Chapter 9. Special Materials

In this chapter, we will cover the following recipes:

- Using Cycles volume materials
- Creating a cloud volumetric material
- Creating a "fire and smoke" shader
- Creating a shadeless material in Cycles
- Creating a fake immersion effect material
- Creating a fake volume light material

Introduction

In this final chapter, we are going to see some special materials, that is, materials that can be used for special effects or for situations where very realistic results are not required, for example, creation of volumetric effects (fire, smoke, mist, volumetric light, and so on) and special materials to obtain peculiar results (shadeless images, alpha backgrounds, and so on).

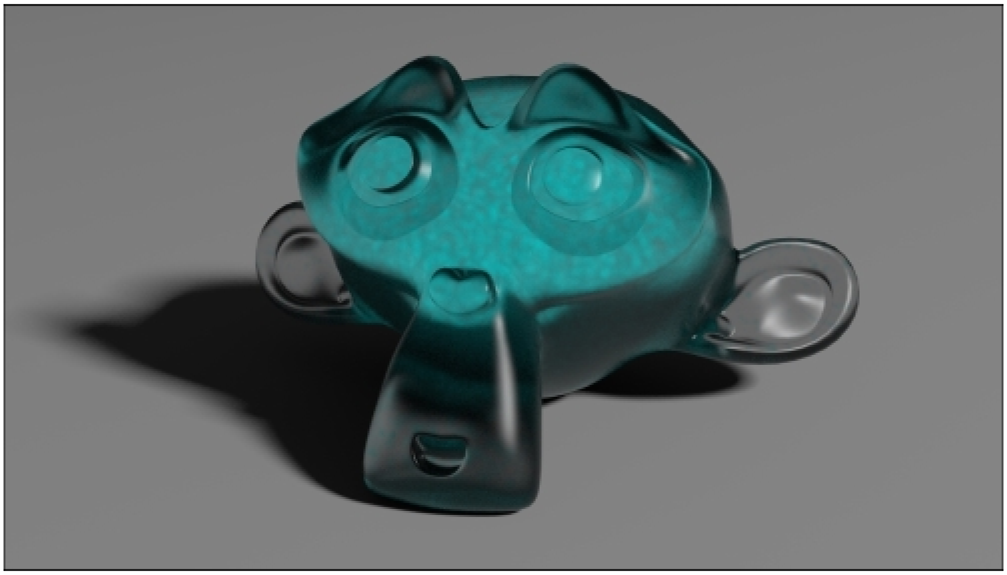
Using Cycles volume materials

In all the recipes we have seen so far, Cycles used the **Surface** input socket and (very rarely) the **Displacement** input socket for the bump effects of the **Material Output** node to make the renderings. Assigning colors or textures to the surface of an object clearly means that interaction between a ray of light and an object happens only at the surface level of the object, and until this surface doesn't show what should be inside, that's OK. The surface attribute is enough for a realistic rendering.

Things get more complex when there is a need to show what's inside an object, for example, water inside a glass container, smoke and clouds in a thick atmosphere, and so on.

Usually, these are effects that require the use of the volume attribute more than the surface attribute to be effectively rendered.

So, in the first recipes of this chapter, we are going to see the use of the **Volume** input socket of the **Material Output** node. Rather than covering a specific material, this recipe is more of a "tour" to show the possibilities related to the **Volume** shader assigned to a mesh object. Have a look at the following screenshot:



A glass Suzanne containing some kind of liquid

Getting ready

Start Blender and open the `9931OS_09_start.blend` file, with the usual Suzanne object leaning on a Plane, a mesh-light Emitter, and the Camera.

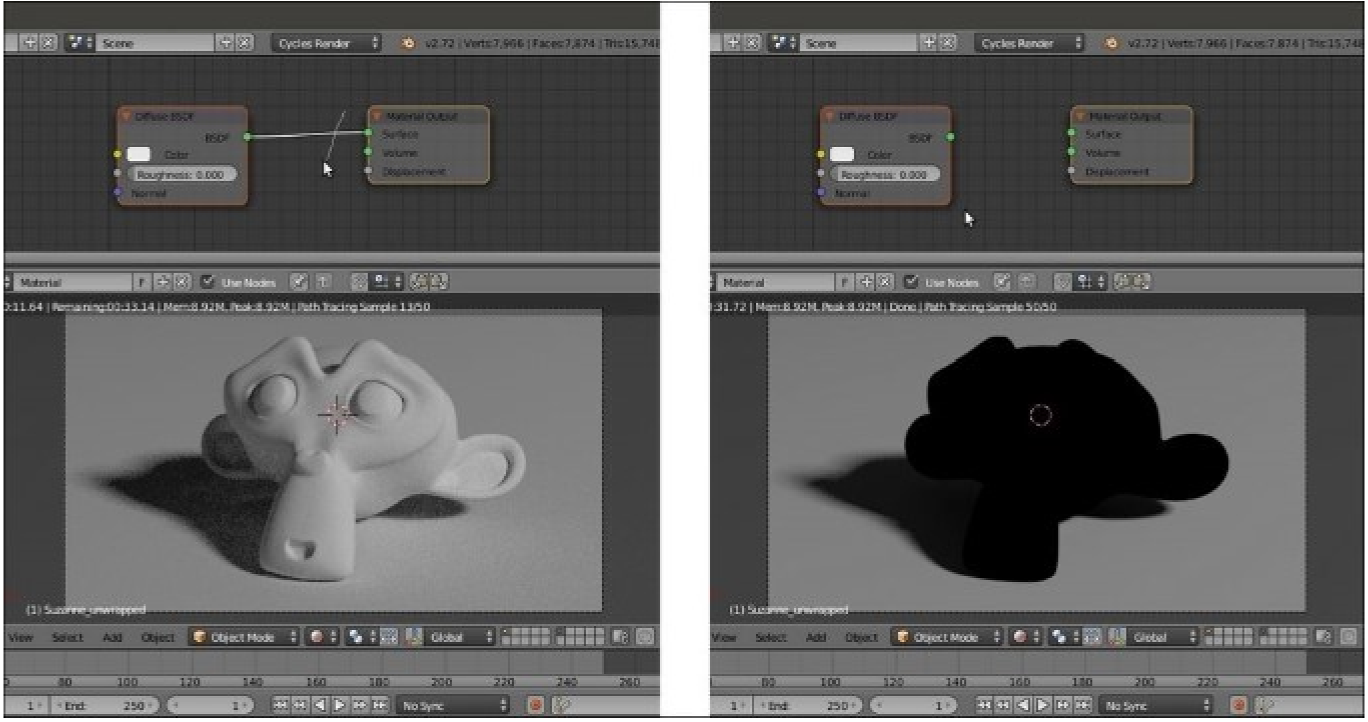
1. Go to the **Render** window, and under the **Sampling** subpanel, set **Samples** for **Preview** to `50` and for **Render** to `100`. Switch **Pattern** from **Sobol** to **Correlated Multy-Jitter**.

2. Still in the **Render** window, go to the **Volume Sampling** subpanel, and under the **Heterogeneous** item, set the **Step Size** value to `0.25`. The default value is `0.10`. Increasing this will make the rendering of volumes less accurate but faster, and lowering it will result in the opposite.

How to do it...

First, let's see the Volume applied to our usual Suzanne mesh primitive by performing the following steps:

1. Move the mouse to the **Camera** view and press *Shift* + *Z* to switch the **Viewport Shading** mode to **Rendered**.
2. Make sure that you have the **Suzanne_unwrapped** object selected, and click on the **New** button in the **Node Editor** toolbar, or in the **Material** window under the main **Properties** panel.
3. In the **Node Editor** window, press *Ctrl* and click and drag a line onto the link connecting the **Diffuse BSDF** shader to the **Material Output** node to cut it away. Because nothing is connected to the **Material Output** node sockets, in the **Camera** view, the **Suzanne** object turns pitch black as shown in the following screenshot:

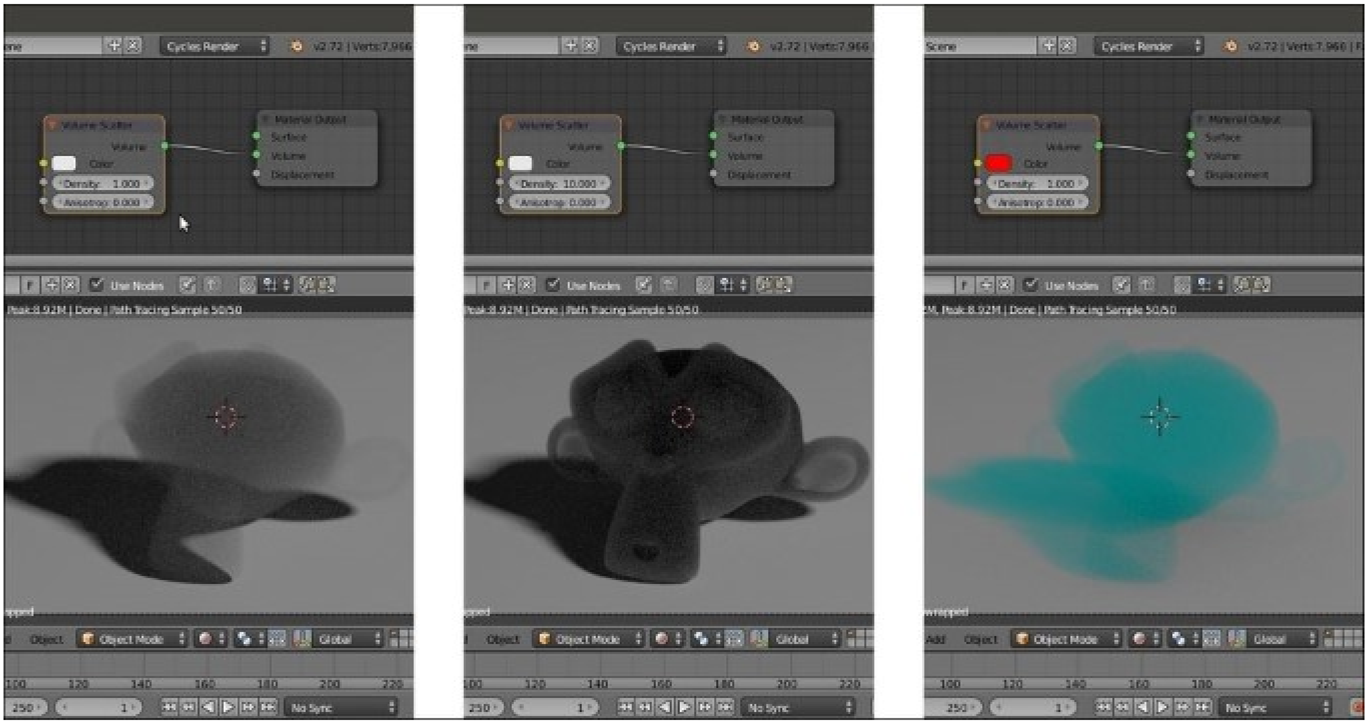


0:11.64 | Remaining:00:33.14 | Mem:8.92M, Peak:8.92M | Path Tracing Sample 13/50

0:31.72 | Mem:8.92M, Peak:8.92M | Done | Path Tracing Sample 50/50

The Diffuse shader connected and disconnected from the Material Output node

4. Select and delete the **Diffuse BSDF** shader node. Still in the **Node Editor** window, add a **Volume Scatter** node (press *Shift* + *A* and navigate to **Shader** | **Volume Scatter**) and connect its output to the **Volume** input socket of the **Material Output** node.



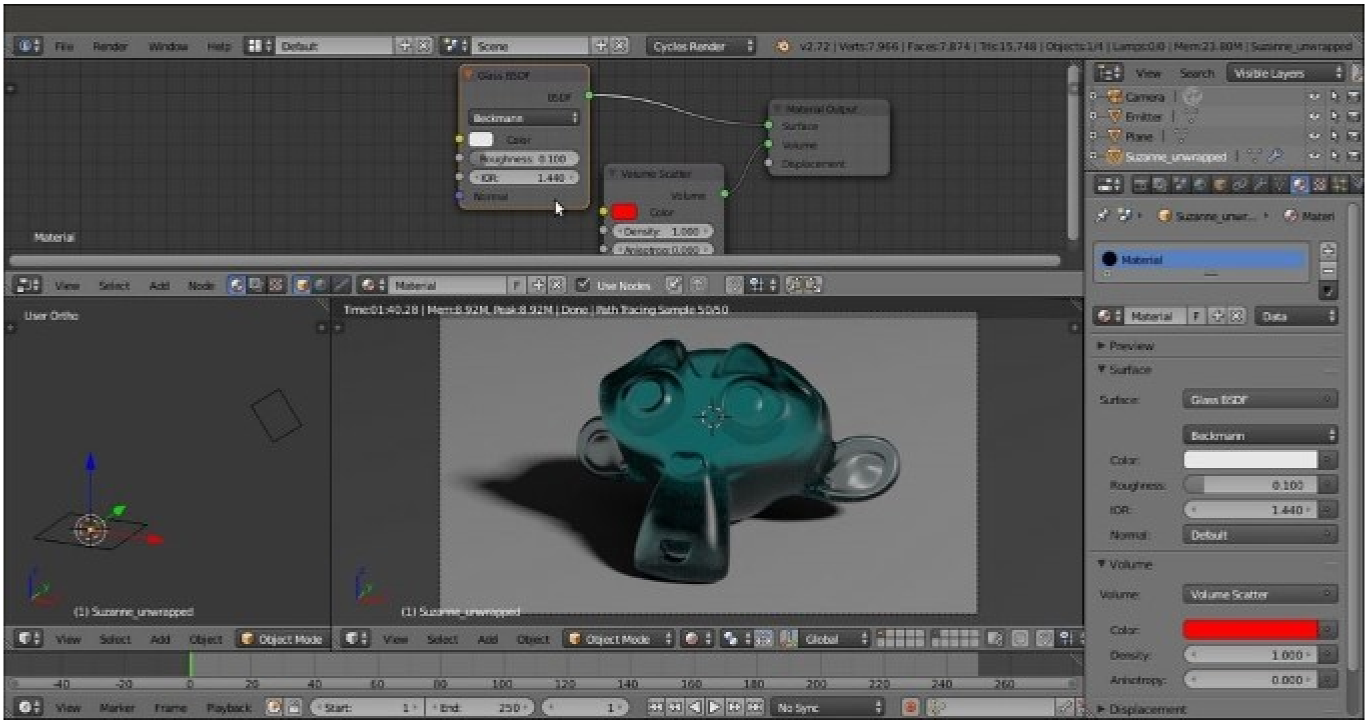
Density: 1.000
Anisotrop: 0.000

Density: 10.000
Anisotrop: 0.000

Density: 1.000
Anisotrop: 0.000

Different effects of the Volume Scatter node obtained by changing density and color

5. Try to increase the **Density** value to `10.000`, either in the node interface in the **Node Editor** window, or in the slot under the **Volume** subpanel in the main **Properties** panel. Suzanne's volume looks more solid, as shown in the middle of the preceding screenshot.
6. Change the **Density** value back to the default `1.000` and change the **Color** values of the **Volume Scatter** node for **R** to `1.000`, **G** to `0.000`, and **B** to `0.000` (a red color). The **Suzanne** object now appears as complementary colored smoke (on the right side of the preceding screenshot) because light is scattered (note that the shadow on the Plane gets the same color).
7. Add a **Glass BSDF** shader (press *Shift* + *A* and navigate to **Shader** | **Glass BSDF**) and connect its output to the **Surface** input socket of the **Material Output** node. Set the **IOR** value to `1.440` and the **Roughness** value to `0.100`.

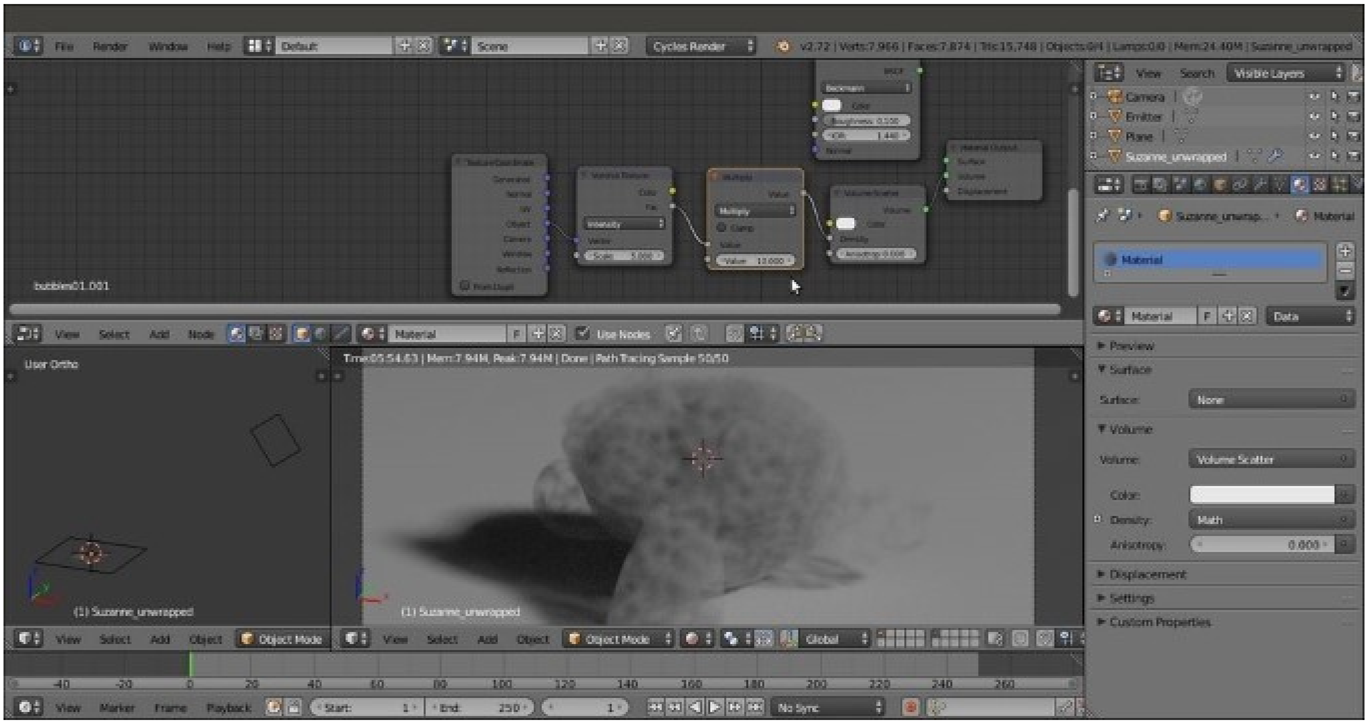


v2.72 | Verts:7,966 | Faces:7,874 | Tris:15,748 | Objects:1/4 | Lamps:0/0 | Mem:23.80M | Suzanne_unwrapped

