press *Ctrl* + *P* to parent them. Rename the frame as `CLOUDS`. This is shown in the screenshot:



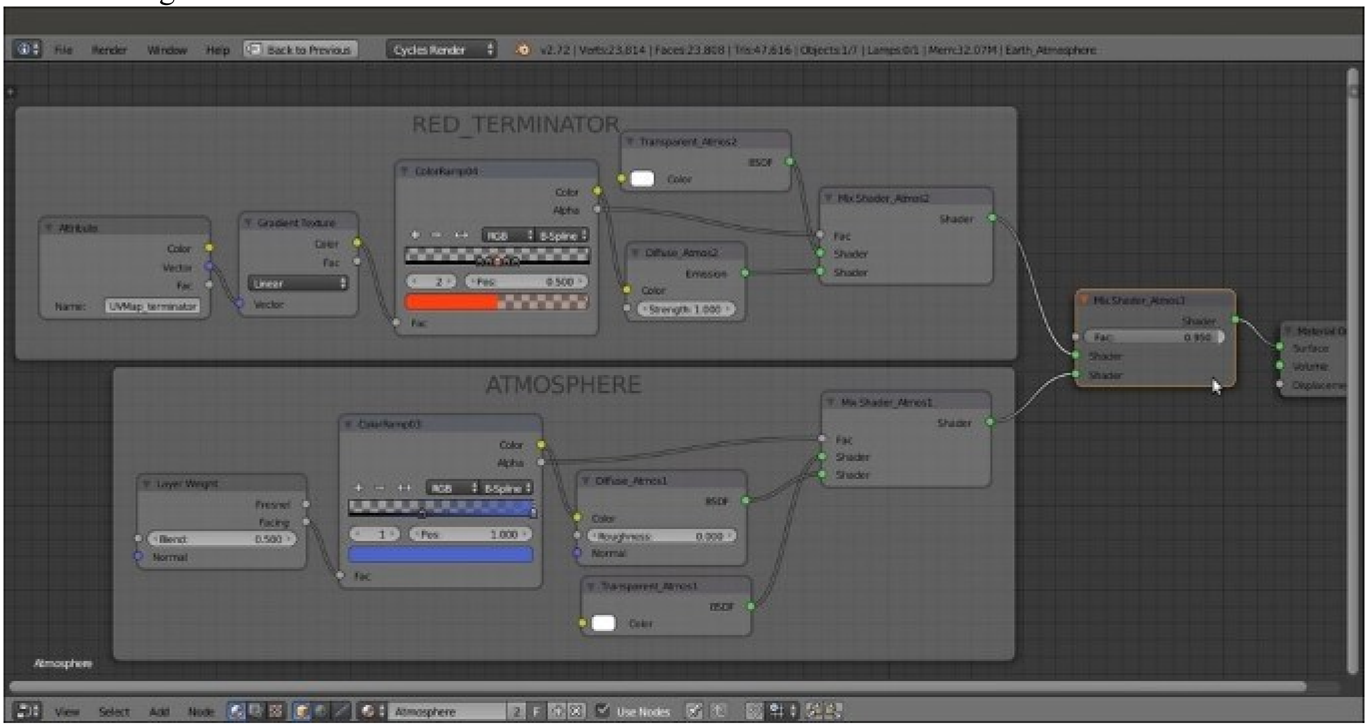
The CLOUDS material

The atmosphere

The third planet material is the atmosphere layer:

1. In **Outliner**, unhide the **Earth_Atmosphere** sphere and select it. Click on **New** in the **Material** window under the main **Properties** panel or in the **Node Editor** toolbar. Rename the new material as `Atmosphere`.
2. In the **Material** window on the right, under the main **Properties** panel, switch the **Diffuse BSDF** shader with a **Mix Shader** node. Label it as `Mix Shader_Atmos1`, and in the first **Shader** slot, load a **Transparent BSDF** shader (label it `Transparent_Atmos1`). In the second **Shader** slot, load a **Diffuse BSDF** shader (label it `Diffuse_Atmos1`).
3. Add a **Layer Weight** node (press *Shift* + *A* and navigate to **Input** | **Layer Weight**) and a **ColorRamp** node (press *Shift* + *A* and navigate to **Converter** | **ColorRamp**). Connect the **Facing** output of the **Layer Weight** node to the **Fac** input of the **ColorRamp** (label it `ColorRamp03`). Set the **ColorRamp03** node's **Interpolation** to **B-Spline**, move the black color stop to the `0.395` position, and set the **Alpha** value to `0.000`. Set the color of the white color stop (index **1**) for **R** to `0.072`, **G** to `0.127`, and **B** to `0.578`.
4. Connect the **Color** output of the **ColorRamp03** node to the **Color** input socket of the **Diffuse_Atmos1** node, and the **Alpha** output to the **Fac** input of the **Mix Shader_Atmos1** node. Set the **Layer Weight** node's blend factor to `0.500`.
5. Add a **Frame** (press *Shift* + *A* and navigate to **Layout** | **Frame**). Press *Shift* to select these nodes and then the **Frame**. Then press *Ctrl* + *P* to parent them. Rename the frame as `ATMOSPHERE`.
6. Add an **Attribute** node (press *Shift* + *A* and navigate to **Input** | **Attribute**), a **Gradient Texture** node (press *Shift* + *A* and navigate to **Texture** | **Gradient Texture**), and a **ColorRamp** node (press *Shift* + *A* and navigate to **Converter** | **ColorRamp**). Connect the **Vector** output socket of the **Attribute** node to the **Vector** input socket of the **Gradient Texture** node, and then the **Color** output of this node to the **Fac** input socket of the **ColorRamp** (label it `ColorRamp04`).
7. In the **Name** slot of the **Attribute** node, type `UVMap_terminator`. Set the **ColorRamp04** node's **Interpolation** to **B-Spline**. Then move the black color stop to the `0.400` position and the white color stop to the `0.600` position, but change this stop's color to black as well. Click on the **+** icon button to add a new color stop. Set its color to pure black and move it to the `0.450` position. Click on the **+** icon button again to add a new color stop. Set its color to pure black and move it to the `0.550` position. Set the **Alpha** of all the four black color stops to the `0.000`. Click once more on the **+** icon button to add a new color stop. Set its color values for **R** to `1.000`, **G** to `0.047`, and **B** to `0.005`. Set **Alpha** value to `0.100` and move it to the `0.500` position.
8. Add a **Mix Shader** node (press *Shift* + *A* and navigate to **Shader** | **Mix Shader**), a **Transparent BSDF** node (press *Shift* + *A* and navigate to **Shader** | **Transparent BSDF**), and an **Emission** node (press *Shift* + *A* and navigate to **Shader** | **Emission**). Label them as `Mix Shader_Atmos2`, `Transparent_Atmos2`, and `Diffuse_Atmos2`.
9. Connect the **Transparent_Atmos2** node's output to the first **Shader** input socket of the **Mix Shader_Atmos2** and the **Diffuse_Atmos2** output to the second **Shader** input. Then connect the **Color** output of the **ColorRamp04** node to the **Color** input socket of the **Diffuse_Atmos2** node and the **Alpha** output to the **Fac** input socket of the **Mix Shader_Atmos2** node.
10. Add a **Frame** (press *Shift* + *A* and navigate to **Layout** | **Frame**). Press *Shift* to select these nodes and then the **Frame**. Then press *Ctrl* + *P* to parent them. Rename the frame as `RED_TERMINATOR`.
11. Add a final **Mix Shader** node (press *Shift* + *A* and navigate to **Shader** | **Mix Shader**), label it as `Mix Shader_Atmos3`, and set the **Fac** value to `0.950`. Connect the output of the **RED_TERMINATOR** frame to the first **Shader** input socket and the output of the

ATMOSPHERE frame to the second **Shader** input socket. Then connect the output of the **Mix Shader_Atmos3** node to the **Surface** input socket of the **Material Output** node as shown in the following screenshot:



The RED_TERMINATOR and the ATMOSPHERE frames

How it works...

