GA2211 – Hard Surfaces Modeling Section A & B – Class Notes – Week 8

Shaders and Rendering Techniques – Car Photo Shoot

The car model is a good example of very specular surfaces. It gives us the opportunity to practice making materials, or "shaders" in cross-CG parlance, that are complicated and directed. For this week's notes, we will cover Car Paint, Reflections, and Rendering techniques to achieve the look of the "Car Commercial Photo Shoot".

"The Look"

Before we start any work, it's important to establish the end-point that we are trying to achieve. It will keep us on-target and steer us on the course to "the Look" we are after. Let's examine the image below. It represents the standard glossy Car Commercial photo shoot of a Car. Let's dissect it into noticeable effects and try to make a list to reproduce in our renders:

Car paint:

Very much of what we see in the color of the car is the reflection. Notice, we know the car is red – but there are tones in the car going from white to pink to red to plum to dark brown. The glossiness of the car we pick up on is created by the reflection. In highly specular (shiny and reflective) surfaces, the quality of the reflection and what is reflected is often more important than the base diffuse color. Also notice that the reflection is more pronounced as the angle to the viewer changes…the car paint is more reflective at glancing angles than straight on.

Glass:

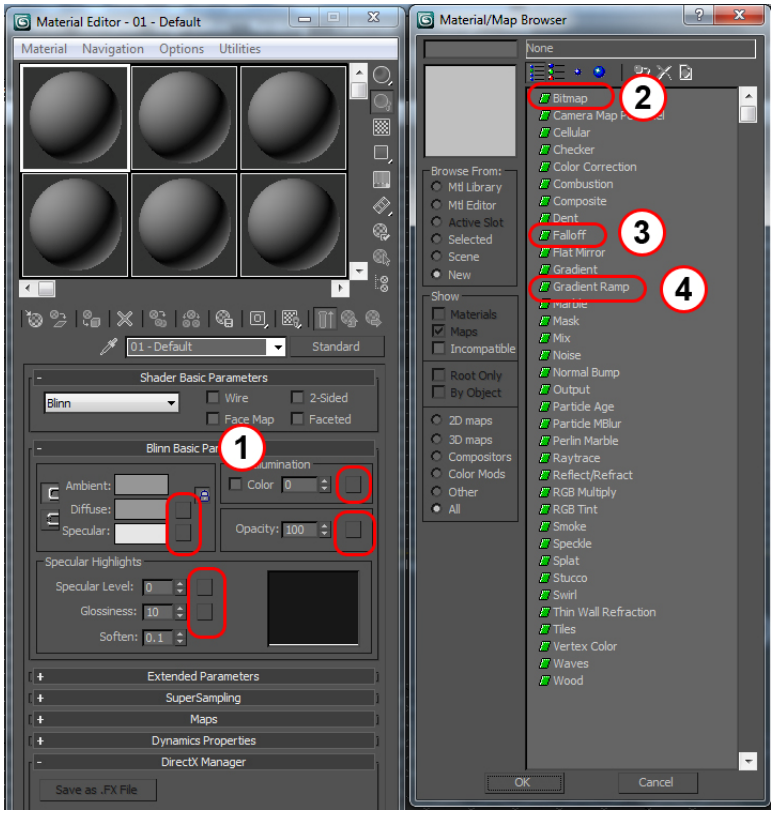
Glass seems like a simple effect to achieve, just set transparency to 100%, right? Many people miss an opportunity to create realistic glass. Notice, in the image above, that the glass also benefits from reflection. Also notice that the reflection of the glass varies as the angle to the viewer/camera changes. The glass is see-through when facing us – as near the driver' seat. But, as the glass starts to face toward 90 degrees to the camera, it becomes almost mirror-like…and we see more reflection than what is behind it – as in the passenger side of the windshield. This effect is called a "Fresnel" (*Fre-nell, do not pronounce the "S"*) effect, after the 18th century French physicist who developed some of these formulas.

