

# Subsurface Scattering Shader for DAZ Studio

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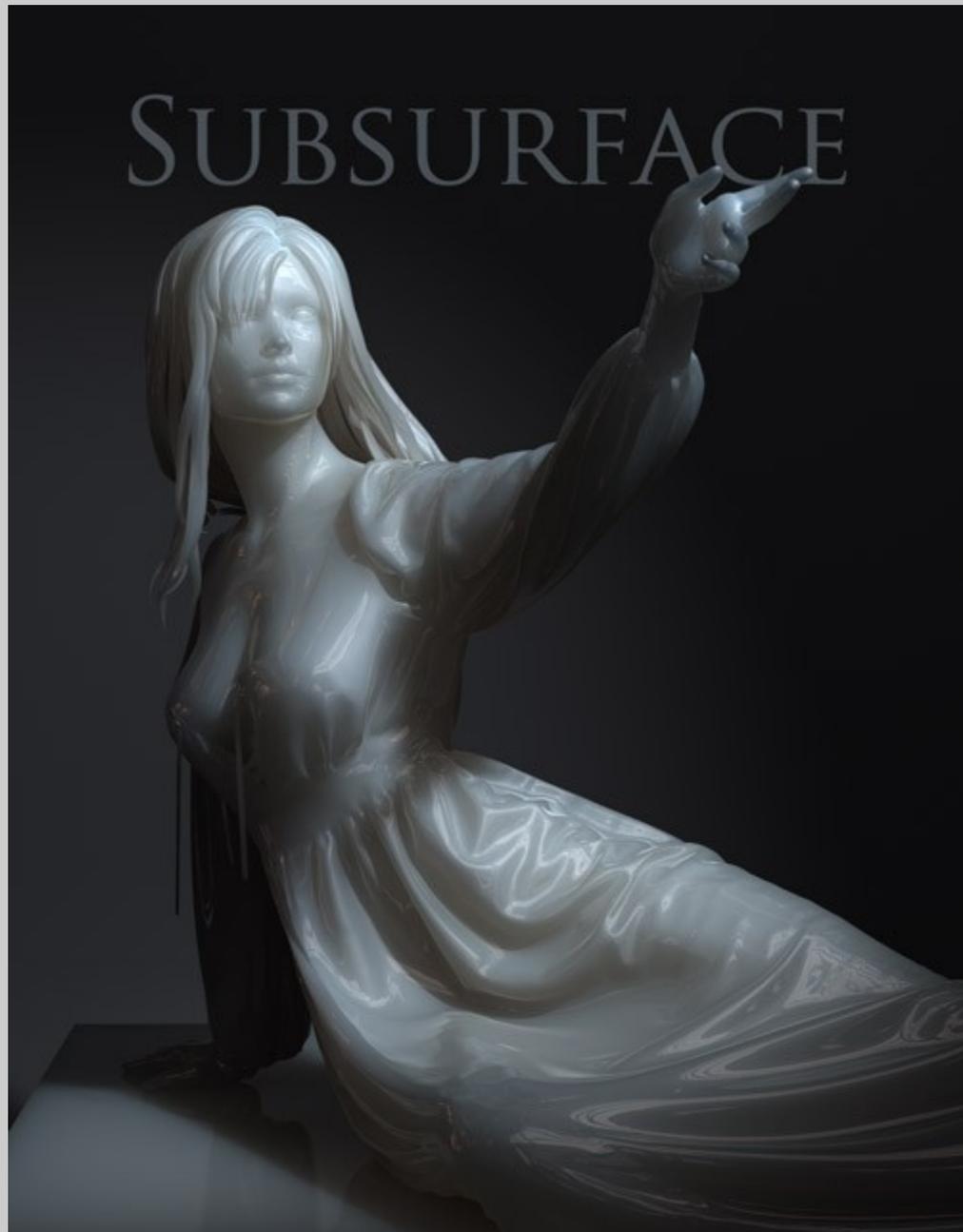
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# Introduction

