O3DCON
BY OPEN 3D FOUNDATION

World Building in Open 3D Engine

Jonny Galloway, AWS

@hogjonny

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Who am i?

- Tech Art for Realtime 3D
- Content Tools And Workflows

Jonny Galloway
Sr. Design Technologist
@hogjonny (everywhere)

- Env Art and Lighting
- Procedural World Building

To get to the top of a mountain, it takes many small steps ...
Or build a helicopter.

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Who are You?

- Skill Level: Intermediate
- Hobbyist, Indie or AAA Game Dev
- Level Designers
- Environment Artists
- Someone who likes procedural design toolkits

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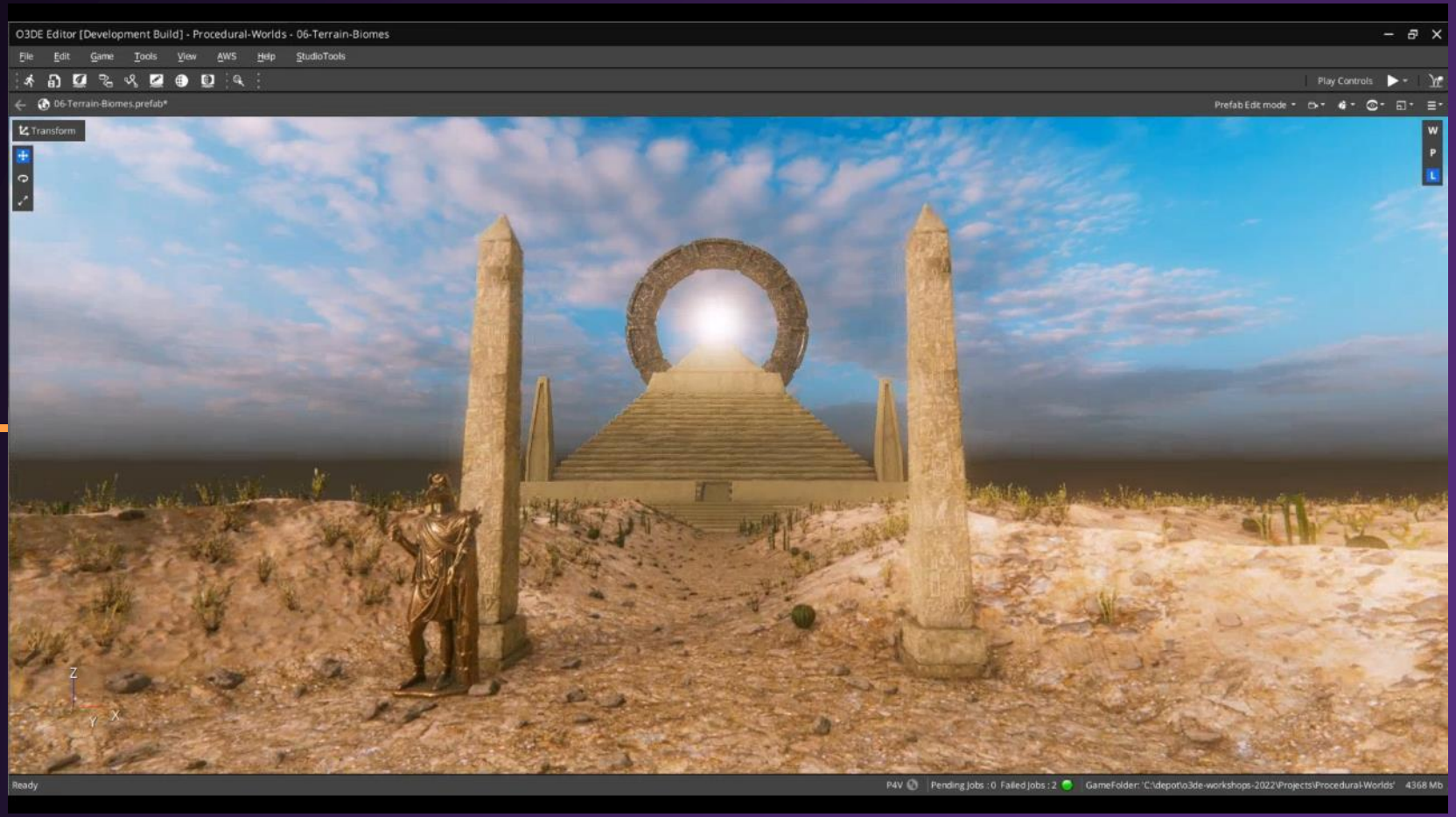

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Core Concepts and Understanding

- I'd like you to walk away with ...
- Zero to Beautiful Accelerated (Work Faster)
- Executing Quality at Scale (Work Bigger)
- Procedural Design: Landscapes, Terrain, Biomes
- HDR Environmental Lighting and Post FX
- Open 3D Engine can make beautiful worlds
- It is still early (there is engine work left to do)

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Worlds need content

- Open 3D Engine … yes, I am plugging our tools
- 3D Models, PBR Materials and texture maps
- HDRi / IBL, skybox and lighting resources
- 3D Digital Content Creation tools
- Image Editors, and Material Authoring tools
- Terrain data like heightfields, and color maps
- Terrain Editors

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Freely available content resources

- 3D Models
  - Sketchfab (and there are many others)
- PBR Materials
  - Top 7 websites (link)
- HDRi "image Based Lighting" aka Skybox / Skylight
  - Polyhaven.com/hdris

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Content Creation Tools

- Autodesk Maya is my 3D DCC tool of choice
  - Blender is a free alternative
- Adobe Photoshop for image editing
  - Krita is a free alternative
- PBR: Adobe Substance Designer, Sampler, Painter
  - Material Maker is a free alternative
- Terrain: Quad-spinner Gaea

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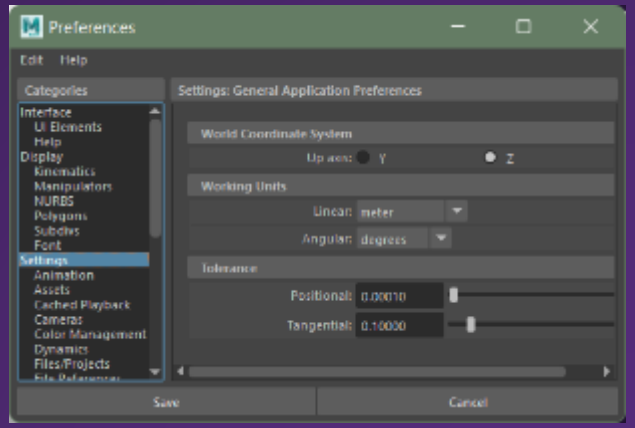
Autodesk Maya, settings for 3D content

- Settings:
  - Scene Units: Meters
  - Coordinate System: Z-up
- Preferred format: FBX



Maya menu >

Windows > Settings/Preferences > Preferences

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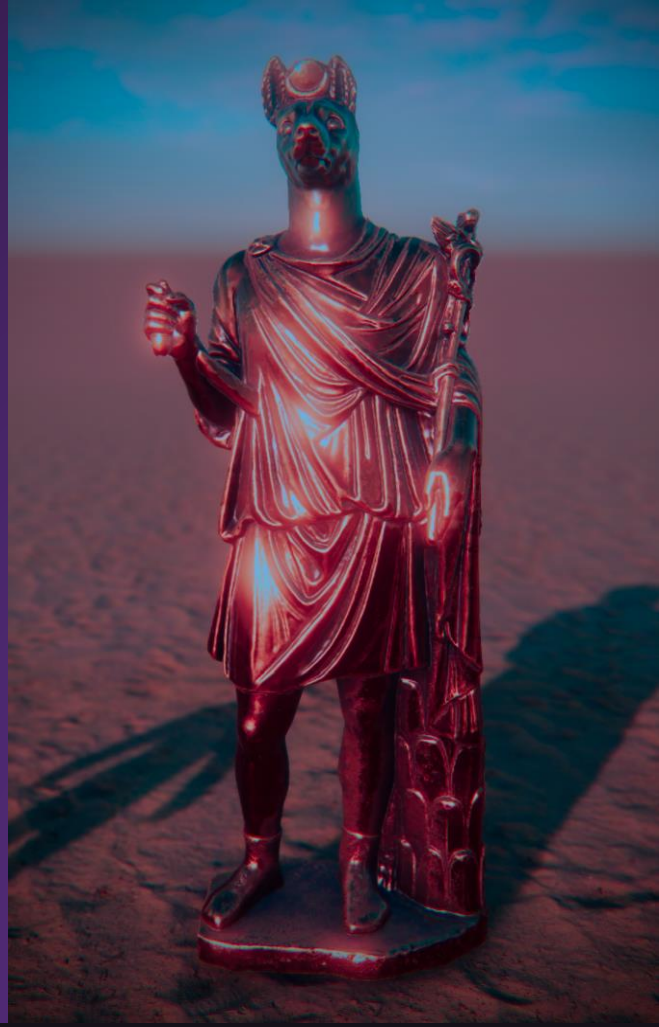
1. Getting Started

Creating a project and our first level



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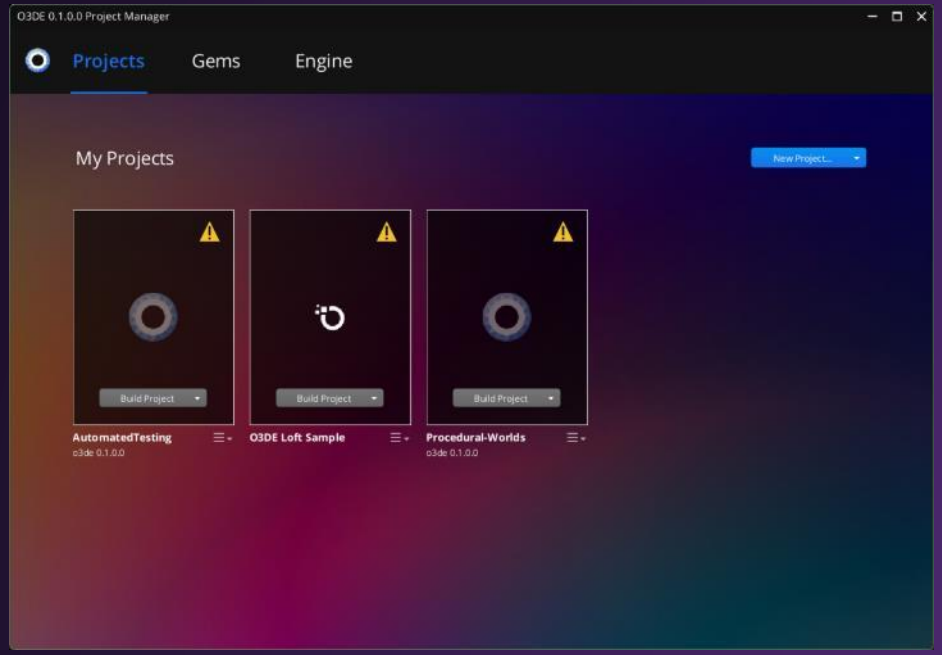
Create a New Project



1. Open O3DE
2. Create Project
3. Enable Gems
    1. Landscape Canvas
    2. FastNoise
    3. Vegetation
    4. Terrain
4. Build Project
5. Launch Editor

