DV15677

Procedural PBR Material Creation using Substance Designer for Visualization

Scott DeWoody

Firmwide Creative Media Manager

@scottdewoody

Design Visualization LIVE presented in partnership with

cgarchitect.com

Class summary

Learn to procedurally create any kind of physically based rendering (PBR) material with Substance Designer. This will enable you to create physically based materials that not only look believable, but also materials that tile perfectly when rendered. In this class you'll learn how to create some basic materials, and how to translate them into the major rendering applications including: mental ray rendering machine, NVIDIA's Iray rendering engine, Chaos Group's V-Ray rendering engine, and A360 cloud-based collaboration service. We will also touch on creating material definition language (MDL) materials by using Iray directly inside Substance Designer. With Substance Designer at the center of your material pipeline, you'll be a0ble to create materials that will look relatively the same across any rendering engine you end up using for visualization. They will even translate into the major gaming engines, such as Stingray game engine, Unreal, and Unity. The industry use case for Substance Designer is unlimited. Anyone doing product design, automotive, architecture, film, and gaming can benefit from adding Substance Designer to his or her pipeline. This session features 3ds Max and A360.

Key learning objectives
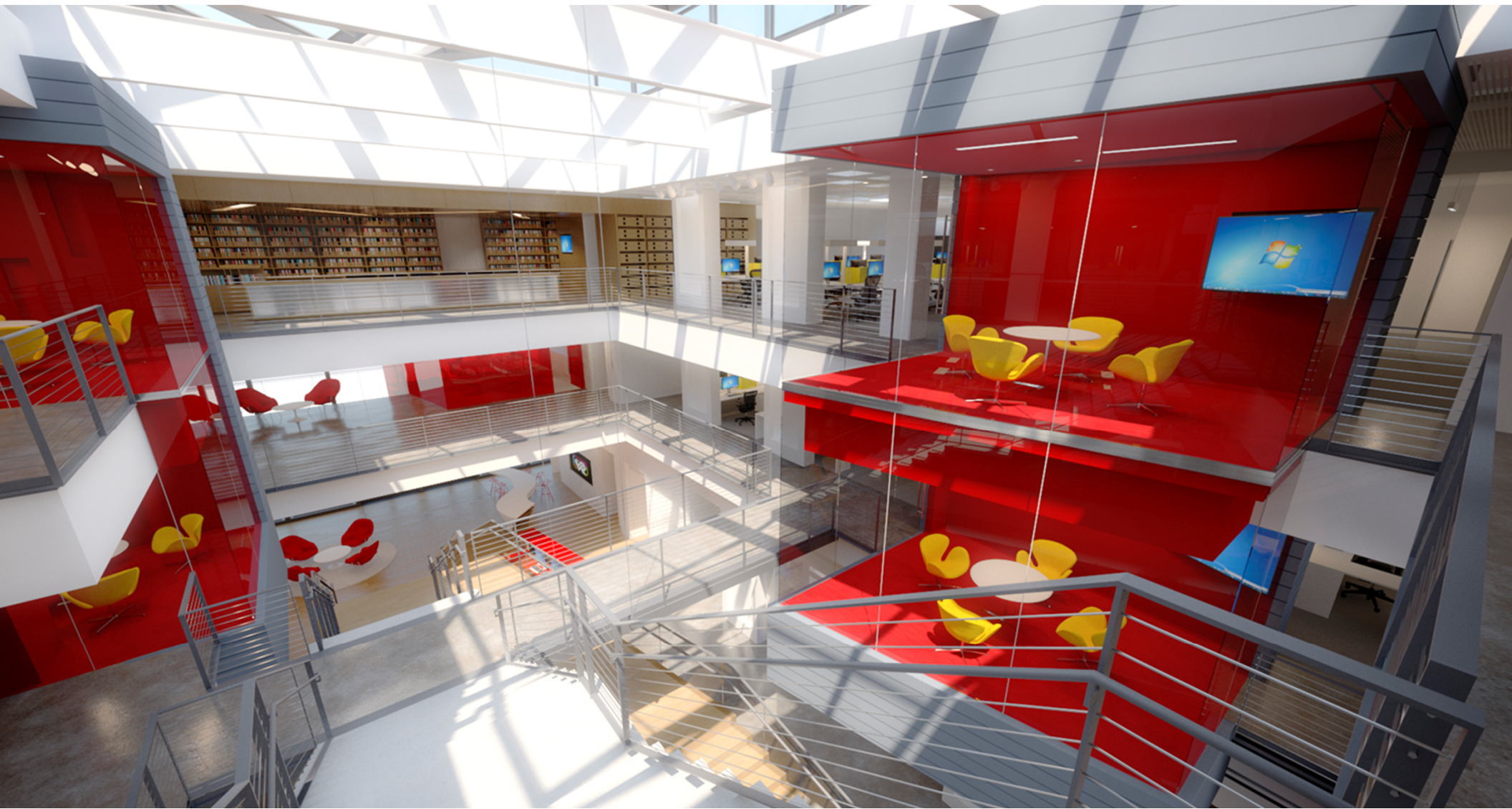
At the end of this class, you will be able to:

- Learn how to create some basic materials
- Learn how to get started in Substance Designer
- Learn how to export the materials created
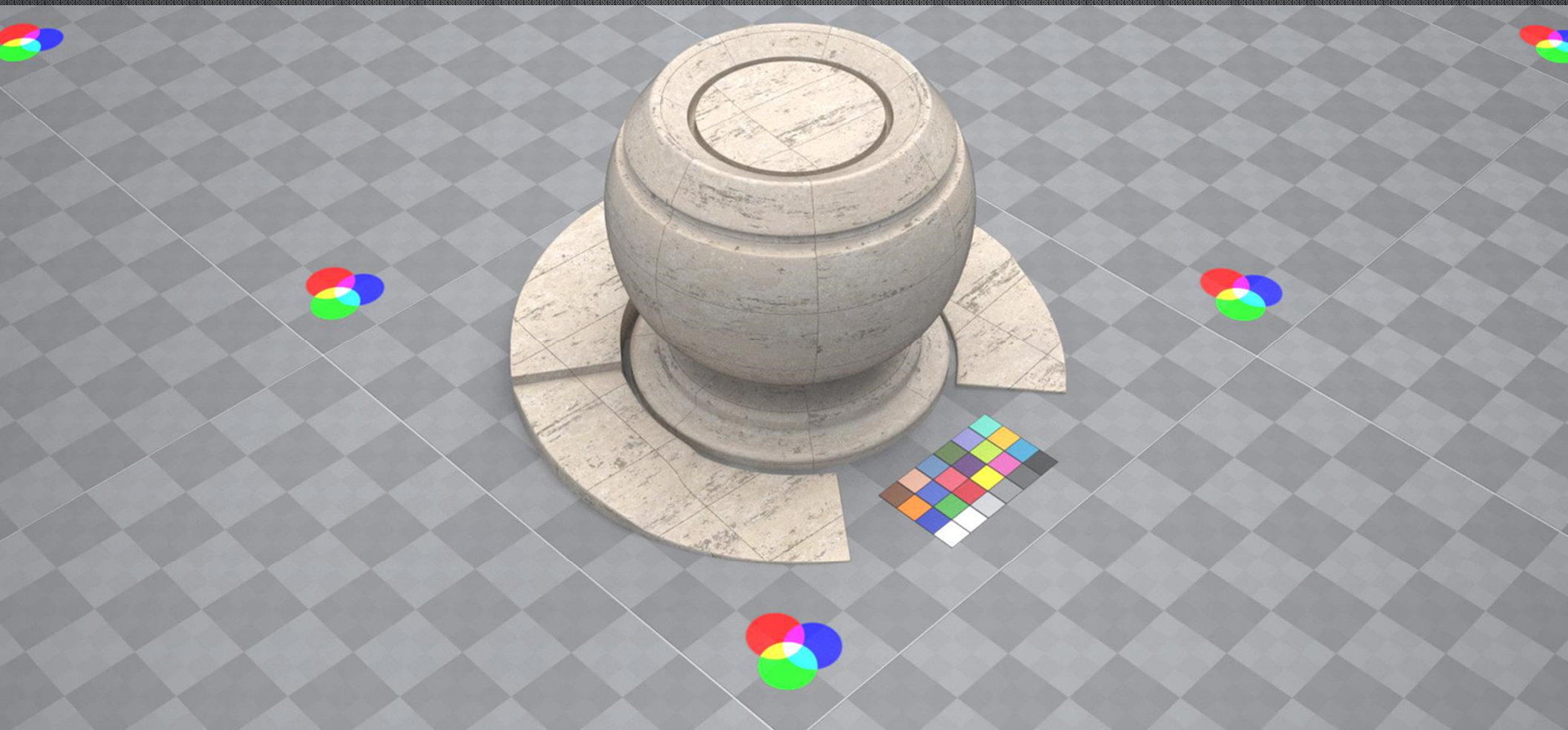- Learn how to apply the materials