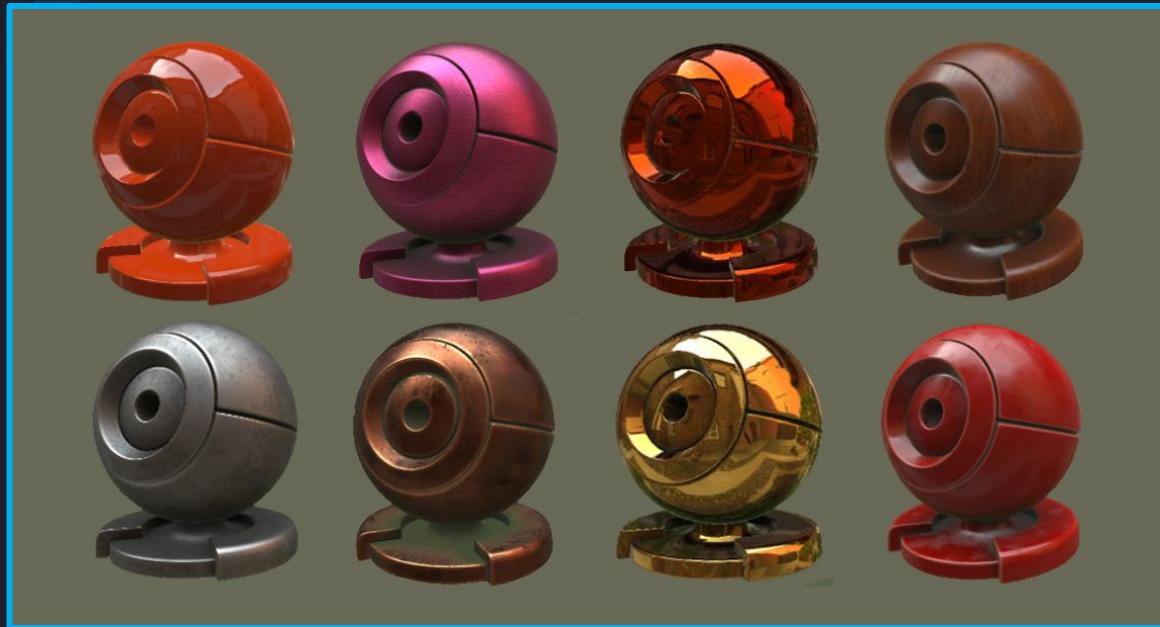


PBR Texture Sets

Attributes and texture formats used in a PBR materials



PBR Textures|Material Attributes



The properties of a physically based rendering (PBR) material are driven by 4 main attributes.

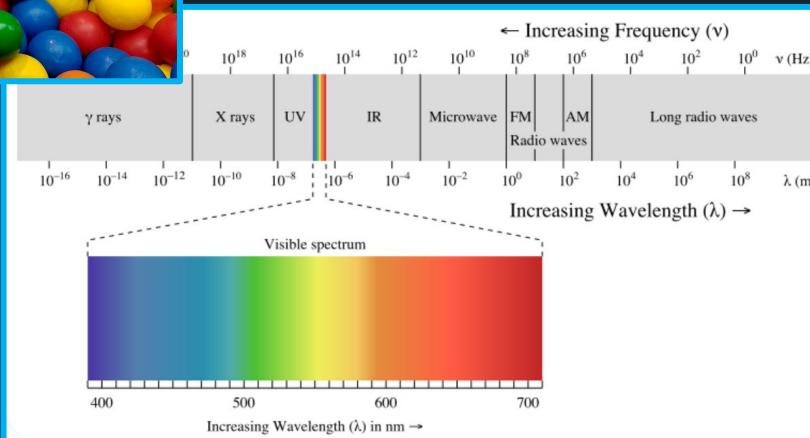
- Colour/Hue/Albedo
- Roughness/Smoothness
- Metallic/Dielectric
- Normals

These can be global values across the whole material or they can be driven using a bitmap image.