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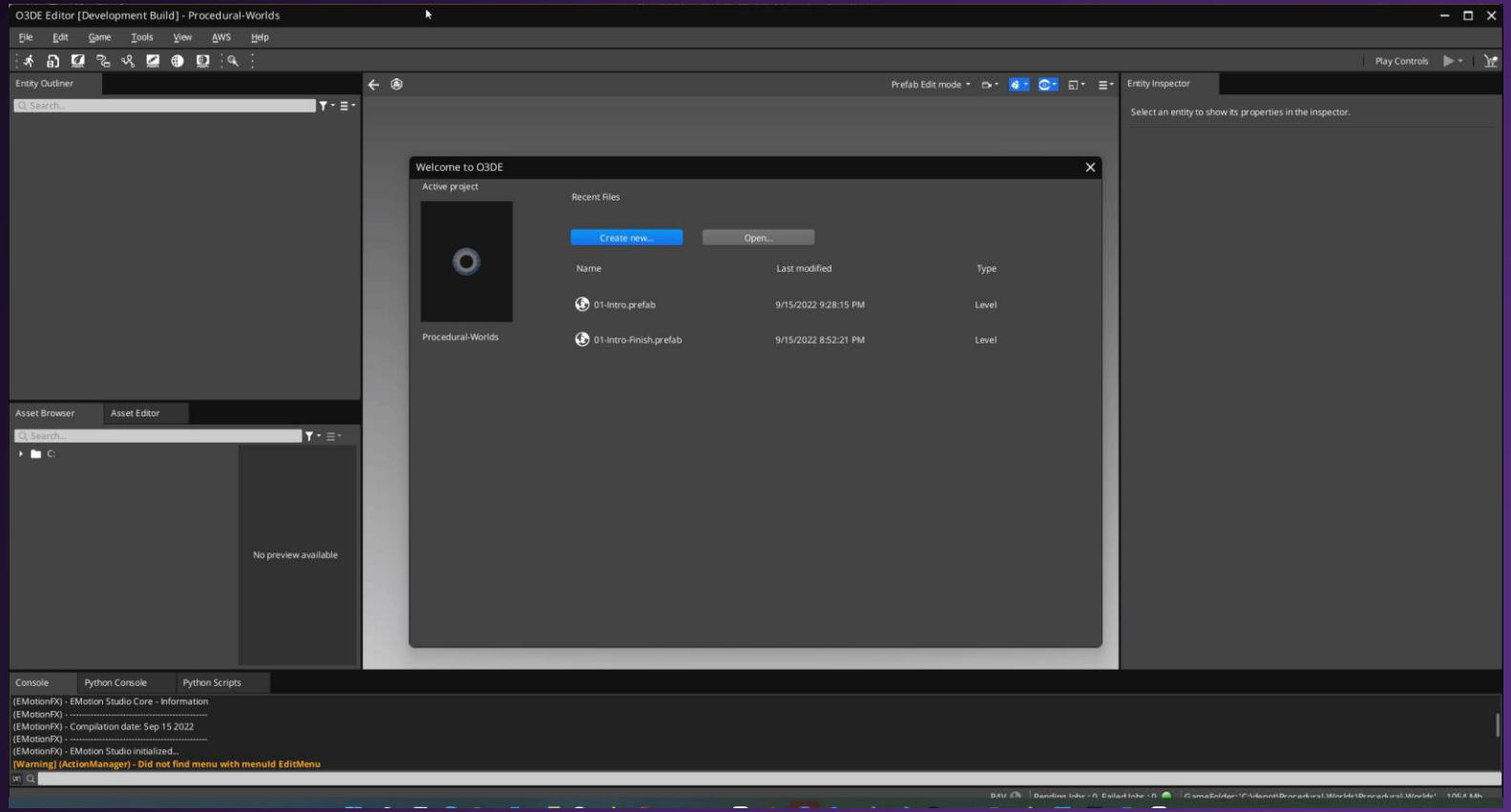
Create a New Level



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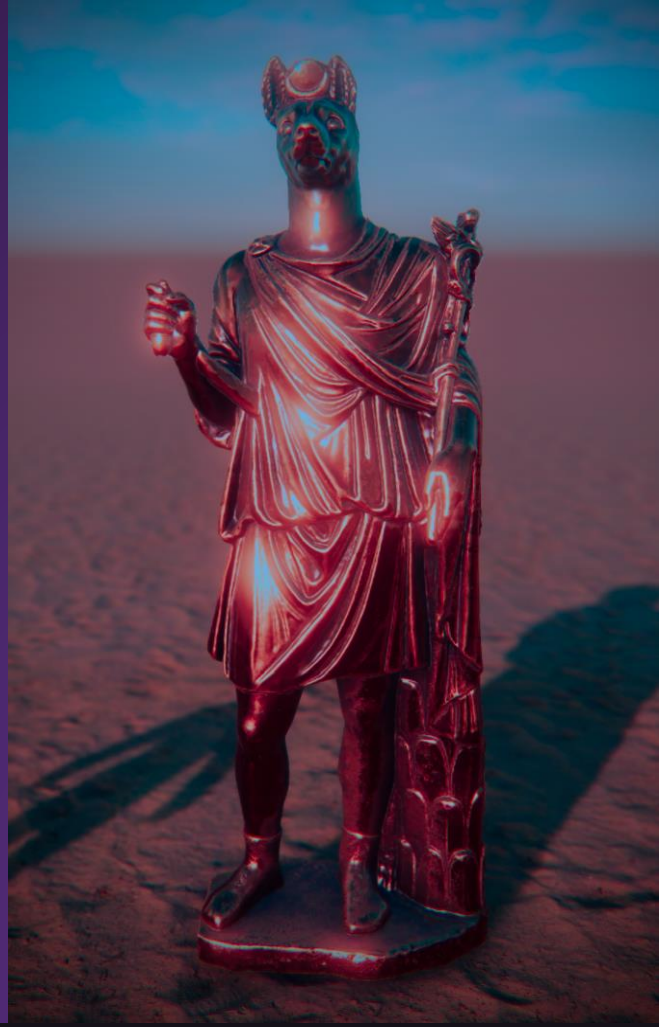
2. Global Lighting

Let there be Light...



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Realistic worlds need realistic lighting

Static, HDR, Image Based Lighting (IBL)

1. Direct Lighting and Shadows
2. HDRi Source (latlong .EXR)
3. Multiple Output Cubemaps:
    1. Skybox
    2. Specular Reflections
    3. Indirect Diffuse

Freely available, HDRi IBL images under Creative Commons Zero license (CC0)
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https://polyhaven.com/license

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HDRi, IBL Naming Conventions

< img >_SkyboxCM

Generates:

Only Skybox Cube:

1. *_skyboxcm*

< img >_**IBL**globalCM

Generates:

Lighing Cubemaps:

1. *_ibldiffuse*
2. *_iblspecular*

< img >_**IBL**skyboxCM

Generates:

All Cubemaps:

1. *_ibldiffuse*
2. *_iblspecular*
3. *_skyboxcm*

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High Contrast HDRi

Example: O3DE\Gems\Atom\Feature\Common\Assets\LightingPresets\HighContrast

Input Image: < HDRi >_SkyboxCM.exr

Generates Output Assets:

1. **< HDRi >_skyboxcm.exr.streamingimage**

Sun painted out

Input Image: < HDRi >_IBLglobalCM.exr

Generates Output Assets:

1. **< HDRi >_iblglobalcm_iblspecular.exr.stream...**
2. **< HDRi >_iblglobalcm_ibldiffuse.exr.stream...**

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Anatomy of Default Level Lighting

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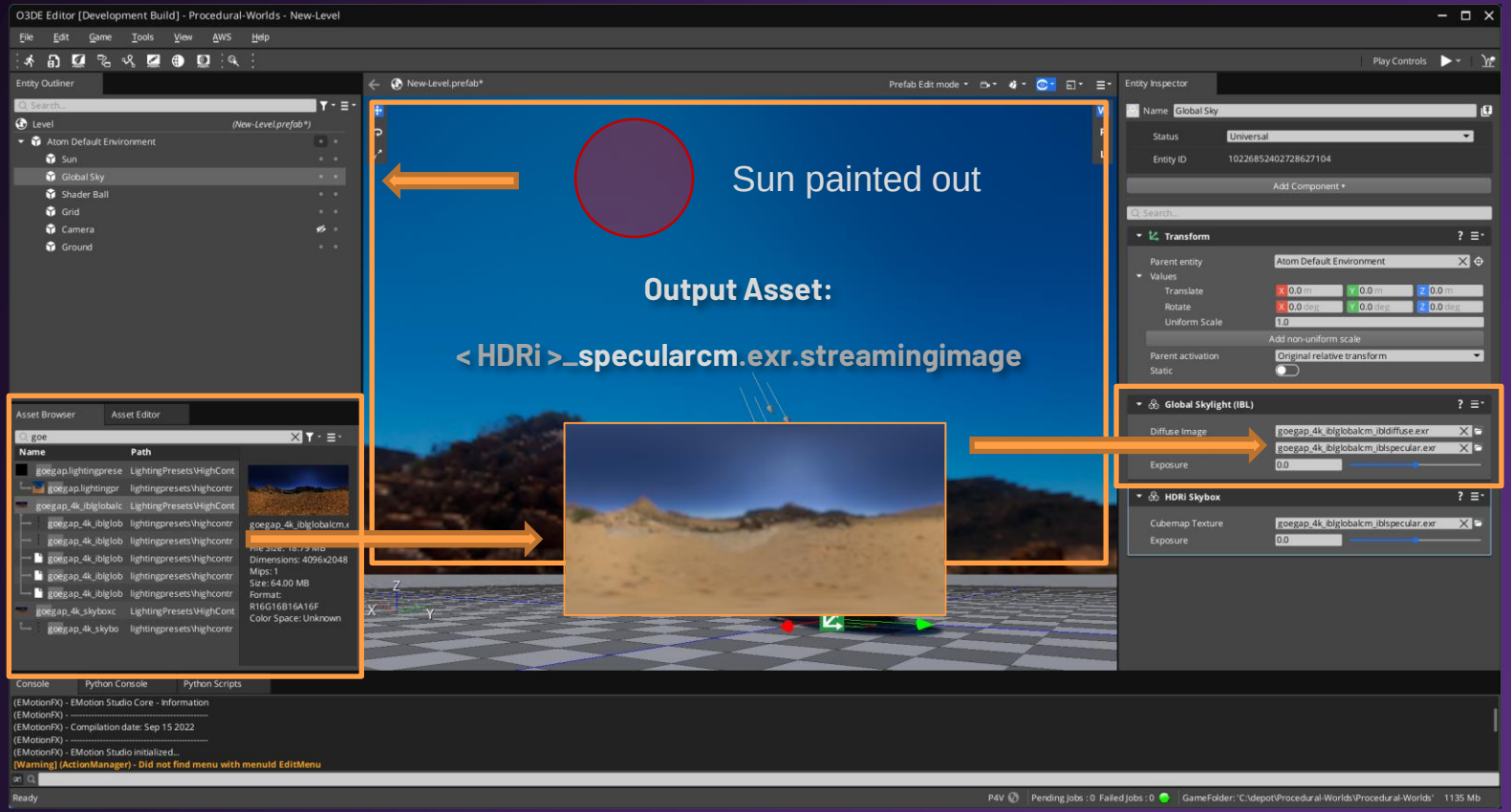
Anatomy of Default Level Lighting



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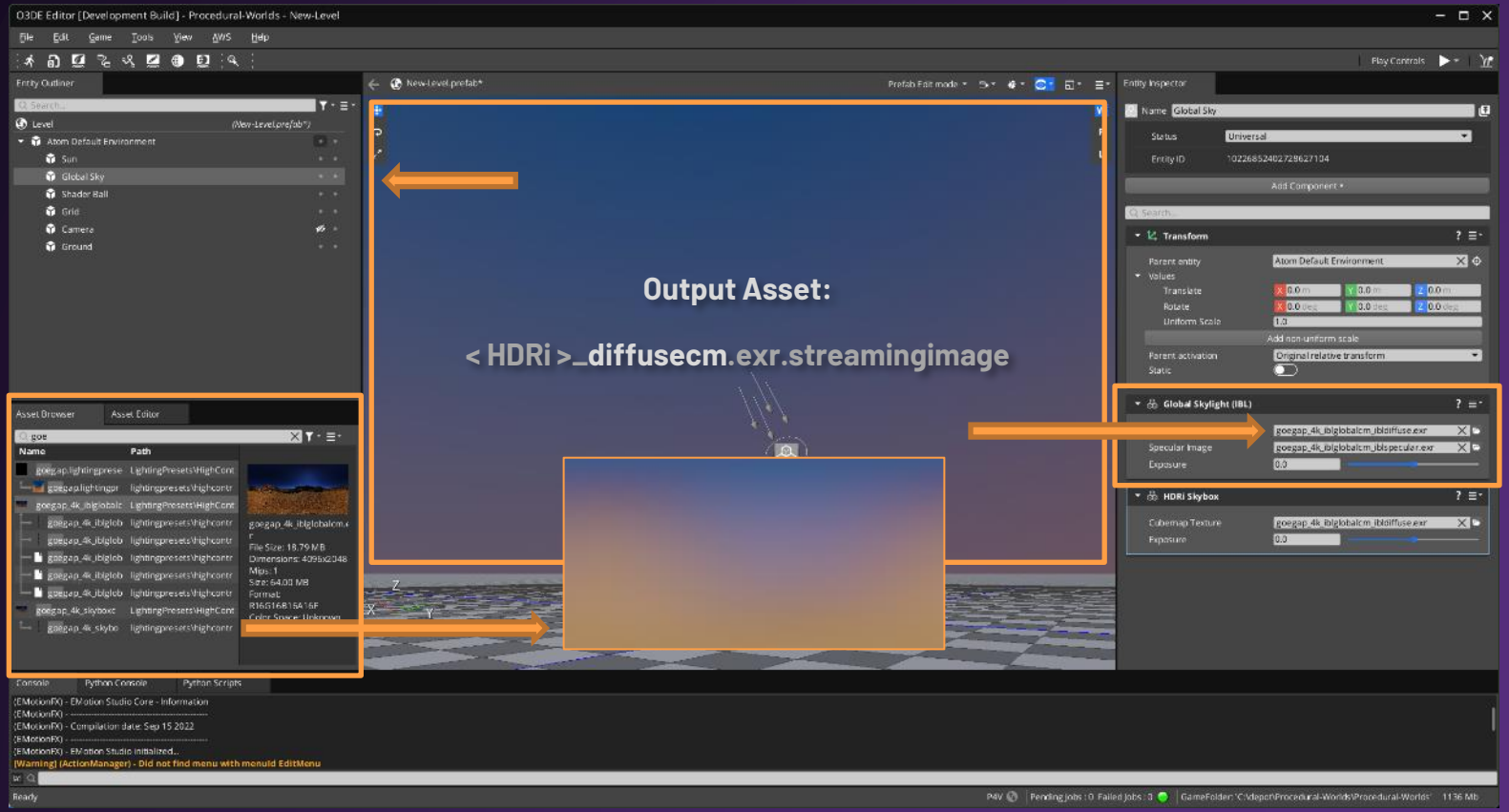
Anatomy of Default Level Lighting