We're going to try to achieve this look in 3DS Max. But first, a word about Materials…

Procedural Materials and Shader Networks:

In Week 2 & 5, we talked about how to use Max's material editor and UV tools to apply maps onto our meshes. Much of the texturing you will be doing will be by painting and applying texture maps (Bitmaps). But there is much more to building shaders than simply painting maps. Many of the effects you will want to create cannot be simply defined with maps. To build shaders that create the complex effects we are after will require that we use the other material nodes available to us.

Material Nodes) Simply put, a Node is just a collection of formulas and algorithms that produce a certain output given a certain input. You can think of them in these terms – I put some value in and another value comes out.



1) You can create and connect nodes in Max any time you click on one of the blank squares next to a map-able channel. Click on this will bring up the "Material/Map Browser". Choose one of the types of nodes to create and connect it. You can then begin to edit it.

2) The "**Bitmap**" node in materials lets you put "in" a texture map and this is output to whatever channel of the main shader you plugged this into – for instance, the "diffuse" map channel for the main color. We used this one to apply our bump maps and diffuse texture maps to our gun and mailbox.

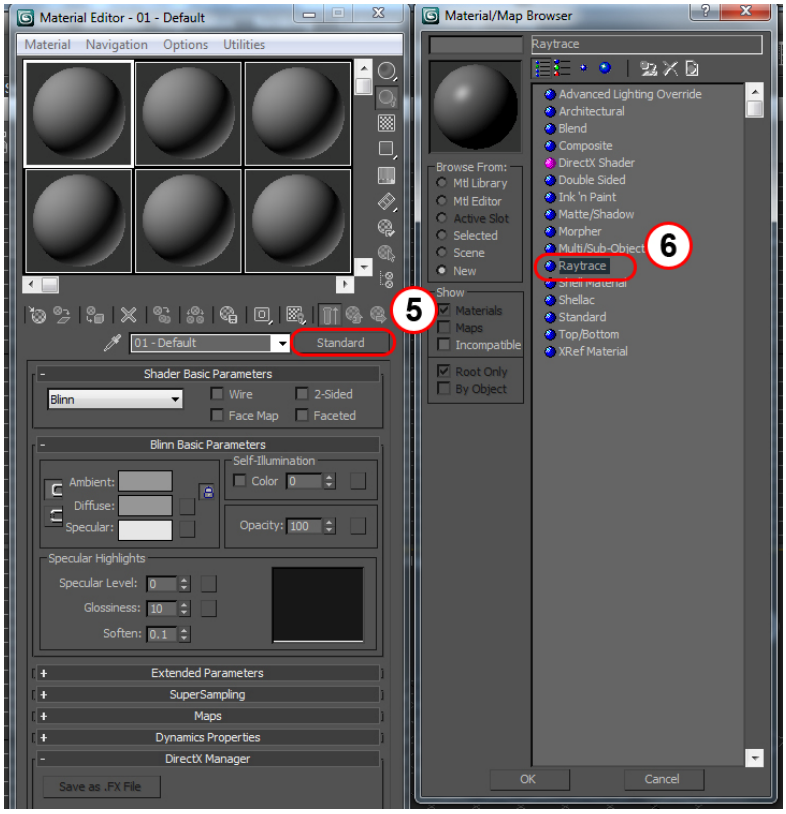
3) The "**Falloff**" node is very useful. It creates a gradient of 2 colors, that blends from one color as the normals of the mesh are pointing to the camera and another color as they are perpendicular to the camera. This lets us get those "Fresnel" effects we are after. More on this later.

4) The "**Gradient Map**" node creates a Gradient with up to 100 color choices. It lets us quickly create a complex gradient and tune the placement and transition of color values. We will use this one in the next example.

We will be using these 3 nodes for our car example.

Raytrace Material:

To be able to get reflections on our material (…in 3DS Max), we must use a different type of material. The "Standard" Material has no option for reflections.



