


# Material

## Assigning a Material

Materials available in the currently open blend-file can be investigated by clicking on the Materials icon  in the Properties editor Header. In this section we look at how to assign or remove a material to/from the Active Object in Blender, either by:

- Creating a new material,
- re-using an existing material, or
- deleting a material.

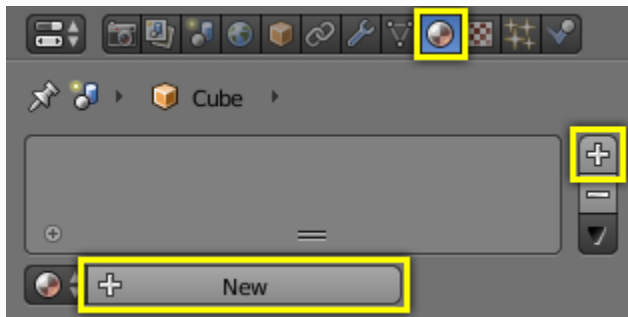
We also give hints about practical material usage.

## Creating a new Material

Every time a new Object is created it has no material linked to it. You can create a new material for the object by:

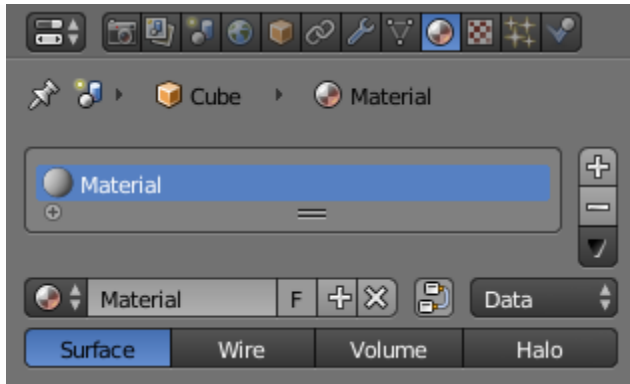
- Selecting the object.
- In the Properties editor, click on the object button.
- Click on the Materials button in the Properties editor header.

The Shading panel then appears. This contains the following elements:



- Context: The currently selected scene and object.
- Object Material Slots: this panel shows the “slots” for the material (or materials) that this object data contains.
- Active Material: Initially empty, asking for “New”.

To add a new material, click “+” in the Active Material box. This action has a series of effects:



*Materials Panel with New Entry.*

1. Opens the new material in the Active Material box.
2. Brings up additional buttons in the immediate panel.
3. Adds the new material to the Available Materials list.
4. Adds the new material to the Object Material Slots list for the active object (or its object data – see below).
5. Brings up a preview of the new material.
6. Provides you with a range of panels allowing you to select the properties of the new material.

## New Material Panel Buttons

Details of the additional buttons which appear in the Material panel for a new Active Material are as follows:

### Active Material

List View.

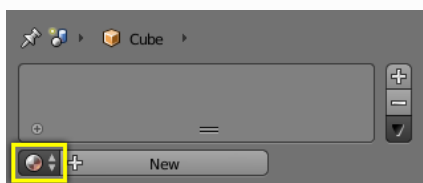
### Material

The Material [Data-Block Menu](#) for the selected Material slot.

## Reusing Existing Materials

Blender is built to allow you to reuse *anything*, including material settings, between many objects. Instead of creating duplicate materials, you can simply reuse an existing material. There are several ways to do this using the Materials data-block menu:

*Single Object* – With the object selected, click the sphere located to the left of the Material name. A pop-up appears showing all the materials available in the current blend-file. To use one, just click on it.



*Select an existing material.*

*Multiple Objects* - In the 3D View, with **Ctrl-L** you can quickly link all selected objects to the material (and other aspects) of the **active object**. Very useful if you need to set a large number of objects to the same material; just select all of them, then the object that has the desired material, and **Ctrl-L** links them to that "parent". (See Tip on Linking Data in Creating about data linking).

## Deleting a Material

To delete a material, select the material and click X in the Available Materials List entry.

Although the material will seem to disappear immediately, the Delete action can depend on how the material is used elsewhere.