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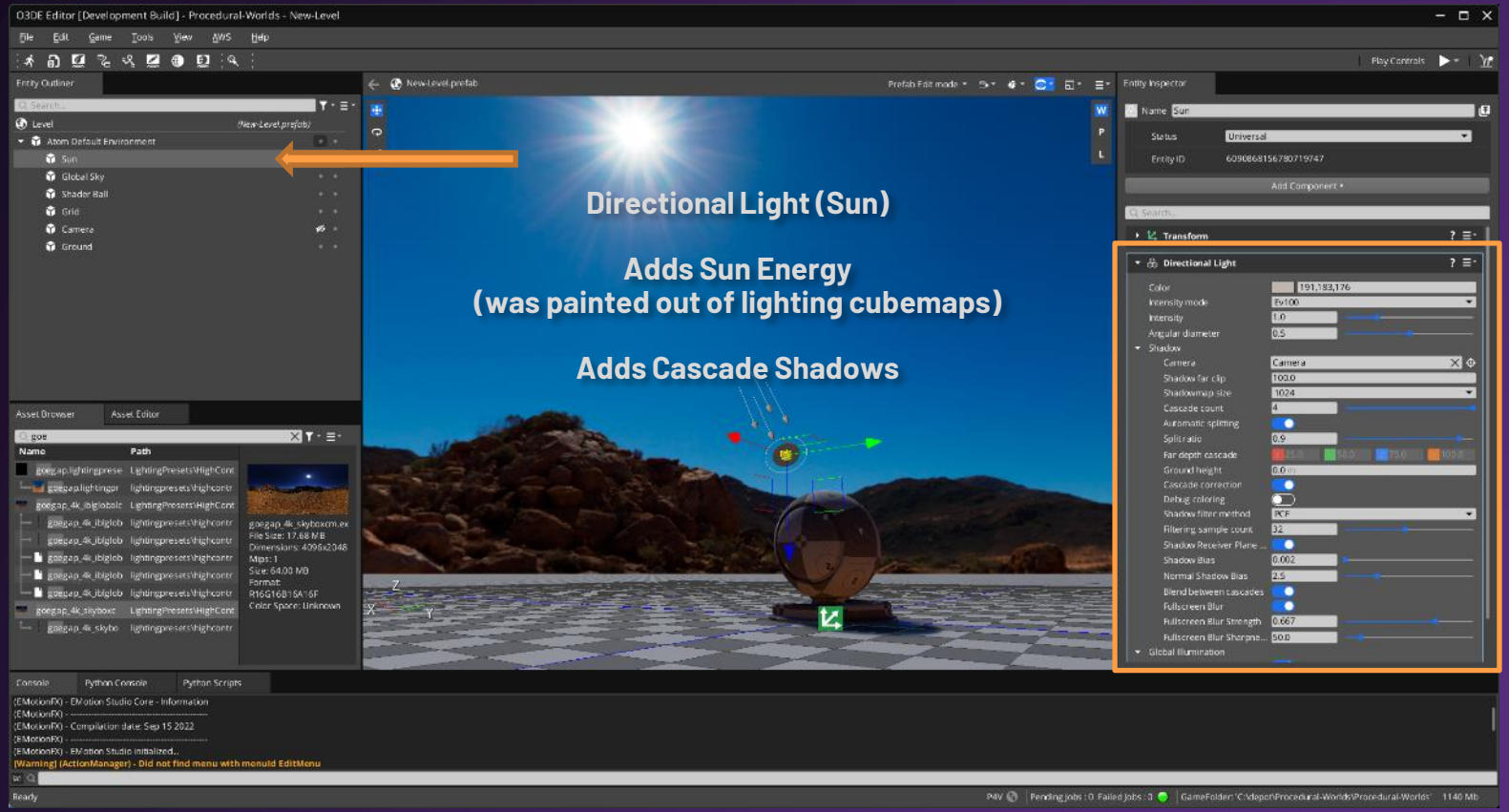
Anatomy of Default Level Lighting



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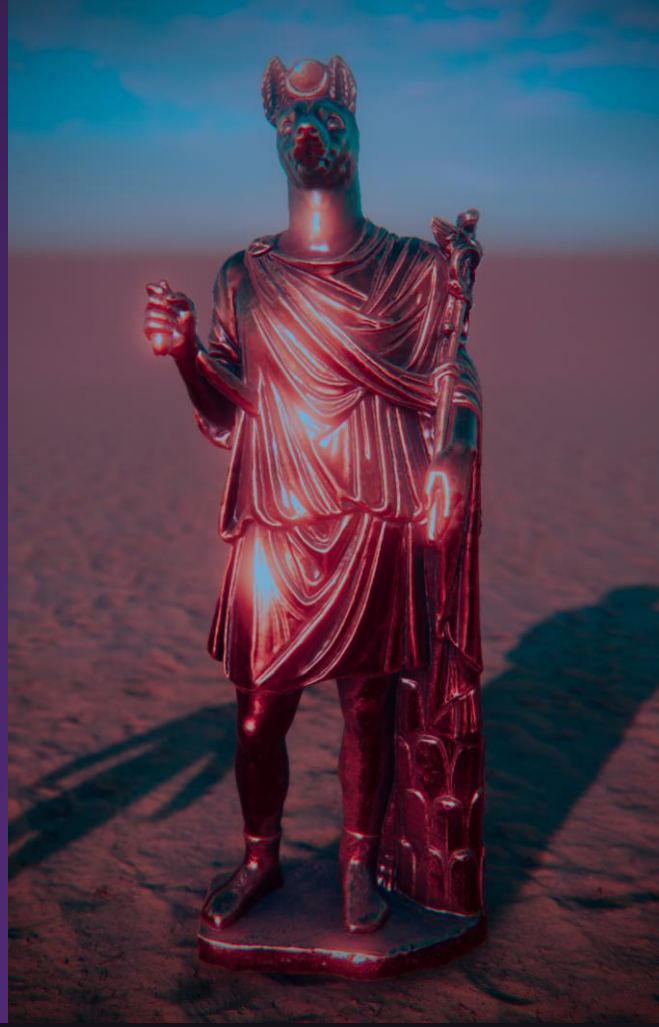
3. Customize Level

Lighting, materials and PostFX



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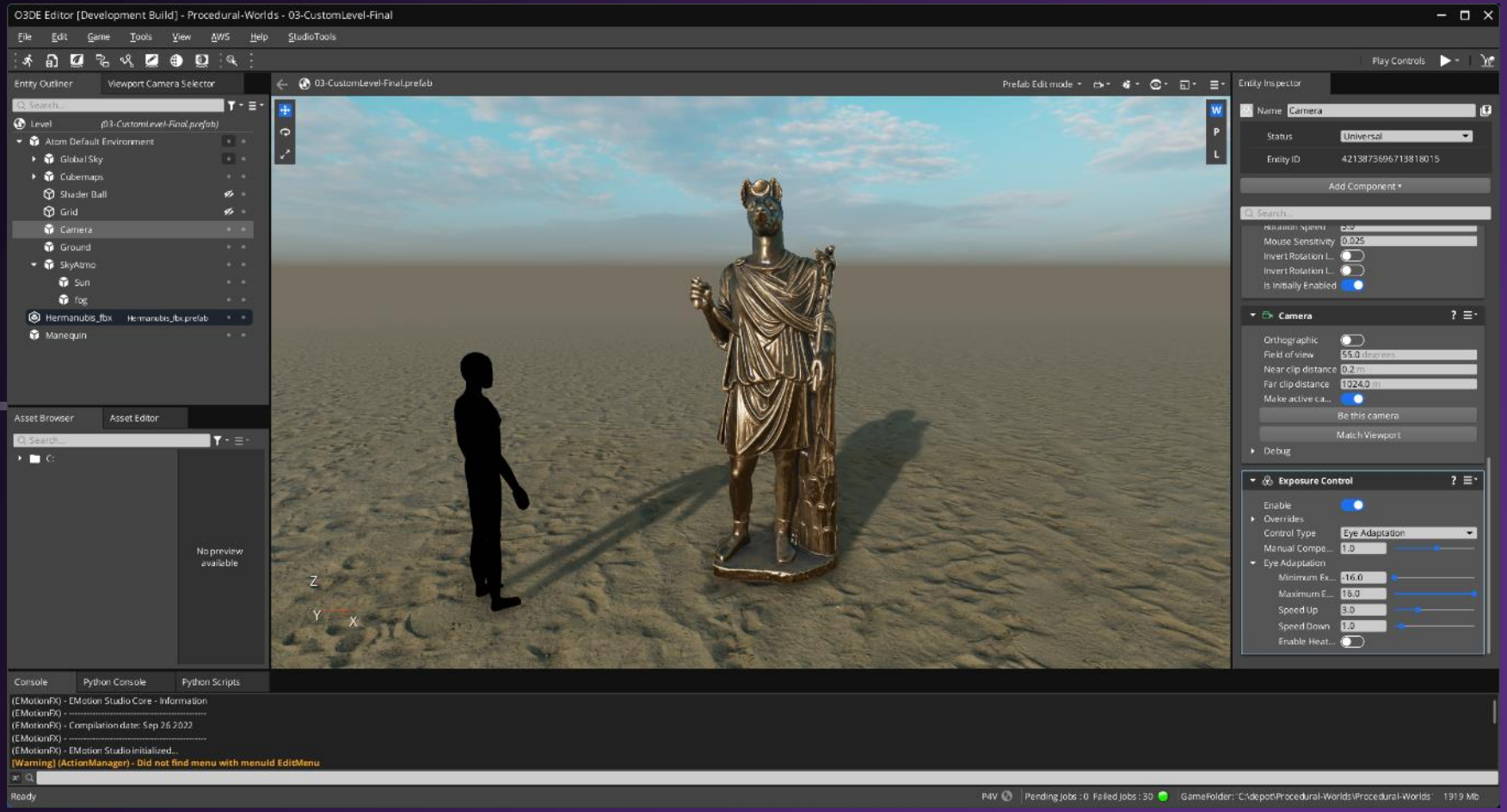

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Customize the default level

1. Create a PBR material, assign to the ground
2. Replace the Skybox and Global Lighting
3. Enable Sky Atmosphere and Fog
4. Replace the Shaderball with a Statue model
    1. Mesh Component, load FBX
    2. Material Component, assign Material

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PBR Materials

1. Base PBR
   - Metal / Rough shading model
2. Standard PBR
   - Adds Emissive and Clearcoat
   - Adds Displacement (parallax)
3. Enhanced PBR
   - Adds Detail Layer
   - Adds Transmission (thick and thin surface)
   - Adds SubSurface Scattering (SSS)