5) In a new material, or Sub-Material (if using Multi-Sub Object material), click on the material type button…typically labeled "standard".

6) Choose "Raytrace" as the type of material. You will notice there are some new channels in this material, and some familiar ones.

The most important new channels are "**reflect**" and "**index of refrac.(**tion)". These will be used to create raytraced reflections and refractions.

Reflection – The result of light bouncing off a specular surface to create a mirrored image.

Refraction – The result of light passing *through* a clear surface and being bent to create a distorted image on the other side.

Reflection:

There are 4 default ways to use reflect channel on the Raytrace Material. You can change methods by clicking the CHECKBOX next to the Reflect channel several times.

A) 

As a color swatch. Click the color swatch to the right of the "Reflect" Channel to set the level of reflectivity. Black is completely matte and white is mirror finish…and all grey values in between throttle the level of reflectivity.

B) 

As a percentage. Drag/click the arrows to increase/decrease the percentage to affect the reflectivity…or type in a number between 0-100.

C) 

As a predefined "Fresnel" algorithm. This method achieves the "more reflection as the angle changes" Fresnel effect – but it does not give us any control over the results. In CG, much of what we do is about the control to push reality and adjust the results to get what we are after. We're going to be using another method to get a "controlled" Fresnel reflection.

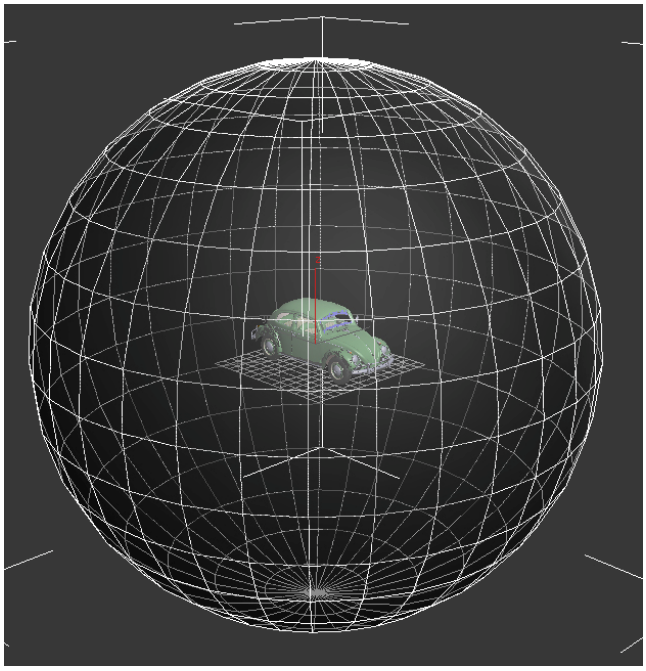
D) Map the Channel – You've noticed that there is a map channel next to Reflect. This means this channel is "map-able". We are going to map a node here to give us control of the reflection.

But first, let's try our Raytrace Material with a reflectivity of about 75% or 75% grey on the Body of the car and another Raytrace material on the chrome.

The result is not very spectacular. It's very dark and does not contain anything interesting in the reflections.

This is because there's NOTHING to reflect. 3D programs give us the unnatural ability to create an object in a complete vacuum…with nothing around, not even a camera man or lights. In the real world, these studio elements are reflected in your car finish – and this makes up the reflection. Professional photographers assemble the lights and lighting equipment in the studio for dramatic effect and it is this we will attempt to do in 3D.

Give the Reflection something to Reflect:



Let's create a DOME light rig to resemble the reflections we would get in a photographer's studio.

7) Create a large primitive sphere in the scene – large enough to surround your model, like an aircraft hanger.

8) Convert this object to an Editable Poly (right click Menu > Convert To > Editable Poly).