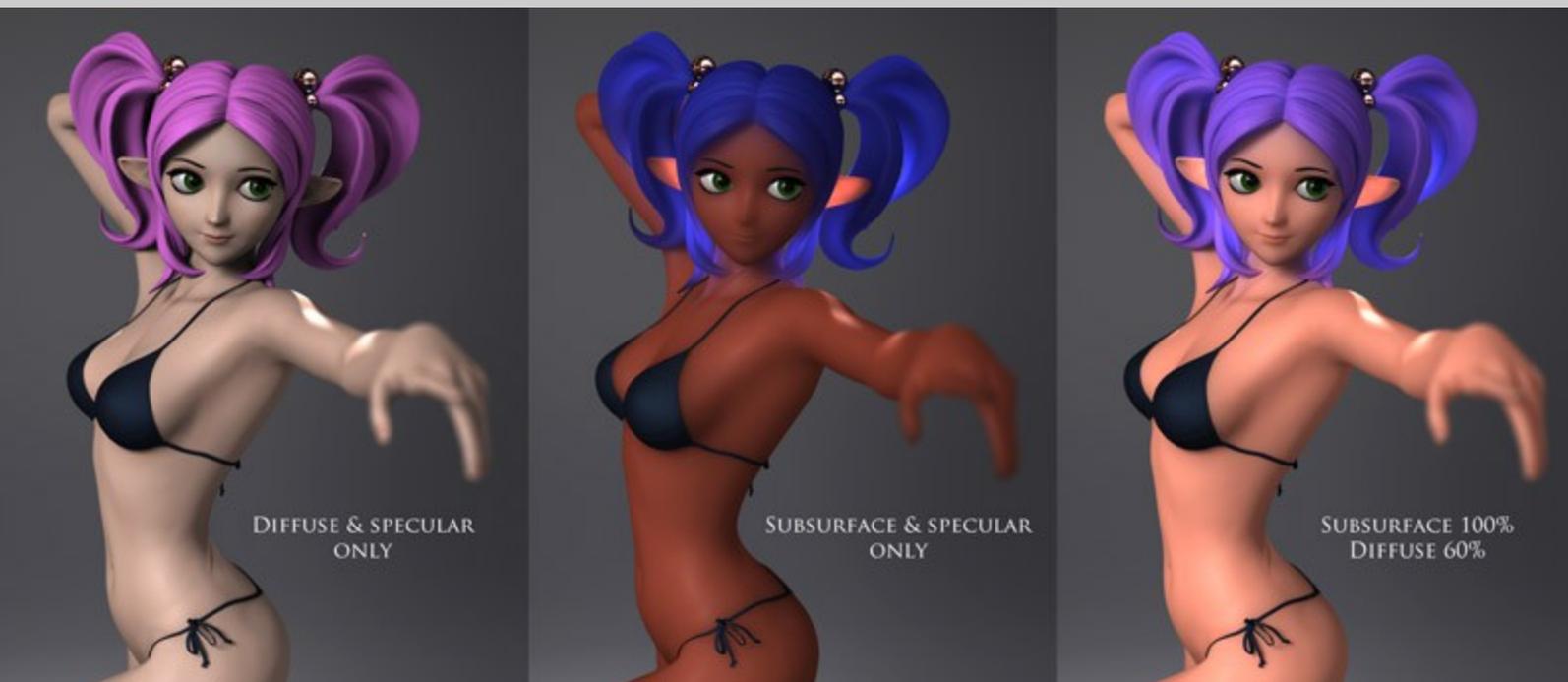


The AoA Metalized Glass Shader for DAZ Studio has been specifically designed to give 3d models the look of fleshy, translucent substances.

The shader adds features not previously available in UberSurface or the DAZ Studio default shader. A few of the new features include procedural, skin pore shaped bump and specular highlights, casting of tinted shadows and super soft translucency.

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# Important Concepts



The two primary contributors to the soft volume effect are the surface diffuse, showing only the light which is directly reflected by the outer surface, and subsurface scattering which is the bouncing of light within the volume of the model.

Subsurface scattering, the principal function that provides the soft translucent effect, is highly tied to lighting and scale. Just like real life translucent materials, these shader presets will look very different depending on the lights around it.