Time:01:40.28 | Mem:8.92M, Peak:8.92M | Done | Path Tracing Sample 50/50

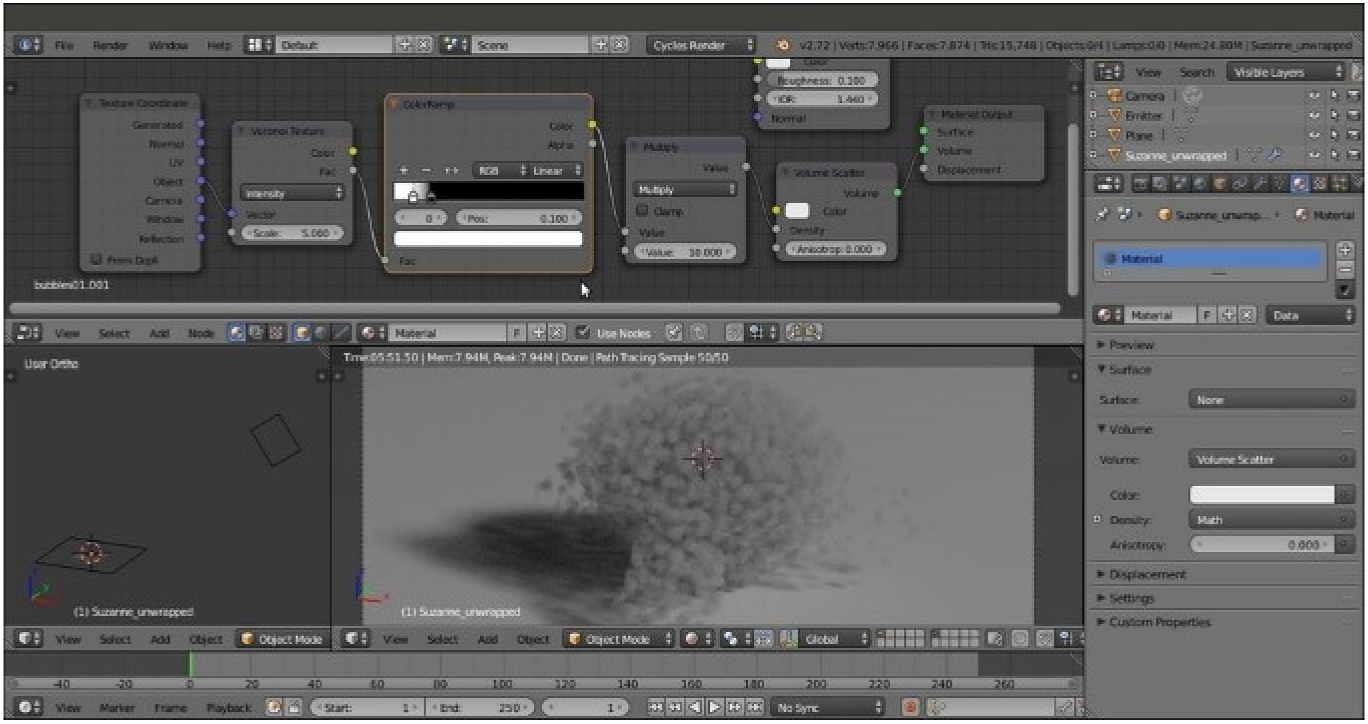
Adding a glassy envelope to the bluish, scattered glassy volume

8. Now you have to temporarily remove the connection of the **Glass BSDF** shader node to the **Surface** input socket of the **Material Output** node, take back the **RGB** value and set it to `0.800` for the **Color** of the **Volume Scatter** node.
9. Add a **Texture Coordinate** node (press *Shift* + *A* and navigate to **Input** | **Texture Coordinate**), a **Voronoi Texture** node (press *Shift* + *A* and navigate to **Texture** | **Voronoi Texture**), and a **Math** node (press *Shift* + *A* and navigate to **Converter** | **Math**).
10. Connect the **Object** output of the **Texture Coordinate** node to the **Vector** input socket of the **Voronoi Texture** node, and the **Fac** output of this node to the first **Value** input socket of the **Math** node. Set the second **Value** to `10.000`, set **Operation** to **Multiply**, and connect its output to the **Density** input socket of the **Volume Scatter** node as shown in the following screenshot:



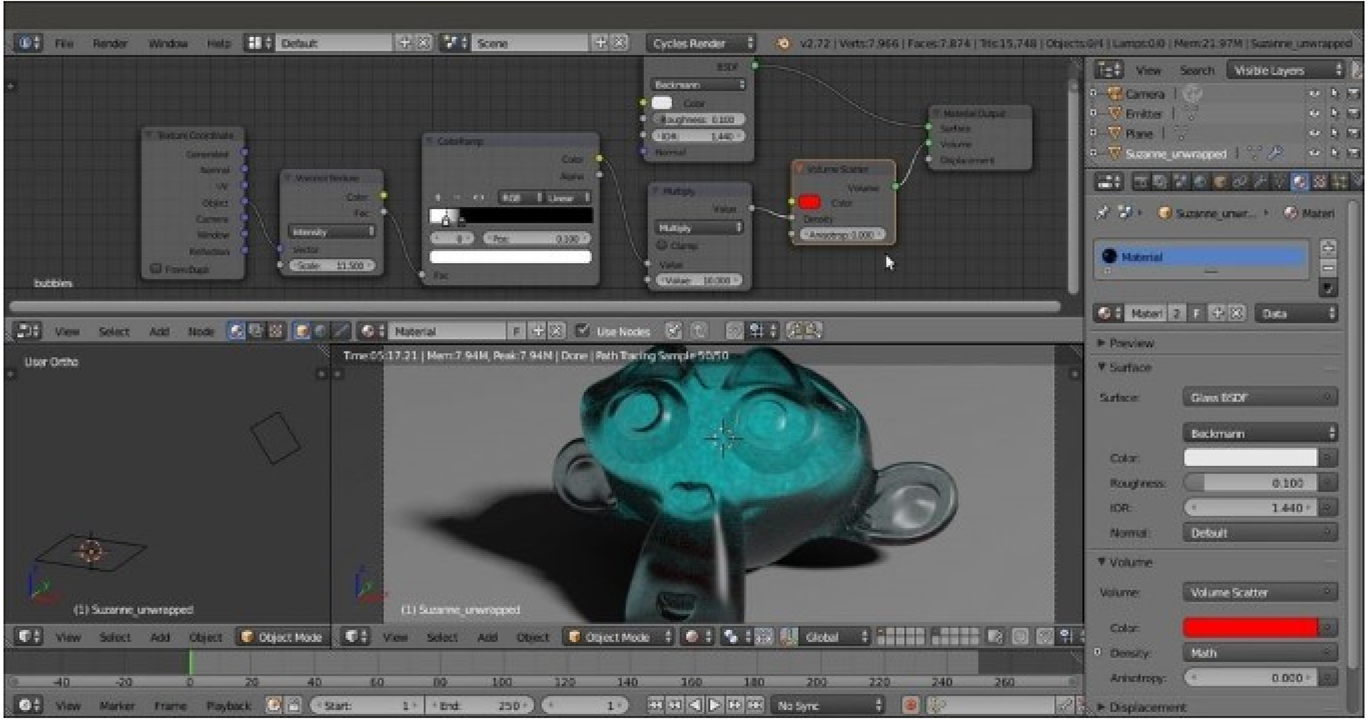
The Density value of the Volume Scatter node driven by a Voronoi texture output

11. Add a **ColorRamp** node (press *Shift* + *A* and go to | **Converter** | **ColorRamp**) and paste it between the **Voronoi Texture** and the **Math** nodes. Move the black color stop to position `0.195` and the white color stop to position `0.100` as shown in the following screenshot:



Enhancing the contrast of the texture output

12. Set the **Voronoi Texture** node's **Scale** value to `11.500`, and reconnect the **Glass BSDF** shader node output to the **Surface** input socket of the **Material Output** node. Change the **Color** values of the **Volume Scatter** node for **R** to `1.000`, **G** to `0.000`, and **B** to `0.000` as shown in the following screenshot:



Cycles Render

Time:05:17.21 | Mem:7.94M, Peak:7.94M | Done | Path Tracing Sample 50/50

Voronoi Texture: Intensity, Scale: 11.500

Multiply: Value: 16.000

Volume Scatter: Anisotropy: 0.000

Preview

Surface

Surface: Glass BSDF

Beckmann

Color:

Roughness: 0.100

IOR: 1.440

Normal: Default

Volume

Volume: Volume Scatter

Color:

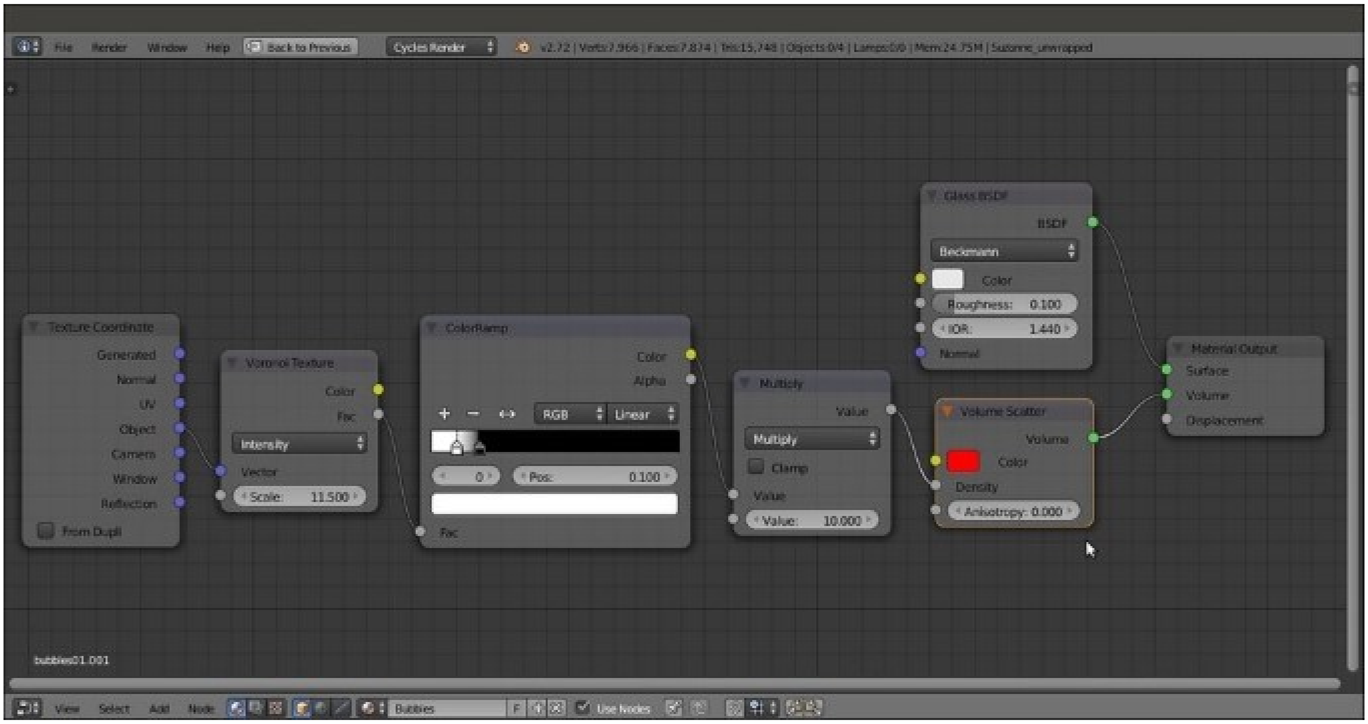
Density: Math

Anisotropy: 0.000

Displacement

The previously cloudy volume covered with a glass surface

13. Rename the material as `Bubbles` and save the file by naming it `9931OS_09_volume.blend`. Have a look at the following screenshot:



Scale: 11.500

0

Pos: 0.100

Value: 10.000

Roughness: 0.100

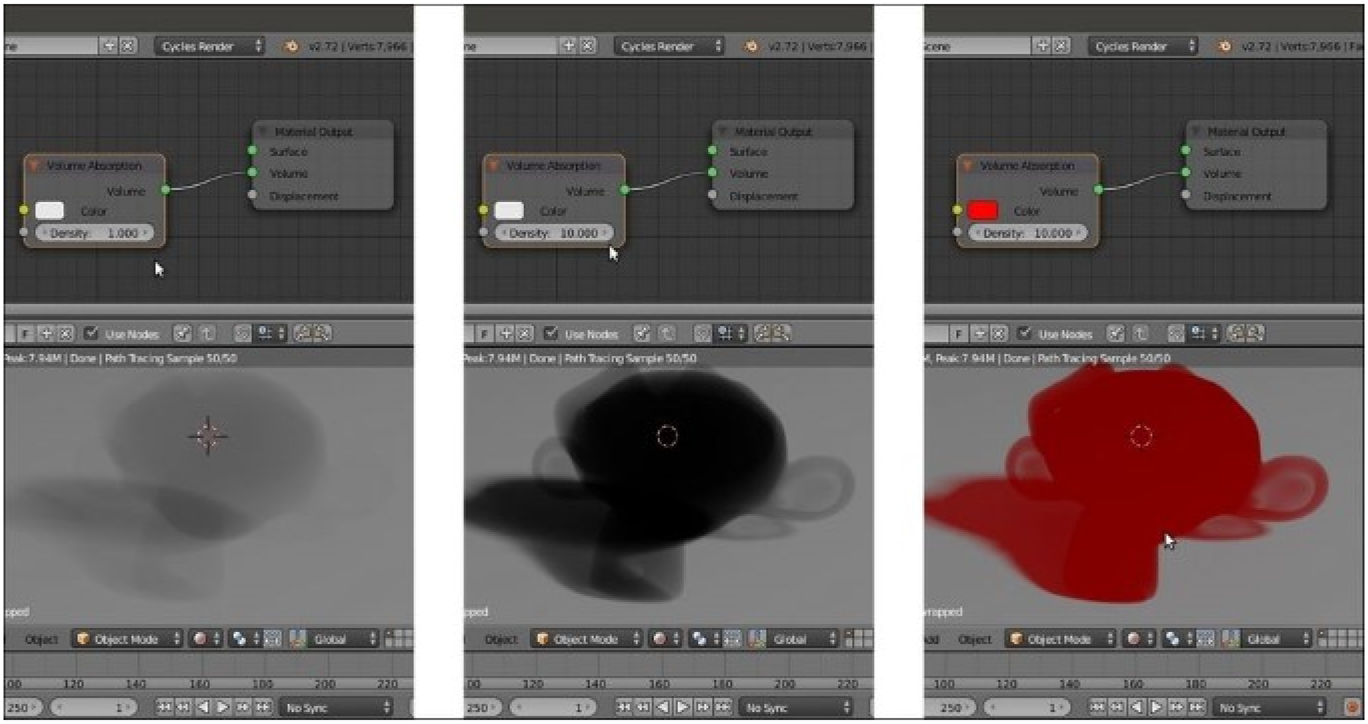
IOR: 1.440

Anisotropy: 0.000

The overall network for the combined surface and volume material

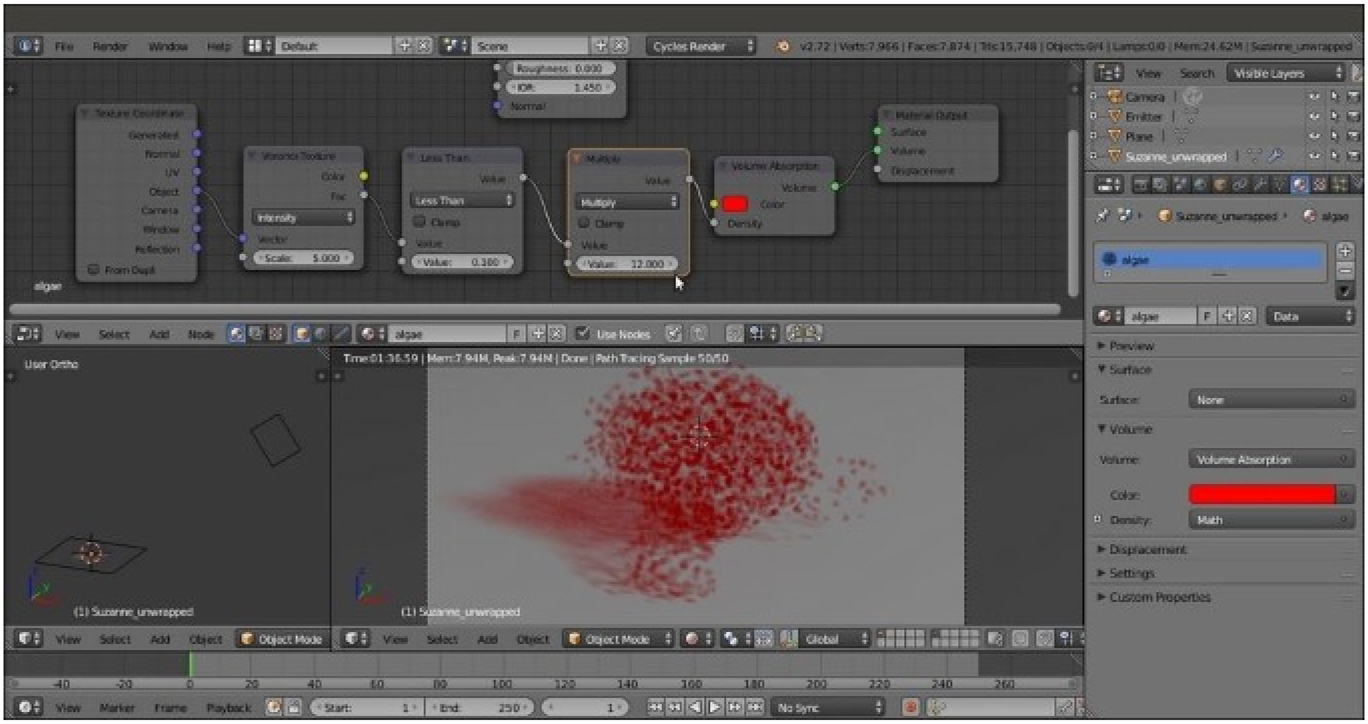
So, for the previous material named `Bubbles`, we used the **Volume Scatter** node. What about the **Volume Absorption** node?

14. In the **Node Editor** toolbar, enable *fake user* for the `Bubbles` material, and click on the **X** icon button to delink the datablock. Then click on the **New** button.
15. Delete the **Diffuse BSDF** shader node and add a **Volume Absorption** node (press *Shift* + *A* and navigate to **Shader** | **Volume Absorption**). Then connect it to the **Volume** input socket of the **Material Output** node.
16. To make a comparison with the **Volume Scatter** node, raise the **Density** value of the **Volume Absorption** node to `10.000` and set the **Color** values for **R** to `1.000`, **G** to `0.000`, and **B** to `0.000`. Have a look at the following screenshot:



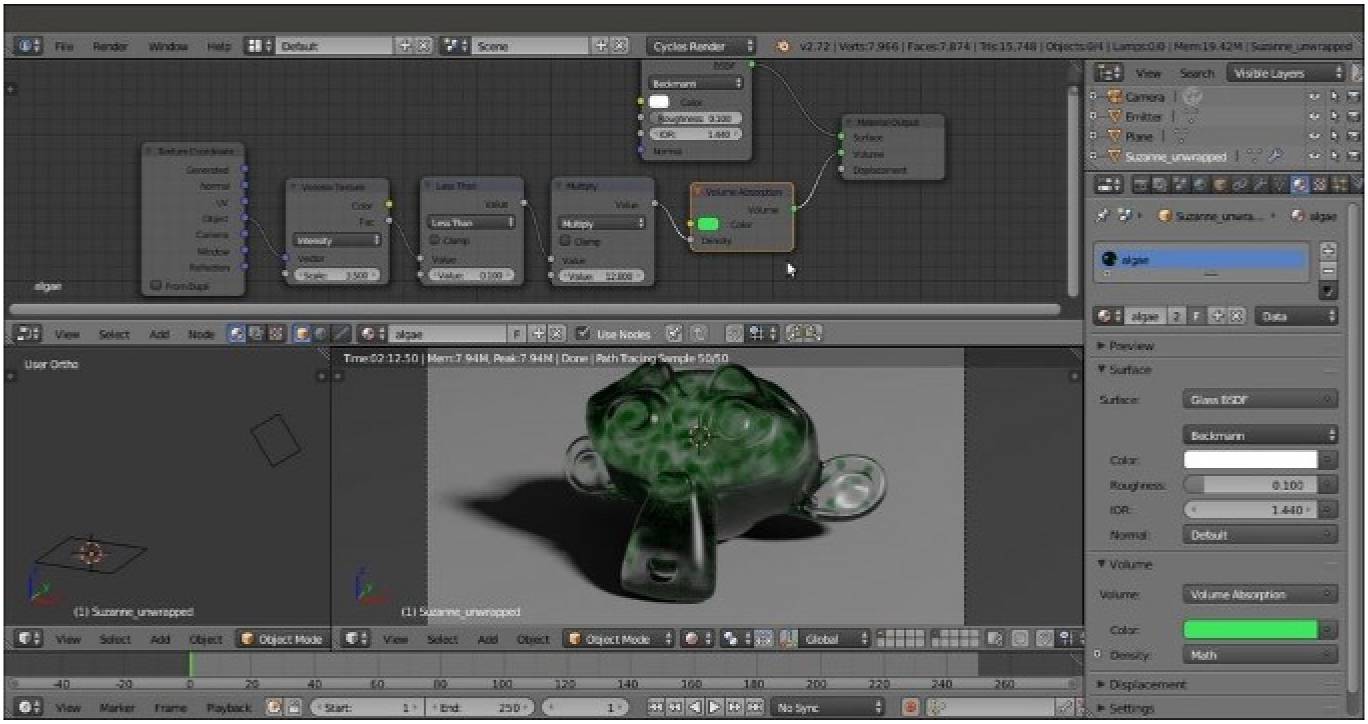
Different effects of the Volume Absorption node