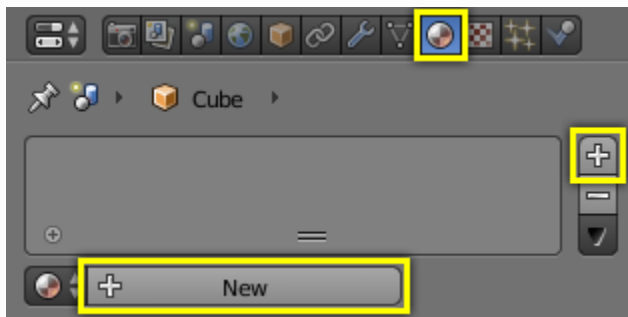
If the material is linked to the Object and there are other objects which use this material, then the material will be removed from that object (but remain on all its other objects).

If the "Fake User" button (F) has been lit in the Available Materials list, then the material will be retained when the file is saved, even if it has no users.

Only if it has 0 "real" users, and no "Fake" user, will the material be permanently deleted. Note that it will still remain in the Materials list until the blend-file is saved, but will have disappeared when the file is reloaded.

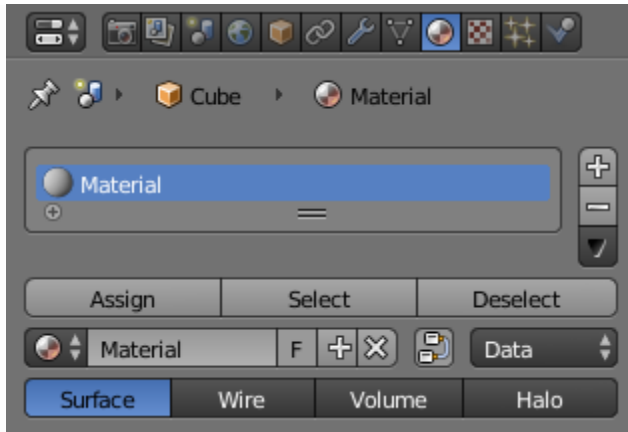
## Multiple Materials

Normally, different colors or patterns on an object are achieved by adding textures to your materials. However, in some applications you can obtain multiple colors on an object by assigning different materials to the individual faces of the object.



*Add new material.*

To apply several materials to different faces of the same object, you use the Material Slots options in the Materials header panel.



*Material menu in edit mode.*

The workflow for applying a second material to some faces of an object covered by a base material is as follows:

1. In Object Mode, apply the base material to the whole object (as shown in [Assigning a material](#)).
2. Create/select the second material (the whole object will change to this new material).
3. In the Active Material box, re-select the base material.
4. Go to Edit Mode and Face Select (a new box appears above the Active Material box with Assign/Select/Deselect).
5. Select the face/faces to be colored with the second material.
6. In the Object Material Slots box, click the **Plus** to create a new slot, and while this is still active, click on the second material in the Available Materials list.
7. Click the Assign button, and the second material will appear on the selected object faces.

You can also make this new material a copy of an existing material by adding the data-block:

Select the object, get the material, **RMB** and Copy data to clipboard. When you have renamed the material, click "Link: Data" to link to the existing material. Proceed to assign faces as required. NB: If you change the material on the original object, the new object color changes too.

## Preview

The Preview panel gives a quick visualization of the active material applied on to one of several basic objects. Including its *Shaders*, *Ramps*, *Mirror*, *Transparency* properties and *Textures*. It provides several

shapes that are very useful for designing new shaders: For some shaders (like those based on *Ramp* colors, or a Diffuse shader like *Minnaert*), one needs fairly complex or specific previewing shapes to decide if the shader being designed achieves its goal.

## Options

**Flat XY plane:-** Useful for previewing textures and materials of flat objects, like walls, paper and such.

**Sphere:-** Useful for previewing textures and materials of sphere-like objects, but also to design metals and other reflective/transparent materials, thanks to the checkered background.