across various rendering engines
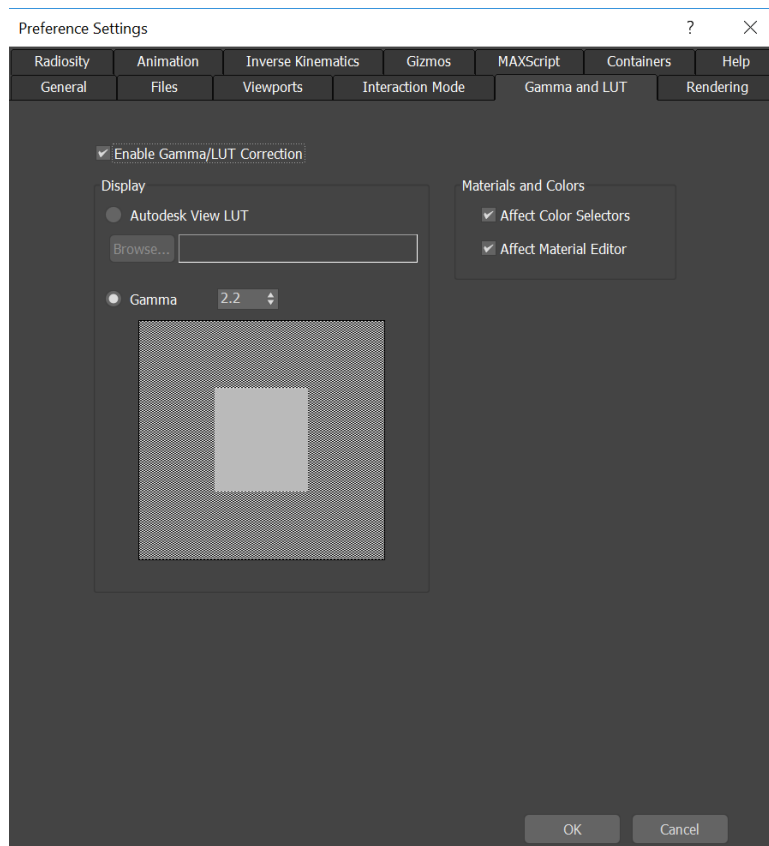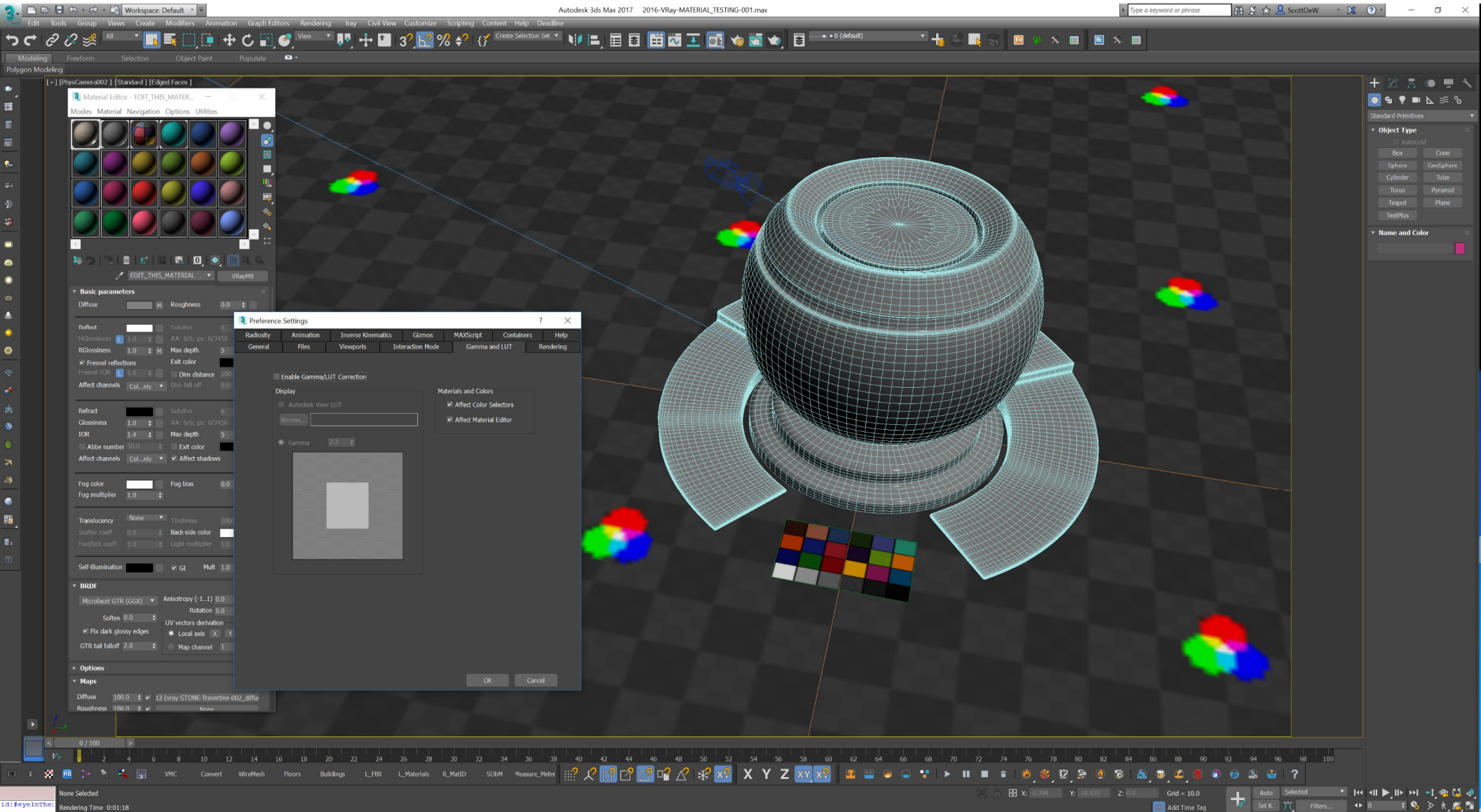
Substance Designer Live Demo
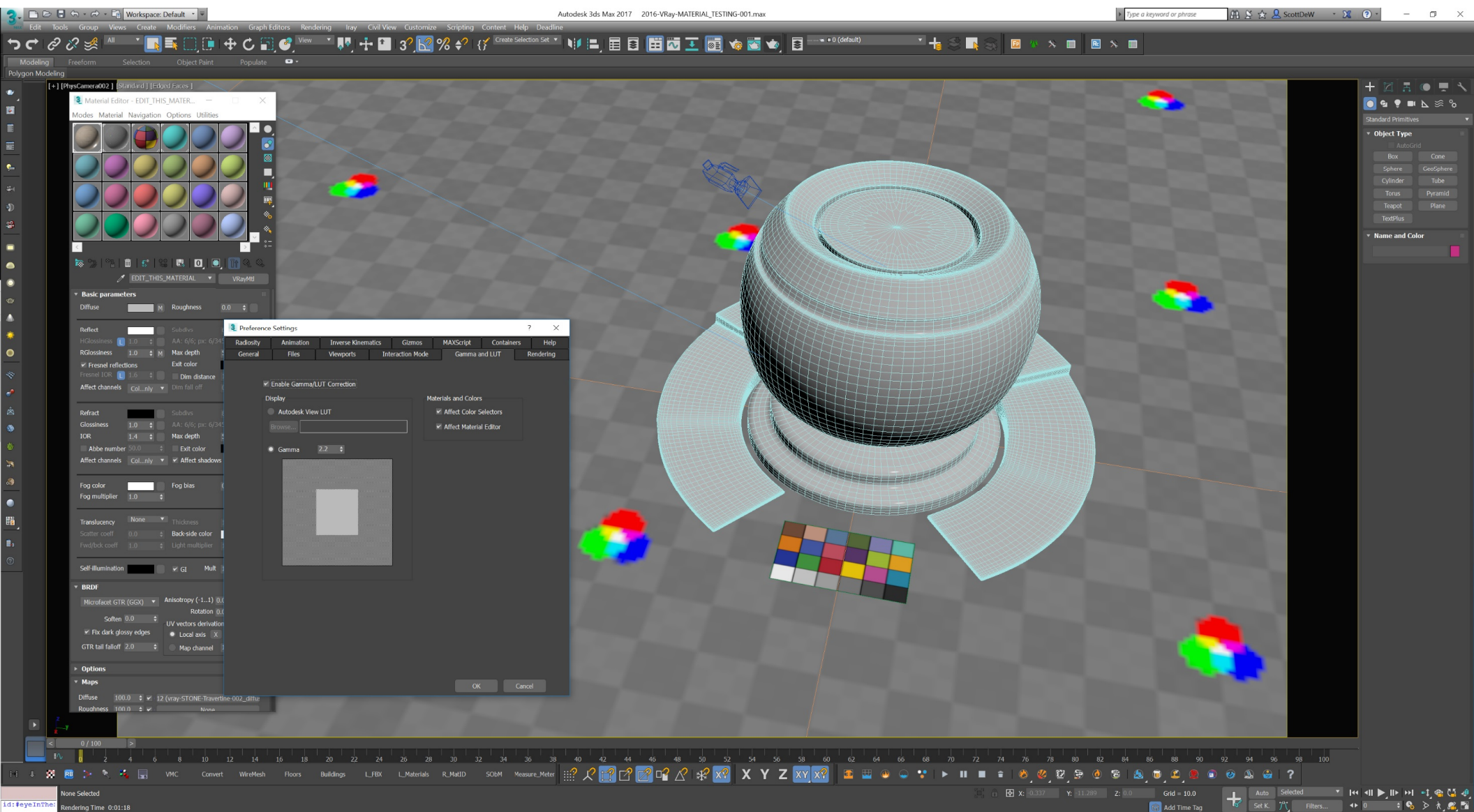
Color Space and Management