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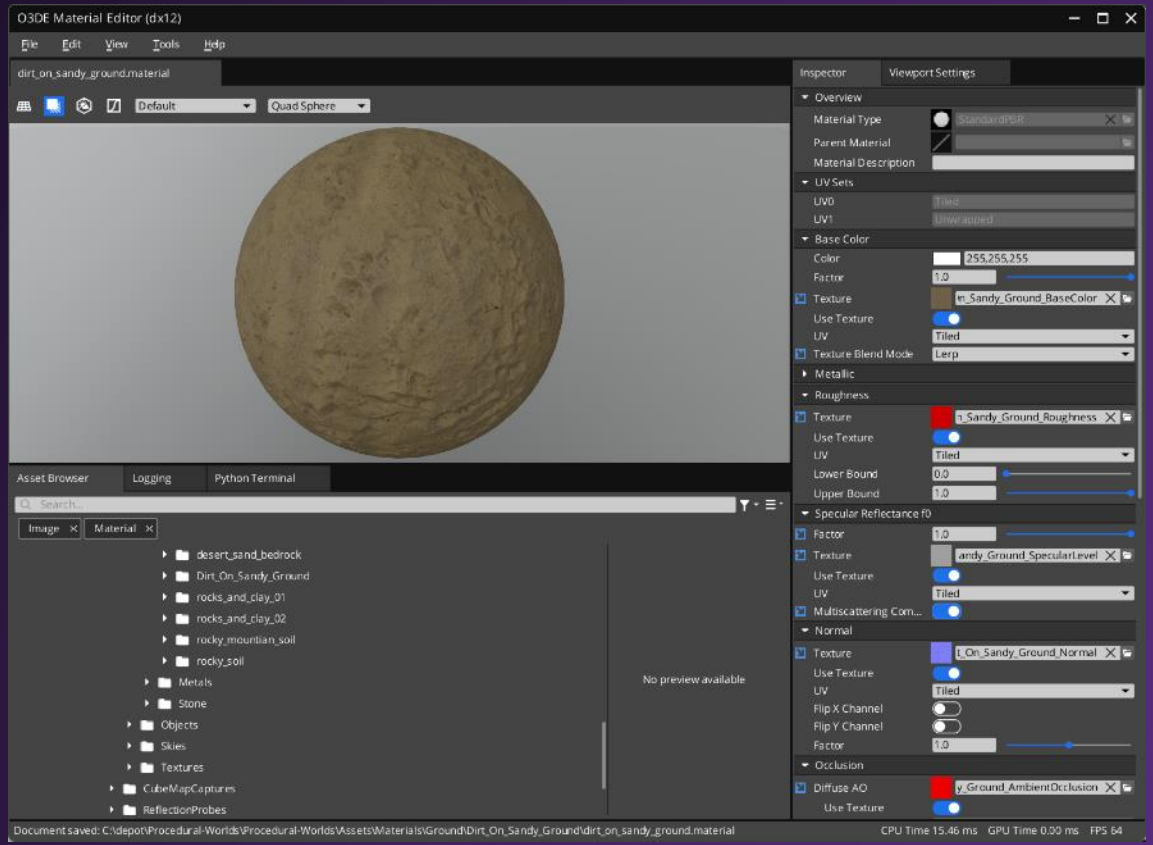
Material Editor



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Adjust Global Lighting

1. Change the Skybox, SkyLight, Fog, Sky Atmosphere
2. Create Entities with Cubemap Capture Components,
   - GlobalSpecular, GlobalDiffuse, and Bake
3. Duplicate GlobalSkyLight Entity,
   - Replace with captured cubemaps
4. Create Reflection Probe Entity and Bake

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Customize Level

LIVE DEMO … Let’s do this

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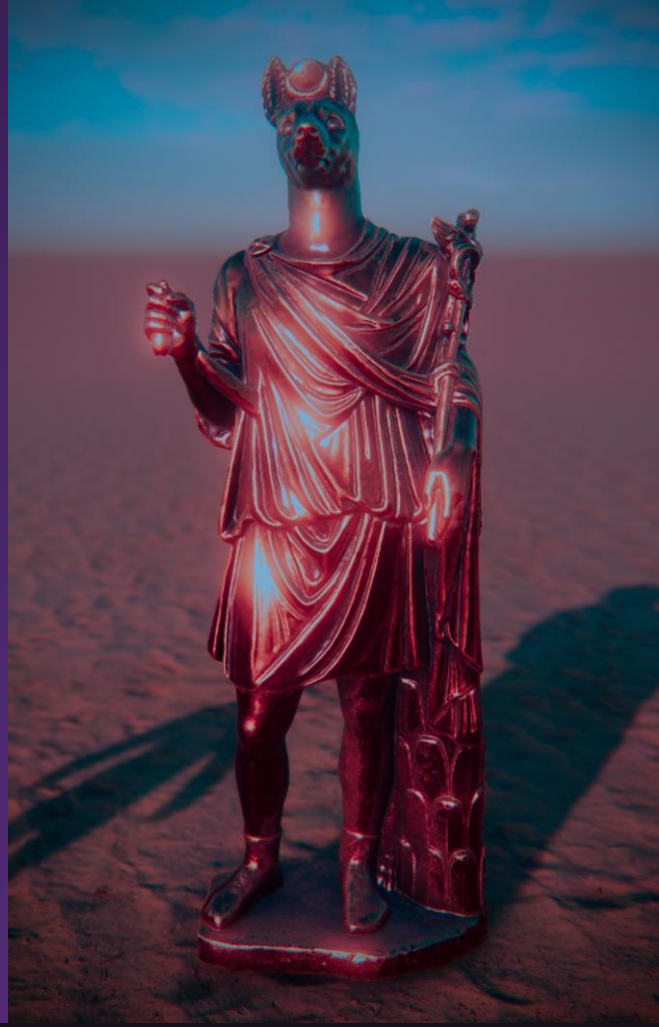
4. PostFX Default Look

Adding some visual pizazz



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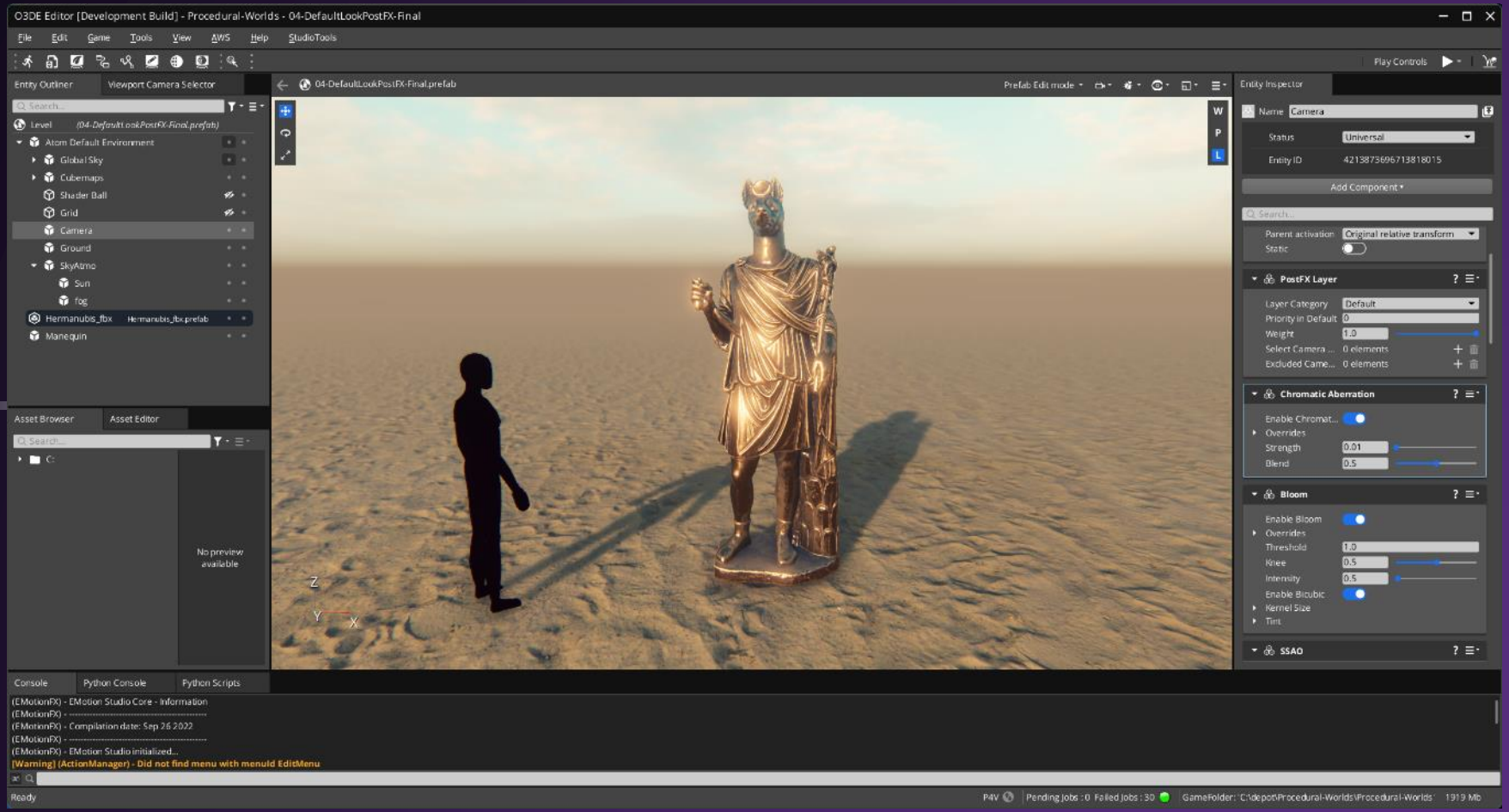

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Customize the default level (live demo)

1. Add PostFX Layer Component to Camera
2. Add Exposure Control Component
3. Add SSAO Component
4. Add Depth of Field Component
5. Add Bloom Component
6. Add Chromatic Aberration Component
7. Add HDR Color Grading Component

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Post FX, Default Look

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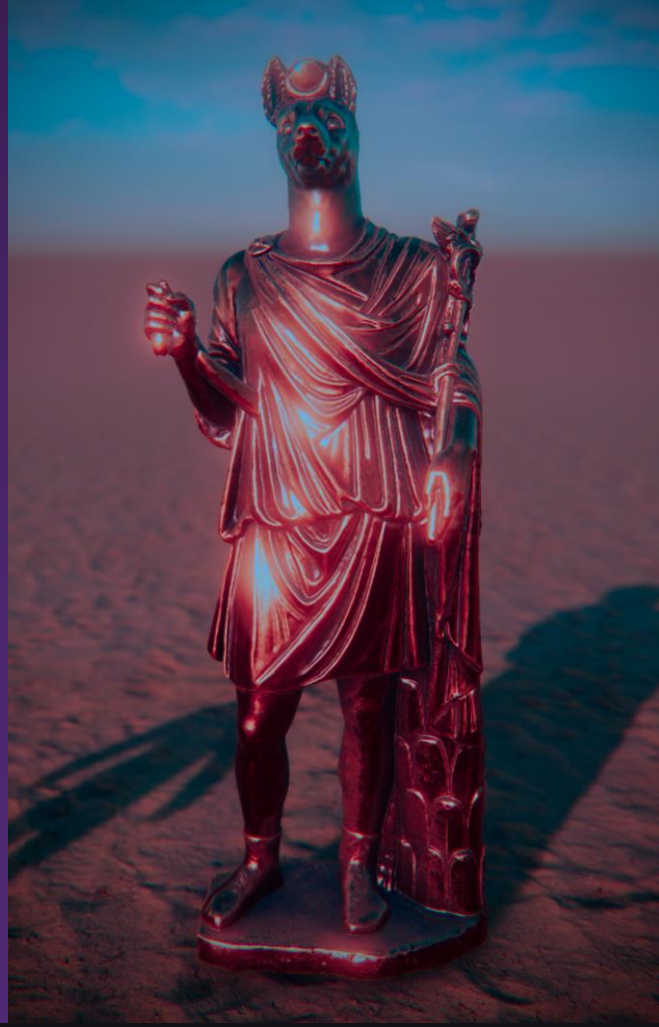
5. Building Blocks

Core Concepts: Let's Get Procedural



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“**Procedural** modeling **is an umbrella term for a number of techniques in computer graphics to create 3D models and textures from sets of rules**. L-Systems, fractals, and generative modeling are procedural modeling techniques since they apply algorithms for producing scenes..”

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O3DE Editor [Development Build] - Procedural-Worlds - 05-Building-Blocks-Final

File Edit Game Tools View AWS Help StudioTools

Play Controls

Entity Outliner | Viewport Camera Selector

Select the camera you wish to view and navigate through. Closing this window will return you to the default editor camera.

Editor camera
Camera2
Camera

05-Building-Blocks-NEW.prefab

Prefab Edit mode

Entity Inspector

Select an entity to show its properties in the inspector.

Asset Browser | Asset Editor

Search...