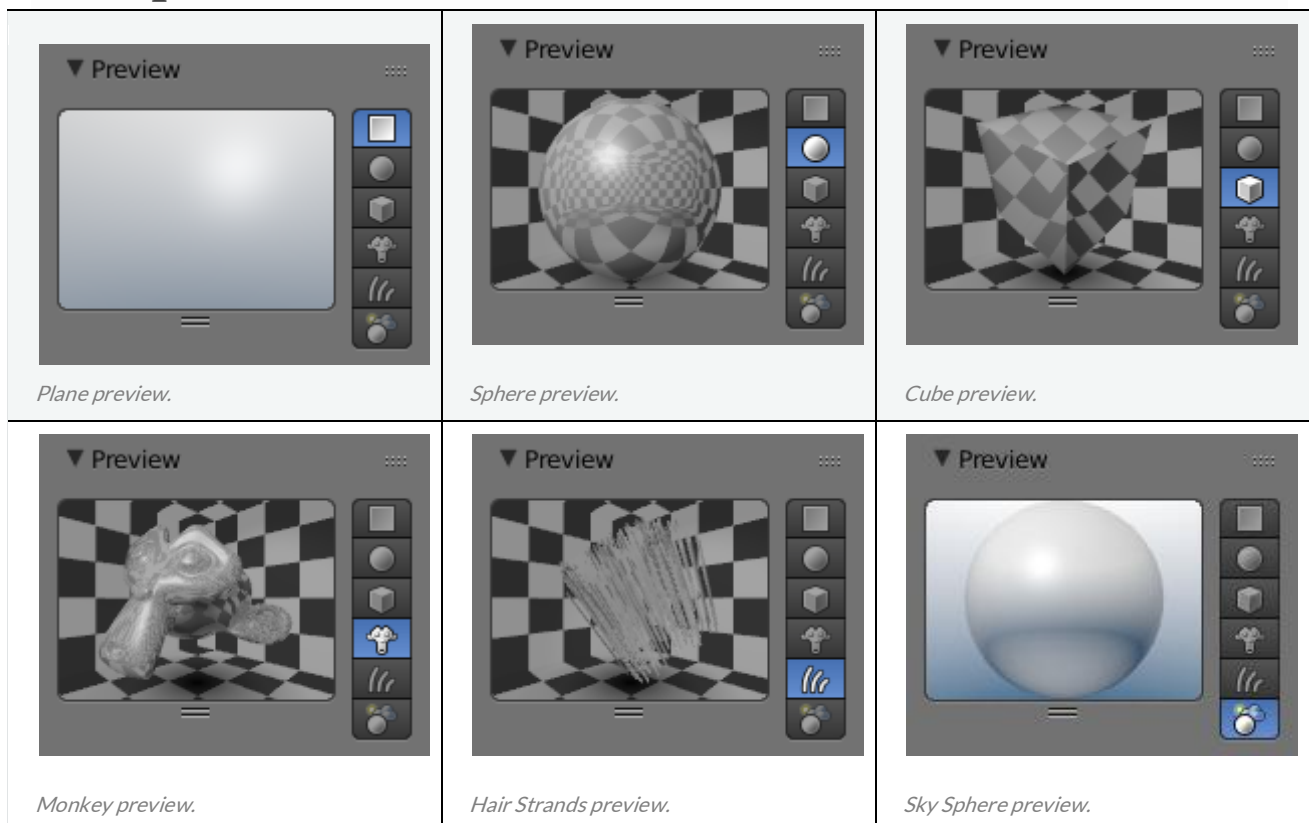
**Cube:-** Useful for previewing textures and materials of cube-like objects, but also to design procedural textures. Features a checkered background.

**Monkey:-** Useful for previewing textures and materials of organic or complex non-primitive shapes. Features a checkered background.

**Hair strands:-** Useful for previewing textures and materials of strand-like objects, like grass, fur, feathers and hair. Features a checkered background.

**Large Sphere with Sky:-** Useful for previewing textures and materials of sphere-like objects, but also to design metals and other reflective materials, thanks to the gradient Sky background.

## Examples



# Diffuse Shaders

A diffuse shader determines, simply speaking, the general color of a material when light shines on it. Most shaders that are designed to mimic reality give a smooth falloff from bright to dark from the point of the strongest illumination to the shadowed areas, but Blender also has other shaders for various special effects.