For additional information on materials properties view the video on Materials & Shaders below:

[Video Link](#)

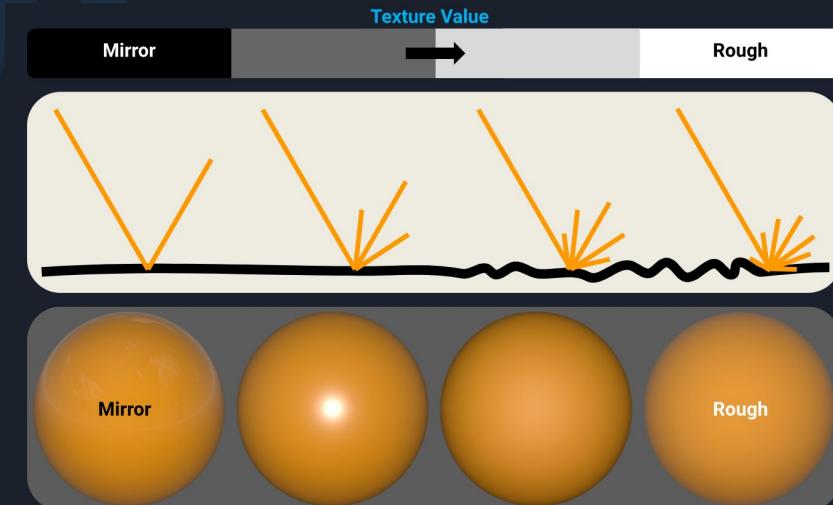
PBR Materials|Colour/Hue/Albedo



The colour of an object's surface is a result of the portion of the light spectrum (wavelength) that is reflected to the viewer.

A red ball **absorbs** the blue-orange wavelengths light and reflects the red portion.

PBR Materials|Roughness/SMOOTHNESS

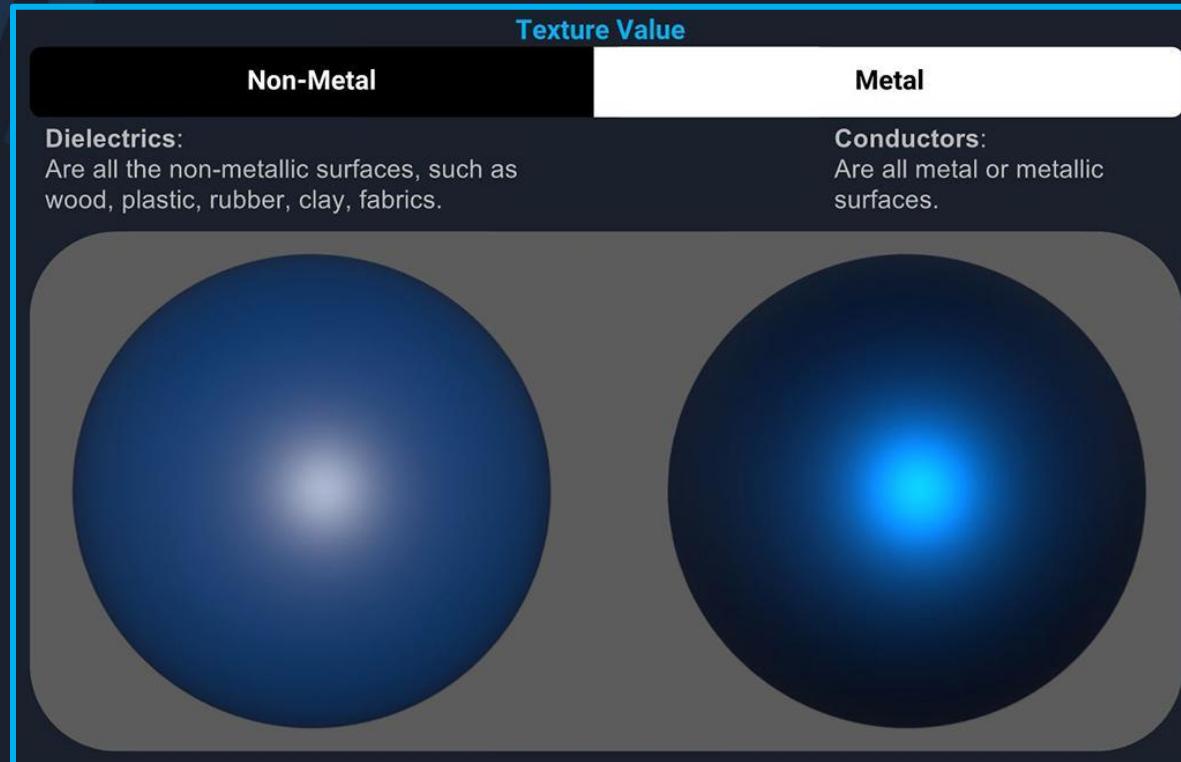


The roughness value in PBR describes the micro surface of a material.