C:

No preview available

Console | Python Console | Python Scripts

(EMotionFX) - EMotion Studio Core - Information
(EMotionFX) - ----------
(EMotionFX) - Compilation date: Sep 26 2022
(EMotionFX) - ----------
(EMotionFX) - EMotion Studio initialized...
[Warning] (ActionManager) - Did not find menu with menuId EditMenu

Ready | P4V | Pending Jobs : 0 Failed Jobs : 30 | GameFolder: "C:\depot\Procedural-Worlds\Procedural-Worlds" | 2893 Mb

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Create Color Block Prefabs

1. Create several materials of varied color
2. Create Entity and Add Mesh Component
3. Load the Block_1m FBX asset
4. Add the Material Component, load first material
5. Duplicate block entity 5 more times
6. Change the material assignment on each
7. Save each as a prefab

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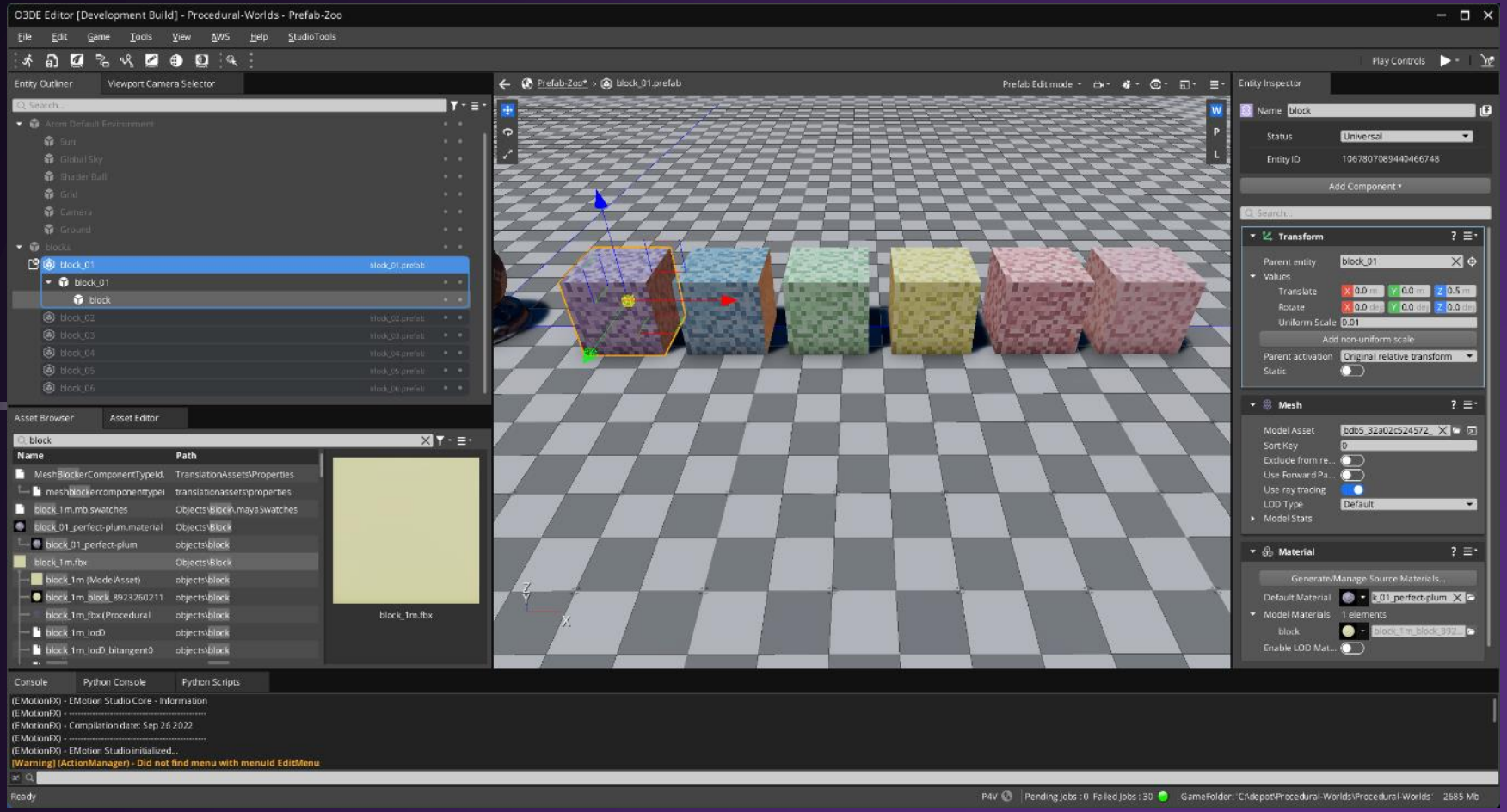

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About Dynamic Vegetation

1. Let's abuse Dynamic Vegetation
2. Gradient Signals (**procedural noise**, images, etc.)
3. Semantic World Design (surface data **tags**)
4. Landscape Canvas (world graph, signal composition)
5. Decorative Object Placement System
6. E.g. Spawns Prefabs

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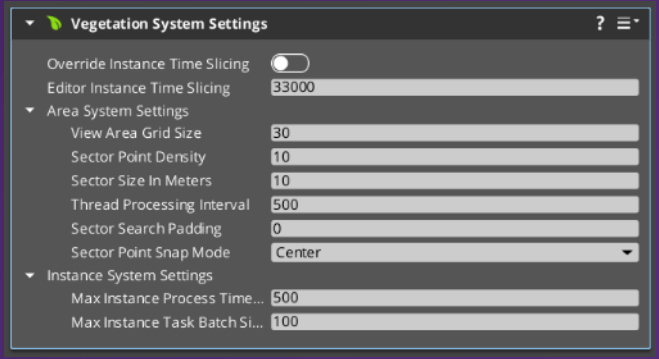
Create Building Blocks World

1. New Level: ‘Save as …’ My-Block-World
2. Select the Level Entity
3. Add Vegetation System Settings Component
4. View Area Grid Size = 30
5. Sector Point Density = 10
6. Sector Size in Meters = 10
7. Sector Point Snap Mode = Center



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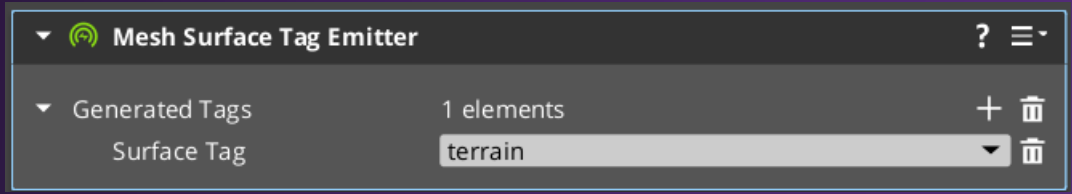
Set up World Data

1. Dyn Veg wants to plant on Terrain
2. Select the Ground entity
3. Add Mesh Surface Tag Emitter
4. Press the + to add a tag
5. Set tag pulldown to = terrain



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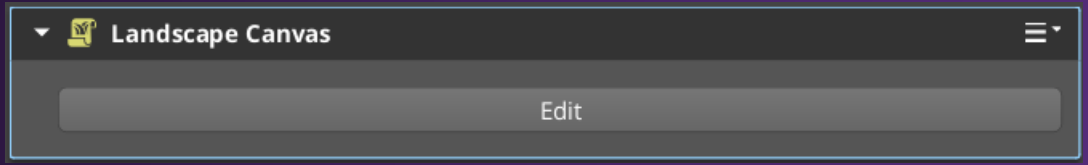
Set up Landscape Canvas (Live Demo)

1. Landscape Canvas is a Visual Graph Tool
2. For Procedural Terrain, Vegetation, Landscaping
3. Create an Entity named BuildingBlocks
4. Add the Landscape Canvas Component



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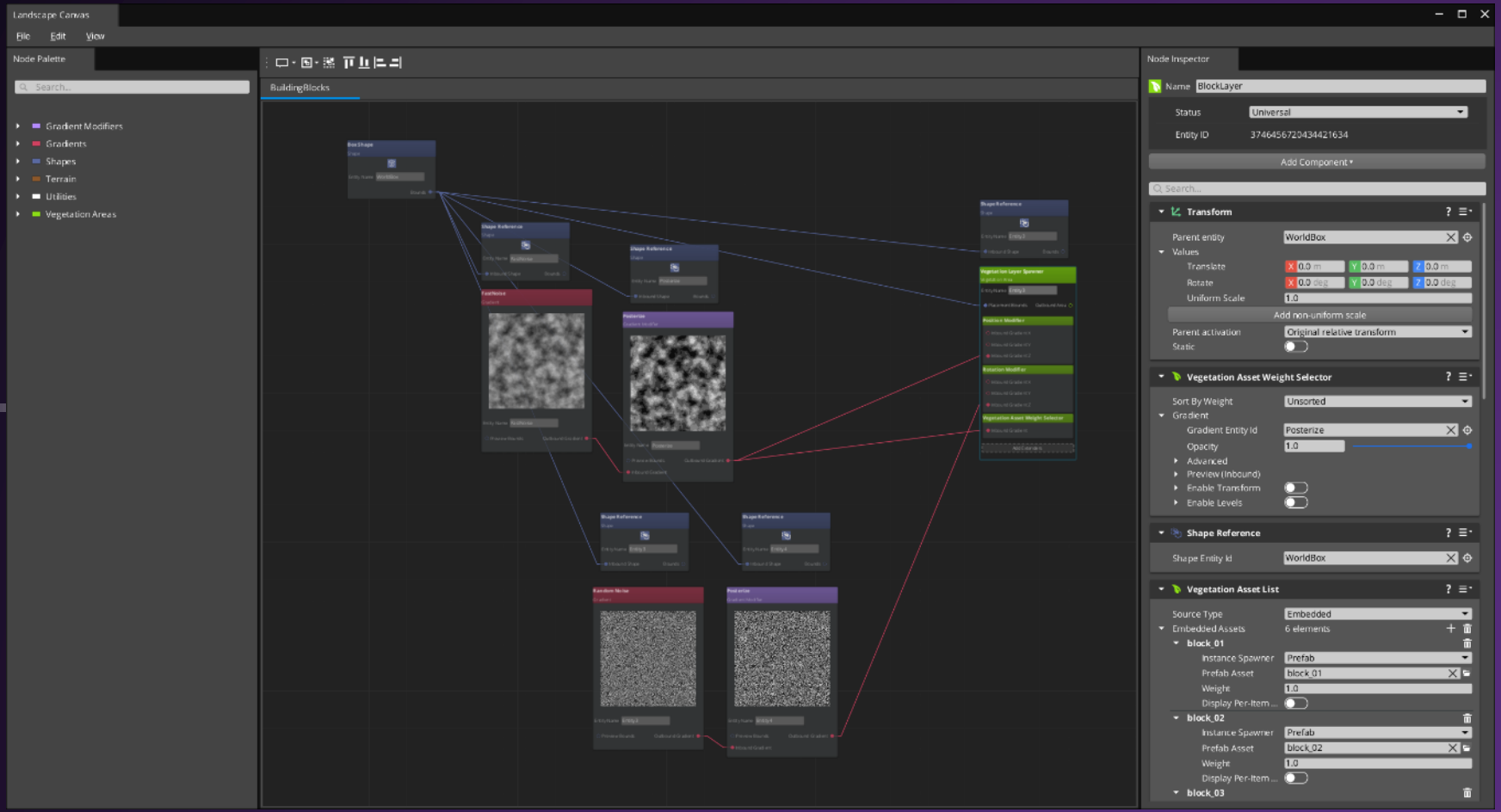

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Building Blocks

LIVE DEMO … Let’s do this

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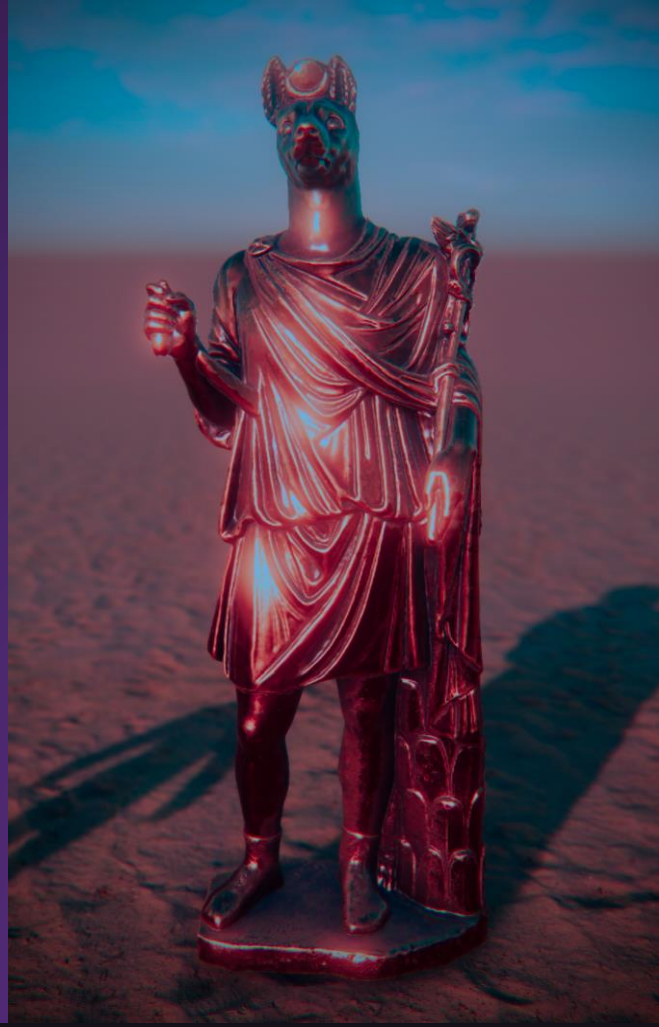
6. Terrain Basics