## Common Options

All diffuse shaders have the following options:

**Color:-** Select the base *diffuse color* of the material.

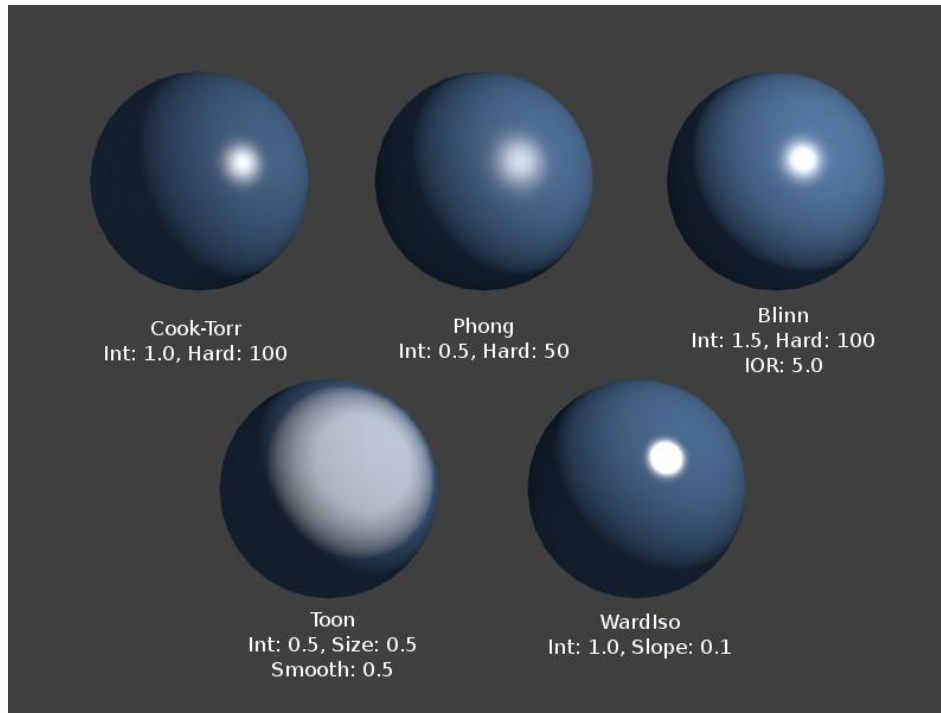
**Intensity:-** The shader's brightness, or more accurately, the amount of incident light energy that is actually diffusely reflected towards the camera.

**Ramp:-** Allows you to set a range of colors for the *Material*, and define how the range will vary over a surface. See Color Ramps for details.

## Technical Details

Light striking a surface and then re-irradiated via a Diffusion phenomenon will be scattered, i.e. re-irradiated in all directions isotropically. This means that the camera will see the same amount of light from that surface point no matter what the *incident viewing angle* is. It is this quality that makes diffuse light *viewpoint independent*. Of course, the amount of light that strikes the surface depends on the incident light angle. If most of the light striking a surface is reflected diffusely, the surface will have a matte appearance (Light re-irradiated in the diffusion phenomenon).

## Lambert



*Lambert Shader.*

This is Blender's default diffuse shader, and is a good general all-around workhorse for materials showing low levels of specular reflection.

### **Johann Heinrich Lambert (1728-1777)**

was a Swiss mathematician, physicist and astronomer who published works on the reflection of light, most notably the [Beer-Lambert Law](#) which formulates the law of light absorption.

This shader has only the default option, determining how much of available light is reflected. Default is 0.8, to allow other objects to be brighter.



## Specular Shaders

Specular shaders create the bright highlights that one would see on a glossy surface, mimicking the reflection of light sources. Unlike diffuse shading, specular reflection is viewpoint dependent. According to Snell's Law, light striking a specular surface will be reflected at an angle which mirrors the incident light angle (with regard to the surface's normal), which makes the viewing angle very important.

### Common Options

Each specular shader share the following common options:

**Specular Color:-** The color of the specular highlight.

**Intensity:-** The intensity, or brightness of the specular highlight. This has a range of [0-1].

**Ramp:-** Allows you to set a range of specular colors for *Material*, and define how the range will vary over a surface. See Ramps for details.

As a result, a material has at least two different colors, a diffuse, and a specular one. The specular color is normally set to pure white (the same "pure white" as the reflected light source), but it can be set to different values for various effects (e.g. metals tend to have colored highlights).

### Phong

Phong is a basic shader that is very similar to Cook-Torr, but is better for skin and organic surfaces. [Bui Tuong Phong](#) (1942-1975) was a Vietnamese-born computer graphics pioneer that developed the first algorithm for simulating specular phenomenon. [His model](#) included components not only for specular lighting, but also diffuse and ambient lighting.