9) Invert the faces to turn it inside-out. In Sub-Object "**Polygon**" mode, select all the faces and use the "**FLIP**" tool. All faces should become black, signifying that they are back-facing.

10) Blackface Cull – turn on "Blackface Cull" on this object from the "Object Properties" (right-click, "Object Properties"). This will make it so that you can see through the back side of the DOME, allowing you to see and select your car.

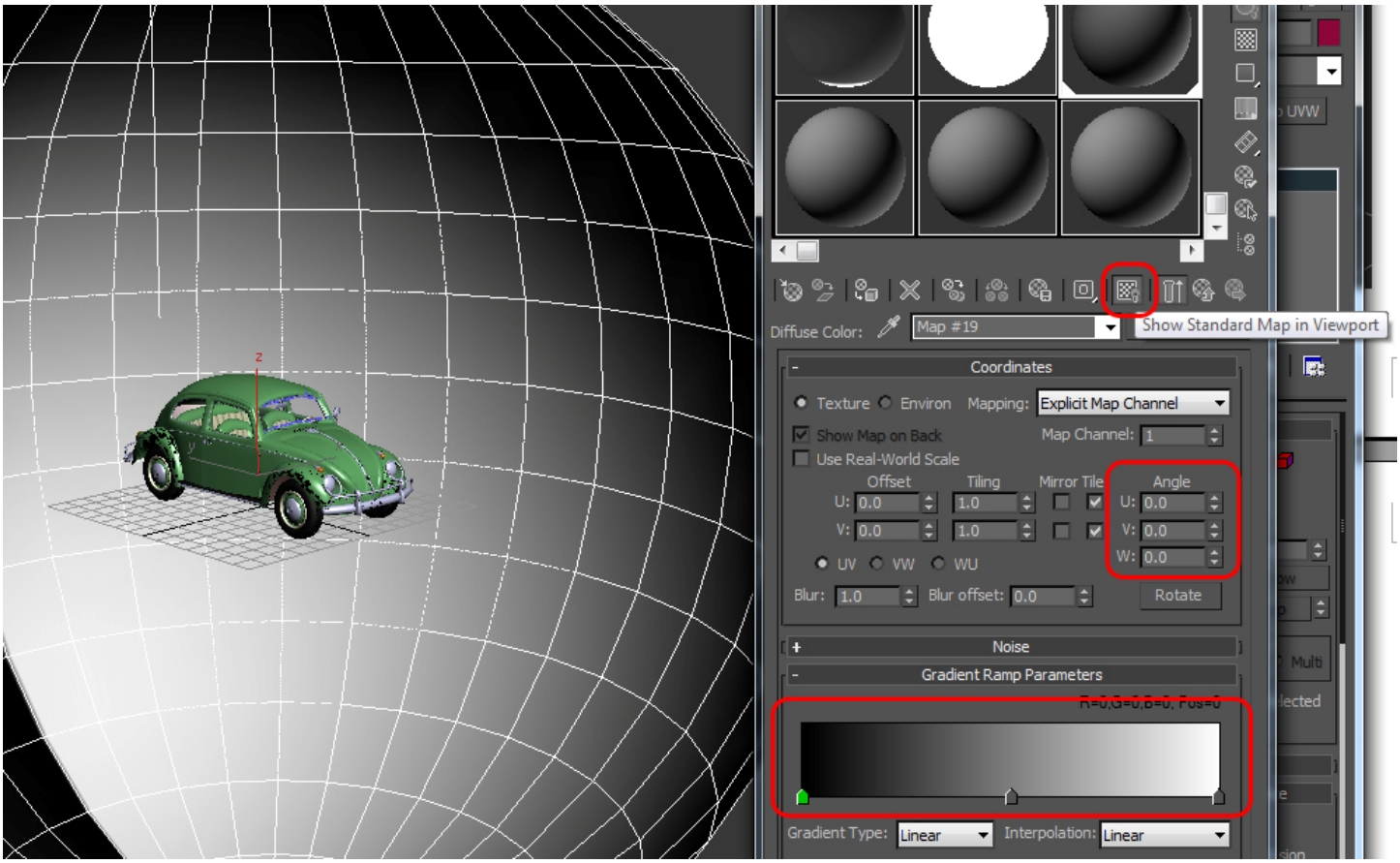
Now that you have the Dome, we will create a material for it.