The three overlapping UV Spheres technique is quite old, and (at least for what relates to Blender) dates back to almost 2004—more precisely to the *How to make a realistic planet in Blender(2004)* tutorial I wrote at that time for Blender version 2.23/2.30 (http://www.enricovalenza.com/rlpl.html). That tutorial is now outdated, but the technique and basic concepts still work, even in Cycles. Hence, we get the planet surface on the smaller of the spheres, a clouds layer on a slightly bigger sphere, and the enveloping atmospheric Fresnel effect on the biggest sphere.

We divided the material creation process into the three stages, corresponding to the three layers/spheres. First, we built the more complex of all the three shaders that is the Surface material:

- From step 1 to step 8, we built the shader for the continents—simple image textures connected as color factors to a **Diffuse BSDF** and **Glossy BSDF** shaders. From step 9 to step 13, we made the basic shader for the oceans.
- In steps 14 and 15, we split the continents component from the oceans using the `Earth-spec` map, a black-and-white image working as a stencil for the factor input of the **Mix Shader_Surface** node. We also connected the `Earth-color` map to the **SEAS** diffuse shader to bring color back to the oceans.

- From step 16 to step 19, we added a **ColorRamp** node to the **SEAS** frame, driven by a **Facing** fresnel node. This was done to enhance the color of the water's specularity (according to what NASA's satellite photos often show). A deep blue color was mixed with the color image map by a **MixRGB** node. Thanks to the **Facing** fresnel node, the blue color was mapped on the mesh faces perpendicular to the point of view, resulting in darker water masses towards the center of the Earth sphere.
- From step 20 to step 23, we built the night shader. The Earth-night image was clamped (contrasted) by a **ColorRamp** node, and the resulting brightness values were multiplied by a reddish color in the **MixRGB** node. All of this was then assigned to an **Emission** shader. The night side of the Earth surface shows only in the shadow part of the sphere thanks to the **Empty_terminator** trick.
- From step 24 to step 27, we built the day/night terminator stencil.
- Then, from step 28 to step 36, we built the `Clouds` layer on the second sphere. We added more variety to the single `Clouds_low.png` image by superimposing and offsetting (the mapping rotation of) a copy of the same cloud image.
- From step 37 to step 47, we built the `Atmosphere` layer on the third (bigger) sphere, with the Fresnel atmospheric effect and the reddish terminator.

As you have probably noticed, we didn't use any **Texture Coordinate** or **Mapping** nodes to map the image maps. This is because the UV Spheres had been unwrapped with **Image Texture** nodes. The existing UV coordinate layer was automatically taken into account by Cycles for the mapping.

For the ocean bump, which was obtained by the **Noise** procedural, the Generated mapping option was automatically used.

Thanks to the Damped Track constraints, which were targeted to the position of the Sun lamp, we could use the **Empty_terminator** object as a UV coordinates projector for the day/night division on the planet surface and for the red colored transition zone (the red terminator) in the `Atmosphere` layer.

Chapter 6. Creating More Complex Man-made Materials

In this chapter, we will cover the following recipes:

- Creating cloth materials with procedurals
- Creating a leather material with procedurals
- Creating a synthetic sponge material with procedurals
- Creating a spaceship hull shader

Introduction

In this chapter, we will see some more complex artificial materials, starting with the relatively simpler materials. Remember that the procedure is basically the same as that for all the materials we have seen so far—the generic shader followed by the color pattern or the bump effect (one or more), depending on the preponderance of the different components.

The only difference is the level of complexity they can reach (for example, look at the *Creating a spaceship hull shade* recipe at the end of this chapter).