### Blinn

Blinn is a more 'physical' specular shader, often used with the Oren-Nayar diffuse shader. It can be more controllable because it adds a fourth option, an index of refraction, to the aforementioned three. James F. Blinn worked at NASA's Jet Propulsion Laboratory and became widely known for his work on Carl Sagan's TV documentary *Cosmos*. The model he described in his 1977 paper [Models of Light Reflection for Computer Synthesized Pictures \(PDF\)](#) included changes in specular intensity with light direction and more accurately positioned highlights on a surface.



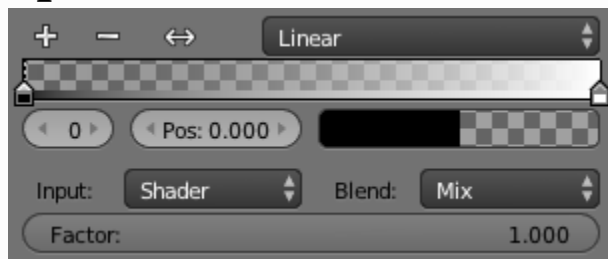
## Color Ramps

On many real-world materials, like skin or metals, the color of diffuse and specular reflections can differ slightly, based on the amount of energy a surface receives or on the light angle of incidence. The *Ramp Shader* options in Blender allow you to set a range of colors for a *Material*, and define how the range will vary over a surface, and how it blends with the 'actual color' (typically from a material or as output of a texture).

Ramps allow you to precisely control the color gradient across a material, rather than just a simple blend from a brightened color to a darkened color, from the most strongly lit area to the darkest lit area. As well as several options for controlling the gradient from lit to shadowed, ramps also provide 'normal' input, to define a gradient from surfaces facing the camera to surfaces facing away from the camera. This is often used for materials like some types of metallic car paint that change color based on viewing angle.

Since texture calculations in Blender happen before shading, the *Ramp Shader* can completely replace texture or material color. But by use of the mixing options and Alpha values it is possible to create an additional layer of shading in Blender materials.

### Options



*Ramps panel.*

For the first part of the color ramp option see Color Ramp Widget.

### Input

The input menu contains the following options for defining the gradient:

#### Shader

The value as delivered by the material's shader (*Lambert*, *Cook-Torrance*) defines the color. Here the amount of light does not matter for color, only the direction of the light.

#### Energy

As *Shader*, now also lamp energy, color, and distance are taken into account. This makes the material change color when more light shines on it.

## Normal

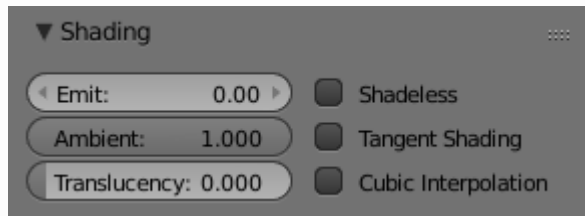
The surface normal, relative to the camera, is used for the *Ramp Shader*. This is possible with a texture as well, but added for convenience.

## Result

While all three previous options work per lamp, this option only works after shading calculations. This allows full control over the entire shading, including 'Toon' style results. Using alpha values here is most useful for tweaking a finishing touch to a material.

# Shading

In the *Shading* panel six more characteristics of the shading model for the material are available:



## Emit

Amount of light to emit.

## Ambient

Amount of global ambient color the material receives. Each material has an *Ambient* slider that lets you choose how much ambient light that object receives. Set to 1.0 by default.

You should set this slider depending on the amount of ambient light you think the object will receive. Something deep in the cave will not get any ambient light, whereas something close to the entrance will get more. Note that you can animate this effect, to change it as the object comes out of the shadows and into the light.

## Translucency

Amount of light from the back side that shows through.

## Shadeless

Disables the calculation of any shading. This makes material insensitive to light or shadow, resulting in a solid, uniform color for the whole object.

### **Tangent Shading**

Use the material's tangent vector instead of the normal for shading, i.e. for anisotropic shading effects (like soft hair and brushed metal). This shading was introduced in 2.42, see also settings for strand rendering in the menu further down and in the Particle System menu.

### **Cubic Interpolation**

Use cubic interpolation for diffuse values, for smoother transitions between light areas and shadowed areas. Enhances the perceived contrast.