In 3ds Max this can be simply done in the Gamma/LUT Settings.

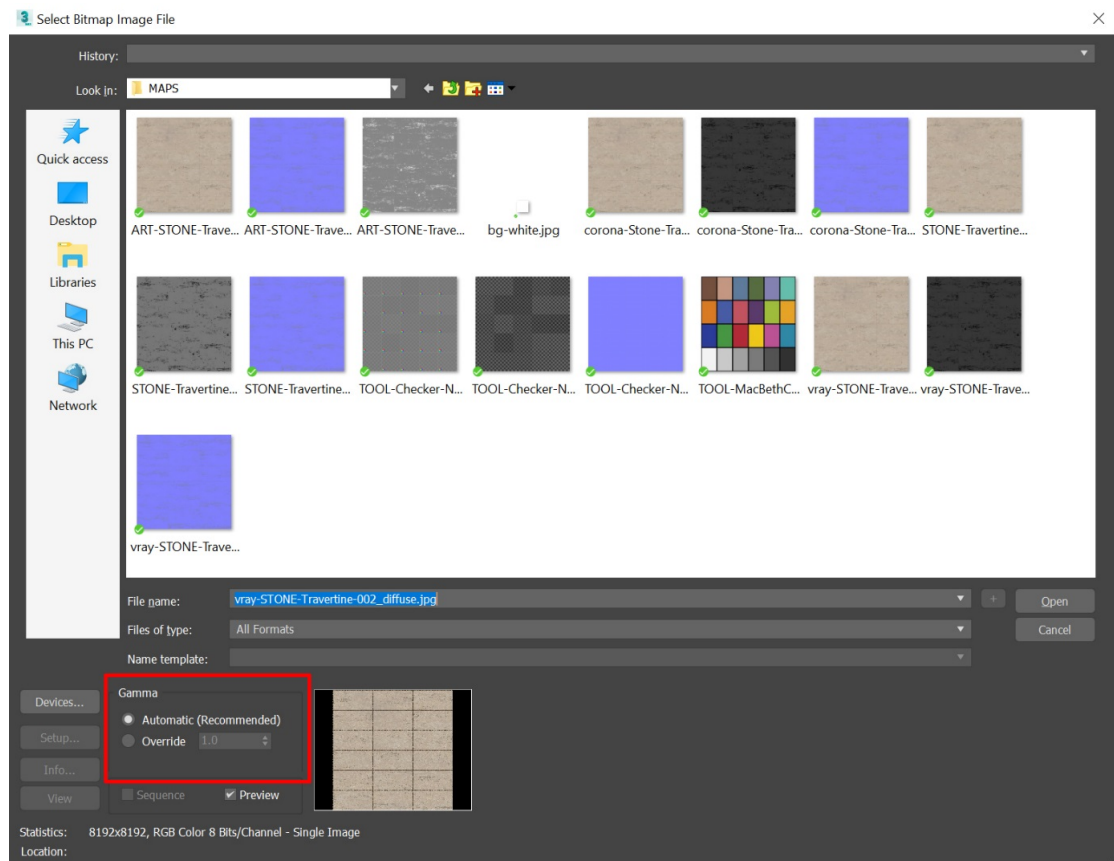*This is now on by default in **3ds Max 2017**