17. Add a **Texture Coordinate** node (press *Shift* + *A* and navigate to **Input** | **Texture Coordinate**), a **Voronoi Texture** node (press *Shift* + *A* and navigate to **Texture** | **Voronoi Texture**), two **Math** nodes (press *Shift* + *A* and navigate to **Converter** | **Math**), and a **Glass BSDF** shader (press *Shift* + *A* and navigate to **Shader** | **Glass BSDF**).
18. Connect the **Object** output of the **Texture Coordinate** node to the **Vector** input socket of the **Voronoi Texture** node, and the **Fac** output of this node to the first **Value** input socket of the first **Math** node. Set the second **Value** to `0.100`, set **Operation** to **Less Than**, and connect its output to the first **Value** input socket of the second **Math** node. Set the second **Value** to `12.800` and the **Operation** to **Multiply**.
19. Connect the output of this **Multiply-Math** node to the **Density** input socket of the **Volume Absorption** node, and rename the material as `algae`. Here is a screenshot for your reference:



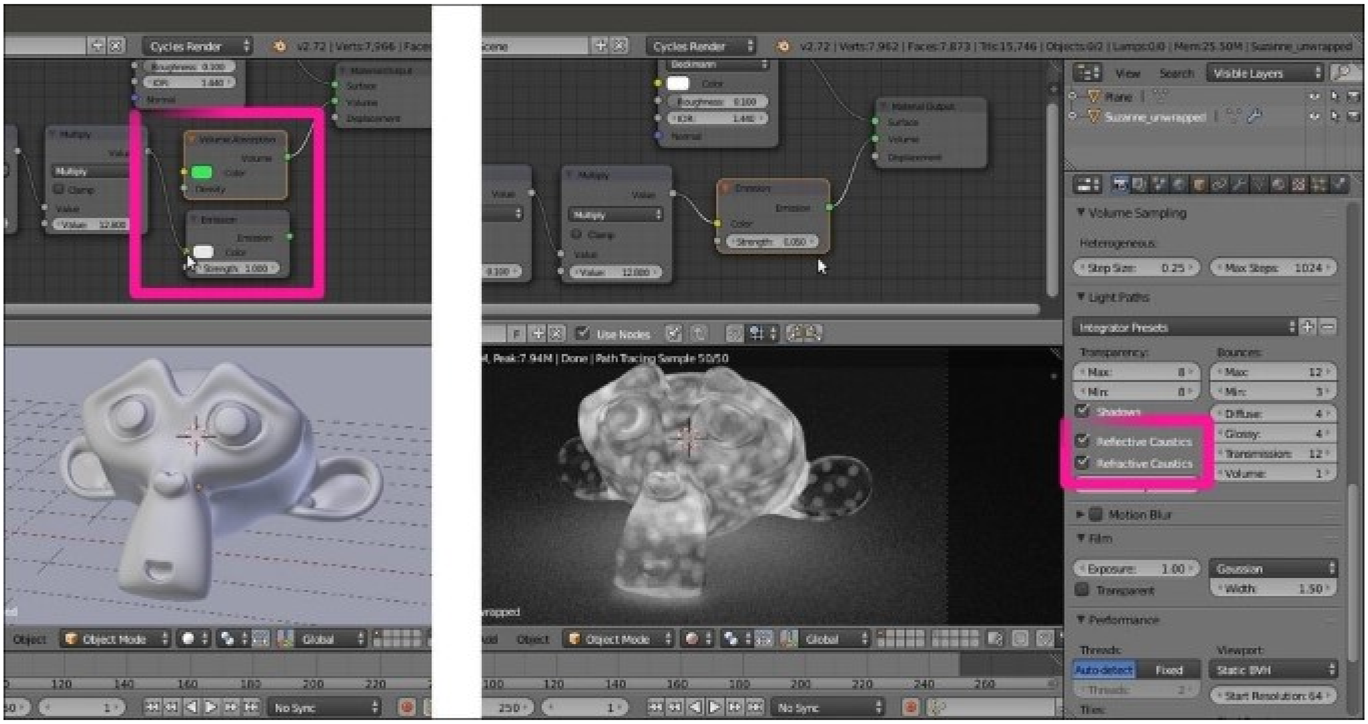
The density of the Volume Absorption node driven by the Voronoi Texture output

20. Set the **Scale** value of the **Voronoi Texture** node to `3.500`, change the **Color** of the **Volume Absorption** node for **R** `0.045`, **G** `0.800`, and **B** `0.113`, and connect the output of the **Glass BSDF** shader node to the **Surface** input socket of the **Material Output** node. Set the **IOR** value to `1.440` and the **Roughness** value to `0.100` as shown in the following screenshot:



Different colors and a glass cover for the absorption volumetric material

21. In the **Node Editor** toolbar, enable *fake user* for the `algae` material, and then click on the **2** icon (**Display number of users for this data**) to create a duplicate of the material, named `algae.001`.
22. Rename the material as `emitting_volume` and substitute the **Volume Absorption** node with an **Emission** node (press *Shift* + *A* and go to | **Shader** | **Emission**). Connect the output of the **Multiply-Math** node to the **Color** input socket, and set the **Strength** value to `0.050`.
23. Disable the visibility of the sixth scene layer to hide the **Emitter** mesh-light, and go to the **Render** window. In the **Light Paths** subpanel, enable both the **Reflective Caustics** and **Refractive Caustics** items. Here is a screenshot for your reference:



Volume Absorption
Volume
Color
Density

Emission
Emission
Color
Strength: 1.000

Multiply
Value
Multiply
Clamp
Value: 12.000

Material Output
Surface
Volume
Displacement

Emission
Emission
Color
Strength: 0.050

Path Tracing Sample 50/50

▼ Volume Sampling
Heterogeneous:
Step Size: 0.25
Max Steps: 1024

▼ Light Paths
Integrator Presets
Transparency:
Max: 8
Min: 8
☑ Shadows
☑ Reflective Caustics
☑ Refractive Caustics
Bounces:
Max: 12
Min: 3
Diffuse: 4
Glossy: 4
Transmission: 12
Volume: 1

▼ Film
Exposure: 1.00
□ Transparent
Gaussian
Width: 1.50

▼ Performance
Threads:
Auto-detect
Viewport:
Static BVH
Start Resolution: 64

Substituting the Volume Absorption node with an Emission node as the volume material

24. Enable *fake user* for the `emitting_volume` material and save the file.

How it works...

In this tour recipe, we saw the three shaders used for the volumetric attribute of a material in Cycles, that is, the **Volume Scatter**, **Volume Absorption**, and **Emission** shaders (we have already seen the **Emission** shader the previous chapters, and it is commonly used in Lamps and mesh-lights).

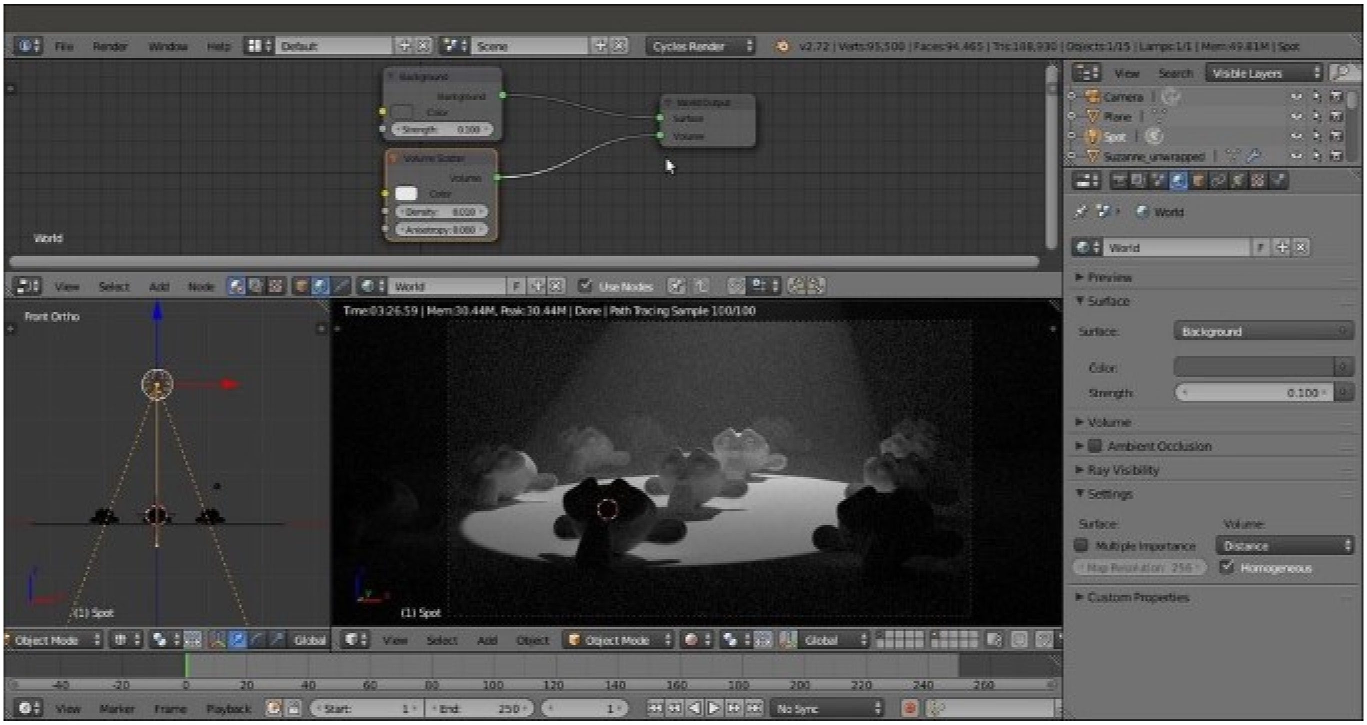
The **Volume Scatter** and **Absorption** shaders do exactly what their names say, as we saw in the examples. If we give them a color other than black, gray, or white, the **Volume Scatter** shader returns a complementary hue, while the **Volume Absorption** shader returns the same hue we set up.

About the **Density** value, remember that the higher the value, the more particles inside the volume. This allows for simulation of very light and rarefied vapors or very dense clouds of smoke, where the material looks almost solid.

There's more...

A Volume can be associated not only with objects but also with the World. This allows for several effects, for example, mist, or the famous God's rays. They are obtained by simply scattering light in the air of a Spot lamp.

The setup is really simple and intuitive: a **Volume Scatter** node connected to the **Volume** input socket of the **World Output** node. Have a look at the following screenshot:



v2.72 | Verts:95,500 | Faces:94,465 | Tris:188,930 | Objects:1/15 | Lamps:1/1 | Mem:49.81M | Spot

Background: Strength: 0.100

Volume Scatter: Density: 0.010, Anisotropy: 0.000

Time:03:26.59 | Mem:30.44M, Peak:30.44M | Done | Path Tracing Sample 100/100

Surface: Background

Strength: 0.100

Settings

Surface: □ Multiple Importance, Map Resolution: 256

Volume: Distance, ☑ Homogeneous

Start: 1, End: 250, 1

The cone of a Spot lamp visible through the ambient volume material

The **Density** value of the **Volume Scatter** node in this case is set very low (0.010) to allow the light of the Spot lamp to shine through.

Open the `9931OS_09_volume_ambient.blend` file to have a look.

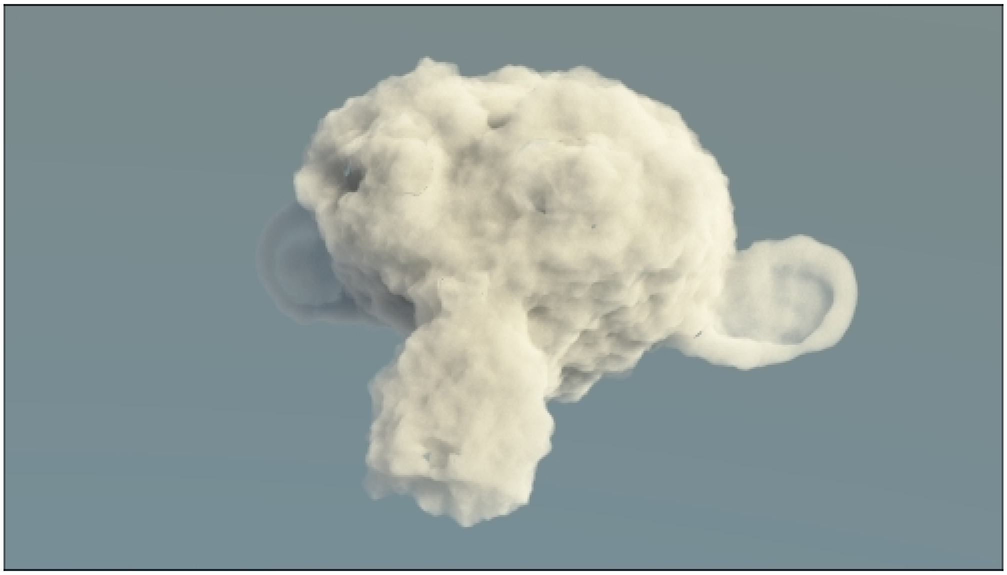
See also

- http://wiki.blender.org/index.php/Doc:2.6/Manual/Render/Cycles/Materials/Volume

Creating a cloud volumetric material

The natural consequence of a volumetric material is (quite obviously) clouds.

A simple way to create clouds in Cycles is by modeling the desired shape and then assigning an appropriate volumetric material. In the following screenshot, you can see this method applied to the usual Suzanne mesh:

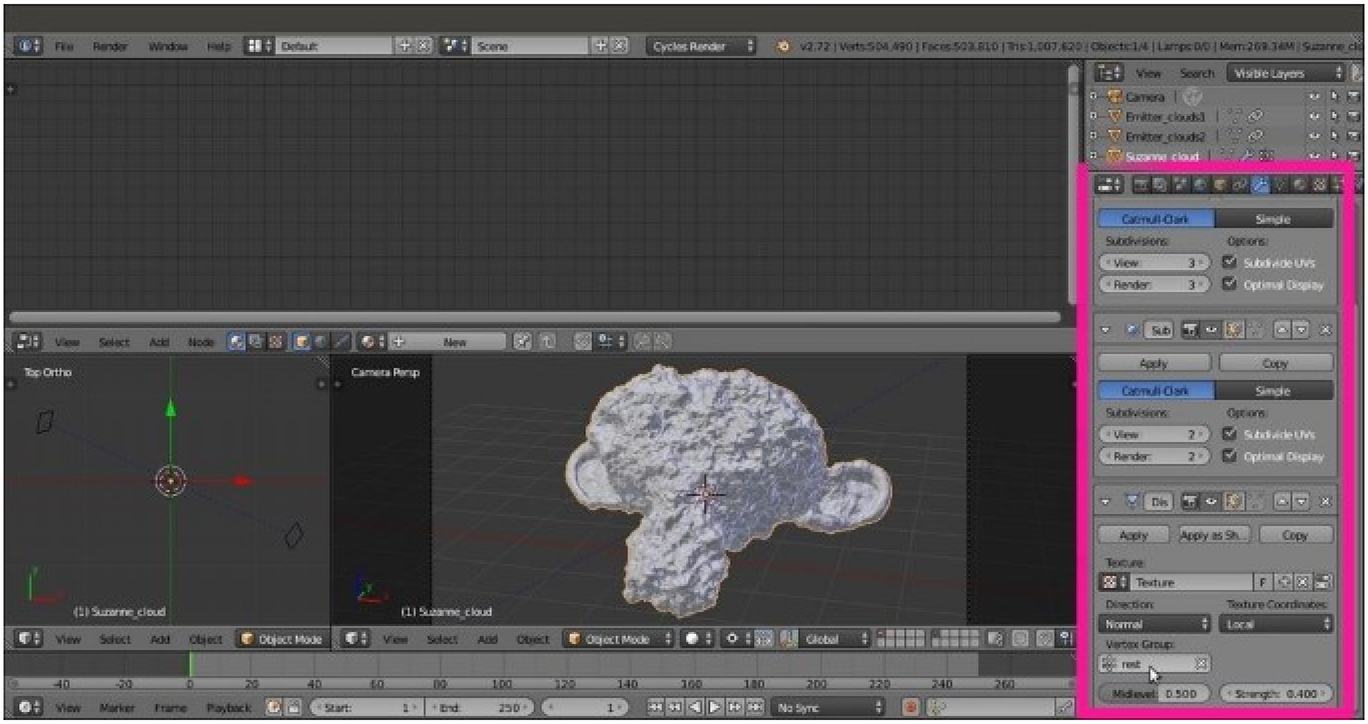


The volumetric Suzanne cloud as it appears in the final rendering

Getting ready

Start Blender and open the `9931OS_09_cloud_start.blend` file, where there is the **Suzanne_cloud** object with two **Emitter** mesh-lights and a bright **World** set with a **Sky Texture**.

1. Go to the **Object modifiers** window and raise the **Subdivisions** level of the **Subdivision Surface** modifier from `2` to `3` for both **Preview** and **Render**.
2. Assign a new **Subdivision Surface** modifier. Set the **Subdivisions** level to `2`.
3. Assign a **Displace** modifier. Click on the **Show texture in texture tab** button to the right of the **New** button to switch to the **Texture** window.
4. Click on the **New** button under the **Displace** item, then click on the **Type** slot to switch from **Image or Movie** to **Clouds**. Set the **Size** to `0.35` and the **Depth** to `3`.
5. Go back to the **Object modifiers** window and click on the **Vertex Group** slot to select the **rest** item. Then set the **Strength** value to `0.400`.



Catmull-Clark | Simple
Subdivisions: View: 3, Render: 3
Options: ☑ Subdivide UVs ☑ Optimal Display

Sub
Apply | Copy
Catmull-Clark | Simple
Subdivisions: View: 2, Render: 2
Options: ☑ Subdivide UVs ☑ Optimal Display

Dis
Apply | Apply as Sh... | Copy
Texture: Texture
Direction: Normal
Texture Coordinates: Local
Vertex Group: rest
Midlevel: 0.500
Strength: 0.400

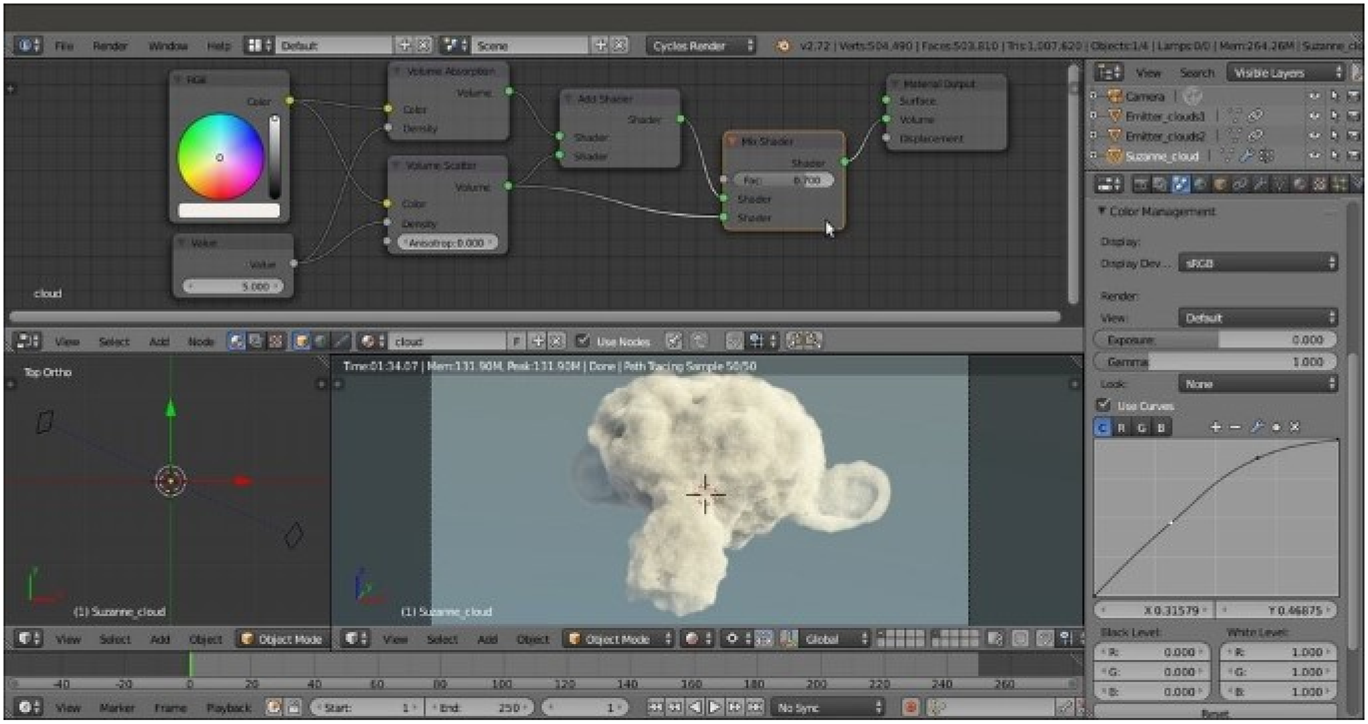
The displaced Suzanne cloud seen in the Solid Viewport Shading mode and the assigned modifiers in the main properties panel to the right

How to do it...