Core Concepts: Let's Get Procedural



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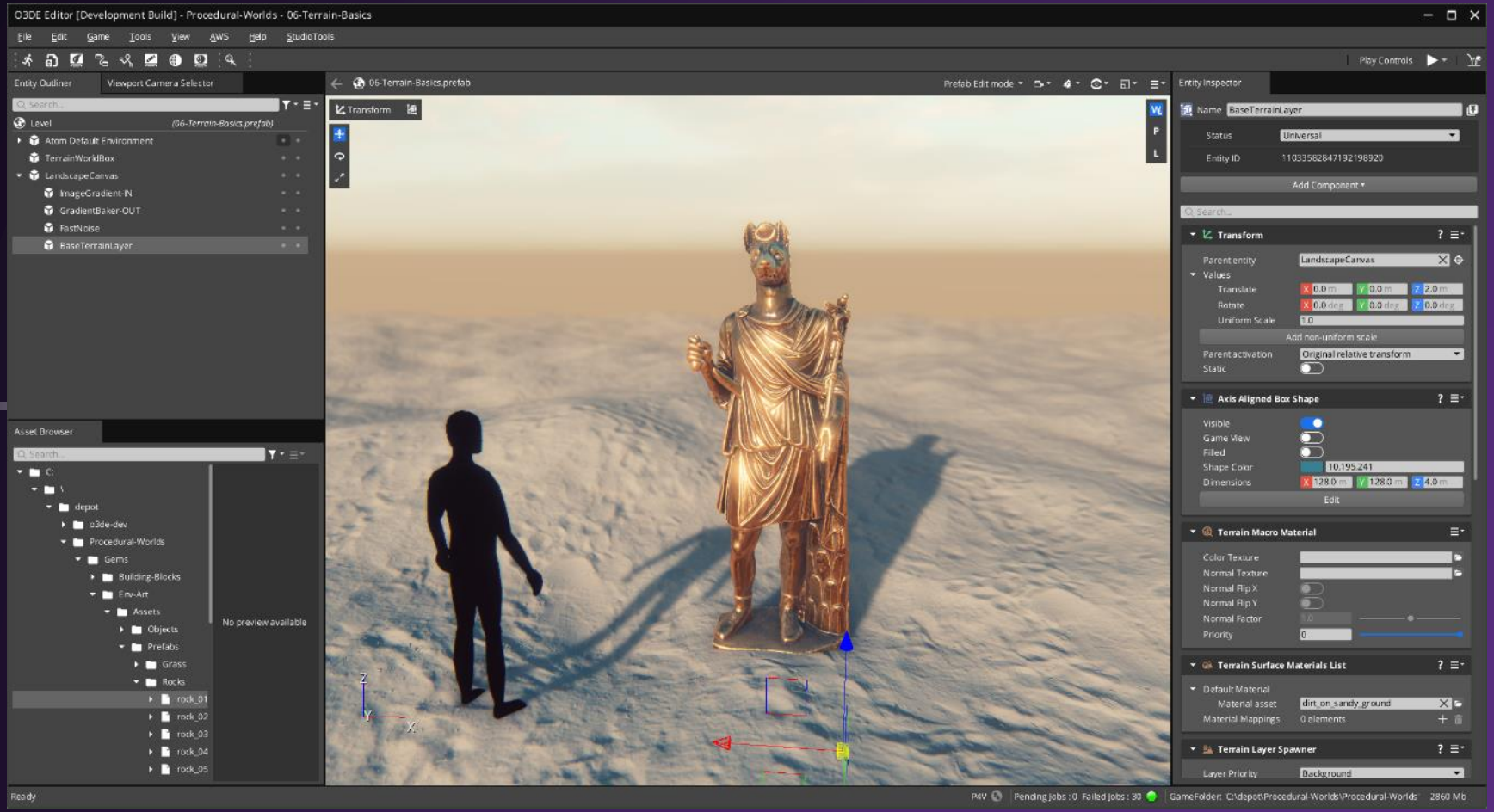

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Simple Terrain

1. Level Entity: Terrain System Components
2. Set up Terrain World Box
3. Set up Landscape Canvas
4. Set up Fast Noise (bumpy procedural noise)
5. Set up Terrain Layer (heightfield)
6. Assign Terrain Material

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Terrain Basics

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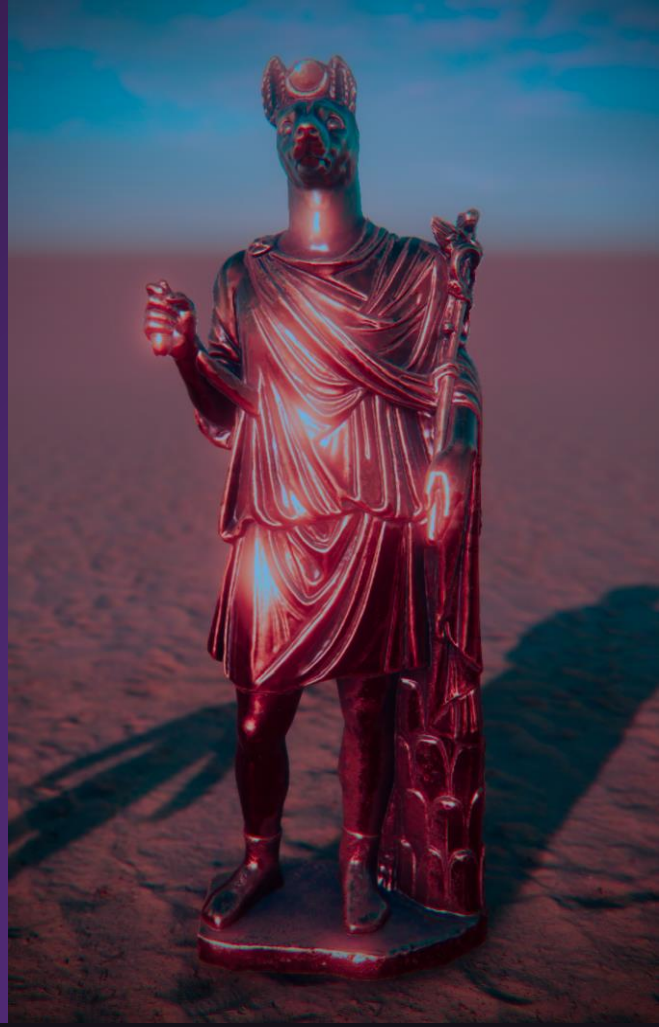
6B. Macro Color

Concept: External Data



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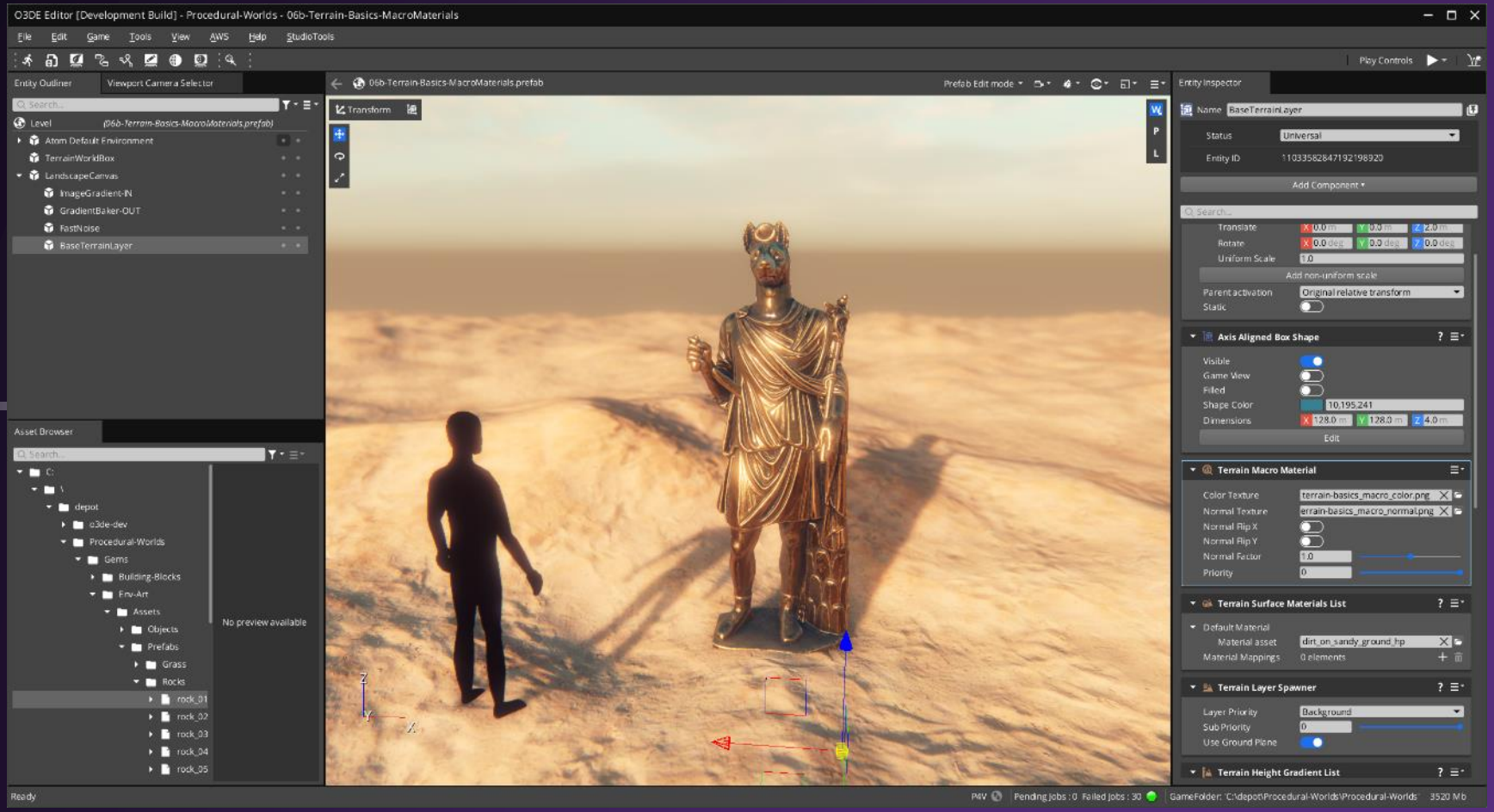

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Terrain Macro Material

1. Bake heightmap out with Gradient Baker
2. Take heightmap into Terrain DCC tool
3. I used Quadspinner Gaea
4. Generate new Terrain outputs …
5. Macro Color, Normal and some Splatmaps

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Terrain Macro Color

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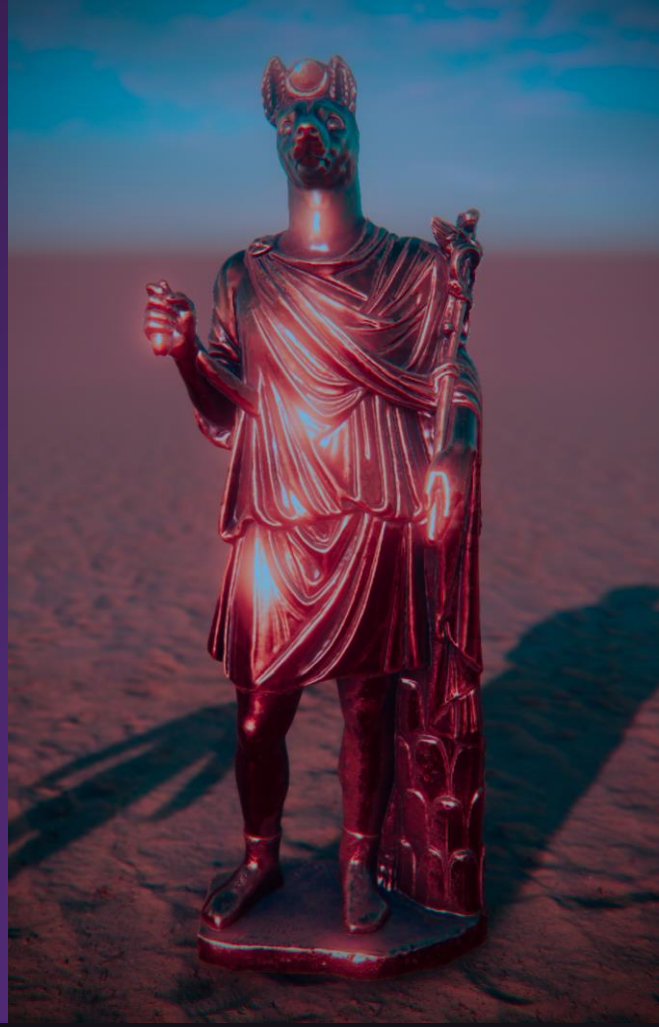
6C. Detail Blending