AUTODESK.

Autodesk 3ds Max 2017   2016-VRay-MATERIAL_TESTING-001.max

Edit Tools Group Views Create Modifiers Animation Graph Editors Rendering Iray Civil View Customize Scripting Content Help Deadline

Modeling   Freeform   Selection   Object Paint   Populate
Polygon Modeling

[+] [PhysCamera002] [Standard] [Edged Faces]

Material Editor - EDIT_THIS_MATER...
Modes Material Navigation Options Utilities

EDIT_THIS_MATERIAL   VRayMtl

Basic parameters
Diffuse   M   Roughness   0.0

Reflect   Subdivs
HGlossiness   L   1.0   AA: 6/6; px: 6/34
RGlossiness   1.0   M   Max depth
☑ Fresnel reflections   Exit color
Fresnel IOR   L   1.6   ☐ Dim distance
Affect channels   Col...nly   Dim fall off

Refract   Subdivs
Glossiness   1.0   AA: 6/6; px: 6/34
IOR   1.4   Max depth
Abbe number   50.0   ☐ Exit color
Affect channels   Col...nly   ☐ Affect shadows

Fog color   Fog bias
Fog multiplier   1.0

Translucency   None   Thickness
Scatter coeff   0.0   Back-side color
Fwd/bck coeff   1.0   Light multiplier

Self-illumination   ☑ GI   Mult

BRDF
Microfacet GTR (GGX)   Anisotropy (-1..1) 0.0
Soften 0.0   Rotation 0.0
☑ Fix dark glossy edges   UV vectors derivation
GTR tail falloff 2.0   ○ Local axis   X
                    Map channel

Options

Maps
Diffuse   100.0   12 (vray-STONE-Travertine-002_diffu...
Roughness 100.0   None

Preference Settings   ?   ×

Radiosity   Animation   Inverse Kinematics   Gizmos   MAXScript   Containers   Help
General   Files   Viewports   Interaction Mode   Gamma and LUT   Rendering

☑ Enable Gamma/LUT Correction

Display   Materials and Colors
○ Autodesk View LUT   ☑ Affect Color Selectors
Browse...   ☑ Affect Material Editor

○ Gamma   2.2

                OK   Cancel

Standard Primitives

Object Type
        AutoGrid
Box   Cone
Sphere   GeoSphere
Cylinder   Tube
Torus   Pyramid
Teapot   Plane
TextPlus

Name and Color

None Selected
Rendering Time 0:01:18
id:#eyeInThe

0 / 100

VMC   Convert   WireMesh   Floors   Buildings   L_FBX   L_Materials   R_MatID   SObM   Measure_Meter