DOME light material:

Choose an empty material editor slot and assign that “Standard” material to the DOME we just created.

11) Next to the “Diffuse” channel, click the empty box to map this channel.

12) Choose **“Gradient Ramp”(4)** as the node type. This will map a “Gradient Ramp” to the diffuse channel. Click the “Show Standard map in Viewport” button to see the gradient on the DOME.



Notice our gradient is being applied laterally to our DOME. Also notice the controls in the new Gradient Ramp node.

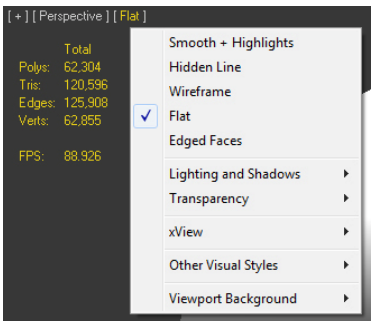
13) There are 2 sections we will initially be concerned with:

Angle: Type “-90” in the “W:” field of the the Angle section to rotate the projection of the gradient 90 degrees. This should put the gradient top-down, with white on the top of your DOME and black on the bottom.

Gradient Ramp Parameters: This section lets you define the profile of your gradient.

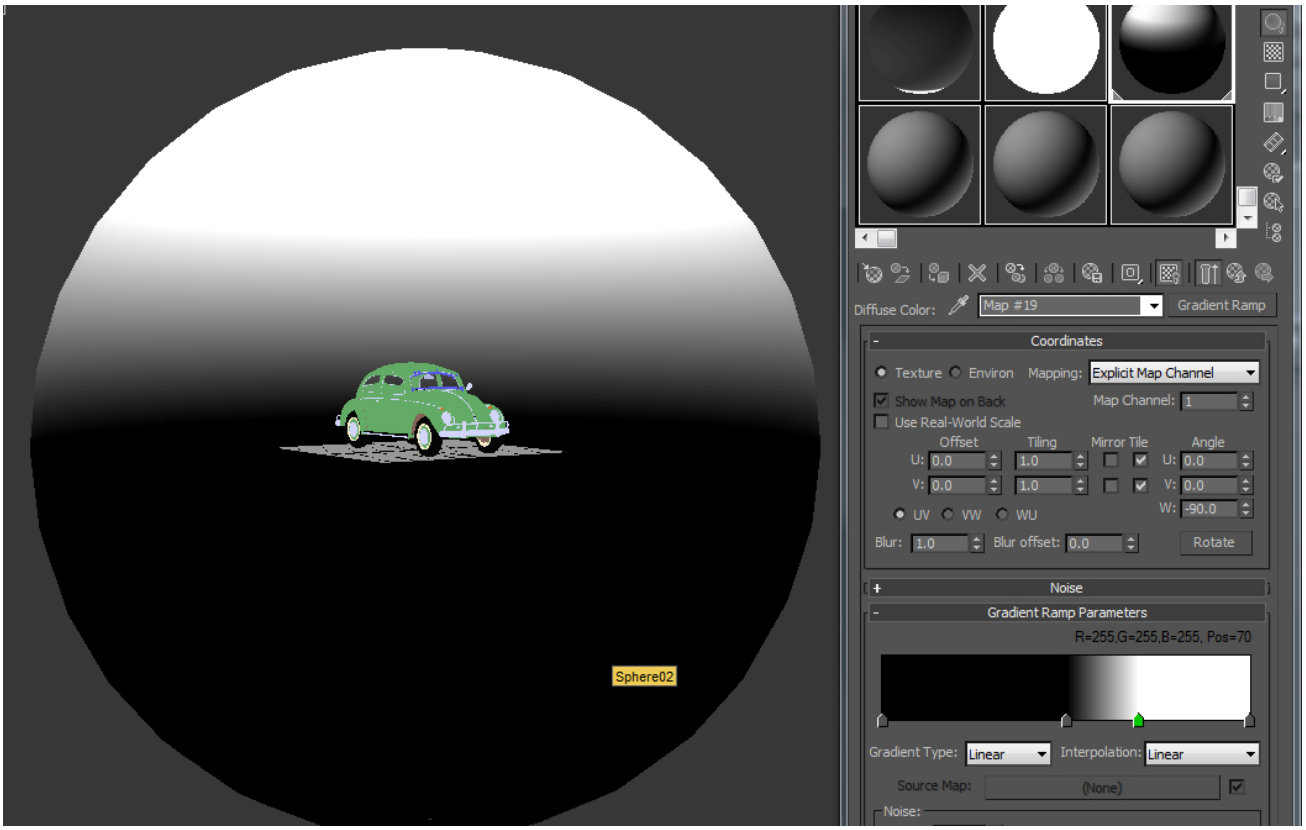
Click inside the gradient to create new color entries. Drag them into position to change the profile. Drag them to the right or left end-caps to remove them, or right-click > delete.