After creating the cloud shape, let's make a start on the material:

1. Ensure that the **Suzanne_cloud** object is still selected, and click on the **New** button in the **Node Editor** toolbar or in the **Material** window under the main **Properties** panel.
2. In the **Node Editor** window, select and delete the **Diffuse BSDF** shader node.
3. Add a **Volume Scatter** node (press *Shift* + *A* and navigate to **Shader** | **Volume Scatter**), a **Volume Absorption** node (press *Shift* + *A* and navigate to **Shader** | **Volume Absorption**), and an **Add Shader** node (press *Shift* + *A* and navigate to **Shader** | **Add Shader**).
4. Connect the output of the **Volume Absorption** node to the first **Shader** input socket of the **Add Shader** node, and the **Volume Scatter** output to the second **Shader** input socket. Connect the output of the **Add Shader** node to the **Volume** input socket of the **Material Output** node.
5. Add a **Mix Shader** node (press *Shift* + *A* and navigate to **Shader** | **Mix Shader**) and paste it between the **Add Shader** node and the **Material Output** node. Connect the output of the **Volume Scatter** node to the second **Shader** input socket of the **Mix Shader** node. Set the **Fac** value to `0.700`.
6. Add a **Value** node (press *Shift* + *A* and navigate to **Input** | **Value**) and an **RGB** node (press *Shift* + *A* and navigate to **Input** | **RGB**). Connect the **Value** output to both the **Density** input sockets of the **Volume Absorption** and **Volume Scatter** nodes. Set the input value to `5.000`.

7. Connect the output of the **RGB** node to the **Color** input sockets of the **Volume Absorption** and **Volume Scatter** nodes. Set the color values for **R** to `0.890`, **G** to `0.866`, and **B** to `0.832`.
8. Under the **Material** windows, go to the **Settings** subpanel and enable the **Homogeneous** item.
9. Go to the **Scene** window, and under the **Color Management** subpanel, enable the **Use Curves** item. Then click on the curves window to create a new control point. Set its coordinates as **X** to `0.67206` and **Y** to `0.88125`. Click again to create a new control point, and set the coordinates as **X** to `0.31579` and **Y** to `0.46875`. Have a look at the following screenshot:

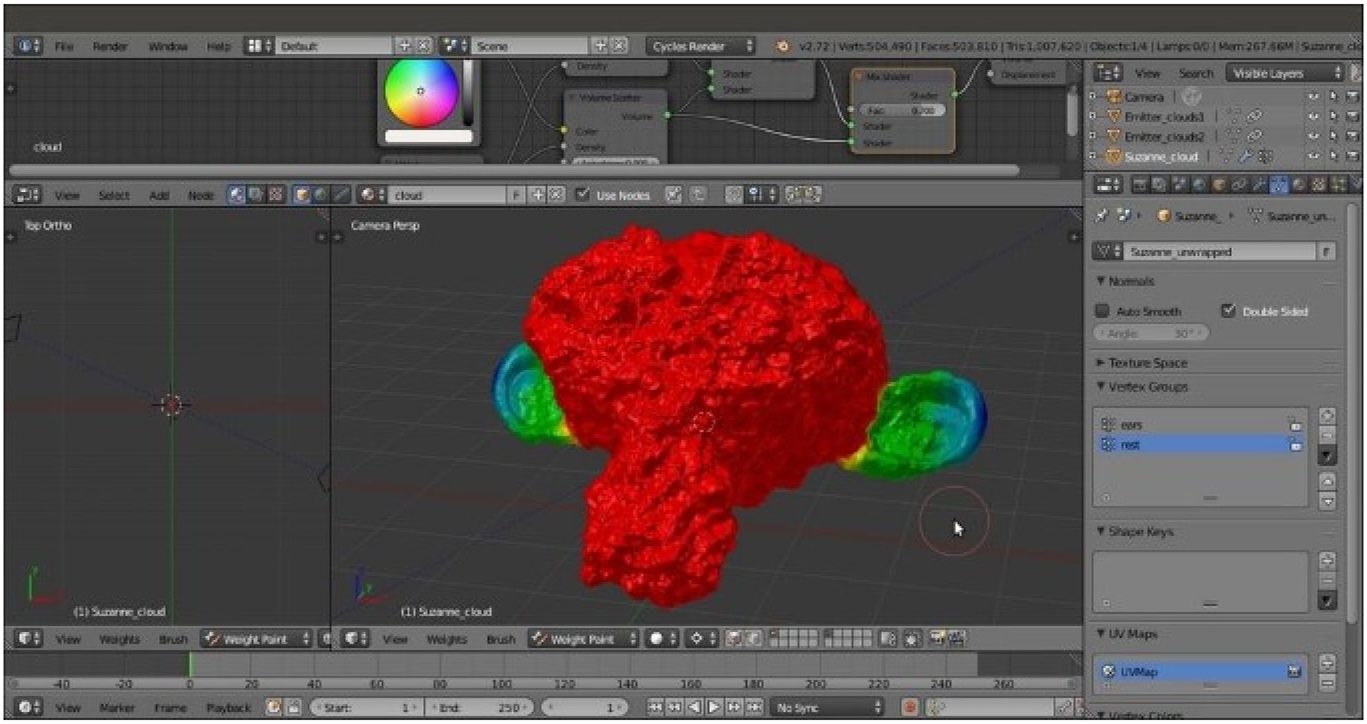


The Rendered preview of the Suzanne cloud and the material network in the Node Editor window

How it works...

Most of the effect of this material is because of the **Displace** modifier deforming the Suzanne mesh in order to resemble the shape of a Suzanne cloud. The material itself is simply a combination of the **Volume Scatter** and the **Volume Absorption** shader, first added by the **Add Shader** node and then with a **Mix Shader** node to further control the mixing of the scattering in the whole shader.

The **Vertex Group**, **rest**, selected in the **Displace** modifier slot is simply a group with lower weight going towards the ears, because they are quite thin, and the displacement we're using can easily cause bad mesh intersections.

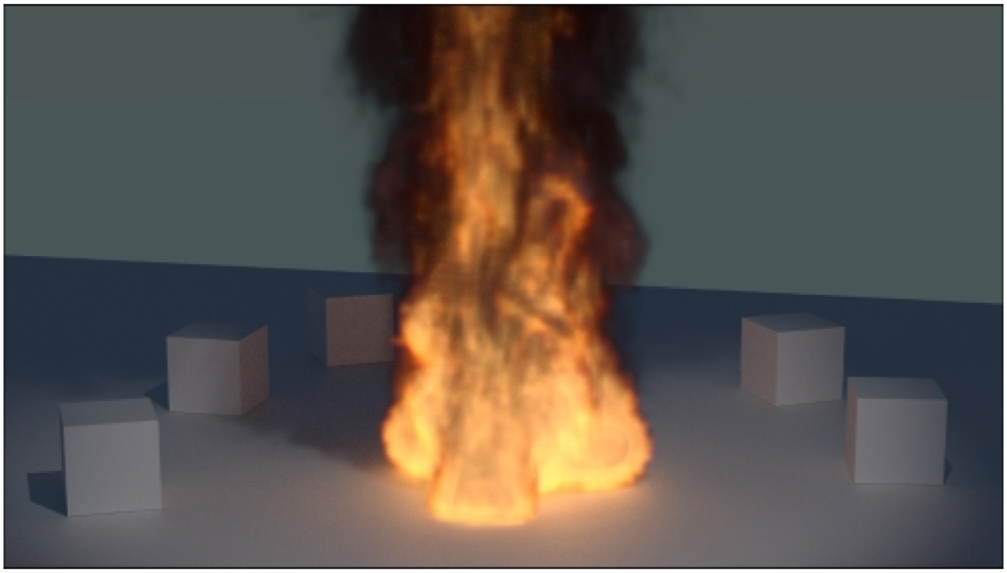


The Rest Vertex Group visible in the Weight Paint mode

In the last step, we enabled curves for the Color Management to obtain a brighter and more contrasted rendering of the cloud against the sky.

Creating a fire and smoke shader

In this recipe, we are going to see one of the most exciting effects we can obtain in Cycles—a fire and smoke simulation effect:



The fire and smoke shader as it appears in the final rendering when assigned to the Suzanne mesh

Getting ready

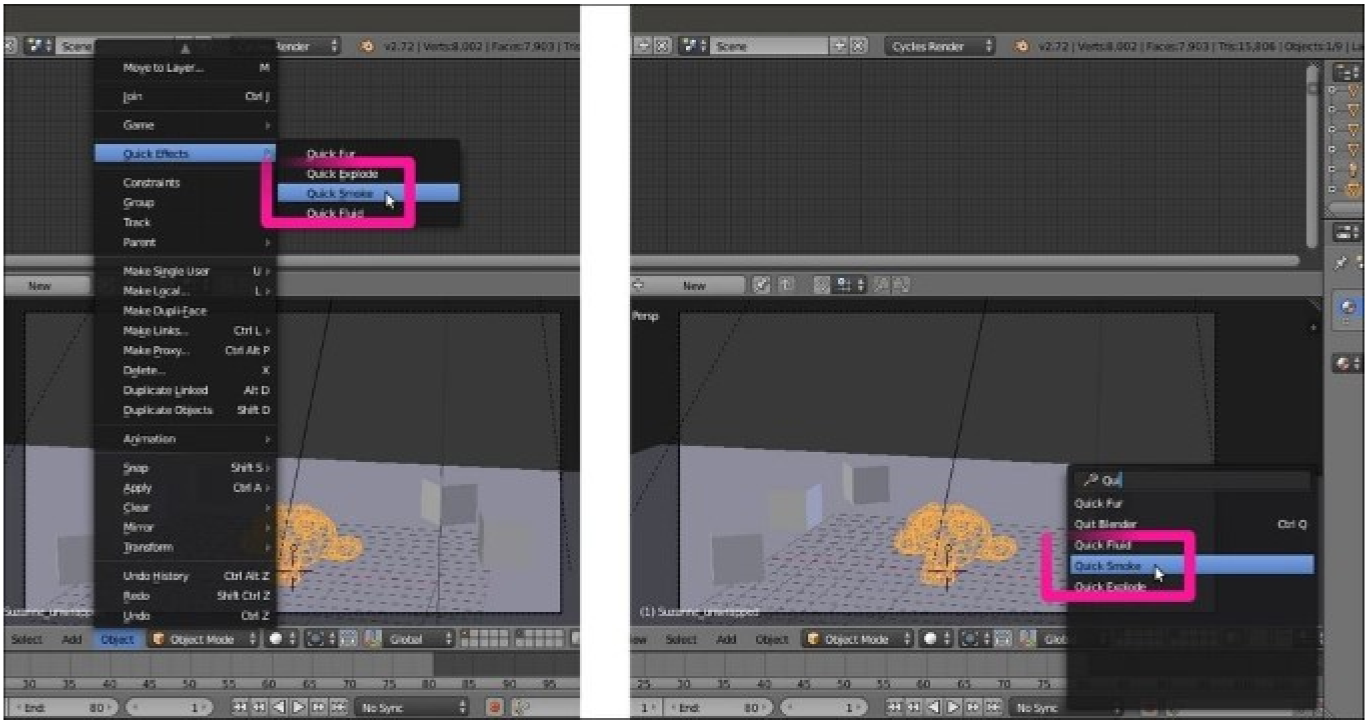
Start Blender and open the `9931OS_09_fire_smoke_start.blend` file, where there is the **Suzanne_unwrapped** object leaning on a Plane and surrounded by five small Cubes, a Spot lamp, the Camera, and a medium-intensity World with a **Sky Texture**.

1. Go to the **Render** window, and under the **Sampling** subpanel, set the **Preview** samples to `50` and the **Render** samples to `100`. Then go to the **Dimensions** subpanel and set the **End Frame** to `80`. Under the **Light Paths** subpanel, enable the **Reflective** and **Refractive Caustics** items.

How to do it...

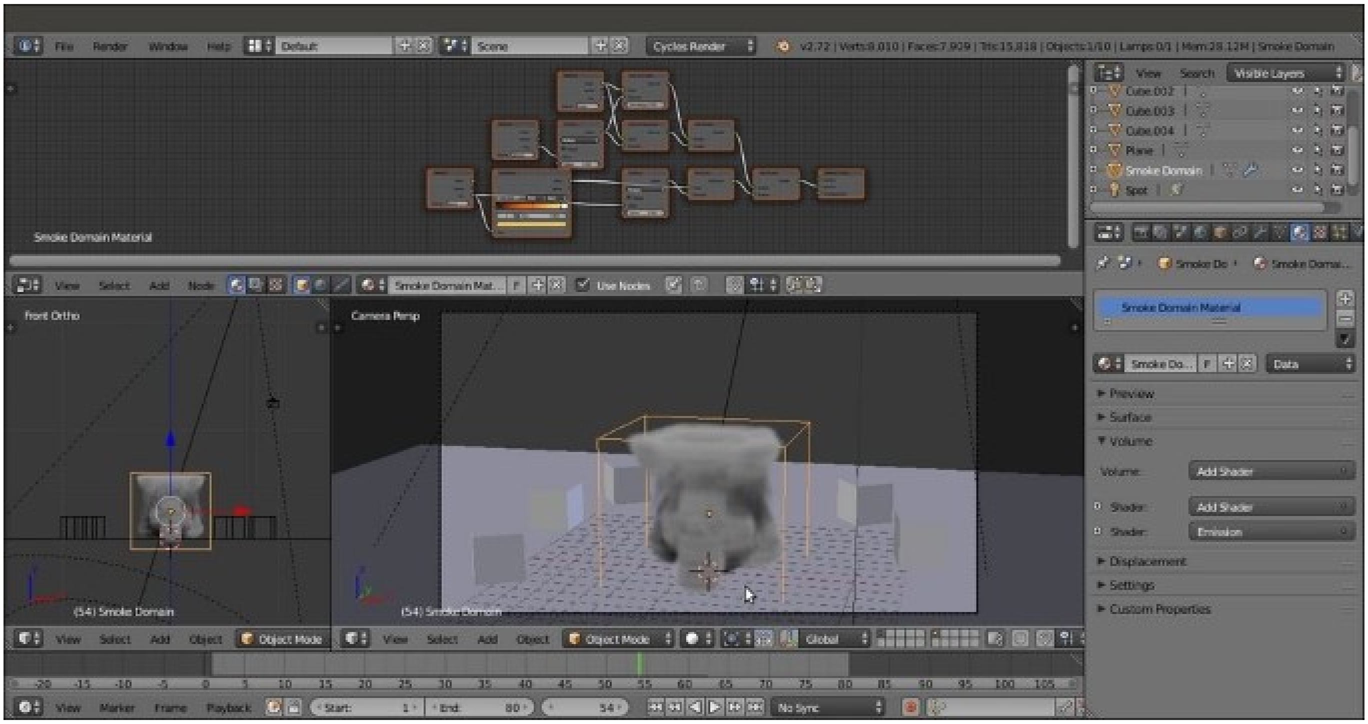
Let's start by creating the smoke simulation by a shortcut:

1. Select the **Suzanne_unwrapped** object, click on the **Object** item in the 3D viewport toolbar to go to **Quick effects**, and select the **Quick Smoke** item. Alternatively, press the spacebar, and in the search window, start typing `Quick`. Then select the **Quick Smoke** item from the menu as shown in the following screenshot:



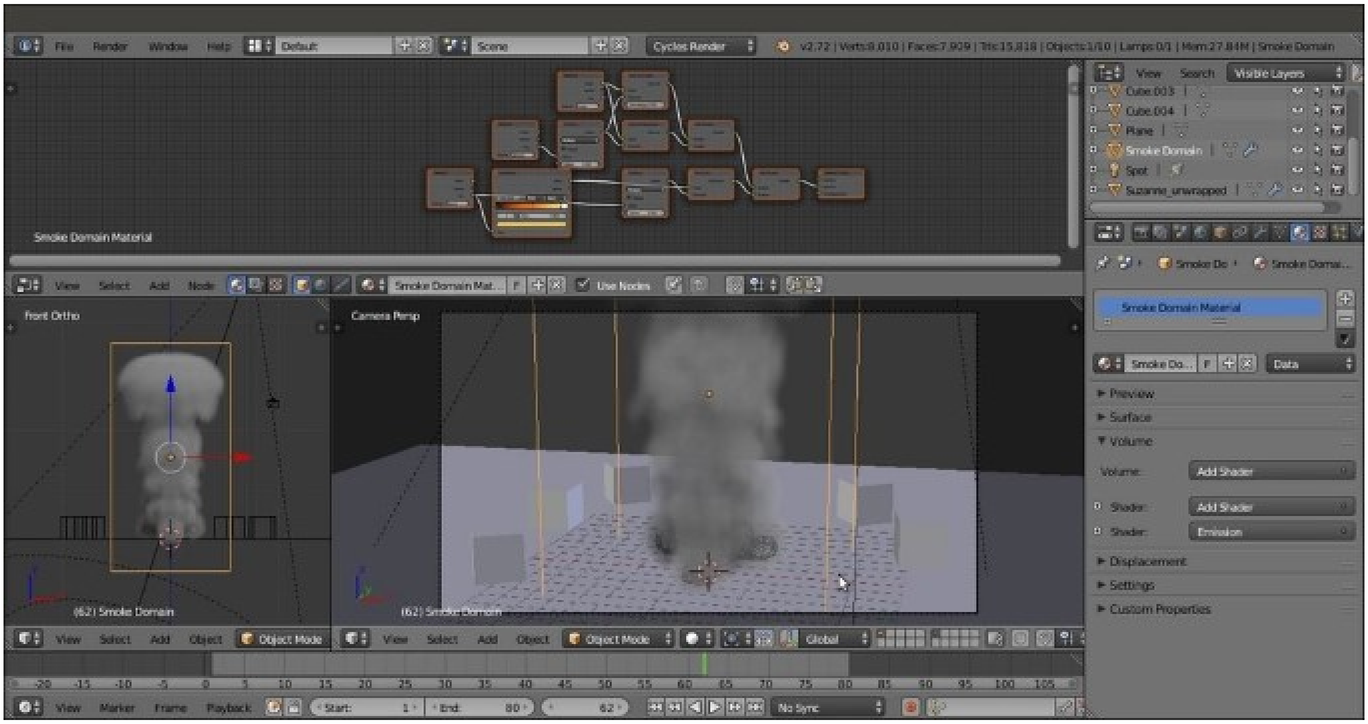
The Quick Effects menu

2. A **Smoke Domain** (the selected wire box around the **Suzanne** object) with a prepared fire/smoke material (`Smoke Domain Material`) is automatically set up on the selected object, and when you press the **Play** button in the **Player Control** on the **Timeline** toolbar, the smoke simulation starts. Have a look at the following screenshot:



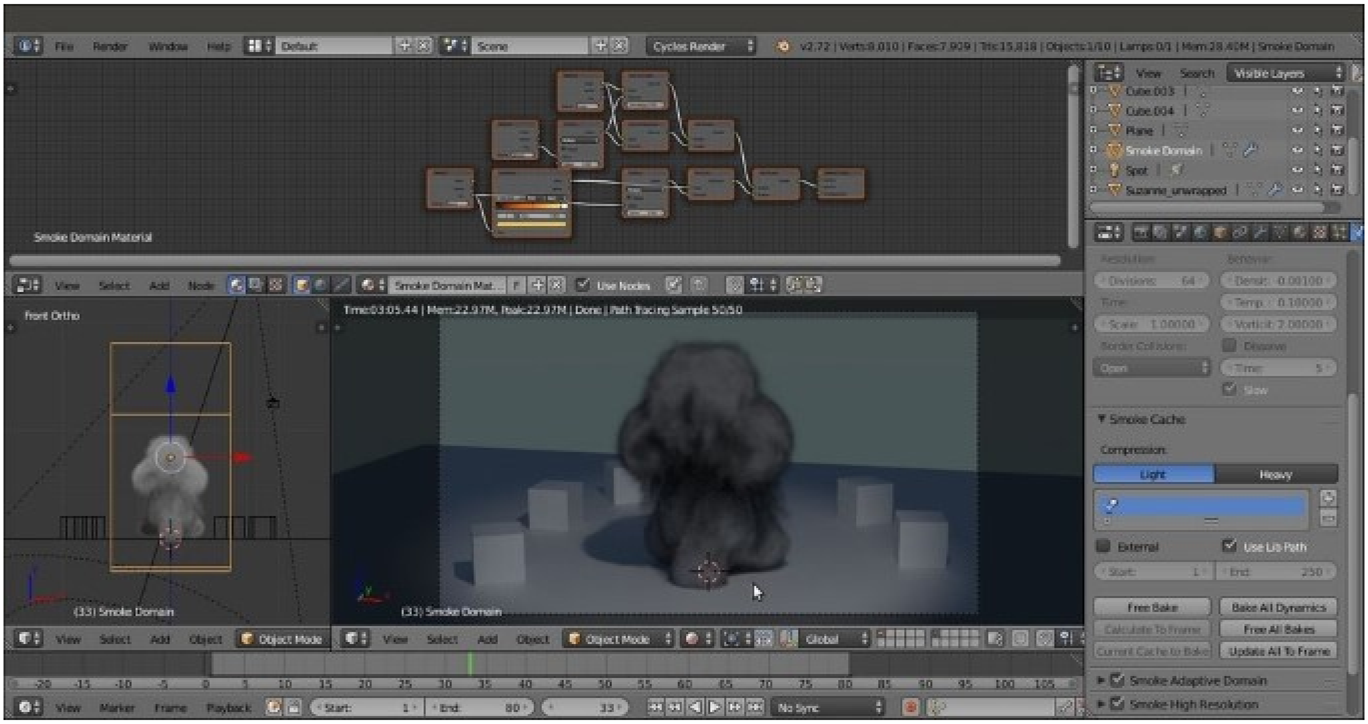
The smoke simulation: in the upper Node Editor window, the material being automatically created by the Quick Effects tool

3. Go back to frame **1** and scale the **Smoke Domain** to a larger size on the global *z* axis such that its top goes out of the Camera frame boundary. Scale it by `3.000` (press *S*, enter digit `3.000`, then press *Enter*). Then move it 5 units upwards.
4. Go to the **Physics** window, and under the **Smoke** subpanel, set the **Divisions** value to `64`. Then go to the **Smoke Flames** subpanel and set the **Speed** value to `2.00000`, **Smoke** to `0.50000`, and **Vorticity** to `1.00000`. Restart the **Play** button to recalculate the cache. Have a look at the following screenshot:



The smoke simulation inside a bigger domain box

5. As all the 80 frames have been cached, go to the **Physics** window, and under the **Smoke Cache** subpanel, click on the Current Cache to Bake button.
6. Enable the **Smoke Adaptive Domain** and the **Smoke High Resolution** subpanels. Leave the default settings as they are.
7. With the mouse arrow in the **Camera** view, press *Shift* + *Z* to switch to the **Rendered** viewport shading mode. Have a look at the following screenshot:

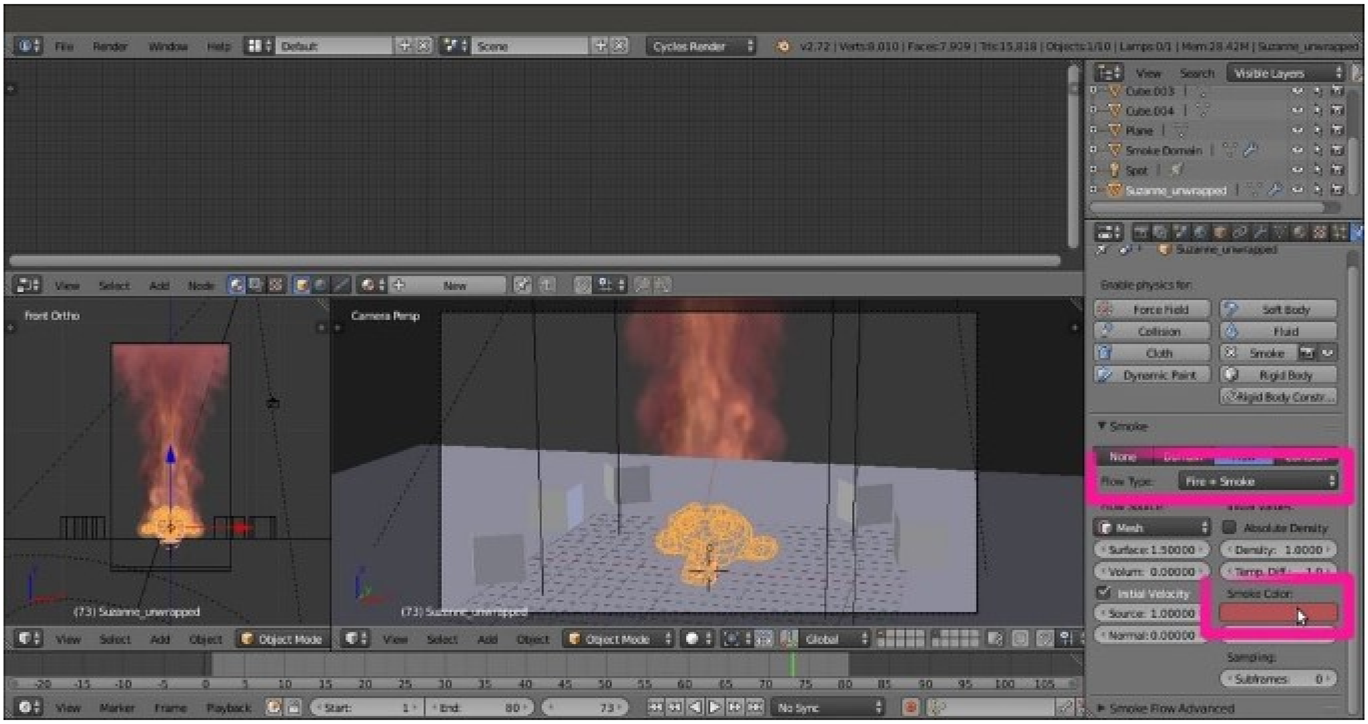


Divisions: 64
Dens: 0.00100
Temp: 0.10000
Scale: 1.00000
Vortic: 2.00000
Open
☐ Dissolve
Time: 5
☑ Slow
☐ External
☑ Use Lib Path
Start: 1
End: 250
Start: 1
End: 80
33

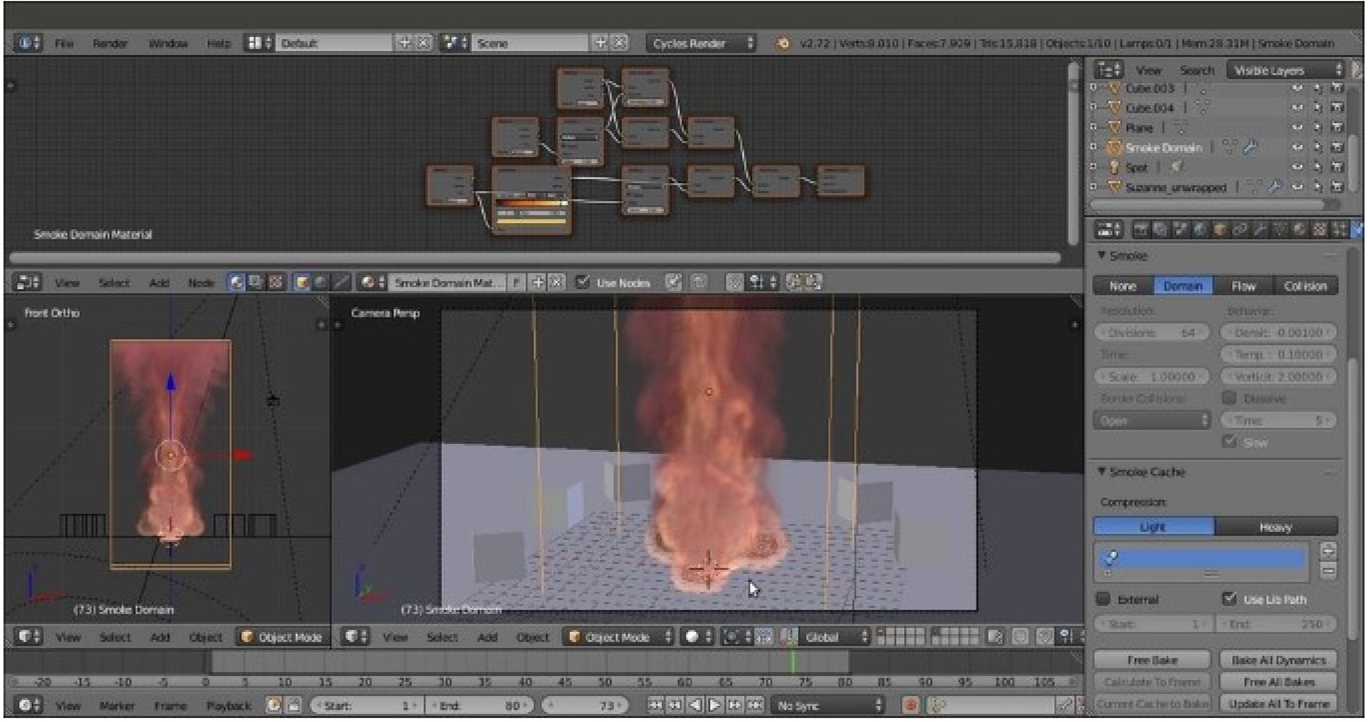
The smoke simulation seen in the Rendered preview

In the **Rendered** preview (be careful that the smoke is not supported by GPU yet), we can see the dark grey smoke, but what about the fire?

8. In the **Physics** window, under the **Smoke Cache** subpanel, click on the **Free All Bakes** button.
9. Go to the **Outliner** to select the **Suzanne_unwrapped** item. Then go to the **Physics** window again. Under the **Smoke** subpanel, click on the **Flow Type** slot and switch from **Smoke** to **Fire + Smoke**. Then click on the **Smoke Color** slot and change the color values for **R** to `0.700`, **G** to `0.317`, and **B** to `0.335`. Have a look at the following screenshot:



10. Reselect the **Smoke Domain** object and click on the **Play** button to cache the smoke simulation again, this time with reddish smoke and also the fire. Then click on the **Current Cache to Bake** button again.

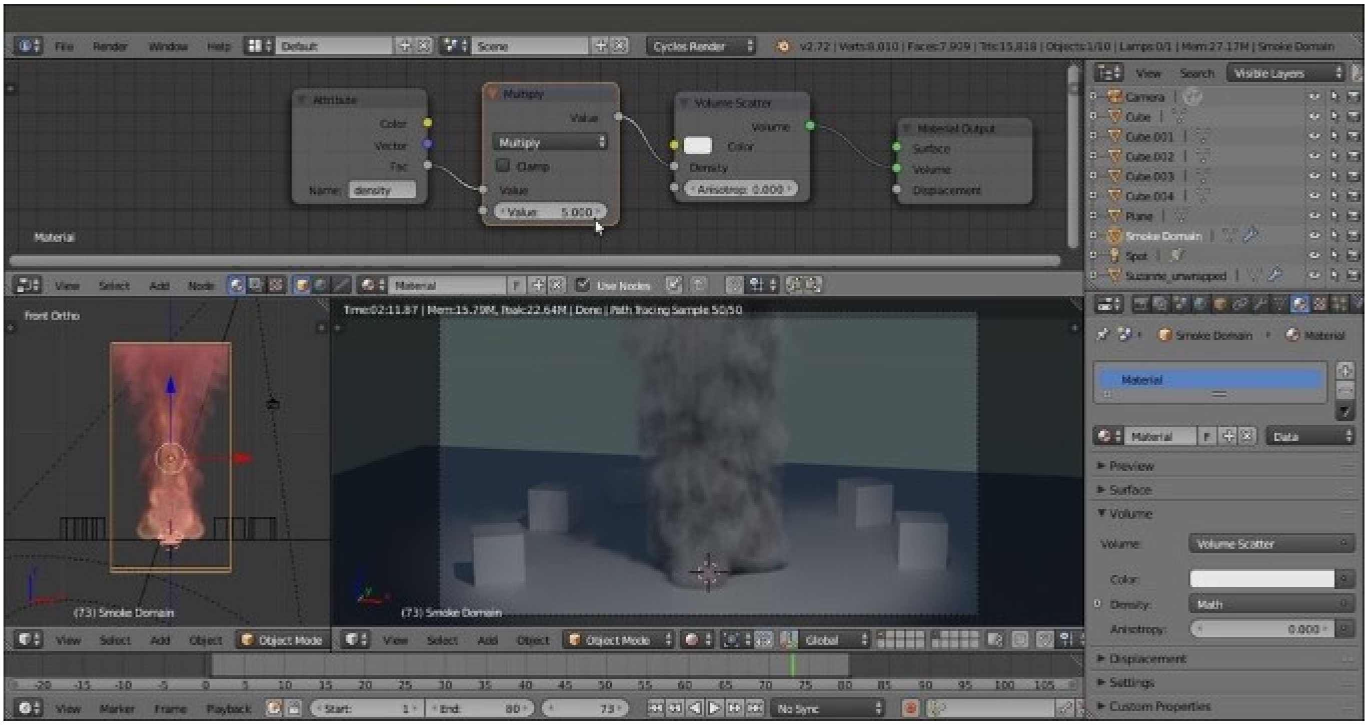


The new smoke (and fire) simulation

But this is a Cookbook about materials, so let's put aside the smoke simulation settings and concentrate on the material. To better understand how this works, let's delete the ready-made material and create a new material from scratch.

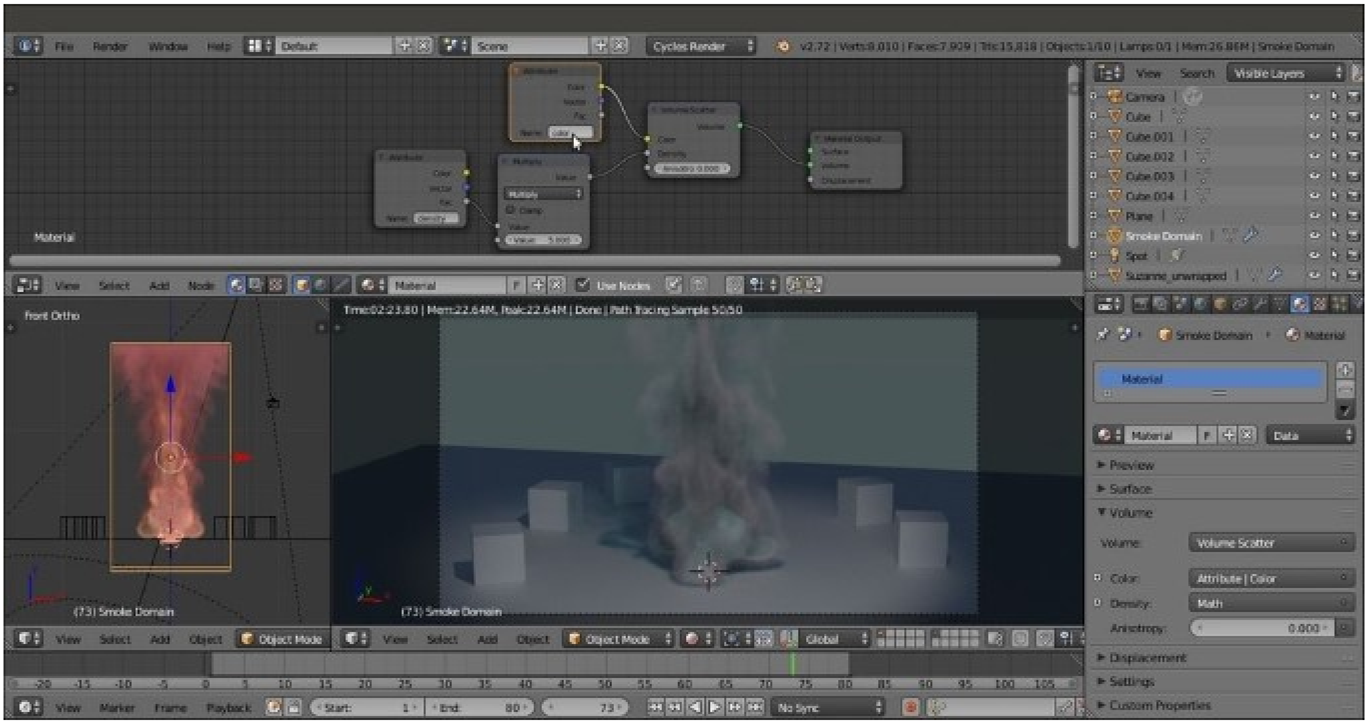
11. In the **Node Editor** toolbar, press *Shift* and click on the **X** button to unlink the `Smoke Domain Material`. Set the users to zero.

    Now, setting the **Camera** view shading mode to **Rendered** shows only the Smoke Domain box as a solid object because no material is assigned to the simulation.
12. Click on the **New** button in the **Node Editor** window toolbar. Delete the **Diffuse BSDF** shader node and add a **Volume Scatter** node (press *Shift* + *A* and navigate to **Shader** | **Volume Scatter**). Connect it to the **Volume** input socket of the **Material Output** node.
13. Add an **Attribute** node (press *Shift* + *A* and navigate to **Input** | **Attribute**) and connect its **Fac** output to the **Density** input socket of the **Volume Scatter** node. In the **Name** field of the **Attribute** node, write `density`.
14. Add a **Math** node (*Shift* + *A* | **Converter** | **Math**), set the **Operation** to **Multiply**, and paste it between the **Attribute** and the **Volume Scatter** nodes. Set the second **Value** to `5.000`.



Building the smoke density after deleting the default Quick Effects material

15. Press *Shift* + *D* to duplicate the **Attribute** node, connect the duplicated node's output to the **Color** input socket of the **Volume Scatter** node. In the **Name** field, write `color`.