X Y Z XY XP

Auto   Selected
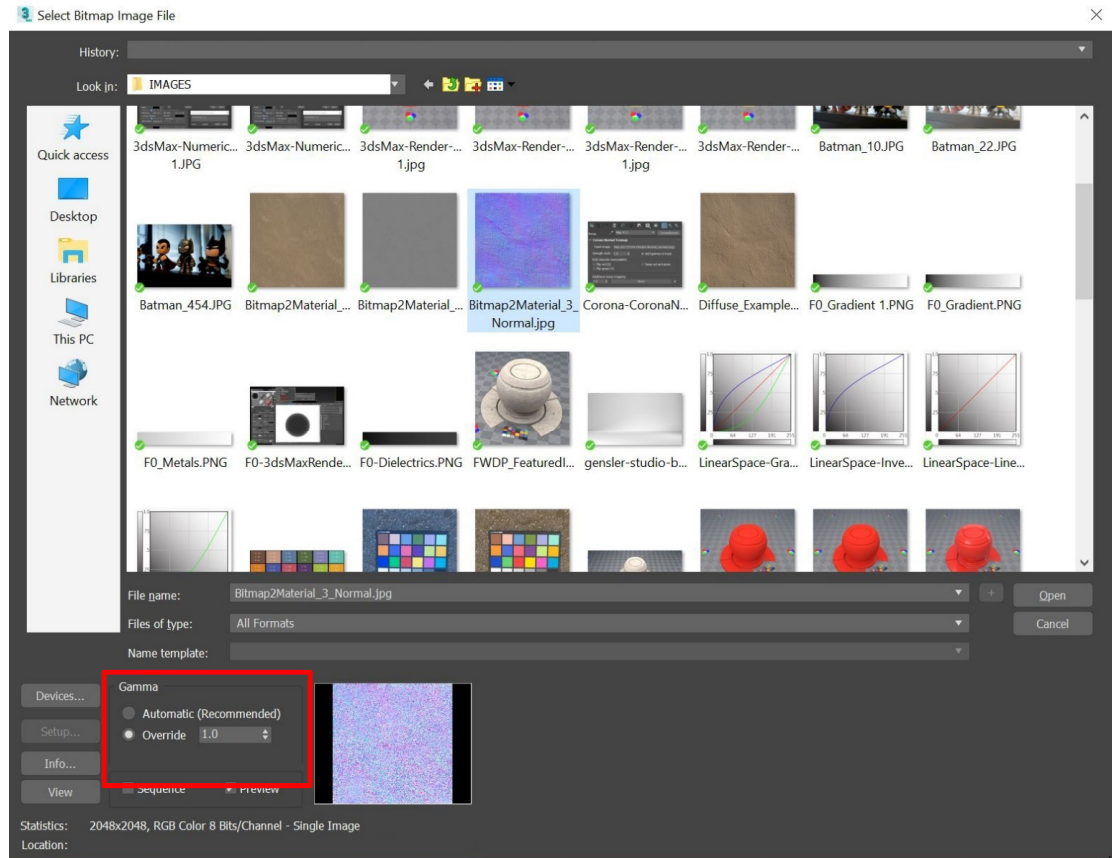Set K.   Filters...