Much like a real world material, roughness values define how light will be diffused or reflected from a surface.

The 8 ball in the image is very smooth, the green tables felt is very rough, the light is reflected in very different ways.

PBR Materials|Metalness/Dielectric



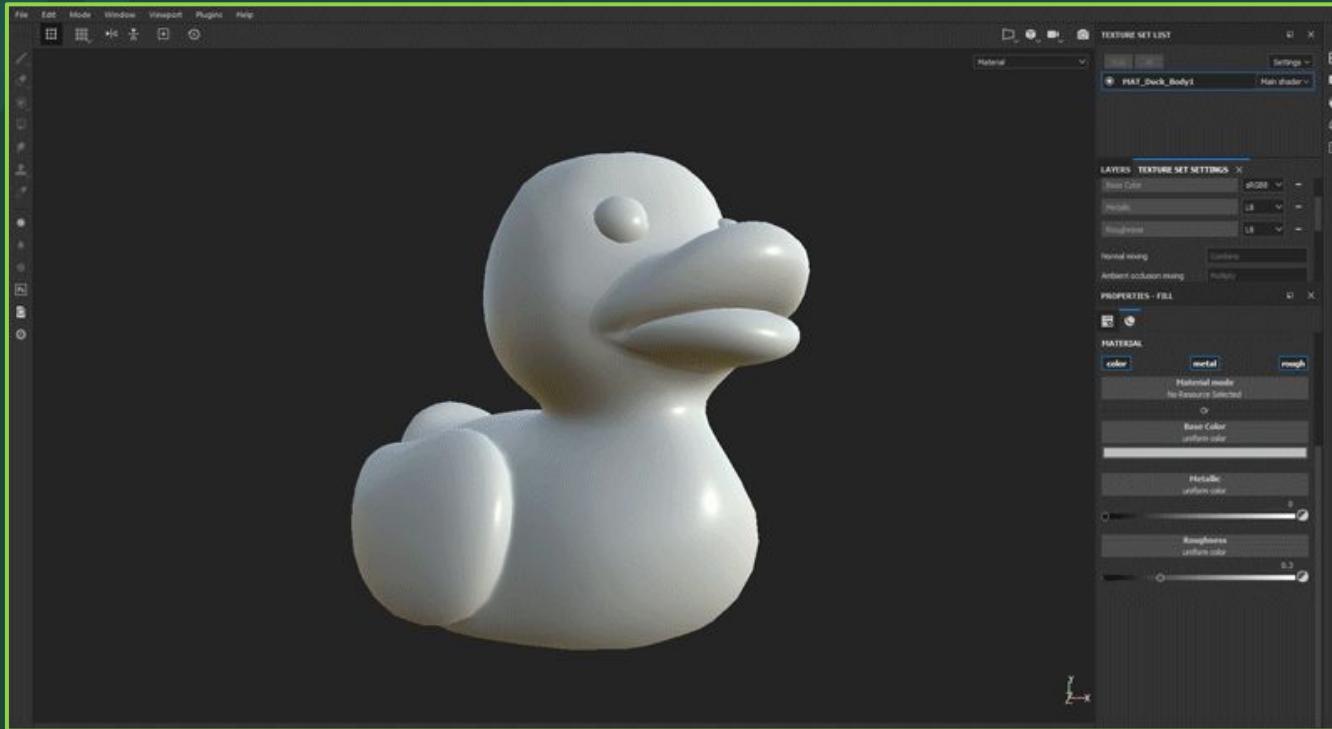
Metalness is both the reflectivity and the conductivity of a substance.

Having a high reflectivity light from the surrounding environment will bounce off the surface with little penetration into the substance.

This IS NOT SMOOTH/ROUGHNESS

Another quality of metalness is that the reflected specular light will be tinted. You will notice that any reflected light takes on the colour of the metal. This is due to the conductivity of metal, a portion of the spectrum is absorbed by the metal.

Demo|Material Attributes in Substance Painter



By adjusting PBR material attributes/values in Substance Painter we can see the contribution of those attributes to the surface of the material.