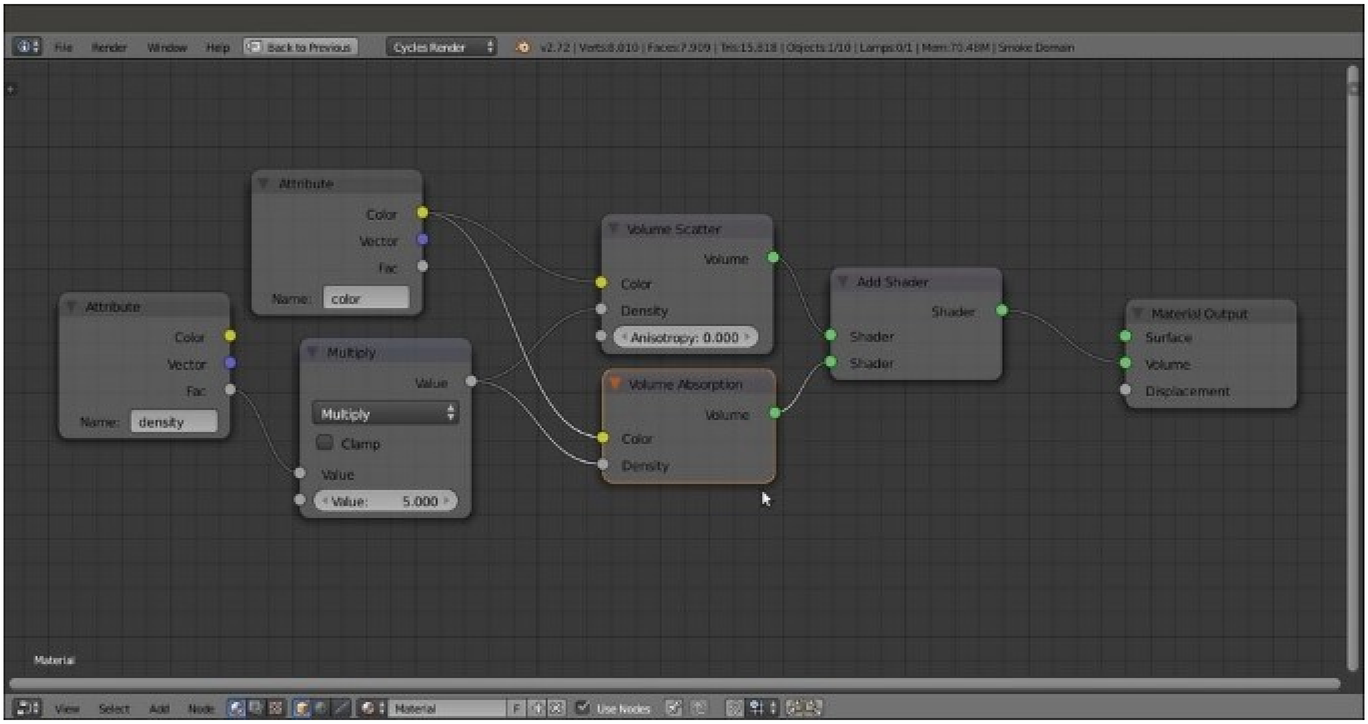
Time:02:23.80 | Mem:22.64M, Peak:22.64M | Done | Path Tracing Sample 50/50

Volume: Volume Scatter
Color: Attribute | Color
Density: Math
Anisotropy: 0.000

The smoke color

As you can see in the rendered preview, the smoke gets a bluish coloration, with the complementary color (orange) getting scattered.

1. Add a **Volume Absorption** node (*Shift* + *A* | **Shader** | **Volume Absorption**) and an **Add Shader** node (*Shift* + *A* | **Shader** | **Add Shader**). Paste the **Add Shader** node between the **Volume Scatter** and the **Material Output** nodes. Then connect the **Volume Absorption** output to the second **Shader** input socket of the **Add Shader** node.
2. Connect the **Color** output of the **Color-Attribute** node to the **Color** input socket of the **Volume Absorption** node, and the output of the **Multiply** node to the **Density** input socket of the **Volume Absorption** node as shown in the following screenshot:



Name: color

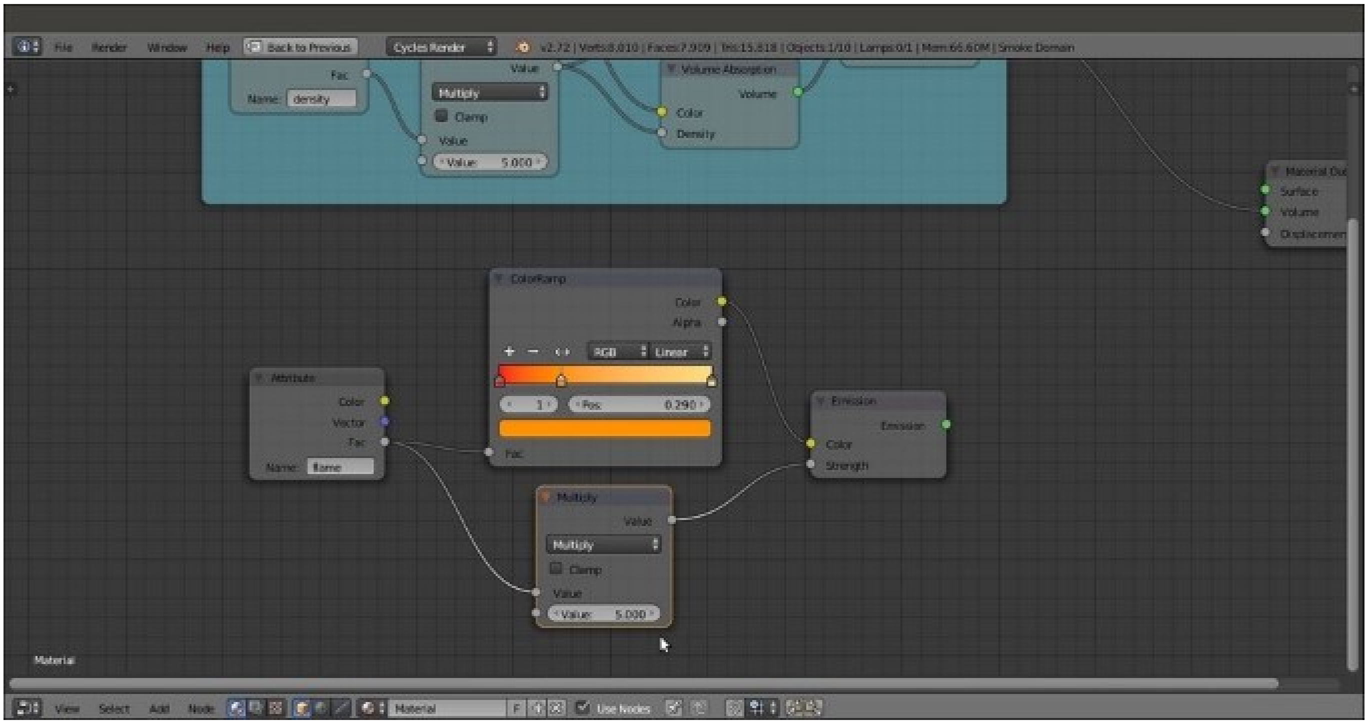
Name: density

Value: 5.000

Anisotropy: 0.000

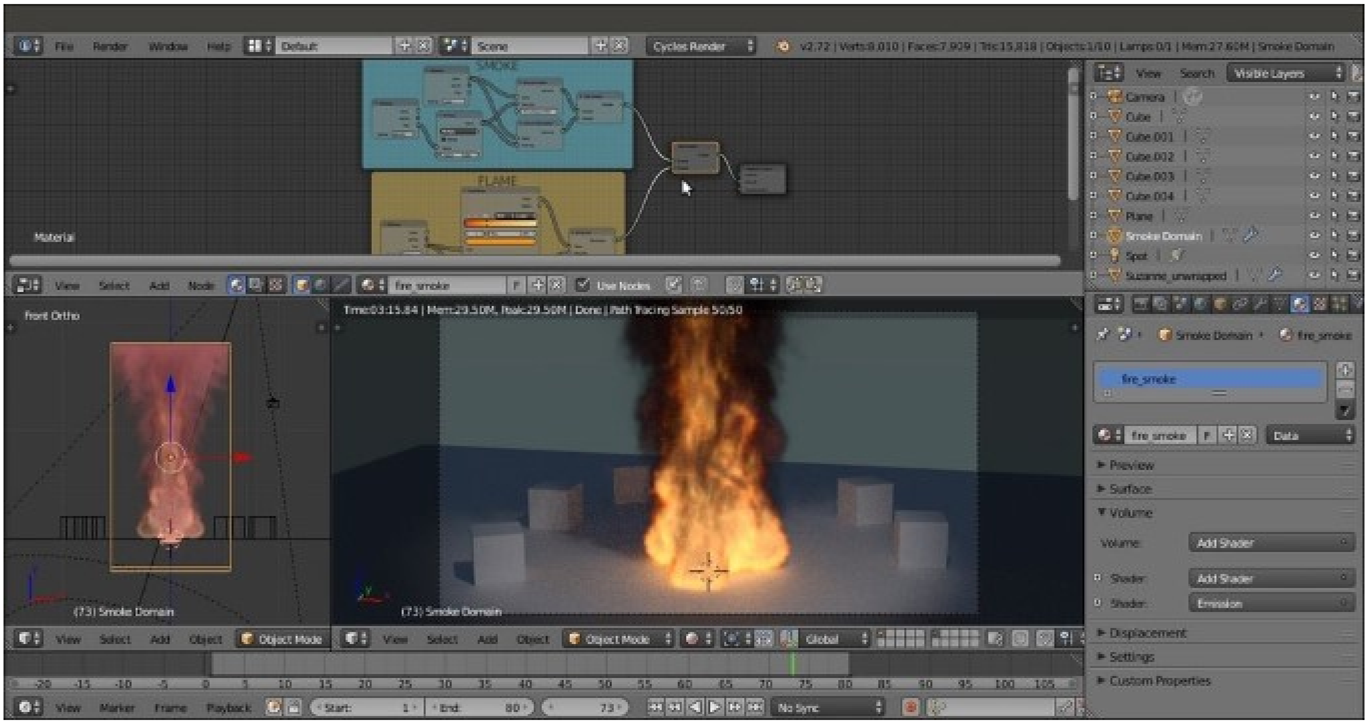
The complete smoke network

3. Parent all of these nodes, except the **Material Output** node, to a **Frame**. Label it as `SMOKE`.
4. Duplicate or add a new **Attribute** node, and in the **Name** field, write **flame**. Add an **Emission** shader (press *Shift* + *A* and navigate to **Shader** | **Emission**) and connect the **Fac** output to both the **Strength** and the **Color** input sockets of the **Emission** shader node.
5. Add a **ColorRamp** (*Shift* + *A* | **Converter** | **ColorRamp**) and paste it between the **Attribute** output and the **Color** input socket of the **Emission** node. Set the black color stop values for **R** to `1.000`, **G** to `0.000`, and **B** to `0.010`. Then set the white color stop values for **R** to `1.000`, **G** to `0.724`, and **B** to `0.224`. Add a new color stop and move it to the `0.290` position. Set the color values for **R** to `1.000`, **G** to `0.280`, and **B** to `0.000`.
6. Add a **Math** node and paste it between the **Attribute** output and the **Strength** input socket of the **Emission** node. Set the **Operation** to **Multiply** and the second **Value** to `5.000`.



Starting to build the fire shader

7. Parent these four nodes to a new **Frame** labeled as `FLAME`.
8. Add an **Add Shader** node (press *Shift* + *A* and navigate to **Shader** | **Add Shader**) and paste it between the output of the **Add Shader** inside the **SMOKE** frame and the **Material Output**. Connect the output of the **Emission** shader inside the **FLAME** frame to the second **Shader** input socket of the last **Add Shader** node.



Smoke and fire shaders added

9. Rename the material as `fire_smoke` and save the file as `9931OS_09_fire_smoke_final.blend`.

How it works...

Considering that we basically used the default settings for the fire and smoke simulation, the result was pretty good. To find out more about the different settings and types of smoke, take a look at the links provided in the *See also* section of this chapter.

We used the Quick Effects menu to let Blender automatically set up the smoke simulation for us. The steps usually involved are as follows:

- For the simulation domain, set an object that defines the bounds of the simulation volume. In our case, it was the **Smoke Domain** box in the wireframe viewport shading mode. It could be scaled, moved, or rotated if necessary.
- For the flow, set an object that determines where the smoke will be produced from, that is, the **Suzanne_unwrapped** object.
- Assign a material to the smoke. In our case, it was the automatically created `Smoke Domain Material`, which we then remade as the `fire_smoke` material.
- Bake the simulation by computing the cache for the required frames and then clicking on the **Current Cache to Bake** button.
- Save the blend file.

The `fire_smoke` material we set in the **Node Editor** is made exactly as shown in the previous volume recipes of this chapter. It consists of all the three shader nodes that can be used for a Volume: the **Volume Scatter**, the **Volume Absorption** and the **Emission** shaders, driven by the **flame**, **density** and **color** attributes we wrote in the **Name** field of the **Attribute** nodes and coming from the smoke simulation.

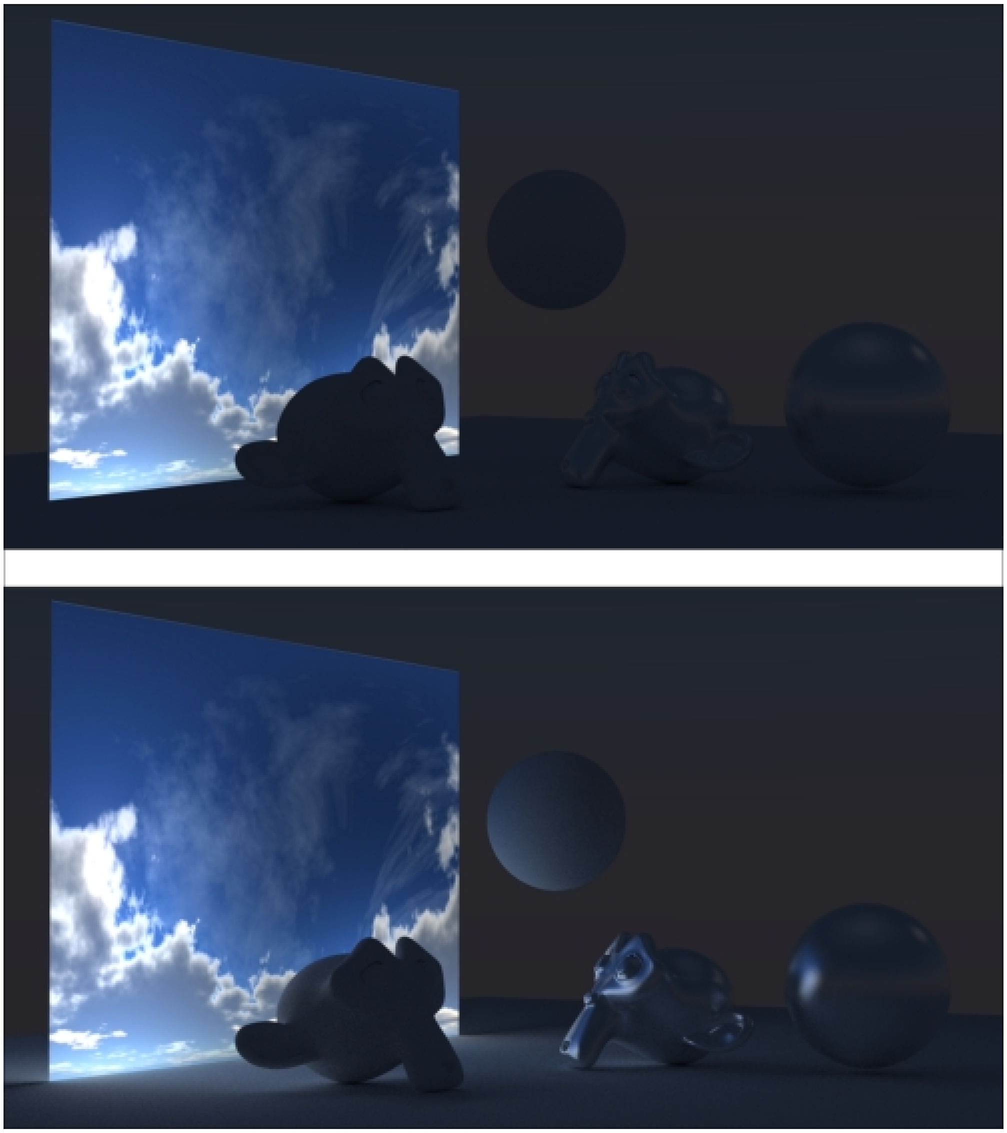
See also

- http://wiki.blender.org/index.php/Doc:2.6/Manual/Physics/Smoke
- https://cgcookie.com/blender/lessons/02-cycles-fire-and-smoke/
- http://www.blendernation.com/2014/04/14/rendering-smoke-and-fire-in-cycles/

Creating a shadeless material in Cycles

In this recipe, we will create a shadeless material, which is a material that behaves as self-illuminated but does not actually emit any light on the nearby objects.

In the following screenshot, we can see the difference between a Plane with a shadeless material and a Plane with an emitting material:



A shadeless Plane and an emitting Plane in comparison

At the top, the cloudy sky image is perfectly self-illuminated and visible, but it's neither affecting the Spheres or the Suzannes nor the floor Plane (nevertheless slightly visible because of a low intensity World).

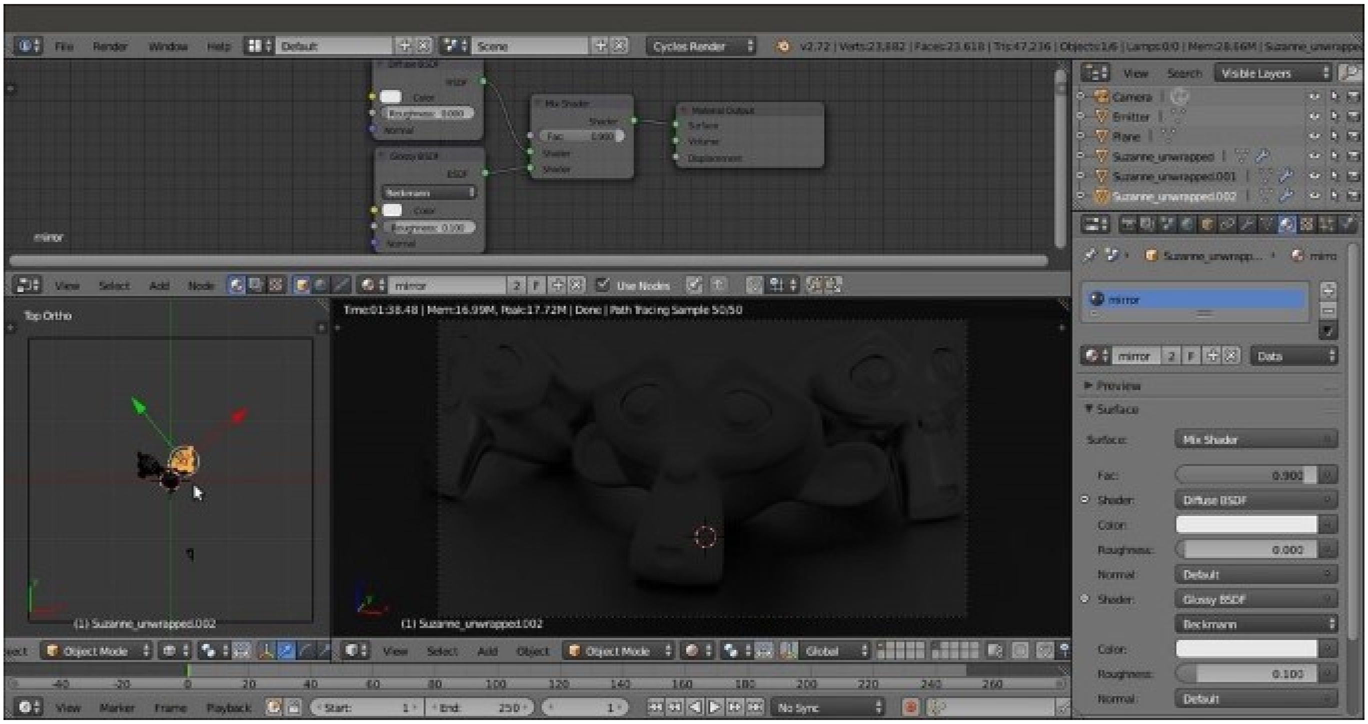
This is the reason a shadeless material is perfect for backdrop elements mapped on Planes (or more often on unwrapped half-spheres called domes) to simulate skies, clouds, and even distant trees. It can also simulate forests and mountains in the background of a scene.

In Blender Internal, obtaining a shadeless material is very simple. Enabling the appropriate item in the material panel is enough. In Cycles, there are two methods to obtain this effect: one based on the material and the other based on the **Ray Visibility** subpanel in the **Object** window, under the main **Properties** panel.