Concept: Blending Materials



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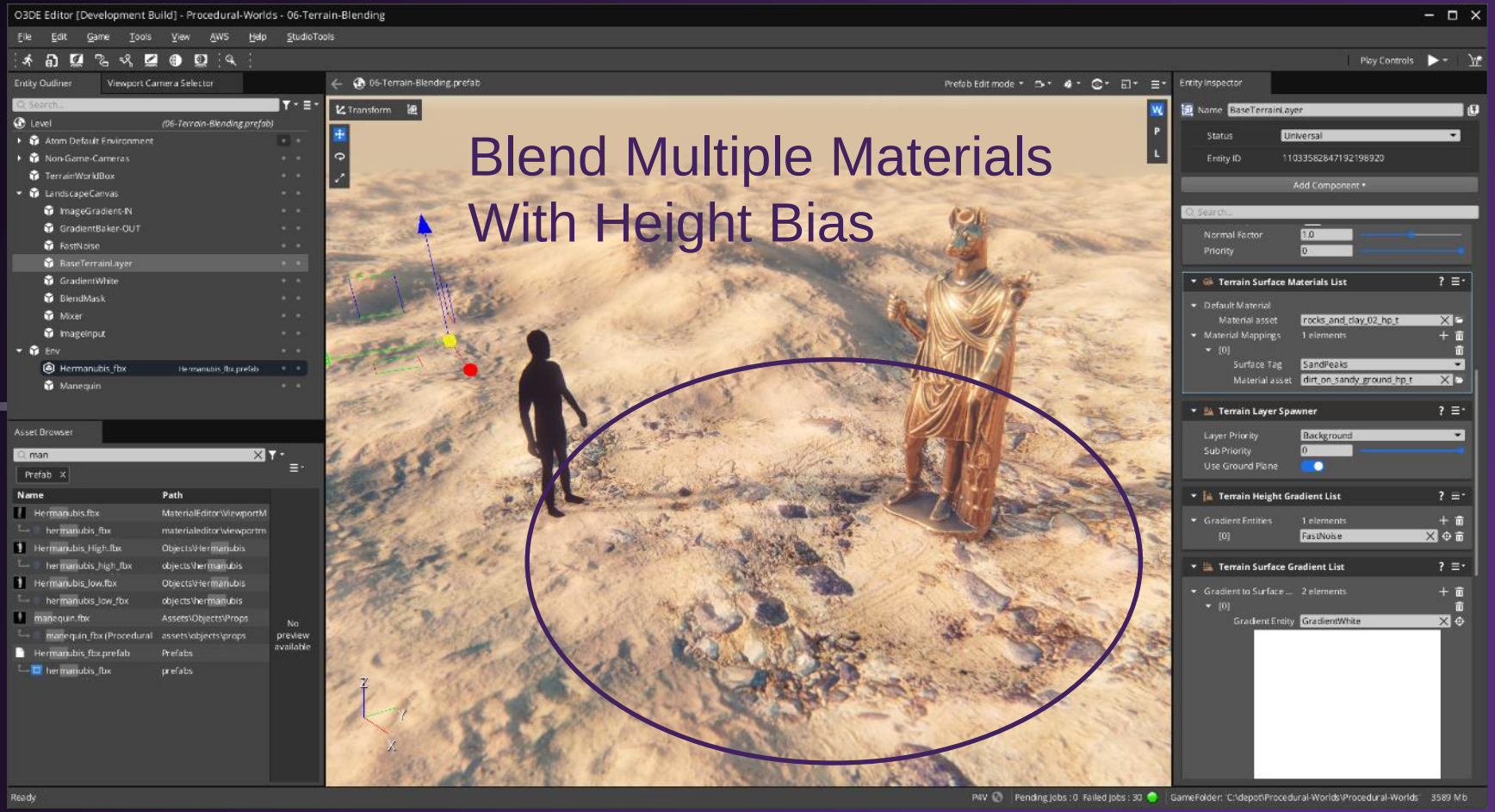

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Terrain Material Blending (Live Demo)

1. Set up Gradient Mask (for Rocky Dirt)
2. Set up Terrain Surface Gradient List
3. Create a High-Pass TerrainDetailMaterial
4. Set up Terrain Surface Materials List
5. Tweak material height biased blending params

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Detail Blending

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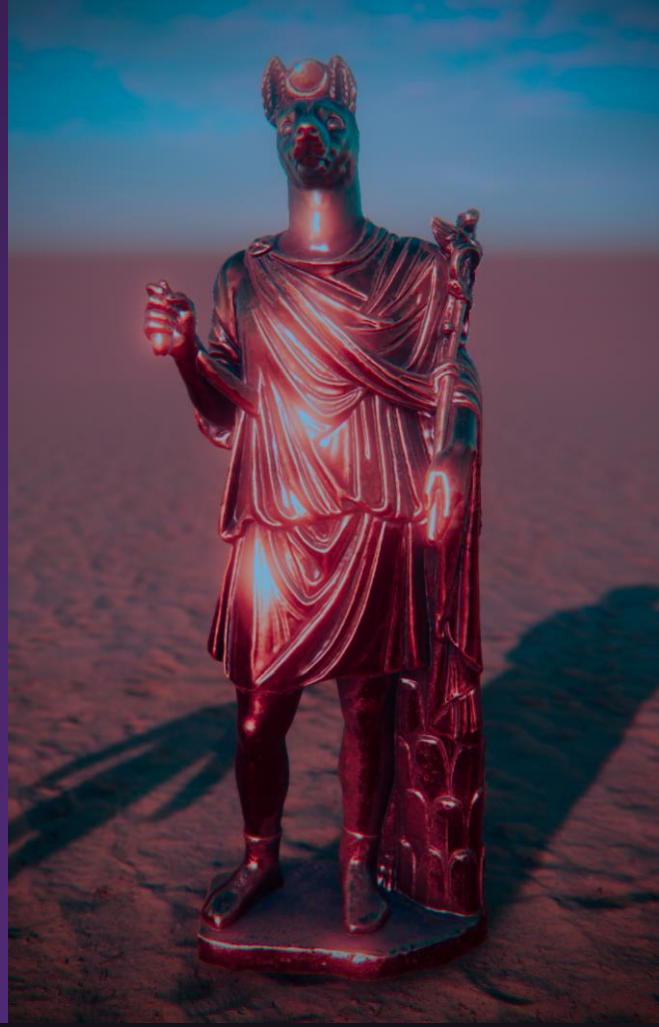
7. Procedural Biomes

Advanced Concepts at Scale



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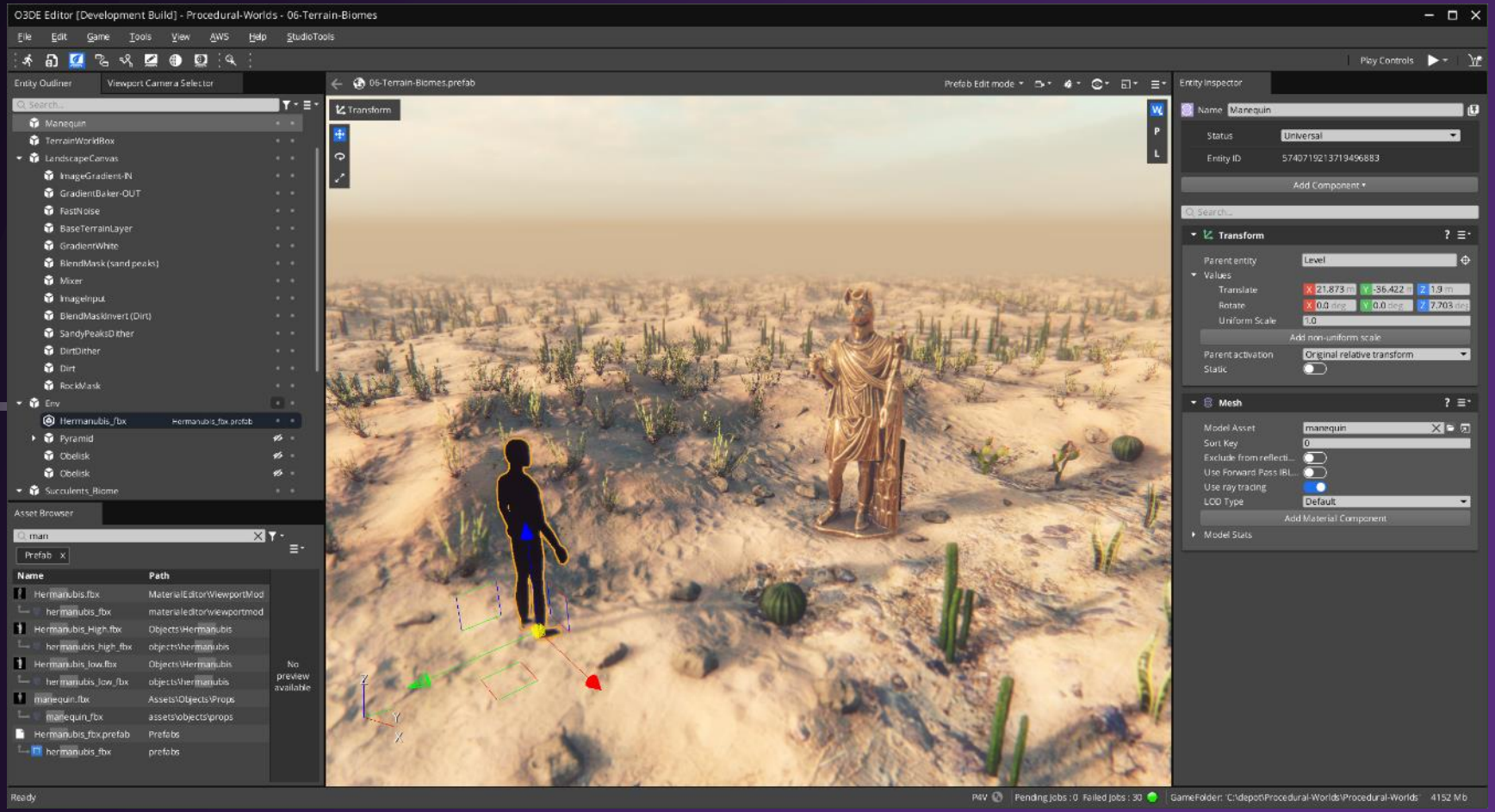

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Designing Biomes

LIVE DEMO … Let’s do this

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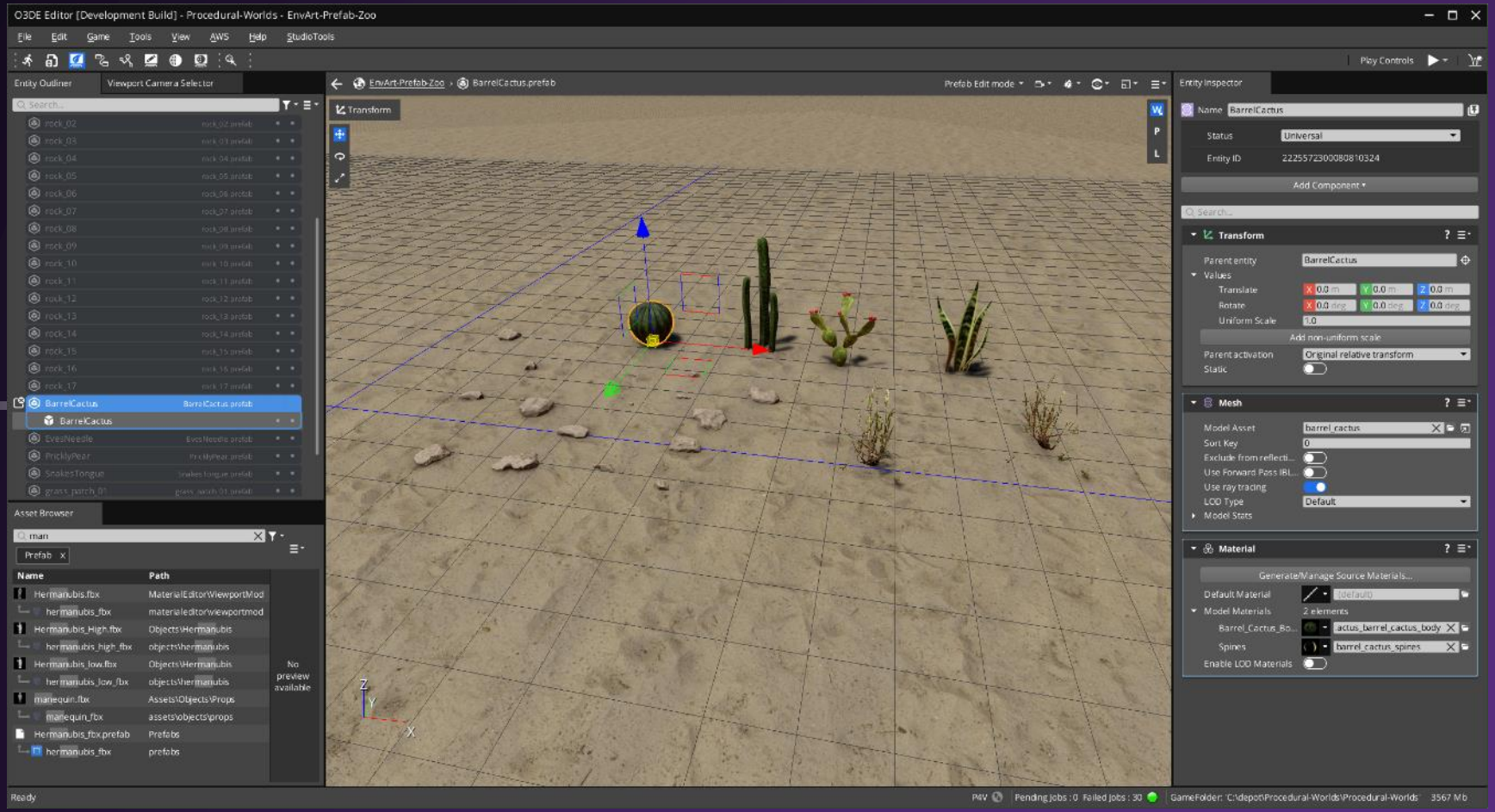