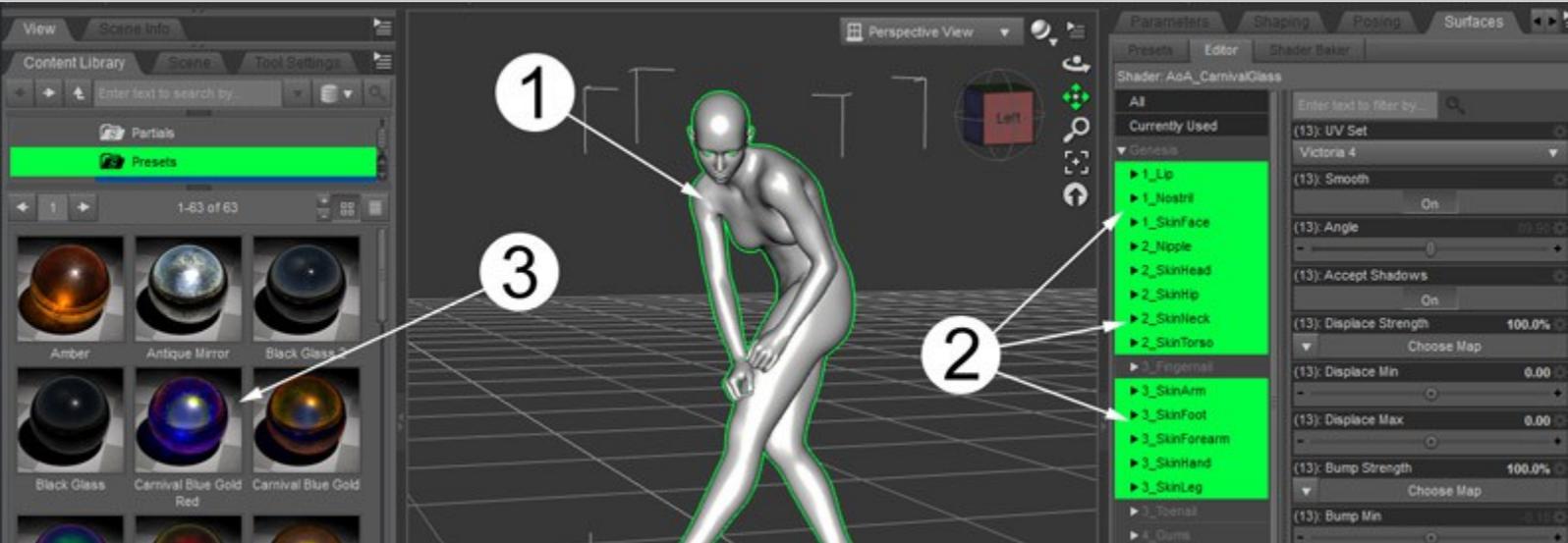
For example, a person photographed using only a flash coming from the front will show very little subsurface scattering. If a strong light is placed directly behind the person, their ears will glow and scattered highlights may be seen in the skin along the edges of the persons silhouette.

Ambient lights tend to have a strong effect on subsurface scattering. Use of an ambient light, in conjunction with rim, key and fill lights can make 3d models using subsurface scattering look very soft and translucent.

The objects shape and scale is taken into account when the renderer calculates subsurface scattering. Just as with objects in the real world, a large wax statue will scatter and absorb light differently than a small candle made of the same wax. This does not mean you will need to scale your objects in the 3d scene. An easier method is to simply adjust the Shading Scale slider in the [subsurface settings](#).

# Quick Start

## Applying the Base Shader or Presets



To apply a shader preset first select the object, then select the material zones you wish the shader to be applied to. Holding Ctl/Cmd while clicking will allow multiple material zones to be selected at once. The surface selection tool also automatically selects the object when a material zone is clicked in the 3d viewport.

With the surfaces selected, double click the base shader or a preset.

The base shader has no preset settings. It updates the internal shading code then takes the maps and settings that were previously on the surface and attempts to create a surface that closely resembles the original but additional features will now be available.

Presets do contain predefined settings and will usually change colors, glossiness, bump strength and may replace the texture maps that previously existed on the surface.

A "Reset to DS Default" preset is included should you wish to revert the material back to the standard DAZ Studio shader.

# Quick Tips

## General

- When a render bucket first reaches an object with subsurface scattering, the render will pause while the scattering is calculated for all materials of that group ID number. The more complex the object and/or lighting the longer the calculation pause.
- A subsurface shading scale of 0.10 is physically correct for DAZ Studio scattering calculations however, increasing this value is an easy way to make surfaces appear more translucent.
- The subsurface shading rate setting controls how finely the scattering is calculated. Lower values result in higher quality though materials with higher shading scales usually need less quality to produce good results.
- All materials in the same subsurface group should share the same shading scale, shading rate and subsurface index of refraction. The colors, bump, specular, reflection and other settings may be different.
- The Pre SSS diffuse texture setting works better for very thick, soft materials or "hyper real" toon skin.
- The Post SSS diffuse texture setting creates sharper details in the outer surface and may look better for realistic human skin than using the Pre SSS setting.
- If you hold Control or Command when applying presets a dialogue will appear where you will have the option "Map Settings - Ignore". This will preserve any texture maps already applied to the surface.
- Holding Shift or Control (Command on a Mac) while clicking will allow for multiple objects or material zones to be selected at once.
- Objects with Sub-D applied usually look significantly nicer in renders than those where the base mesh is used.
- Many parameter limits can safely be turned off or increased if needed.
- To change parameter limits left click the gear icon in the parameter's upper right corner and select "Parameter Settings" from the pop up menu.
- A few settings should *not* have their limits changed such as Off - On switches.