Getting ready

Start Blender and open the `9931OS_09_start.blend` file. Then follow these steps:

1. Go to the **Render** window, and under the **Sampling** subpanel, set the **Samples** to `50` for **Preview** and `100` for **Render**.
2. Set the **Camera** view to the **Rendered** shading mode by pressing *Shift* + *Z* with the mouse arrow in the viewport.
3. Go to the **World** window and set the **Background** strength to `0.200`.
4. Go to **Outliner** and select the **Emitter** object. In the **Node Editor** window, set the **Strength** of the **Emission** shader node to `0.100`.
5. Select the **Plane** object, and in the **Material** window under the main **Properties** panel to the right, replace the **Diffuse BSDF** shader with a **Glossy BSDF** shader node. Switch the **Distribution** of this node from **GGX** to **Beckmann** and set the **Roughness** value to `0.200`.
6. Select the **Suzanne_unwrapped** object and click on the **New** button in the **Node Editor** window toolbar, or in the **Material** window under the main **Properties** panel to the right.
7. With the mouse arrow in the bottom-left corner of the 3D window, press the *7* key in the numeric keypad to switch to the **Top Ortho** view. Press *Shift* + *D* to duplicate the Suzanne mesh, and move it to the left of the scene. Rotate it to accommodate it close to the original mesh. Click on the **2** button to the side of the **Material** datablock in the **Node Editor** window toolbar to make it single-user.
8. In the **Material** window, switch the **Diffuse BSDF** node with a **Mix Shader** node. In the first **Shader** slot, select a **Diffuse BSDF** node, and in the second **Shader** slot, select a **Glossy BSDF** shader node. Set the **Glossy** distribution to **Beckmann**, the **Roughness** value to `0.100`, and the **Fac** value of the **Mix Shader** node to `0.900`. Rename the material as `mirror`.
9. Press *Shift* + *D* to duplicate the `mirror` Suzanne mesh, and move it to the right of the scene, close to the original mesh.



v2.72 | Verts:23,882 | Faces:23,618 | Tris:47,236 | Objects:1/6 | Lamps:0/0 | Mem:28.66M | Suzanne_unwrappe

Time:01:38.48 | Mem:16.99M, Peak:17.72M | Done | Path Tracing Sample 50/50

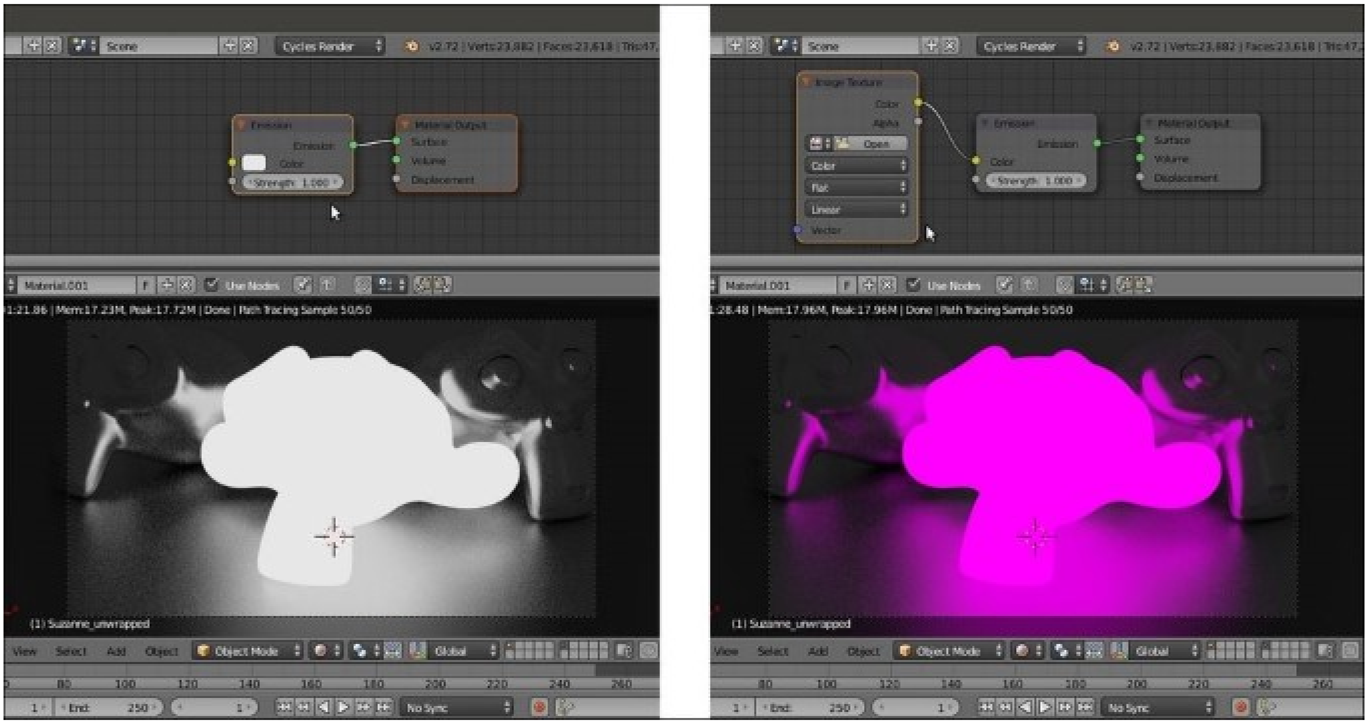
Surface: Mix Shader
Fac: 0.900
Shader: Diffuse BSDF
Color:
Roughness: 0.000
Normal: Default
Shader: Glossy BSDF
Beckmann
Color:
Roughness: 0.100
Normal: Default

The three Suzannes on the floor Plane in the dark

How to do it...

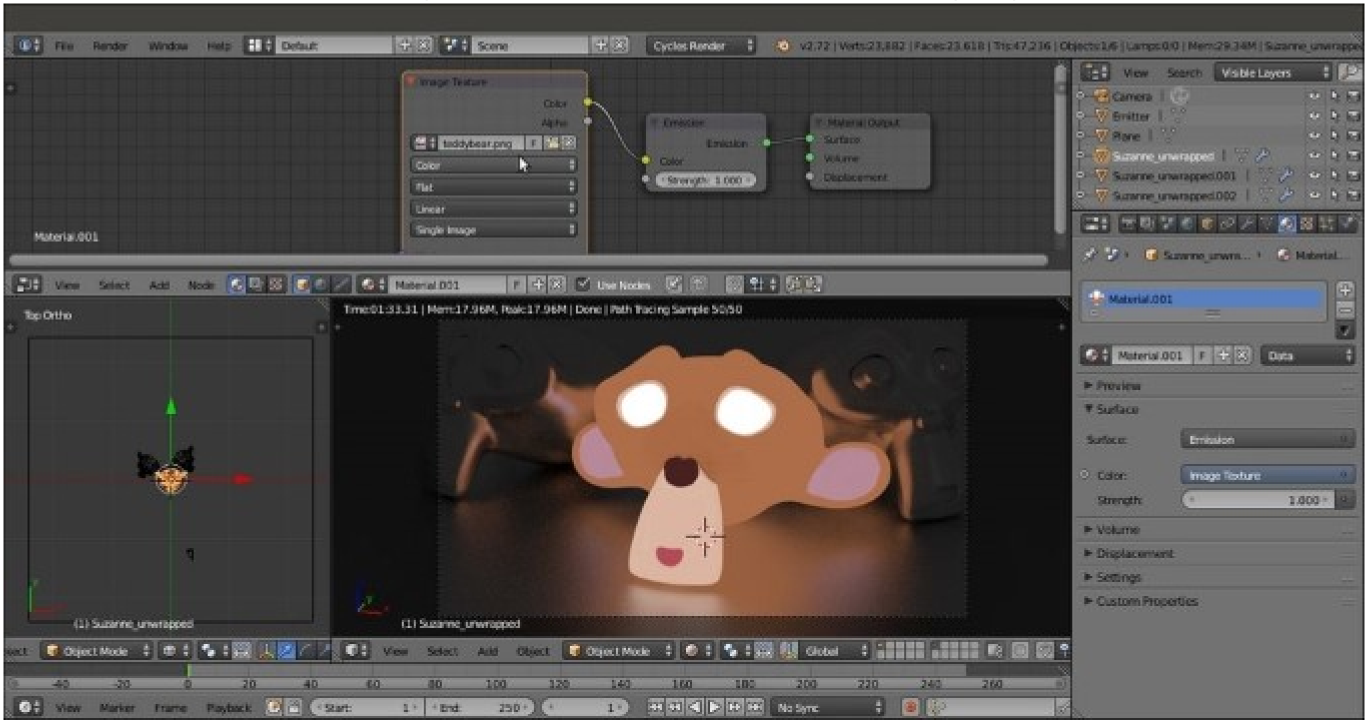
Let's start with the first method, based on the material:

1. Select the original **Suzanne_unwrapped** mesh, which is in the middle, and click on the **New** button in the **Node Editor** window toolbar. In the **Material** window, switch the **Diffuse BSDF** shader with an **Emission** shader. Add an **Image Texture** node (press *Shift* + *A* and navigate to **Texture** | **Image Texture**) and connect its **Color** output to the **Color** input socket of the **Emission** node.
2. In the **Rendered Camera** view, the original Suzanne mesh is emitting pink light on the scene. Pink is the default color that Blender uses to tell us that we haven't loaded an image texture yet.



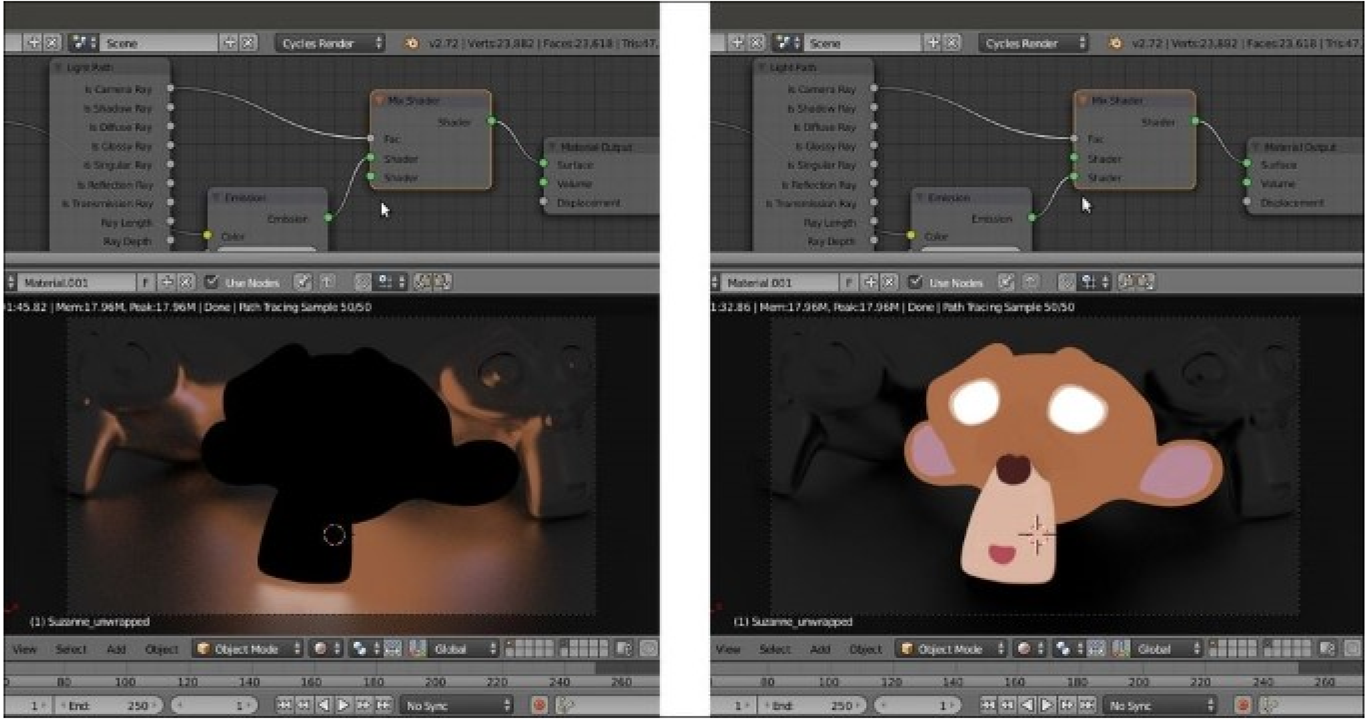
Suzanne emitting light and the texture being missing

3. Click on the **Open** button of the **Image Texture** node, browse to the `textures` folder, and load the `teddybear.png` image (which was used in [Chapter 8](#), *Creating Organic Materials*).



Suzanne with the UV-mapped texture

4. In the **Node Editor** window, add a **Mix Shader** node (press *Shift* + *A* and navigate to **Shader** | **Mix Shader**) and paste it between the **Emission** node and the **Material Output** node.
5. Add a **Light Path** node (press *Shift* + *A* and navigate to **Input** | **Light Path**) and connect its **Is Camera Ray** output to the **Fac** input socket of the **Mix Shader** node. The Suzanne mesh turns totally black (no material) but still lights the scene based on the `teddybear.png` image's values.
6. Switch the connection of the **Emission** node from the first **Shader** input socket of the **Mix Shader** node to the second **Shader** input socket.



1:45.82 | Mem:17.96M, Peak:17.96M | Done | Path Tracing Sample 50/50

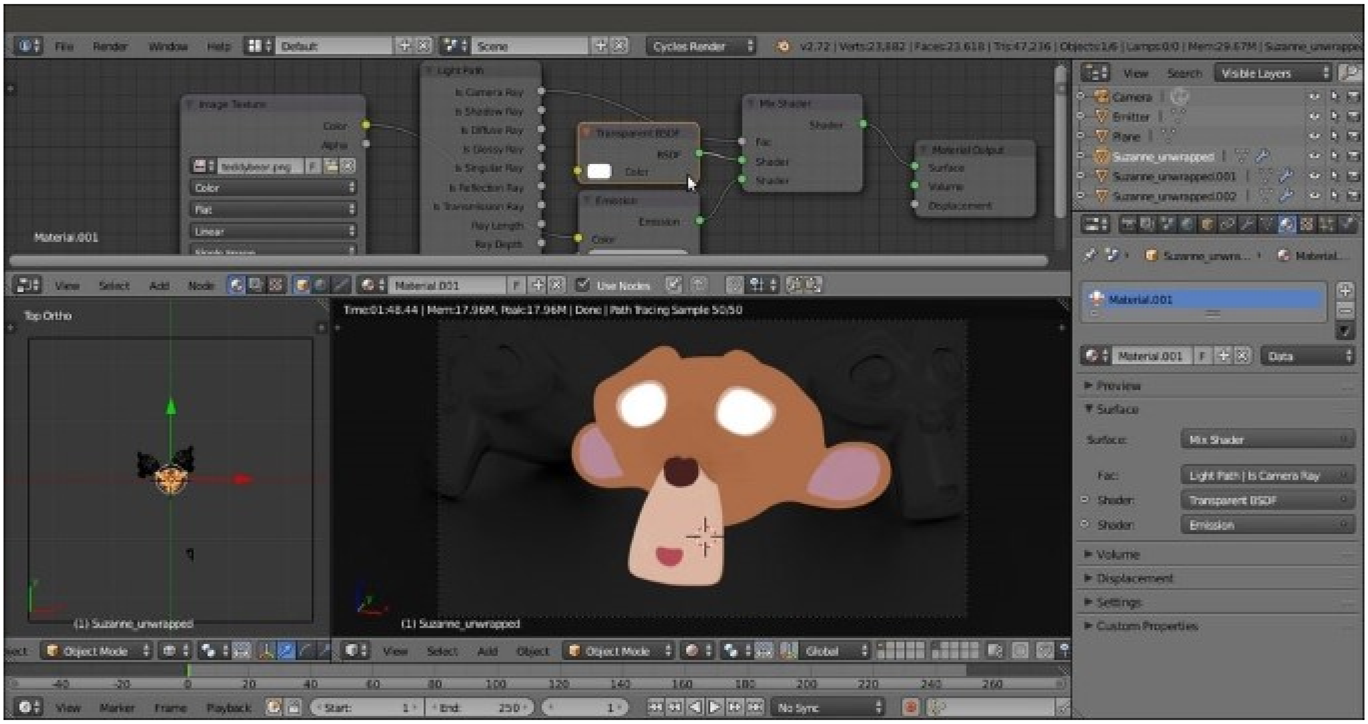
1:32.86 | Mem:17.96M, Peak:17.96M | Done | Path Tracing Sample 50/50

Inverting the order of the connections in the Mix Shader node

At this point, the shadeless Suzanne is still affecting the surrounding objects. It's reflected as a black object by the floor and by the `mirror` Suzannes. In fact, the output of the first empty input socket of the **Mix Shader** node is a black color because there is no material at all.

To prevent the shadeless Suzanne from getting reflected, follow these steps:

1. Add a **Transparent** shader node (press *Shift* + *A* and navigate to **Shader** | **Transparent BSDF**) and connect it to the first **Shader** input socket of the **Mix Shader** node.



Time:01:48.44 | Mem:17.96M, Peak:17.96M | Done | Path Tracing Sample 50/50

Surface: Mix Shader
Fac: Light Path | Is Camera Ray
Shader: Transparent BSDF
Shader: Emission

The totally shadeless Suzanne

2. Rename the material as `shadeless` and save the file as `9931OS_09_shadeless.blend`.

How it works...

Thanks to the **Is Camera Ray** output of the **Light Path** node, all the light rays from the Camera that directly hit the Suzanne mesh are rendered with the **Emission** material brightness (because this material has a value equal to 1, which is due to its connection to the second **Shader** socket of the **Mix Shader** node). For the other kind of rays (reflected, transmitted, and so on, first socket = 0 value) there is no emitting material coming from the Suzanne mesh. Actually, there is initially no material at all, and this gives a black, reflected Suzanne. Following this, to avoid the black reflections, a **Transparent BSDF** shader has been connected to the first socket of the **Mix Shader** node.

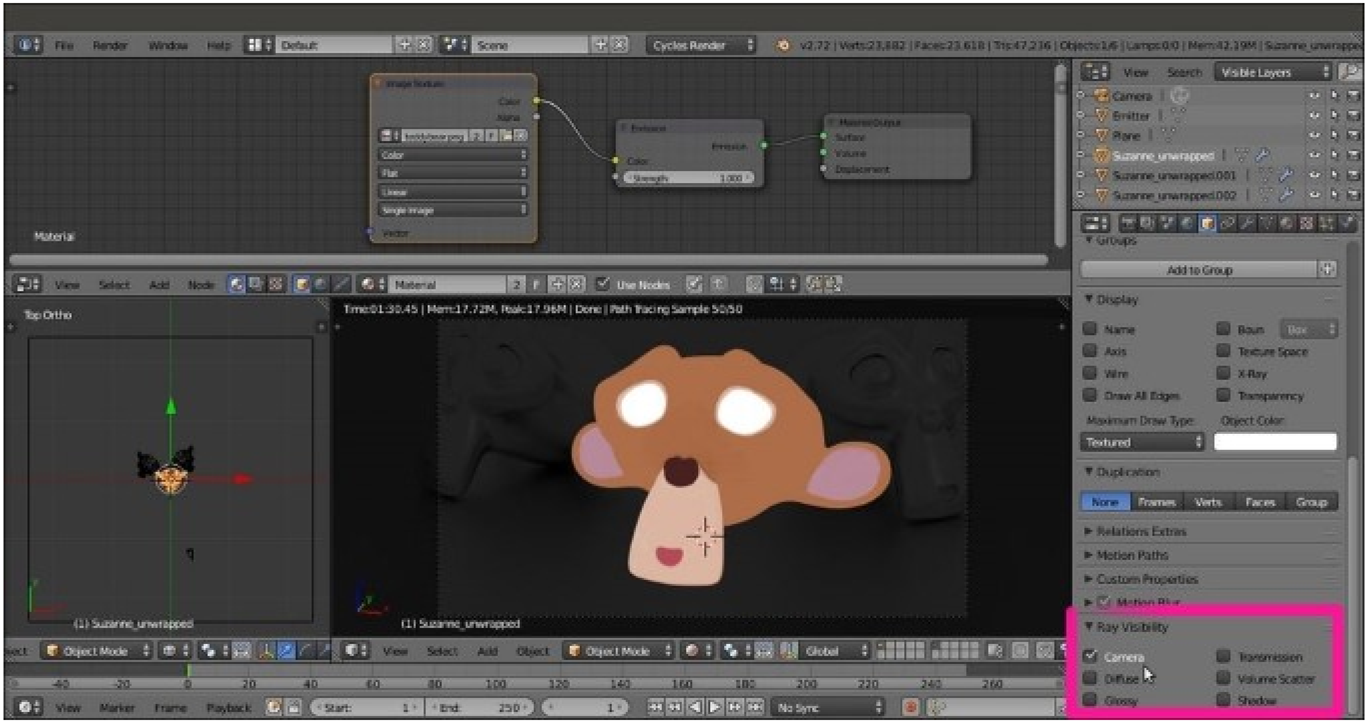
There's more...