Colour:

Metalness:

Roughness:

Exercise|Recreate Materials



1. Download and Open the provided Substance Painter scene:
`Exercise_PBRMaterials.spp`
2. Adjust the material attributes to recreate these objects as closely as you can.
(No bitmaps or procedural textures)

You have 30 minutes

PBR Textures | Using Images in Materials



As well as numeric parameters to define the attribute of a material we can also use images.

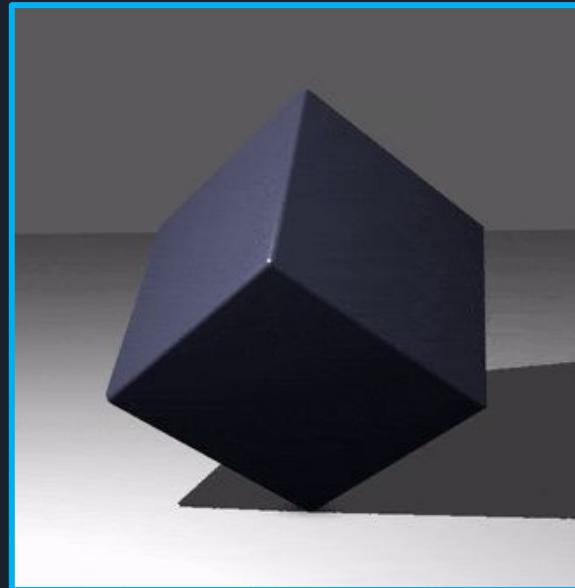
Applying a texture to a material applies values to its attributes at a per pixel level.

The position of these values on the model is defined by the models UV layout.

PBR Textures|A Matrix of Values

10	42	69	128	107	185	219	245
10	42	69	0	0	185	219	245
10	42	69	0	0	185	219	245
10	0	0	0	0	0	0	245
10	0	0	0	0	0	0	245
10	42	69	0	0	185	219	245
10	42	69	0	0	185	219	245
10	42	69	128	107	185	219	245

Roughness map



Materials roughness values being driven by the bitmap image

When using bitmaps to define a materials attributes it can be useful to think of them as a matrix of values (a grid of numbers).

In a black and white bitmap a black pixel is 0 (off) and a white pixel is 255 (on).

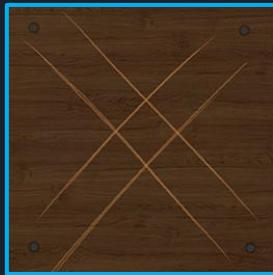
In an 8 bit greyscale image each square or pixel represents a value between 0 and 255 (an 8 bit value).

BLACK = OFF = 0

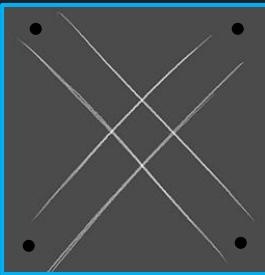
WHITE = ON = 255

GREY = A value between 1 and 254

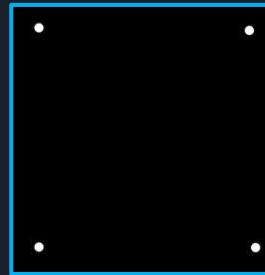
PBR Textures|Texture Formats



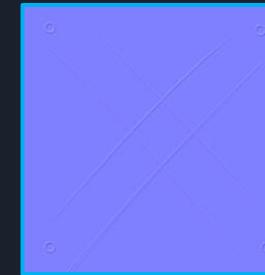
Colour/Hue
(RGB Colour)



Rough/Smooth
(Greyscale)



Metalness
(Black & White)



Normal
(RGB Colour)

4 basic textures used in common PBR materials

Bitmap images must be in a particular format to properly describe the values of each attribute in PBR material.

By combining these images to define the attributes of a PBR material most substances can be convincingly replicated.

NOTE:

There are a few other maps that can be included in a PBR workflow depending on the capabilities of the material shader or rendering engine.

PBR Textures|Interplay



Interplay is where the textural elements of your material are reflected across multiple maps within the texture set.

Each texture map working in combination with the others in the set will give the most plausible or convincing results

Example: In the image on the left, the scratches on the wood are not only depicted in the colour map but also in the roughness and the normal map.

With each textural element, such as scratches you need to consider how it will affect the other 3 maps.