Grid = 10.0

sRGB Bitmaps

- Diffuse

- Albedo

- BaseColor

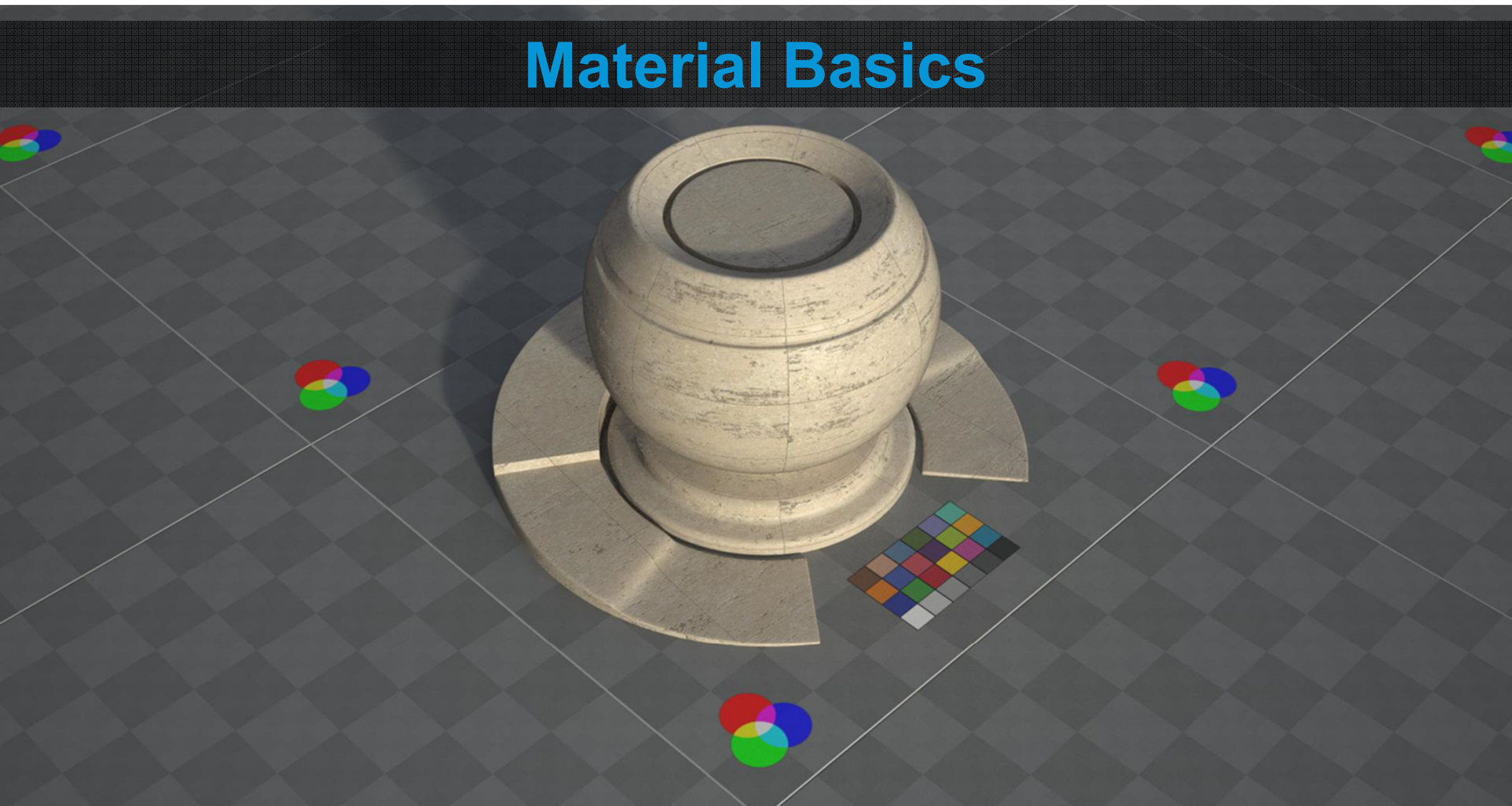- Reflection

- Specular

Linear Bitmaps

- Glossiness

- IOR

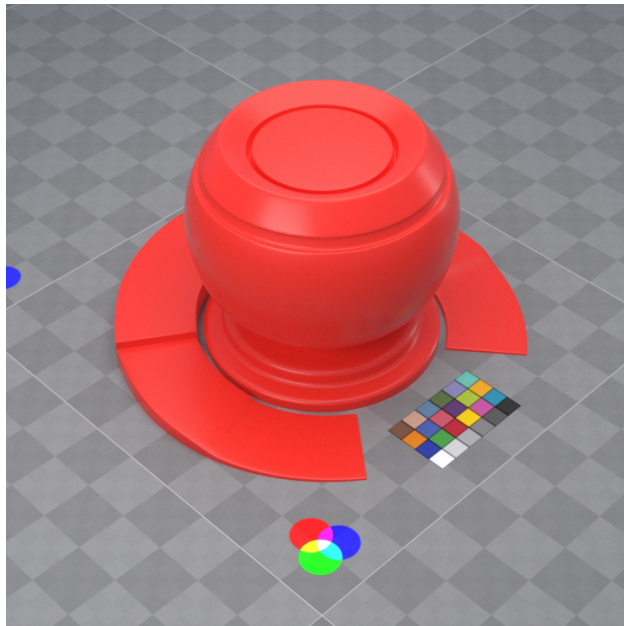- Refraction
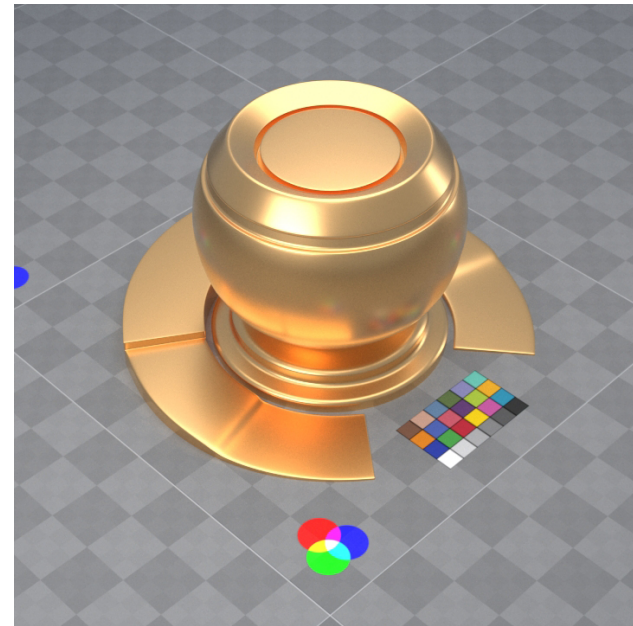
- Normal

- Bump

- Translucency

- Opacity

AUTODESK.

Material Basics

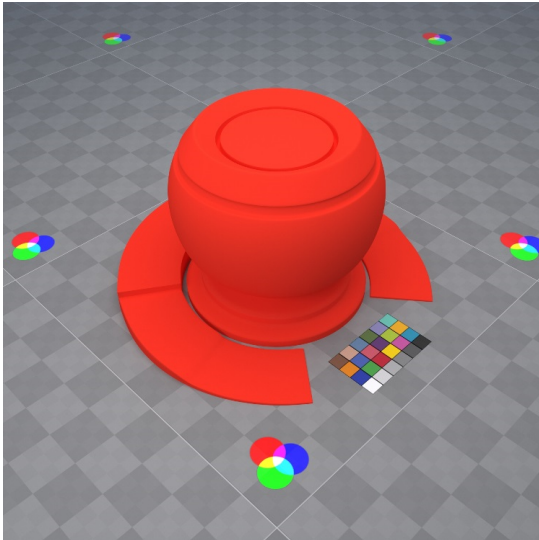# Two TYPES of Materials

Dielectrics

Metals

AUTODESK.
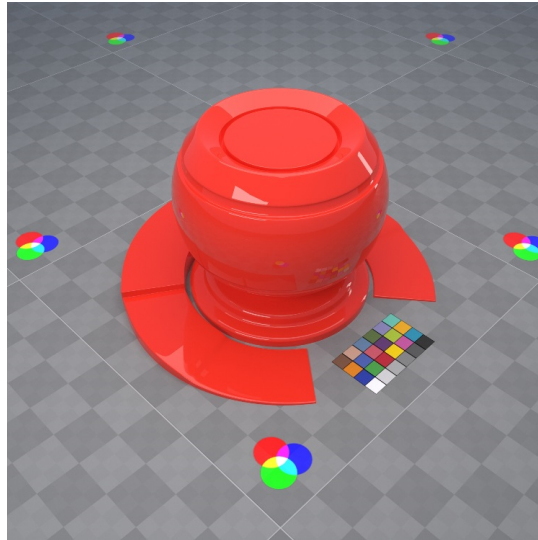
Three KEY TYPES of Properties

Diffuse   **Reflection**   **Glossiness**

AUTODESK.