Double-Click them to change color. Or *right-click > “Edit Properties”* over the entries to change color or discretely set their position numerically.

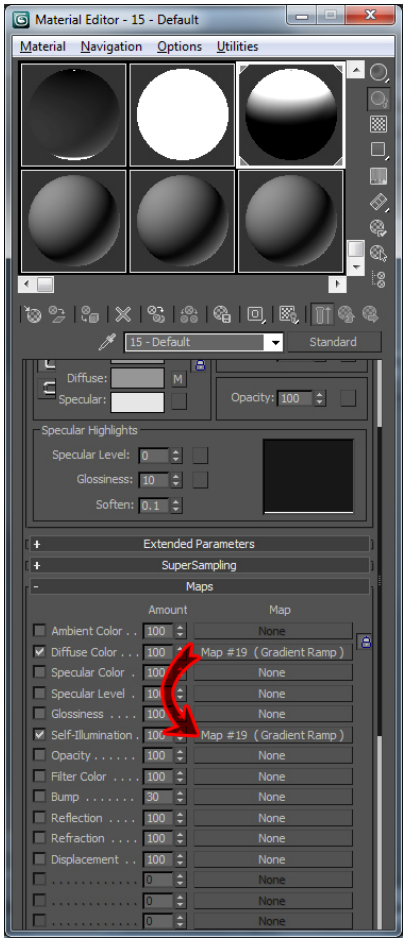


Use the Gradient Ramp Parameters color entries to create a gradient that is 50% black, then sharply transitions to white at about 70-75%, as shown. Notice how your DOME looks.

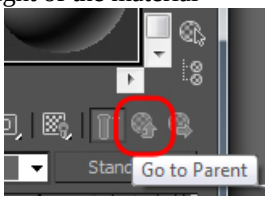
[Note:] *It may be easier to see the DOME texture in your viewport if you use the "FLAT" shading mode. This mode turns off lighting and shows you textures at full color.*



Once we have our gradient to our liking, we need to instance the Gradient to the "Self Illuminate" channel. This will make the DOME glow with our gradient, and not be affected by the scene lighting.