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Decorative Object Prefabs

1. Open level: EnvArt-Prefab-Zoo
2. Create a Prefab per-object
    1. Mesh Component
    2. Material Component (assign materials)
    3. Right-click: ‘Create Prefab …’

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O3DE Editor [Development Build] - Procedural-Worlds - Rocks-biome-layer

File Edit Game Tools View AWS Help StudioTools

Entity Outliner | Viewport Camera Selector

Level (Rocks-biome-layer.prefab*)
- Atom Default Environment
- Mannequin
- TerrainWorldBox
- LandscapeCanvas
  - BaseTerrainLayer_64m
  - GradientConstantBlack
  - GradientConstantWhite
- Rocks_Biome (Rocks_Biome.prefab)
  - Rocks_Biome
    - TempBiomeBox
    - Rocks-Veg-Layer
    - WhiteNoise_01
    - ScaleNoise
    - WhiteNoise_02

Asset Browser

man

Prefab x

Name	Path
Hermanubis.fbx	MaterialEditor\ViewportMod
hermanubis_fbx	materialeditor\viewportmod
Hermanubis_High.fbx	Objects\Hermanubis
hermanubis_high_fbx	objects\hermanubis
Hermanubis_low.fbx	Objects\Hermanubis
hermanubis_low_fbx	objects\hermanubis
mannequin.fbx	Assets\Objects\Props
mannequin_fbx	assets\objects\props
Hermanubis_fbx.prefab	Prefabs
hermanubis_fbx	prefabs

No preview available

Rocks-biome-layer* › Rocks_Biome.prefab

Prefab Edit mode

Transform

Entity Inspector

Name: Rocks-Veg-Layer

Status: Universal

Entity ID: 6119875518748823294

Add Component

Enable Levels

Shape Reference

Shape Entity Id: TempBiomeBox

Vegetation Asset List

Source Type: Embedded

Embedded Assets: 18 elements

- rock_01
- rock_02
- rock_03
  - Instance Spa... : Prefab
  - Prefab Asset: rock_03
  - Weight: 1.0
  - Display Per-It...
- rock_04
- rock_05
- rock_06
- rock_07
- rock_08
- rock_09
- rock_10
- rock_11
- rock_12
- rock_13
- rock_14
- rock_15
- rock_16
- rock_17
- <asset name>

Vegetation Layer Spawner

Preview Settings

Layer Priority: Background

Sub Priority: 2

Play Controls

Ready | P4V | Pending Jobs : 0 Failed Jobs : 30 | GameFolder: 'C:\depot\Procedural-Worlds\Procedural-Worlds' 3671 Mb

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O3DE Editor [Development Build] - Procedural-Worlds - Succulent-biome-layer

File Edit Game Tools View AWS Help StudioTools

Entity Outliner | Viewport Camera Selector

Level (Succulent-biome-layer.prefab*)
- Atom Default Environment
- Mannequin
- TerrainWorldBox
- LandscapeCanvas
  - BaseTerrainLayer_64m
  - GradientConstantBlack
  - GradientConstantWhite
- Succulents_Biome — Succulents_Biome.prefab
  - Succulents_Biome
    - TempBiomeBox
    - Succulent-Veg-Layer
    - WhiteNoise_01
    - ScaleNoise
    - WhiteNoise_02

Asset Browser

man

Prefab x

Name	Path
Hermanubis.fbx	MaterialEditor\ViewportMod
hermanubis_fbx	materialeditor\viewportmod
Hermanubis_High.fbx	Objects\Hermanubis
hermanubis_high_fbx	objects\hermanubis
Hermanubis_low.fbx	Objects\Hermanubis
hermanubis_low_fbx	objects\hermanubis
manequin.fbx	Assets\Objects\Props
manequin_fbx	assets\objects\props
Hermanubis_fbx.prefab	Prefabs
hermanubis_fbx	prefabs

No preview available

Succulent-biome-layer* › Succulents_Biome.prefab — Prefab Edit mode

Transform

Entity Inspector

Name: Succulent-Veg-Layer

Status: Universal

Entity ID: 14833877003264691355

Add Component

Gradient
- Gradient Entity Id: WhiteNoise_01
- Opacity: 1.0
- Advanced
- Preview (Inbound)
- Enable Transform
- Enable Levels

Shape Reference
- Shape Entity Id: TempBiomeBox

Vegetation Asset List
- Source Type: Embedded
- Embedded Assets: 5 elements
  - barrelcactus
    - Instance Spa... Prefab
    - Prefab Asset: BarrelCactus
    - Weight: 0.5
    - Display Per-It...
  - evesneedle
  - pricklypear
  - snakestongue
  - <empty>
    - Instance Spa... Empty Space
    - Weight: 30.0
    - Display Per-It...

Vegetation Layer Spawner

Vegetation Rotation Modifier

Vegetation Scale Modifier

Vegetation Surface Mask Filter

Vegetation Position Modifier

Ready | P4V | Pending Jobs : 0 Failed Jobs : 30 | GameFolder: 'C:\depot\Procedural-Worlds\Procedural-Worlds' 3609 Mb

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O3DE Editor [Development Build] - Procedural-Worlds - Grass-biome-layer

File Edit Game Tools View AWS Help StudioTools

Entity Outliner | Viewport Camera Selector

Grass_Biome
- TempBiomeBox
- Grass-Veg-Layer
- WhiteNoise_01
- ScaleNoise
- WhiteNoise_02

Asset Browser

Prefab

Name	Path
Hermanubis.fbx	MaterialEditor\ViewportMod
hermanubis_fbx	materialeditor\viewportmod
Hermanubis_High.fbx	Objects\Hermanubis
hermanubis_high_fbx	objects\hermanubis
Hermanubis_low.fbx	Objects\Hermanubis
hermanubis_low_fbx	objects\hermanubis
mannequin.fbx	Assets\Objects\Props
mannequin_fbx	assets\objects\props
Hermanubis_fbx.prefab	Prefabs
hermanubis_fbx	prefabs

No preview available

Grass-biome-layer › Grass_Biome.prefab

Prefab Edit mode

Transform

Entity Inspector

Name: Grass-Veg-Layer

Status: Universal

Entity ID: 3366496036167027421

Add Component

Shape Reference

Shape Entity Id: TempBiomeBox

Vegetation Asset List

Source Type: Embedded

Embedded Assets: 3 elements

grass_patch_01
- Instance Spa... Prefab
- Prefab Asset grass_patch_01
- Weight 1.0
- Display Per-It...

grass_patch_02
- Instance Spa... Prefab
- Prefab Asset grass_patch_02
- Weight 1.0
- Display Per-It...

grass_patch_03
- Instance Spa... Prefab
- Prefab Asset grass_patch_03
- Weight 1.0
- Display Per-It...

Vegetation Layer Spawner

Preview Settings

Layer Priority: Background

Sub Priority: 1

Inherit Behavior

Allow Empty Assets

Filter Stage: PreProcess

Vegetation Rotation Modifier

Allow Per-Item Overr...

Rotation X

Ready | Pending Jobs : 0 Failed Jobs : 30 | GameFolder: 'C:\depot\Procedural-Worlds\Procedural-Worlds' | 3605 Mb

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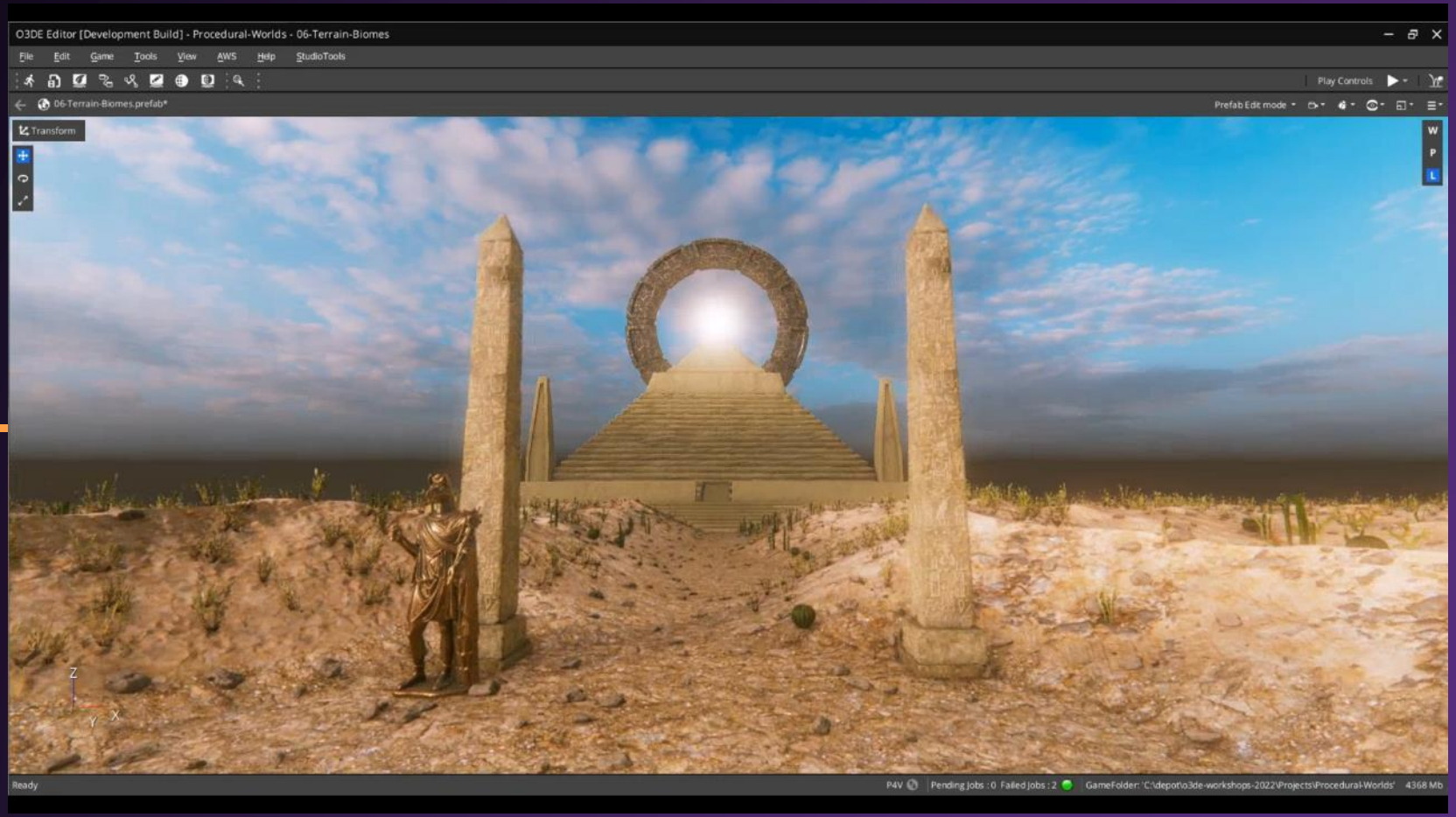

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Q and A

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THANK YOU

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