PBR Textures|Base Colour

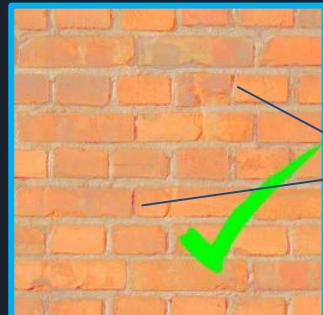


Base colour maps handle the amount of light (Brightness) and distribution and proportion of wavelengths (Hue/Colour) reflected or absorbed by a surface.

PBR Textures|Base Colour



This image contains lighting information and shadows



This image contains NO lighting information, Only the Albedo levels and Colour

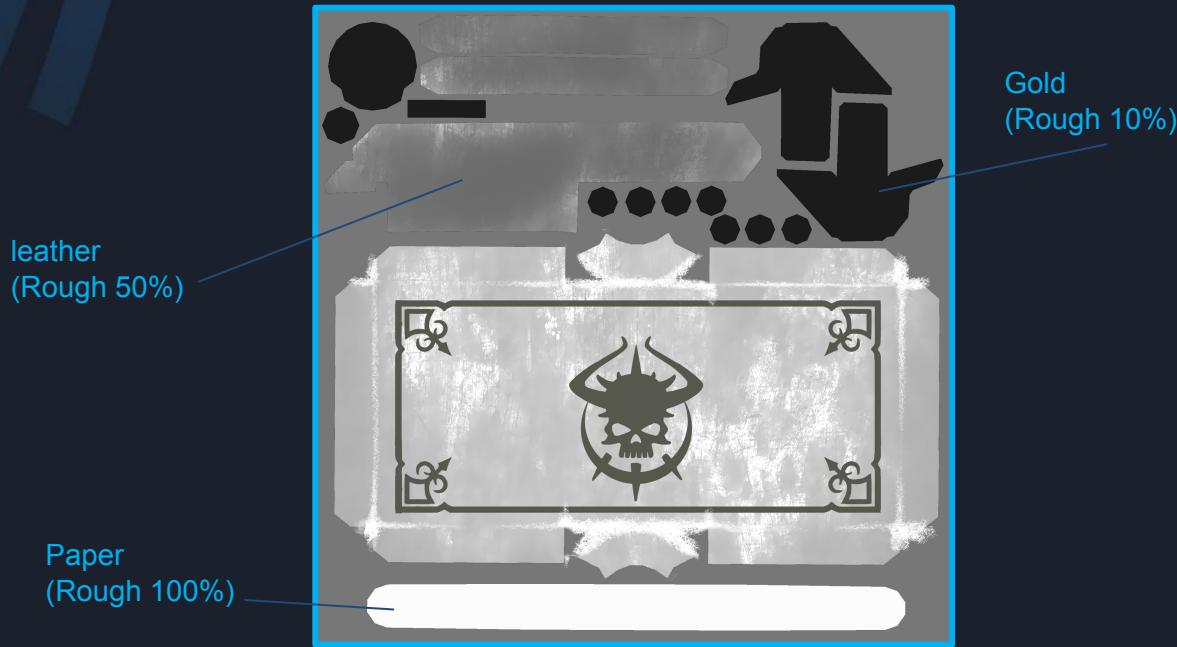
(OK so there's a tiny bit here)

When we create a base colour map for a PBR material only the colour information is needed.

When using images or photographs to create a base colour map, the subjects lighting should be as neutral as possible containing no shadows or highlights.

TIP: Shoot your own reference photos on an overcast day to avoid shadows or directional lighting.

PBR Textures|Roughness/SMOOTHNESS



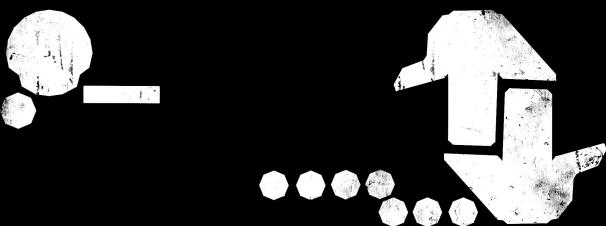
The Roughness map

The Roughness or smoothness map affects the scattering of light bouncing off the material due to micro surface irregularities.

BLACK = 0% ROUGH (SMOOTH)
50% GREY = 50% ROUGH
WHITE = 100% ROUGH

NOTE: Some 3D rendering engines will use roughness (UE4) and some smoothness (Unity). It is important to apply the $0 = \text{OFF} / 1 = \text{ON}$ principle where x is the driven attribute.