# Shader Settings

## Ambient

### AMBIENT SSS CONTRIBUTION



Note that these settings work much in the same way as the ambient settings of the default DAZ Studio shader with the exception that changes to these settings do not show in the DAZ Studio Preview window.

Ambient should not be confused with subsurface scattering. Ambient is intended to make an object glow independently of the lighting in the scene. Subsurface scattering is a translucency effect that reacts to lights in the scene.

With that said, ambient settings are taken into consideration by, and can contribute to, subsurface scattering. If a material with ambient shares the same Subsurface Group ID with other materials, the ambient color will bleed into those other surfaces. This can be useful for creating the look of softly glowing surfaces or neon lights.

- **Ambient Color** - Sets the glow color of the surface.
- **Ambient Strength** - Controls the overall strength of the Ambient Color. Grayscale images may be used to selectively control the strength of different areas of the surface.
- **Ambient SSS Contribution** - This setting tells subsurface scattering to calculate the ambient brighter than it really is, causing the ambient color to bleed further into any subsurface scattering materials around it. By keeping Ambient Strength and Ambient SSS Contribution internally separate it is less likely to overdrive the surface and cause artifacts around the glowing materials. If you do see artifacts around glowing surfaces try turning Ambient Strength down a bit and, instead, increase the Ambient SSS Contribution. *Ambient colors will only bleed into other surfaces sharing the same [Subsurface Group ID](#).*



PROCEDURAL NOISE FEATURE  
USED TO CREATE BUMPY  
ORANGE PEELS

NOTE: The density of Bump Noise matches that of the Specular Noise Density found under the [Specular settings](#).

- **Bump Noise Strength** - Adds procedural, pore shaped bumps to the surface. This setting is dependent on the bump strength settings listed below. *If Bump Strength, Negative Bump and Positive Bump are set to 0 then this setting will have no effect.*
- **Bump Strength** - The percentage value affects both the Bump Noise Strength and grayscale bump maps to give the appearance of a bumpy surface.
- **Negative Bump** - How deep that dark pixels of bump maps should appear to displace the surface.
- **Positive Bump** - How high bright pixels of bump maps should appear to displace the surface.



Diffuse refers to the color of the *outer surface* of the 3d model and how it reacts to light. The shader has two methods for calculating diffuse with subsurface scattering.

Pre SSS uses the diffuse color and texture in the subsurface calculation. This generally gives a softer looking diffuse. Under this method the diffuse strength may be increased or decreased. At a high diffuse strength the surface may look more solid and the effects of subsurface scattering may not be as noticeable. At very low settings, some of the detail of textures, like lip color, moles or freckles will "wash out" and the model will appear more like soft wax.

Post SSS diffuse tells the subsurface portion of the shader to consider the outer surface as being solid white. After subsurface scattering is calculated, the shader takes the subsurface result then multiplies it with the diffuse color, texture and strength. This preserves detail in the outer surface but limits the usefulness of diffuse strength. A very low diffuse strength, strong color or dark texture map will also darken the subsurface color. The subsurface or diffuse strength may need to be increased to help adjust for this.

- **Diffuse Color** - Sets the outer surface color which reacts to lights in the scene. Images used in this channel are tinted by the color setting.
- **Diffuse Strength** - Controls how strongly the Diffuse Color reacts to lights. Grayscale texture maps may be used to further control the diffuse strength.
- **Pre SSS - Post SSS** - This switch sets whether the diffuse texture and color should be calculated within subsurface scattering or applied (by color multiplication) after subsurface scattering has been calculated.

## Displacement

The settings work in the same way as the default DAZ Studio shader with the exception that, when no displacement map is used, the Maximum Displacement and Minimum Displacement settings should be set to 0.

- **Displacement Strength** - Grayscale images may be used to move areas of the surface inward or outward. The strength of the displacement map is multiplied by the percentage slider.
- **Maximum Displacement** - How far (in centimeters) bright pixels of displacement maps should move the surface outward. *Set this value to 0.00 when no displacement map is used.*
- **Minimum Displacement** - How far (in centimeters) dark pixels of displacement maps should displace the surface inward. *Set this value to 0.00 when no displacement map is used.*

## Normal Mapping

- **Normal Map** - Accepts tangent space normal maps to perturb the surface's geometric normals and create the illusion of a more complex, displaced shape on the surface. This map is not affected by tile settings.
- **Normal Map Strength** - Allows you to control the strength of the effects generated by the normal map.