Additional Material Properties

Bump/Normal   Refraction   Translucency   Opacity

Material Workflows

Three Workflows…

Reflection / Glossiness

- V-Ray
- Mental Ray
- Iray
- Corona
- Redshift
- Arnold
- F-Storm
- Autodesk Raytracer

Metal / Roughness

- Unreal Engine
- Unity
- Stingray
- Marmoset Toolbag
- Autodesk Raytracer

Specular / Glossiness

- Unity
- Marmoset Toolbag

Reflection / Glossiness

This is the **most common workflow** inside a majority of **Raytrace Engines**, and it has been around for the longest time. This model follows the Material Basics that were outline earlier in the document **extremely closely**.

- **Diffuse Map** should contain no lighting information
    - **Metals are Black in the Diffuse**
- **Reflection** should be set to **100% (White)**
    - **Metal Color goes in this channel**
- **Fresnel** is turned **On**
- Set the **IOR**
    - **IOR 1.4 is a safe number for Dielectrics if the IOR unknown for the material.**
    - **IOR of 20-50 is good when creating materials, although not accurate.**
- **Glossiness** controls how light reflects off the surface
    - Use a **FallOff Map** in this Channel to help control the spread based on the viewing angle for additional realism. **(Not supported by all engines)**

Metal / Roughness

**We will be using this workflow inside of Substance Designer.
This workflow is the **new kid on the block**, and has recently been introduced through **Gaming Engines** adopting **PBR** into their workflow. The basics of Materials are still here, but a few things get **flip-flopped when it comes to Dielectrics and Metals.**

- Unlike the other two workflows in this list, the **Metal/Roughness Workflow** controls the **IOR and Reflectivity** through a **Metallic Channel**. The **Metallic Channel** tells the engine if the Shader is either a **Metal or a Dielectric**. So the value of **0.0 (Black)** defines the material as a **Dielectric**, and a value of **1.0 (White)** defines the material as a **Metal.** This essentially sets either the **IOR to 1.4 for Dielectrics**, or something around **IOR 25+ for Metals**. There is the ability to move the value between that range, but there is not much need to do so. Materials are really one or the other, so setting it to **0 or 1** is ideal.
- The **Roughness Map** will control how light is **reflected off of the surface**. **Black Values (0.0)** will result in a **clean reflection**, while **White Values (1.0)** values will result in a much more **diffuse reflection.**
    - **This is the exact opposite of how Reflection/Glossiness works.**
- **BaseColor** should not contain any lighting information.
    - **Metal Colors do not go in the Metal Channel, but instead go into the Base Color Channel.**
- **Fresnel** is already enabled, and handled by the Shader. **It cannot be disabled.**

Specular / Glossiness

This workflow combines the **IOR Values into the Specular Values**. So it does assume that the material is **always reflective**, but it's the value inputted into **the Specular Channel** that determines what kind of material the Shader becomes. This is equivalent to the **F0** value talked about earlier.

- **Diffuse Map** should not contain any lighting information.
  - **Metal is Black in the Diffuse Map.**
- Use the **F0 Values** for materials in the **Specular Channel**
  - If the need arises to accurately calculate the F0 value for a material, based off of its IOR, use the following equations: (n=IOR)
    - Linear Equation: $F0=((1-n)^2)/((1+n)^2)$
    - sRGB: $F0=((((1-n)^2/(1+n)^2)^{(1/2.2)})*255$
  - Here are a few guidelines when creating **F0 values**:
    - If all else fails, use a value of **.04 (linear) or 59 (sRGB).** Most Dielectrics tend to be around this value, so it is a safe bet.
    - **No material should go below .02 (linear) or 43 (sRGB).**
    - **Dielectrics tend to be in the range of .02-.08 (linear) or 43-80 (sRGB).**
    - **Metals tend to be in the range of .5-1.0 (linear) or 186-255(sRGB).**
      - **Color does come into play with Metals, but the Value set within the RGB Scale should be in this greyscale range.**
- The **Gloss Map** will control how light is reflected off of the surface. **High values** will result in a **clean reflection**, while **lower values** will result in a much more **diffuse reflection.**
- **Fresnel** is already enabled, and handled by the Shader. **It cannot be disabled.**

How did I do?

- Your class feedback is critical. Fill out a **class survey** now.

- Use the AU mobile app or fill out a class survey online.

- Give feedback after each session.

- AU speakers will get feedback in real-time.

- **Your feedback results in better classes and a better AU experience.**

AUTODESK.