PBR Textures|Metalness



CORRECT



INCORRECT



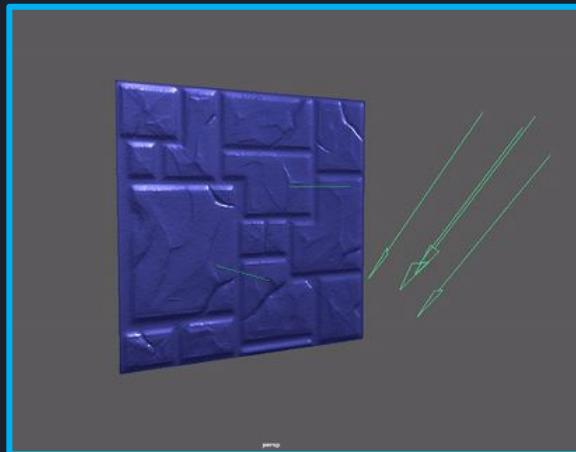
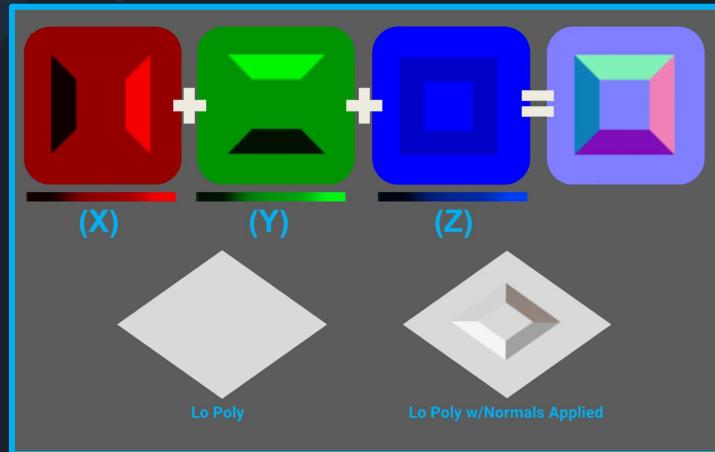
Exceptions

Most substances are either what we call dielectric (insulating) or metal (conductive).

For this reason when mapping out metalness we use a map that is black and white, **NOT GREyscale**.

NOTE: there are some exceptions to this principle Eg. substances such as pearl or satin. Greyscale metalness maps can also be used for styling a metal material.

PBR Textures|Normal Maps



Normal Maps use the RGB channels of an image to adjust the shading of each pixel dynamically relative to lights in the scene.

This creates the illusion of bumps and cavities without altering the underlying geometry.