## Opacity

- **Opacity Strength** - Just as with the DAZ Studio default shader, this setting allows gray scale transparency maps to control the opacity of the surface. Black transparency map pixels will be 100% transparent and white pixels are 100% Opaque. *Use of transparency maps or values other than 100% may cause a significant decrease in rendering speed.*
- **Spec/Reflect Trans Off - On** - This switch determines whether the Opacity Strength setting should also affect specular highlights and reflections. With Opacity Strength set 0% and this switch set to 0 (Off) you would see a transparent object that has reflections and highlights, making the object look like a bubble or clear plastic. This behaves exactly as the "Multiply Specular Through Opacity" setting on other shaders. The label was chosen as I felt it more clearly explained that it controlled both specular and reflection.

## REFLECTION OF REFLECTION



RAY DEPTH 1

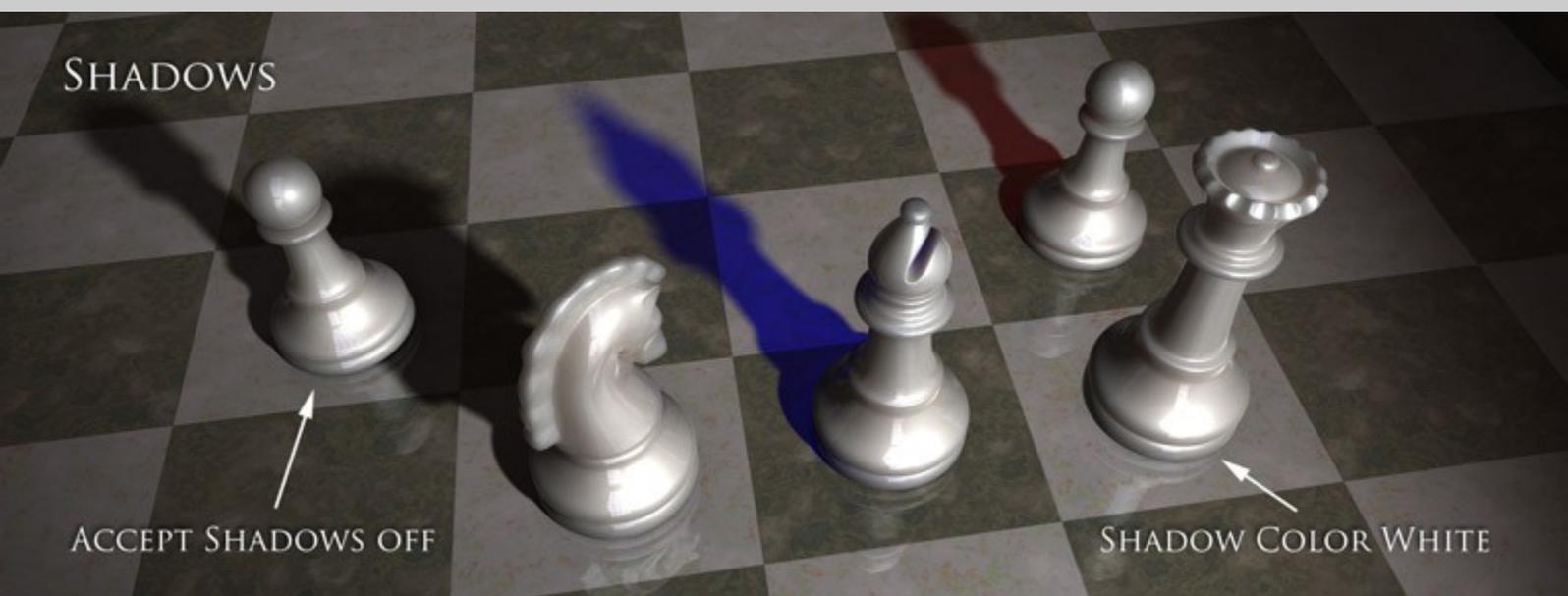


RAY DEPTH 2

It is important to note that this shader does not support "mapped reflections" but rather the more realistic method of ray traced reflections. As such, surfaces using this shader will only reflect items in the scene around it. In other words, if an object using this shader is alone in a scene you will see no reflections because there is nothing for it to reflect.