The second method to obtain a shadeless object is as follows:

1. Starting from the preceding file, select the **Suzanne** mesh, and in the toolbar of the **Node Editor** window, click on the **F** button on the right side of the material name data block to assign a *fake user* (this is to keep the material saved in the blend file even if not assigned to anything). Then click on the **X** icon (to unlink the datablock).
2. Now click on the **New** button to create a new material. In the **Material** window under the **Properties** panel, switch the **Diffuse BSDF** with an **Emission** shader node.

3. In the **Node Editor** window, add an **Image Texture** node (press *Shift* + *A* and navigate to **Texture** | **Image Texture**) and connect its **Color** output to the **Color** input socket of the **Emission** shader.
4. Click on the **Open** button on the **Image Texture** node to load the `teddybear.png` image texture.

   At this point, we are at the same stage as step 2 of the first method. We have created a light emission material based on the image texture mapped on the Suzanne mesh.
5. Now go to the **Object** window under the main **Properties** panel to the right of the screen. In the **Ray Visibility** subpanel (usually the last at the bottom) uncheck the **Diffuse**, **Glossy**, **Transmission**, **Volume Scatter** and **Shadow** items.



Ray Visibility

☑ Camera □ Transmission

□ Diffuse □ Volume Scatter

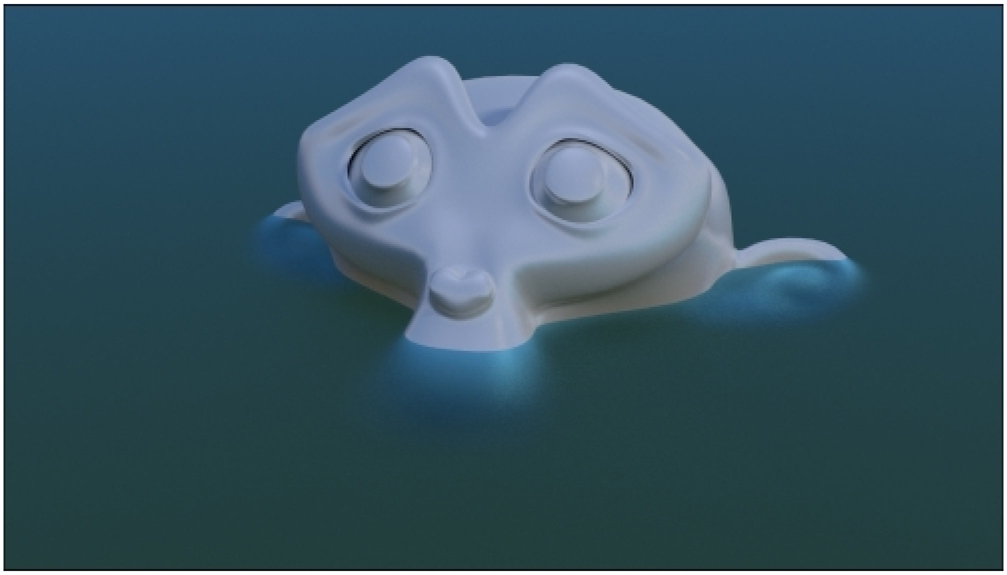
□ Glossy □ Shadow

The shadeless Suzanne obtained through the Ray Visibility subpanel

So basically, only the **Camera** item is active now. Simple, quick, and effective!

Creating a fake immersion effect material

In this recipe, we will create a material to give the effect of an object immersed in a substance becoming more and more opaque as the depth increases, for example, murky water.



The murky water effect as it appears in the final rendering

Getting ready

Start Blender and open the `9931OS_09_start.blend` file. Then follow these steps:

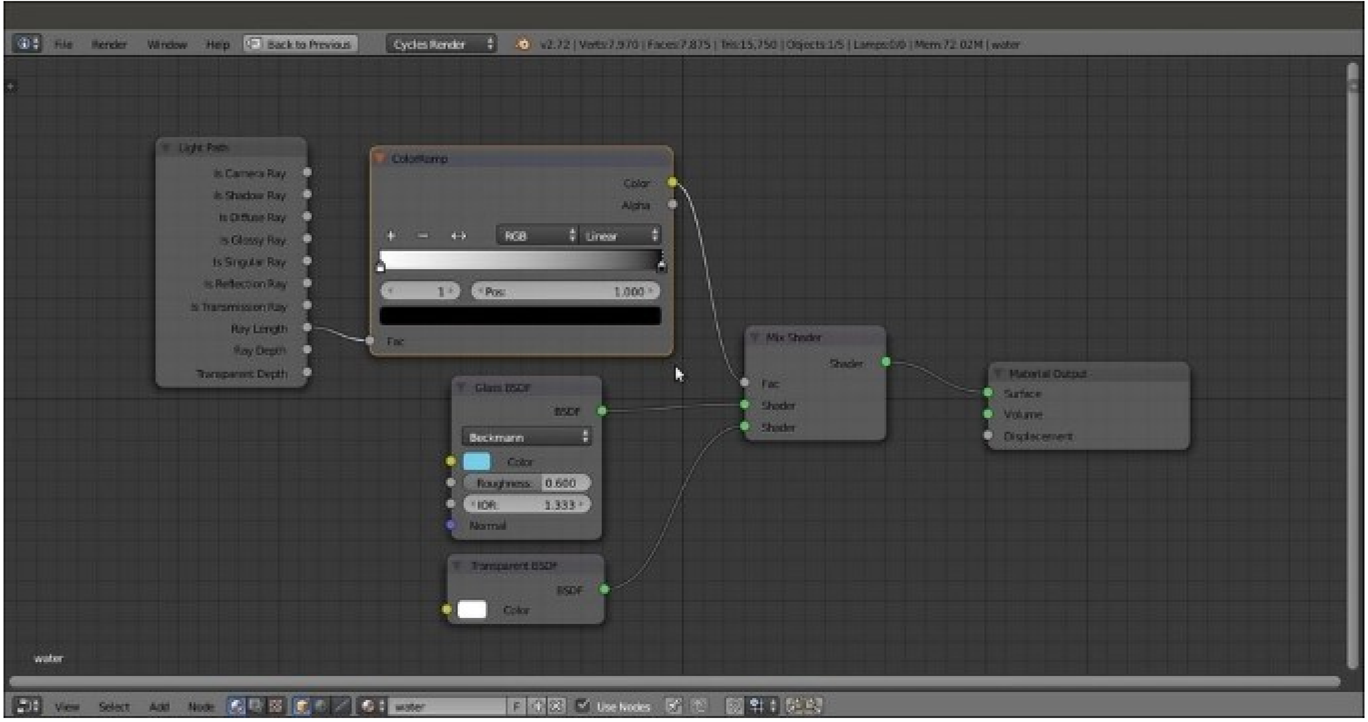
1. Go to the **World** window and click on the little dotted square on the right side of the color slot. From the menu, select **Sky Texture**. Then set the **Strength** value to `0.500`.
2. Select the Plane, rename it as **water**, and move the **Location** value of **Z** to `1.17000`. Then press *Shift* + *D* to duplicate it, rename it as `bed`, and move the **Location** value of **Z** to `-2.00000`.

How to do it...

Let's go ahead and create the different materials:

1. Go to the **Material** window and select the **Suzanne_unwrapped** mesh. In the **Node Editor** window toolbar, click on the **New** button, and rename the material as (simply) `Suzanne`. In the **Material** window under the main **Properties** panel, switch the **Diffuse BSDF** shader with a **Mix Shader** node. In the first **Shader** slot, select a **Diffuse BSDF** shader node, and in the second **Shader** slot, select a **Glossy BSDF** shader node.
2. Set the **Glossy** distribution to **Beckmann** and the **Roughness** value to `0.100`. Then set the **Fac** value of the **Mix Shader** node to `0.600`.

3. Select the **bed** Plane and click on the **New button** in the **Node Editor** window toolbar. Rename the material as `bed`.
4. In the **Material** window, switch the **Diffuse BSDF** shader with an **Emission** shader node. Set the **Color** values for **R** to `0.800`, **G** to `0.659`, and **B** to `0.264`. Then set the **Strength** value to `0.100`.
5. Select the **water** Plane and click on the **New** button in the **Node Editor** window toolbar. Rename the material as `water`.
6. In the **Material** window, switch the **Diffuse BSDF** shader with a **Mix Shader** node. In the first **Shader** slot, select a **Glass BSDF** shader node, and in the second **Shader** slot, select a **Transparent BSDF** node.
7. Set the **Glass BSDF** node's **Roughness** value to `0.600` and the **IOR** to value `1.333`. Then set the **Color** values for **R** to `0.185`, **G** to `0.611`, and **B** to `0.800`.
8. Add a **Light Path** node (press *Shift* + *A* and navigate to **Input** | **Light Path**) and a **ColorRamp** node (press *Shift* + *A* and navigate to **Converter** | **ColorRamp**). Connect the **Ray Length** output to the **Fac** input socket of the **ColorRamp** and invert the position of the black-and-white color stops (that is, move the black color stop to the extreme right and the white color stop to the extreme left of the slider).
9. Connect the **ColorRamp** output to the **Fac** input socket of the **Mix Shader** node.



The murky water material network

How it works...

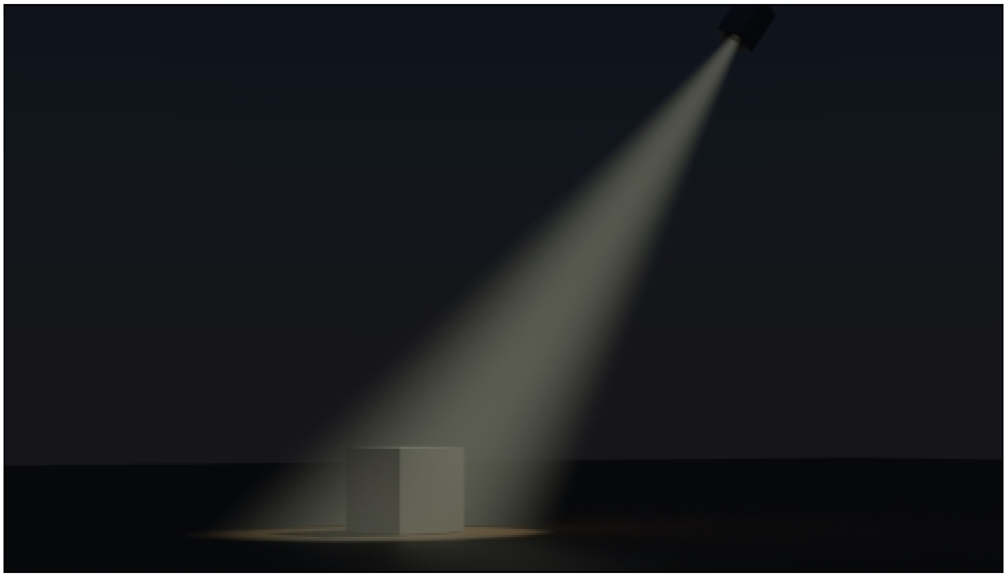
The effect happening on the `water` material is due to the **Ray Length** output, which returns the length of the light rays passing through an object, thus giving the thickness of that object. In our case, the distance from the water mesh surface to the far distance (from the Camera point of view, because the light rays originate from the Camera).

The gradient of the **ColorRamp** is mapped on the length of this **Ray Length** output (also clamped and inverted by the same **ColorRamp** node), connected to the **Fac** input socket of the **Mix Shader** node in order to work as a stencil map to smoothly blend the amount of the **Glass** shader with the amount of the **Transparent BSDF** shader node.

Thus, the transition from the **Transparent** shader to the **Glass** shader returns the impression of a volume of water becoming murkier as the distance of the object from the surface increases.

Creating a fake volume light material

In this recipe, we will create a material to fake the typical effect of a cone of light visible when passing through the dust suspended in the air, or falling from the sky on a cloudy day (the so-called God's rays) different from the real volumetric effect described in the *There's more* section of the *Using Cycles volume materials* recipe. This is a fake—just a mesh and not a real light to be used for the scene. Therefore, a matching Lamp must be set for the real lighting, as shown in the already made blend file.



The fake volume cone of light as it appears in the final rendering

Getting ready

Start Blender and open the `9931OS_09_volumelight_start.blend` file, where there is a scene set with a ground Plane, a Cube, the volumetric cone mesh (**volume_light**), a spot mesh object (**spot_mesh**), and an effective Spot lamp parented to the **volume_light**. The Spot lamp cone follows the shape of the **volume_light**, and its purpose is to light the Cube leaning on the ground Plane.

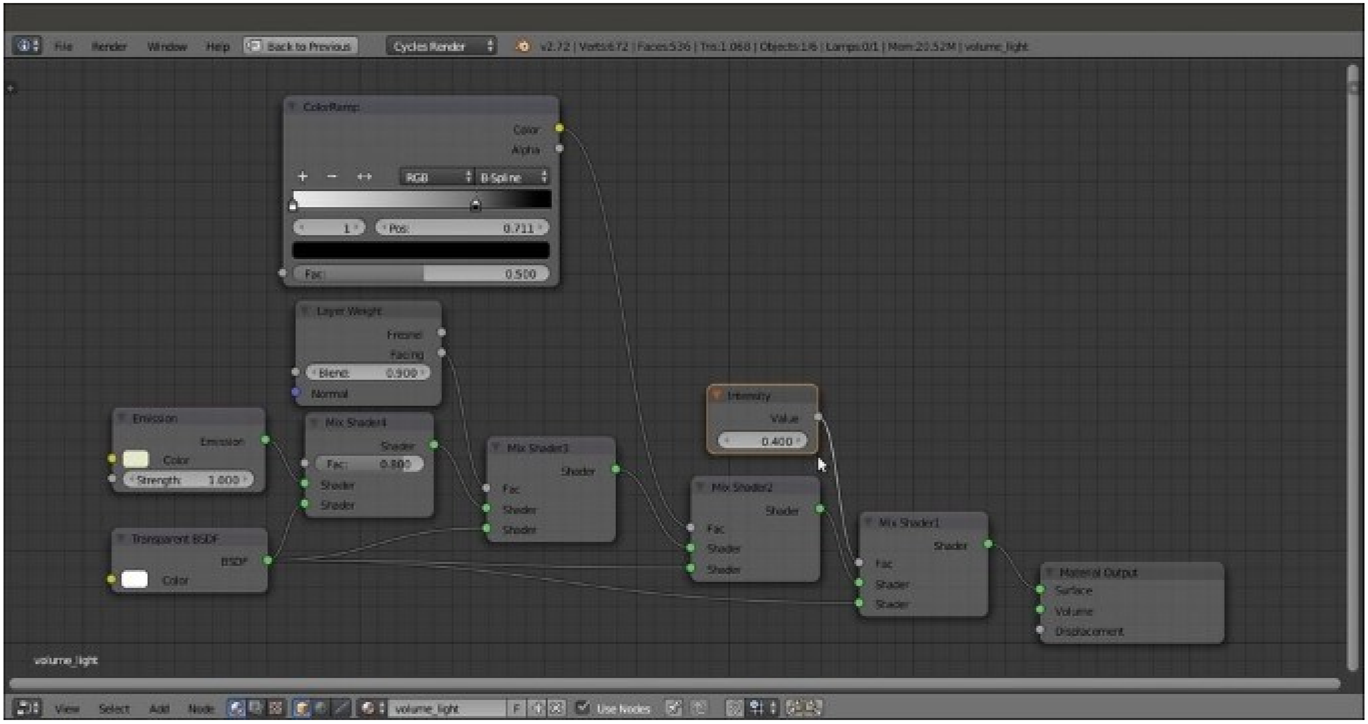
The volume light objects also have a brief animation of 98 frames. To see it, move the Time Cursor inside the **Timeline** window; to point the cone of light to the Cube, go to frame **81**.

How to do it...

Let's go ahead with creating the light cone material:

1. Select the **volume_light** object and click on the **New** button in the **Node Editor** window toolbar, or in the **Material** window under the main **Properties** panel to the right. Rename the material as `volume_light`.

2. In the **Material** window, switch the **Diffuse BSDF** shader node with a **Mix Shader** node. Label it as `Mix Shader1`.
3. In the first **Shader** slot of the **Mix Shader1** node, select a new **Mix Shader** node. Label it as **Mix Shader2**. In the second **Shader** slot, select a **Transparent BSDF** shader node.
4. Go to the **Mix Shader2** node, and in the first **Shader** slot, select a **Mix Shader** node again (**Mix Shader3**). Connect the output of the **Transparent BSDF** node to the second **Shader** slot of the **Mix Shader2** node.
5. Go to the **Mix Shader3** node, and in the first **Shader** slot, select one more **Mix Shader** node (label it `Mix Shader4`). Connect the output of the **Transparent BSDF** node to the second **Shader** slot.
6. Go to the **Mix Shader4** node, and in the first **Shader** slot, select one **Emission** node. Connect the output of the **Transparent BSDF** node to the second **Shader** slot of the **Mix Shader4** node.
7. Set the color values of the **Emission** node for **R** to `0.769`, **G** to `0.800`, and **B** to `0.592`. Then set the **Fac** value of **Mix Shader4** to `0.800`.
8. Add a **Layer Weight** node (press *Shift* + *A* and navigate to **Input** | **Layer Weight**) and connect its **Facing** output to the **Fac** input socket of the **Mix Shader3** node. Set the **Blend** value to `0.900`.
9. Add a **ColorRamp** node (press *Shift* + *A* and navigate to **Converter** | **ColorRamp**) and connect its color output to the **Fac** input socket of the **Mix Shader2** node. Set the **Interpolation** to **B-Spline** and move the black color stop to position `0`. Then move the white color stop to the extreme left.
10. Add a **Value** node (press *Shift* + *A* and navigate to **Input** | **Value**), label it as `Intensity`, and connect it to the **Fac** input socket of the **Mix Shader1** node. Set the value to `0.400`.



The entire material network

11. Save the file as `9931OS_09_volumelight_final.blend`.

How it works...

The effect of light blending with the night is obtained by the various factors of blending of the **Mix Shader** nodes that cause the mixing of the **Emission** shader with the **Transparent** shader. The purpose of connecting the **Value** node to the **Fac** input of the **Mix Shader1** node is to establish the intensity of the fake volumetric light. A value of `1.000` turns it off completely (be careful not to go beyond `1.000`, otherwise the cone mesh will show up as a dark silhouette). On the contrary, values towards `0.000` (or even negative values) make it appear more and more intense.

Be careful with this simulation because being a mesh emitting light, it can produce strange and unrealistic effects if not carefully planned. Suppose you go to frame **62** and start the rendering. Then you will see that the volumetric cone mesh is intersecting the Cube even in those areas where a real light would create shadows.

See also

Since Cycles has been added to Blender, many artists have posted screenshots and tests for almost every possible kind of material. Especially on the Blender Artists forum, you will find a plethora of data and will discover different (and often better) ways to create the same materials that you have seen in this Cookbook.

Now it's up to you to create new, amazing materials and renderings that no one can avoid staring at. Blend on!

Bibliography

This Learning Path is a blend of content, all packaged up keeping your journey in mind. It includes content from the following Packt products:

- *Blender 3D By Example By Romain Caudron and Pierre-Armand Nicq*
- *Blender 3D Cookbook By Enrico Valenza*
- *Blender Cycles: Materials and Textures Cookbook - Third Edition By Enrico Valenza*