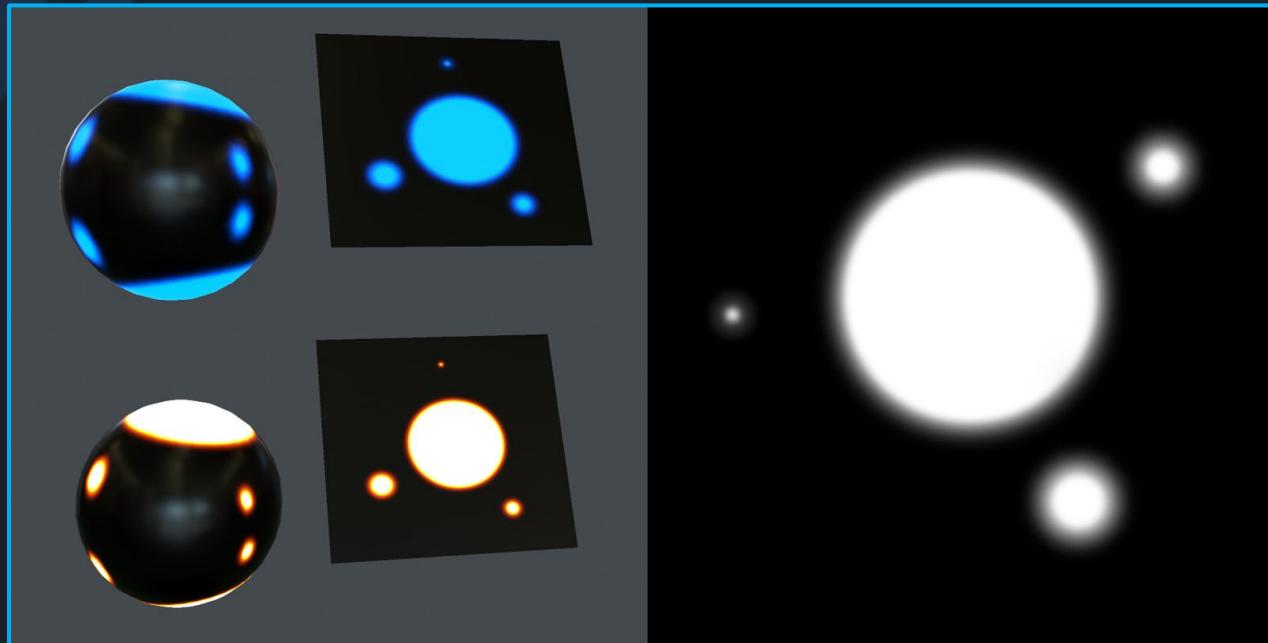
Additional Textures|Opacity Maps



Opacity maps are black and white textures that determine the transparency and opaqueness of an object.

Pure white representing opaque areas and pure black representing completely transparent areas.

Additional Textures|Emissive Maps



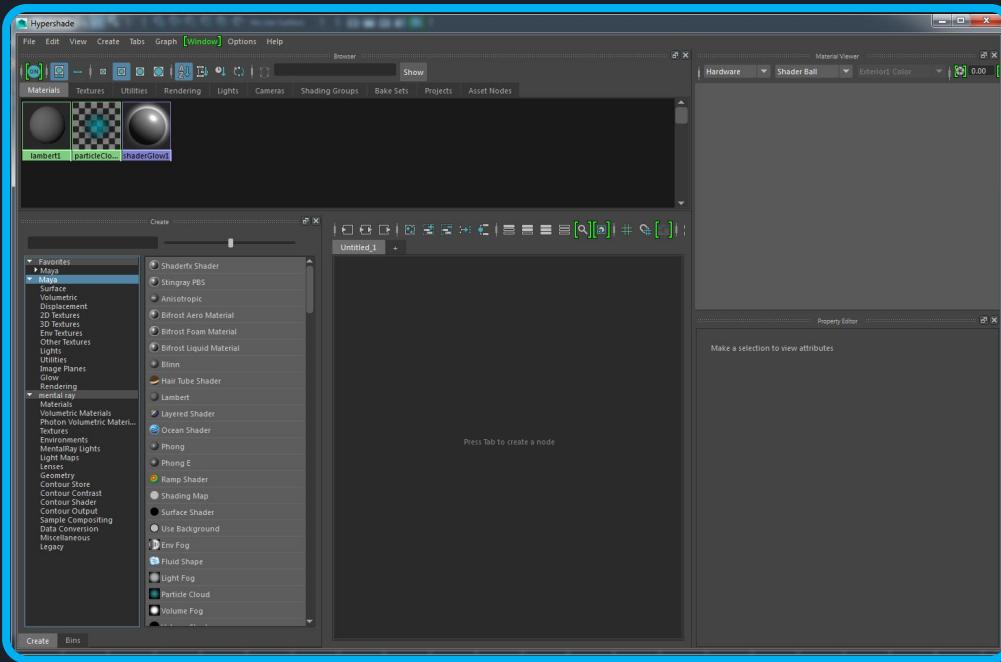
Emissive map are used to create a self-illuminated or glowing effect to an area of your model.

The emissive map can be black and white used as a mask to drive the emissive color.

Materials in Maya

Materials & Shaders | HyperShade

Hypershade is the Main interface to deal with and handle shaders/materials in Maya