- **Reflect Ray Depth** - How many ray bounces will be calculated for reflections. This setting is automatically rounded to the nearest whole number. A setting higher than 1 should not be needed unless there are other reflective objects in the scene and you wish this surface to appear in the reflections of the other objects or vice versa.
- **Reflection Bias** - Bias is a common rendering function which offsets the beginning of raytracing operations slightly away from the surface to prevent artifacts. In most cases the default setting should be sufficient. When rendering small objects or objects with very fine details a lower bias setting, such as 0.1, may better show those details.
- **Reflection Blur Angle** - This simulates the blurry reflections seen on surfaces with very fine imperfections such as frosted glass. This is accomplished by slightly randomizing the angle at which reflection rays bounce off the surface.
- **Reflect Blur Samples** - How many times the reflection of each pixel (or sub-pixel) is calculated. 1 or 2 reflect samples should provide sufficient results in most cases where the Reflection Blur is set to 0%. This setting should be increased for blurry reflections to help reduce visible noise.
- **Reflection Color** - The overall reflection color setting.
- **Reflection Index of Refraction** - Controls how strong reflections are based on viewing angle. On most real life materials, reflections on surfaces facing the camera will be weaker than on surfaces facing perpendicular to the camera. This is commonly referred to as "The Fresnel effect." Generally speaking, the higher the index of refraction, the stronger reflections will appear overall.
- **Reflection Strength** - This controls the overall strength of the reflections. Values above 100% are allowed but are not physically correct and may cause render artifacts in some situations. It is recommended that this setting stay at, or below 100% and instead, the Reflect IOR should be increased or decreased to adjust reflection intensity.

# Shadows

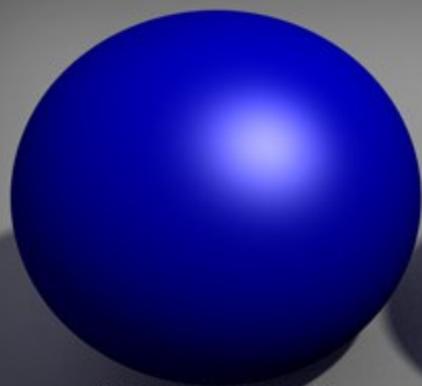


- **Accept Shadows** - Sets whether or not the surface will receive shadows cast upon it by other items. Changing this setting to Off may lower render times at a cost of less believable shadowing.
- **Shadow Color** - Determines the color of the shadows cast by the object. This includes self shadowing and can be used to enhance the look of translucency. For instance, a bright light passing through very translucent blue plastic may cast a blue shadow. Use this feature with caution as any setting other than pure black may greatly increase the rendering time.

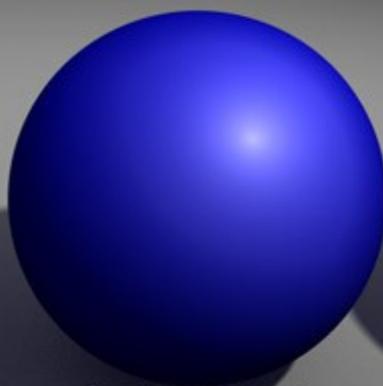
# Smoothing

- **Smooth** - Toggles whether or not the polygons of the object will be rendered as flat, giving a faceted look, or as a smooth shaded, curved surface.
- **Angle** - When Smooth is On, this setting determines at what angle the edges between neighboring polygons will be rendered as sharp transitions. Angles more obtuse than this value will be rendered as smooth.

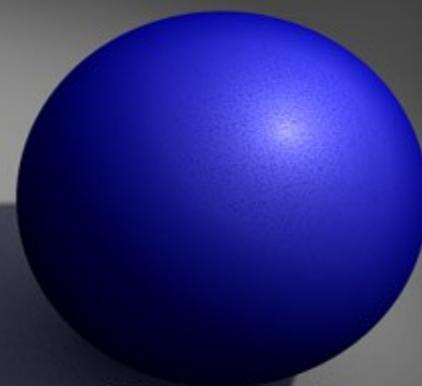
## SPECULAR TYPES



SPECULAR 2  
PHONG



SPECULAR 1  
3DELIGHT



SPECULAR 1  
WITH NOISE

This feature of the shader uses the "3delight Specular Model" to provide highlights. Its falloff looks almost as if there are two aspects to the surface such as skin which is fairly dull but may have a thin, glossy layer of oil over it. It also works well at glossier settings to give the look of shiny plastic with very fine surface imperfections.

Procedural noise settings are available to help break up the highlights, giving them more detail. This feature is particularly useful with closeup rendering of organic material.

- **Specular Color** - Sets the overall color of specular highlights. In general it is best to set the color to white for plastics and white or a very pale blue for human skin. The highlights of metals are usually the color of the metal itself.
- **Specular Glossiness** - Controls the size of highlights provided by directional or point lights in the scene.
- **Specular Noise Density** - Adjusts the size of the pore-shaped variations in the specular highlights. This setting also applies to the noise visible in the bump settings.
- **Specular Noise Strength** - The strength of the skin-pore like noise appearing in specular highlights.
- **Specular Strength** - Overall brightness of specular highlights.