14) Go up one node by clicking the "go to parent" button in the top-right of the material editor…just under the shader balls. In the "Maps" section of the shader…



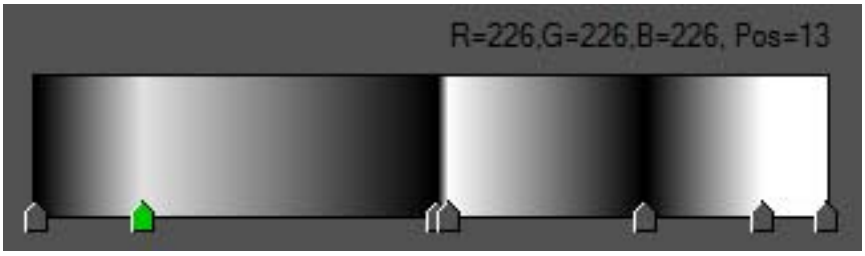
15) Instance the Gradient to the "Self-Illuminate" channel by dragging it from the Diffuse Color over the "Self-Illumination" slot.

16) Choose "Instance" from the resulting window to create a relationship between them whereby you only have to change settings in one node to affect both.

Now render your car again.

Notice how the DOME is reflected in your car paint and chrome. Play with the profile of the gradient, rendering as you make changes, until you get the desired result.

Further refine your Gradient Profile until it looks like the one below:



Render your Car again…you'll notice that we are stating to get the splashes of light we are after…

The shapes of light are there, but our car color is getting pushed down. We need to let the Diffuse Color come through more, and map the reflectivity to be stronger at the glancing angles to the viewer – in short, we need a Fresnel reflectivity.

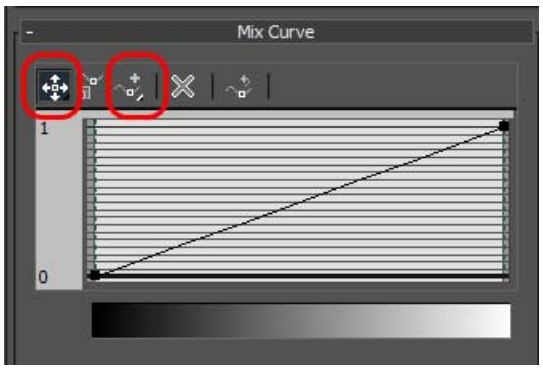
Custom Fresnel Reflectivity

To be able to have the level of control we had with the gradient ramp, we need to map the "REFLECT" channel in the Raytrace Material that is our Car Shader.

17) Click the empty map channel next to the "Reflect" channel. From the resulting window, choose "**FALL-OFF**" (3).

Falloff:

The Falloff node works like a gradient; however the projection is camera-dependent. The blend is between only 2 colors, but the projection goes from polygon faces whose normals face towards the camera – all the way to polygon faces whose normals face 90 degrees to the camera.

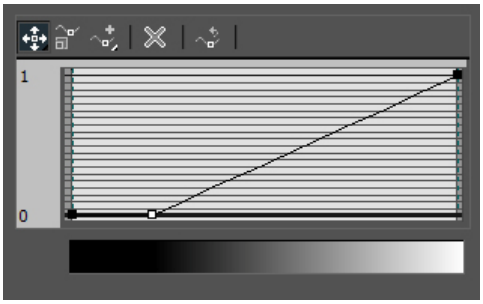


This gradient provides levels of grey depending on view to the camera – perfect for mapping reflection in a Fresnel-like algorithm.

The power of the Falloff node lies in the fact that we can adjust this gradient to push the effect to suit our artistic needs.

You can add curve points with the [+] tool, and move them around to adjust the profile with the move tool (circled in the image to the right).

Adjust your Mix Curve to look like the one on the right and render.



You'll notice we are getting more of the Diffuse Color to come through as it faces the camera. Then, as the surfaces face close to 90 degrees (sideways to the camera), they become more reflective. That flat part of the curve is the "no reflection" part.

Glass:

Glass is accomplished similarly. The only difference is that glass is completely (or nearly) transparent. Set "Transparency" to white/100% and **MAKE SURE TO SET "INDEX OF REFRAC.(tion)" TO 1.0**. This last step is to reduce distortion caused by refraction. Thick glass objects and other transparent materials bend light measurably, and this "index of refraction" lets you set it to known values for certain materials. We want no refraction for windows, which is a value of 1.0.