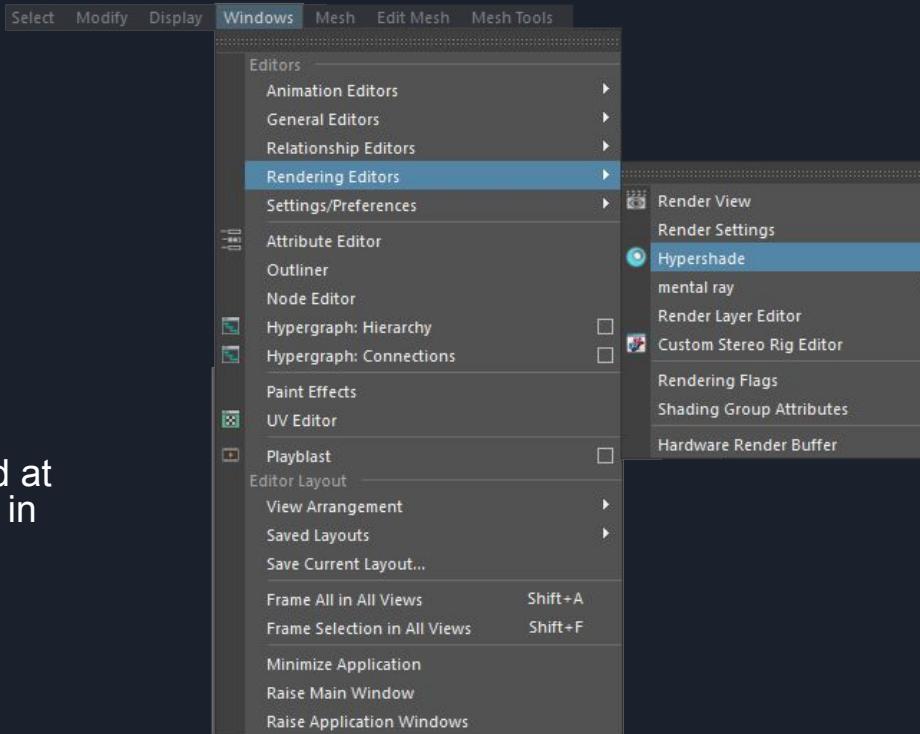
HyperShade is almost a new piece of software in itself, but still follows most Maya's interface and control standards

Materials & Shaders | HyperShade

There are multiple ways to open the Hypershade Window

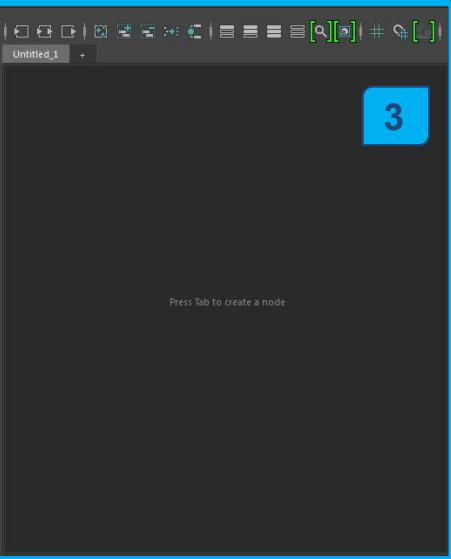
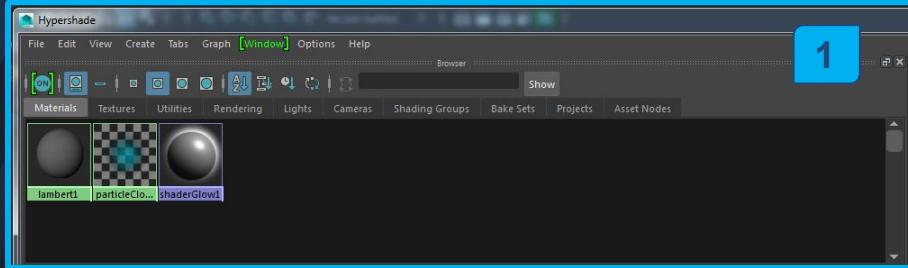


This button is located at
the Top bar of icons in
Maya's interface



HyperShade is almost a piece of software in itself, but still follows most Maya's interface and control standards

Materials & Shaders | HyperShade



1. **Browser** - View Existing Materials and Nodes in your scene
2. **Create** - List of available Materials and Nodes. Click to Create
3. **Node Graph** - Edit and View the structure of a Materials Node Tree
4. **Material Viewer** - Show a Real Time Render of the current Material
5. **Property Editor** - Edit the Attributes of a Material

PBR textures|Summary



COMMONWEALTH OF AUSTRALIA

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Today we have learned the basics of the PBR texture set

- Complete:
We have discussed the use and function of numeric values and bitmaps to adjust the attributes of a PBR material.
- Usability:
We have looked at how these maps combine to create plausible surface through simulating the reaction of light and interplay of map details
- What next:
Programs such as Substance Painter use masks, layers, blend modes and smart materials to leverage the power of PBR materials in a flexible Non destructive workflow. Time to explore these tools to create more complex PBR textures.