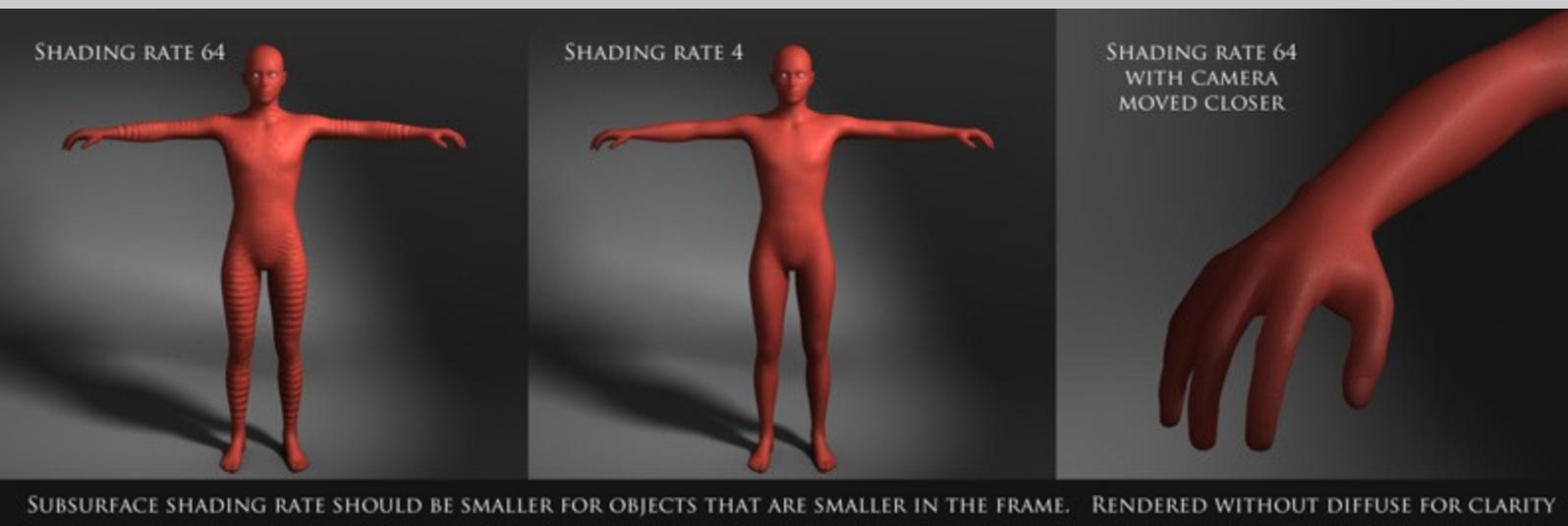
## Specular 2

The highlights created in this section use the "Phong Specular Model." The falloff of this specular model makes it more befitting for polished plastic or glass than the 3delight function.

This specular channel is not affected by the noise settings of the previous specular channel.

- **Specular 2 Color** - Sets the color of specular highlights.
- **Specular Glossiness** - Controls the size of highlights provided by distant, spot or point lights in the scene.
- **Specular Strength** - Overall brightness of the specular highlights.

## Subsurface Scattering - Base Settings



Subsurface scattering provides the look of translucent, waxy, milky or fleshy materials. The effect simulates light passing through the outer surface, bouncing around within the volume of the 3d model then exiting the surface.

The shape of the model, its thickness, material refraction, as well as the absorption and transmission of various spectrums of light are all used in the calculation of subsurface scattering.

Subsurface scattering is quite technical and can be intimidating but, by noting a couple important principles and adjusting just a few key settings, you can achieve a very convincing effect with out having to worry if the result is truly physically accurate.

The most important settings to keep in mind are the Group ID and Shading Scale.



- **Flip Normals** - Turning this on tells subsurface scattering to calculate the surface as if it were turned inside out. The primary purpose of this setting is to allow single sided models, such as a plane primitive, to appear translucent when backlit. The results are generally not physically correct but the feature can be useful in some rare situations.
- **GI Max Ray Depth** - This setting was originally implemented to help speed up renders using indirect lighting but it can also be of benefit in other situations. This sets a limit to the number of ray trace bounces that will see the subsurface effects. For instance, a setting of 0 will make it so subsurface effects are not seen by reflection or refraction rays and SSS will not be calculated for bounced, indirect lighting. A setting of 1 will allow a reflection to see the subsurface effects but they will not appear in reflections of that reflection.