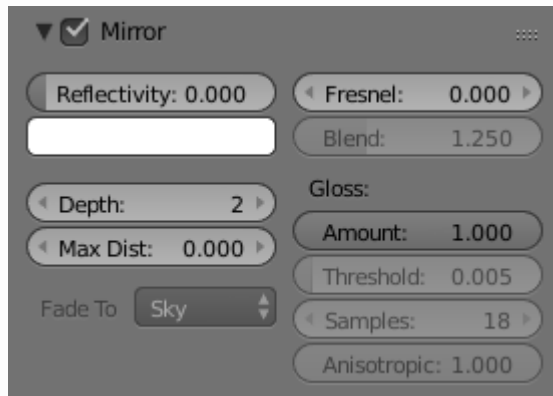
## **Mirror Reflections**

Mirror reflections are computed in the Blender Render and Cycles Renderers using ray tracing. (n.b. Reflections are not available in the Game Engine). Ray tracing can be used to make a material reflect its surroundings, like a mirror. The principle of ray-traced reflections is very simple: a ray is fired from the camera and travels through the scene until it encounters an object. If the first object hit by the ray is not reflective, then the ray takes the color of the object. If the object is reflective, then the ray bounces from its current location and travels up to another object, and so on, until a non-reflective object is finally met and gives the whole chain of rays its color.

Eventually, the first reflective object inherits the colors of its environment, proportional to its *Reflectivity* value. Obviously, if there are only reflective objects in the scene, then the render could last forever. This is why a mechanism for limiting the travel of a single ray is set through the *Depth* value: this parameter sets the maximum number of bounces allowed for a single ray.

The *Mirror Color* in the mirror panel is the color of the light reflected back. Usually, for normal mirrors, use white. However, some mirrors color the reflection (e.g. metals), so you can change the color by clicking on the color button. The amount of mirrored reflection is determined by the *Reflectivity* value. If set to something greater than 0, mirrored reflectivity will be activated and the reflection will be tinted the color set in Mirror Color.

## Options

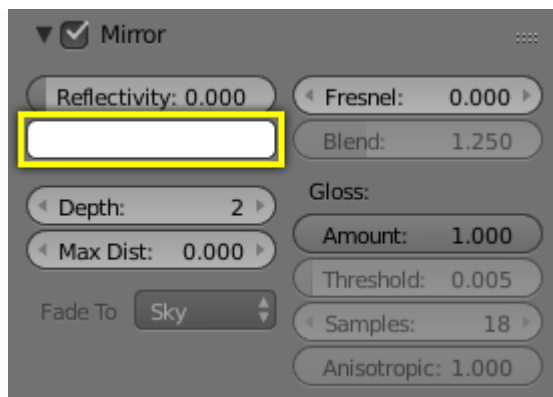


### Enable ray-traced reflections

Enable or disable ray-traced reflections.

### Reflectivity

Sets the amount of reflectiveness of the object. Use a value of 1.0 if you need a perfect mirror, or set it to 0.0 if you do not want any reflection.



### Mirror Color

Color of mirrored reflection By default, an almost perfectly reflective material like chrome, or a mirror object, will reflect the exact colors of its surrounding. But some other equally reflective materials tint the reflections with their own color. This is the case for well-polished copper and gold, for example. In order to replicate this within Blender, you have to set the Mirror Color accordingly. To set a mirror color, simply click the color button in the mirror panel and select a color.

### Fresnel

Sets the power of the Fresnel effect. The Fresnel effect controls how reflective the material is, depending on the angle between the surface normal and the viewing direction. Typically, the larger the angle, the more reflective a material becomes (this generally occurs on the outline of objects).

**Blend**

A controlling factor to adjust how the blending happens between the reflective and non-reflective areas.