Use a "Raytrace" material, map a "Falloff" to the reflect channel, and adjust the reflection accordingly. We want reflections to be stronger as our angle of view is more oblique. Adjust the falloff curve and render until you have something like the next render.

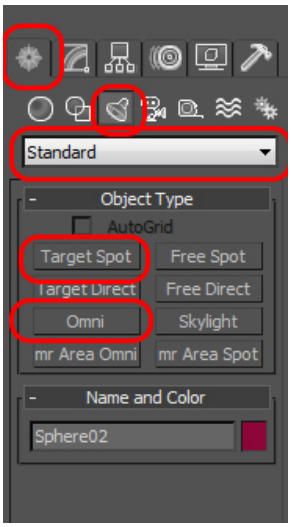
Notice the reflection on the back-side window is more pronounced while there seems to be little reflection on the windshield.

Lights:

Lighting is another subject completely, and it deserves its own study. But, to get some simple grounding shadows and lighting in will push this more into the realm of believable photo reality.

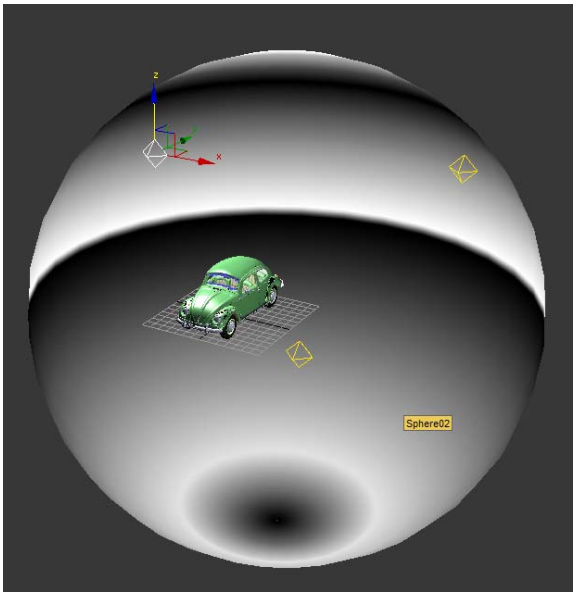
18) In the Create Panel, under the "Lights" section, select "Standard Lights" from the Drop Menu.

19) Create an OMNI or SPOT light, and pose it to form the "Key" light – or dominant light in the scene. Render your scene…

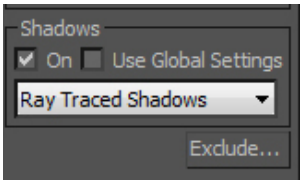


You will notice that the lighting scheme has changed dramatically! Up until now we have been using the default Max light rig behind the scenes. The default lighting rig is a "flashlight" behind the camera. Notice all previous renders had lighting coming from directly behind the camera. Now, we are using this new light as our light source.

20) Create more lights and pose them to fill in the lighting. You want one dominant light with an intensity of 1.0-2.0, and other "FILL" lights with intensities below 1.0…these FILL lights will fill in the dark areas of your lighting to complement the strong KEY light.



The next step is to add shadows to our lighting.
Select your lights and go to the Modify Panel. Under "Shadows", click the ON checkbox and set the type to "**Ray Traced Shadows**". Fill lights do not necessarily need to cast shadows.



The Final Step is to make our DOME not render. This is accomplished very easily, by setting its OBJECT PROPERTIES.

Set “Visible to Camera” OFF and “Cast/Receive Shadows” to OFF…we don’t want our invisible DOME casting shadows.

Notice that “Visible in Reflections/Refractions” is still on. This makes our gradated DOME visible in the reflections, but not visible elsewhere.

Render the final result:

You’ll notice we have the detail in our reflections we where after.