- **Group ID** - Each subsurface group is calculated independently. This setting allows separate material zones and/or objects to be looked at as a single, solid object when subsurface scattering is calculated. If all skin surfaces of a figure are set to Group 1 then light scattering in the hands will also contribute to the scattering of the arm. If each were set to different group numbers then the various material zones, although all equally translucent, would appear to be separate objects. Note: The [Ambient SSS Contribution setting](#) only effects materials that share the same Group ID.
- **Index of Refraction** - Controls how light is refracted (bent) as it passes through the volume the 3d model.
- **Shading Rate** - When the renderer calculates the effects of light in the subsurface material it samples various areas within the volume of the 3d object. A lower shading rate value means a more dense sampling is performed, yielding a more accurate result at the cost of additional render time.
- **Shading Scale** - Sets the scale multiplier of the model in the renderer for the subsurface scattering calculation. The renderer calculates subsurface scattering in millimeters and DAZ Studio units are in centimeters thus 1 unit in Daz studio is 10 times larger than one subsurface unit. A Shading Scale setting of 0.10 will produce a physically correct subsurface calculation. A setting of 1.0 will cause the renderer to treat the model as if it is much smaller, as far as scattering is concerned. Smaller numbers result in brighter subsurface effects but less spreading of those effects. Higher numbers will make the object appear more translucent, giving the subsurface scattering a softer, more spread out effect.
- **Subsurface Color** - This setting defines the color of the model's internal volume.
- **Subsurface Off - On** - A switch to turn on and off subsurface calculation. Values are automatically rounded to 0 or 1.
- **Subsurface Strength** - Overall brightness of the subsurface effect. If you wish to turn off subsurface scattering, it is best to use the above Subsurface On - Off switch rather than to set Subsurface Strength to 0%.

## Subsurface Scattering - Color Settings



The parameters under this heading refine how light, multiplied by the the base subsurface color, changes as it is scattered and absorbed while passing through the volume of the 3d model.

In most cases, the default settings should be sufficient to achieve believable results in renders using subsurface scattering. However, the individual settings give access to 3delight's internal subsurface presets and allow for more physically correct calculations of subsurface scattering.

The "absorption" settings limit how easily red, blue and green light can pass through the volume whereas the "Scatter" settings control the color of the light as it bounces around within the volume of the 3d model.

## Tiling

Tiling allows the image maps used in the shader to be replicated across the surface to create repeating patterns. This affects all texture map channels except for the normal map.

- **Horizontal Offset** - Slides textures horizontally according to UV space.
- **Horizontal Tiles** - The number of times textures should repeat horizontally across the model (dependent on the model's UV mapping).
- **Vertical Offset** - Slides textures vertically according to UV space.
- **Vertical Tiles** - The number of times textures should repeat vertically across the model (dependent on the model's UV mapping).

## UV Maps

- **UV Set** - Allows the switching between various UV Coordinate maps on objects and figures which support multiple UV sets such as Genesis.

## Velvet



- **Velvet Back Scatter** - Sets the apparent strength of the velvet color for surfaces more directly facing the camera. This is akin to the diffuse strength of the velvet rather than the highlights of the velvet.
- **Velvet Color** - Overall color of the velvet effect.
- **Velvet fall Off** - Controls the sharpness of the velvet "highlight" effect.
- **Velvet Roughness** - Adjusts the fall-off of the Backscatter component. Similar to Index of Refraction and the Fresnel Effect of reflection, the Velvet Back Scatter will appear weaker on surfaces facing the camera than on surfaces perpendicular to the camera. The higher the roughness, the less noticeable this effect will be.
- **Velvet Strength** - Sets the overall strength of the velvet effect.

## Known Issues

Colored shadows (AKA light transmission) only appear from lights using ray traced shadows. Mapped shadows will render black.

Using undo to remove the application of a shader preset may cause the surface, or other surfaces using the AoA\_Subsurface shader, to no longer render properly. A simple fix is to select the effected surfaces and apply the "!Subsurface Base Shader" preset. This will only refresh the shader code, not change any of the any of the existing settings.

Procedural specular noise and bump may not properly move along with rigged or morphing objects throughout animations. The effects should follow and rotate properly when used on moving props in animations.

At the time of this writing, the SSS Material Type Spectralon is not properly working. I believe this is either due to a minor bug in DAZ Studio or Shader Mixer. This setting may very well work properly in a future release of DAZ Studio.

Subsurface Scattering tends to take longer to calculate for triangulated models than for models made mostly of quads. The slowdown is more noticeable when the triangulated model uses SubD.

Smoothing angle and Smoothing Off do not currently work on surfaces with SubD applied. This is a current limitation in DAZ Studio but will likely be fixed in a future DS release.

In rare cases, where an object is only partially visible to the camera, the areas not directly visible to the camera may not show the subsurface scattering effects in reflections or refractions. This is simply due to the way many renderers optimize geometry for better memory use, only calculating geometry that is visible to the camera during any given render pass.

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