**Depth**

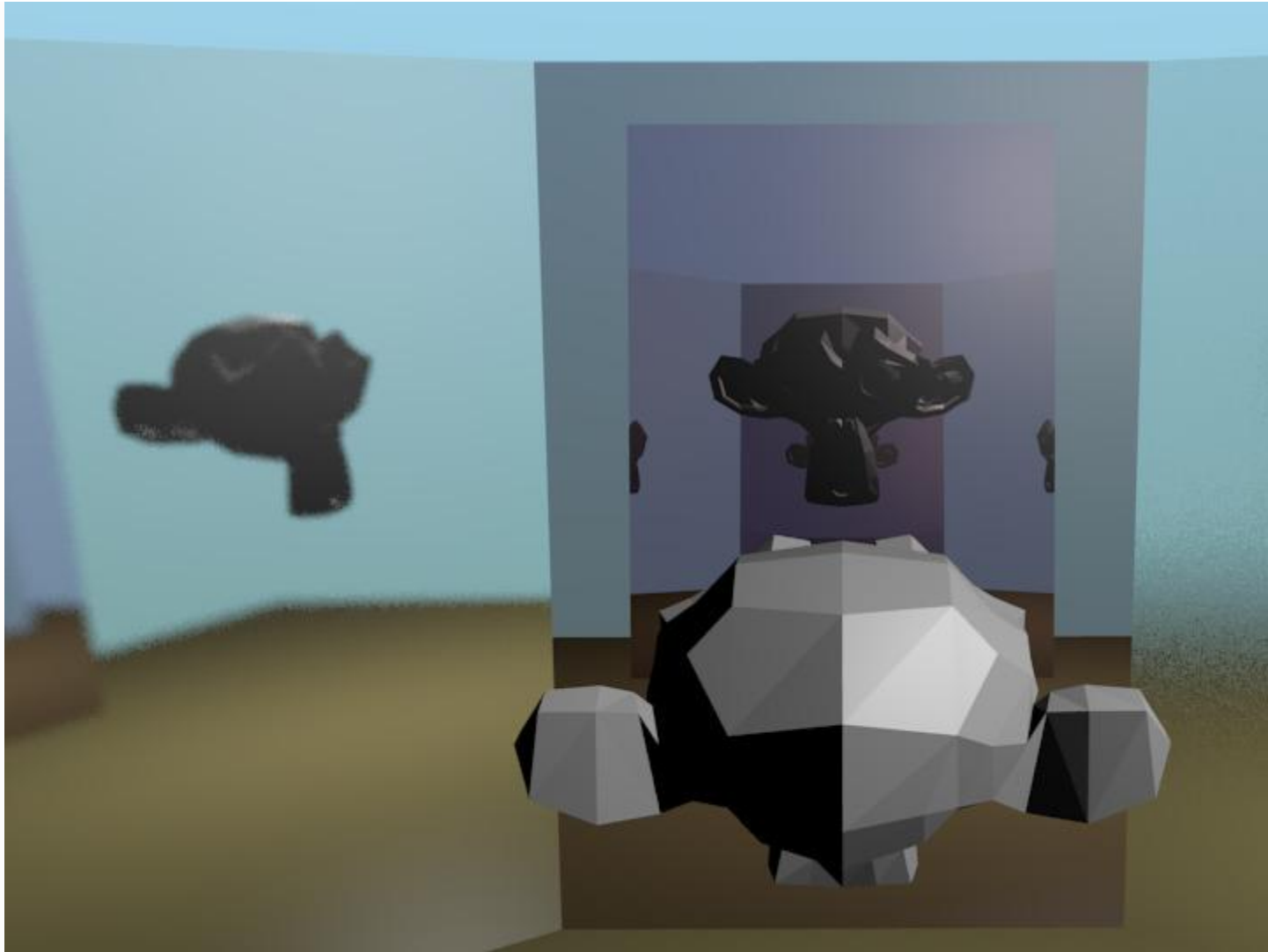
Maximum allowed number of light inter-reflections. If your scene contains many reflective objects and/or if the camera zooms in on such a reflective object, you will need to increase this value if you want to see surrounding reflections in the reflection of the reflected object (!). In this case, a Depth of 4 or 5 is typically a good value.

**Max Distance**

Maximum distance of reflected rays away from camera (Z depth) in Blender units. Reflections further than this range fade out to reduce compute time.

**Fade to**

The color that rays with no intersection within the *Max Distance* take. *Material* color can be best for indoor scenes, *Sky* color (World settings) for outdoor scenes.



## Gloss

In paint, a high-gloss finish is very smooth and shiny. A flat, or low gloss, finish disperses the light and gives a very blurry reflection. Also, uneven or waxed-but-grainy surfaces (such as car paint) are not perfect and therefore slightly need a Gloss greater than 1.0. In the example to the right, the left mirror has a Gloss of 0.98, the middle is Gloss = 1.0, and the right one has Gloss of 0.90. Use this setting to make a realistic reflection, all the way up to a completely foggy mirror. You can also use this value to mimic depth of field in mirrors.

## Amount

The shininess of the reflection. Values < 1.0 give diffuse, blurry reflections and activate the settings below.

