Transparency and IOR
When you check and open the Transparency panel in the Materials tab, you're presented with three options. The one active by default, Z Transparency, is the simplest. Adjusting the Alpha from 1.000 (fully opaque) down to zero (fully transparent) while looking at the preview window, you can see the material is getting more transparent, but in the sense of a balloon filled with gas – that is, there is no distortion of the background image. It is for fast but unrealistic rendering of items like window glass that need to be present, but don't greatly change the appearance of objects behind them. The Fresnel option makes the object more transparent the more its surface is at right angles to the camera; for simple materials you can safely leave this at its default, though you will need it when making realistic glass.

The transparency option on the left, Mask, is a useful option when you are layering different images in a rendering. It cuts the object out of the scene entirely (if you have Alpha set to Transparency in the Render tab) so that it can, as the name suggests, be used as a mask over a separate rendering or animation of the object. The Alpha can be anything from zero (complete masking) to 1.000 (no effect upon the rendering).

But the option on the right is the most interesting, though excessive use will slow your scene rendering down. This is Raytrace. Reduce the alpha of the preview and you will at first see no change. But now increase the IOR, or Index of Refraction, and the checkerboard pattern behind the preview sphere will start to distort, just as a real transparent material will distort (refract) what is behind it.

Typical indices of refraction are air (1.0), water (1.3), glass (1.5 – 1.9), and diamond (2.4). The largest IOR found in relatively common materials is 4.0 for silicon. A comprehensive reference for IORs for 3D applications is at http://www.pixelandpoly.com/ior.html.

Mirror
The mirror panel is best used when you can see the preview window with it. Move the panel up with the triangular grab panel top right until it is directly under the preview panel.

By default the reflectivity of the material is set to zero. Move the slider gradually up to 1.000 and see the results. Realistic materials are never 100% reflective; the maximum practical value is around 0.950. The Fresnel value is the difference between the reflections on surfaces at differeraring angles to the eye; materials like glass are often more reflective at a glancing angle than when light strikes them at ninety degrees. The Fresnel value defines that. The Blend value defines how sharply that happens as the angle increases. A blend value of 5.000 will make the material look like glazed ceramic.

Take the blend and Fresnel values down to zero again and adjust the maximum distance value. This is how far the mirroring "sees". In Blender the zero default value often indicates infinity; you can see that as you gradually adjust the maximum distance value (hold down the Shift key as you slide the value to make more gradual changes). The depth value above it cannot be previewed as it defines the maximum number of times a light ray will bounce between neighboring reflective objects. The default of 2 is generally too low if there is significant inter object reflection, but higher values increase rendering time. When the raytracer runs out of bounces it uses the Alpha setting from the Render
panel; if this is set to Transparent you may get holes in your rendering. Increase the bounce value to prevent this, or set the Alpha to be Sky.

Finally, the gloss value makes the surface appear rougher, as if sand blasted. Something less than 1.000 makes the material more realistic.

**Indirect lighting for glowing objects**

Suppose that you want to make a glowing material like this in the regular renderer. This is easy in Cycles (you simply define the text object as an emitter) but not so much in the basic renderer.

First, the material for the letters needs an emission (glow) value in the Shading panel under Material. But this alone doesn't do it as a more advanced lighting type has to be enabled. Go to the World tab in Properties (the same that as is used to enable Ambient Occlusion) and disable AO if it is on. Then enable Indirect Lighting by checking the box, and increase the number of bounces to at least four. You will need to activate the Approximate Gather button below as well.

Indirect lighting allows surfaces to be lit by the reflected light of nearby surfaces in the same way that a white sheet of paper will look redder if a red book is held above it. The book in that case isn't a light, but it is acting as one as it reflects red light on to the white paper. For this reason the factors that affect the way an object looks in real life include:

1. its actual color
2. its reflectivity
3. the color of the light falling on it from real light sources in the scene
4. the color of light reflected from surrounding objects
5. the color and density of smoke or mist in the air
6. the characteristics of the observer's eye
7. the characteristics of any camera used to take a photograph of the scene
Subsurface scattering
Subsurface scattering imitates the way that light diffuses through waxy materials such as candles, ears, and gels.

Start a new scene and add Suzanne; give her a level 2 subdivision surface modifier. Scale and rotate her so that she fills the view and her ears face the camera.

Delete the ground plane and give her a colored material. Put a point light behind her and reduce ambient occlusion to about 0.100. Render Suzanne.

Now select her and go to the Materials tab. Enable Subsurface Scattering and open the panel. Pick Whole Milk for the preset. Render the image; this is now a two part process as the scattering has to be computed before rendering can take place. See how her ears now transmit the light from behind.
Add another point light in front as a key, and we have a waxy Suzanne.

**Animating materials**

Almost every property of a Blender object defined in a button can be animated by right clicking on it and selecting Insert Keyframe.

Animation is done by moving the playhead (the thick green vertical line) in the Timeline window to the appropriate frame, then right clicking on the material parameter button and choosing Insert Keyframe. Left clicking or dragging will change the parameter value. If you change the value after setting the keyframe you will have to right click and choose Replace Keyframe to record the new value.

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