Slides created by Mollie Johnson

Introduction to Unity for Engineers

Tutorial created for Windows devices

OUTLINE

01 Starting Unity

Download Unity

Step 1: Download the Unity Hub

Before you can start creating in Unity you'll need to download and install the Unity Hub. Windows, Mac Intel, Mac ARM64, or Linux.

Step 2: Install the Unity Hub

Once your download and install has completed, open the Hub and login or create a Unity account.

Step 3: Open the Unity Hub

The Unity Hub is where you see a list of your projects– this is separate from the Unity Engine, which is where you can actively work on a project.

System Requirements:
Windows 10 (64-bit), Windows 11
macOS X 11+
Ubuntu 24.04

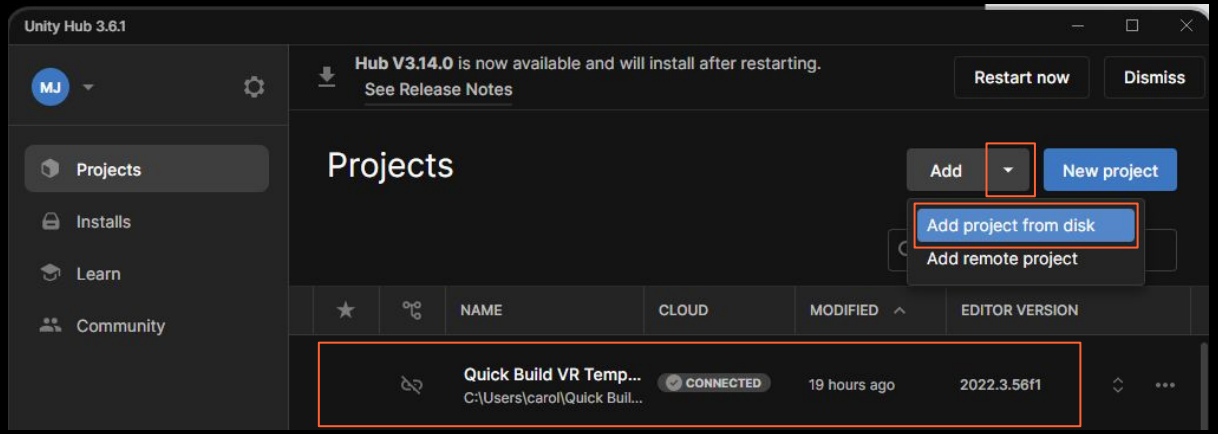
Or if Unity is already installed, skip this slide...

Download the Unity Template

Download project folder "Quick Build VR Template" from the GitHub repo here.

Once the folder is downloaded, add the project to the Unity Hub by clicking Add > Add Project from disk and selecting the folder.

When the project is added, double click to open the Quick Build VR Template.

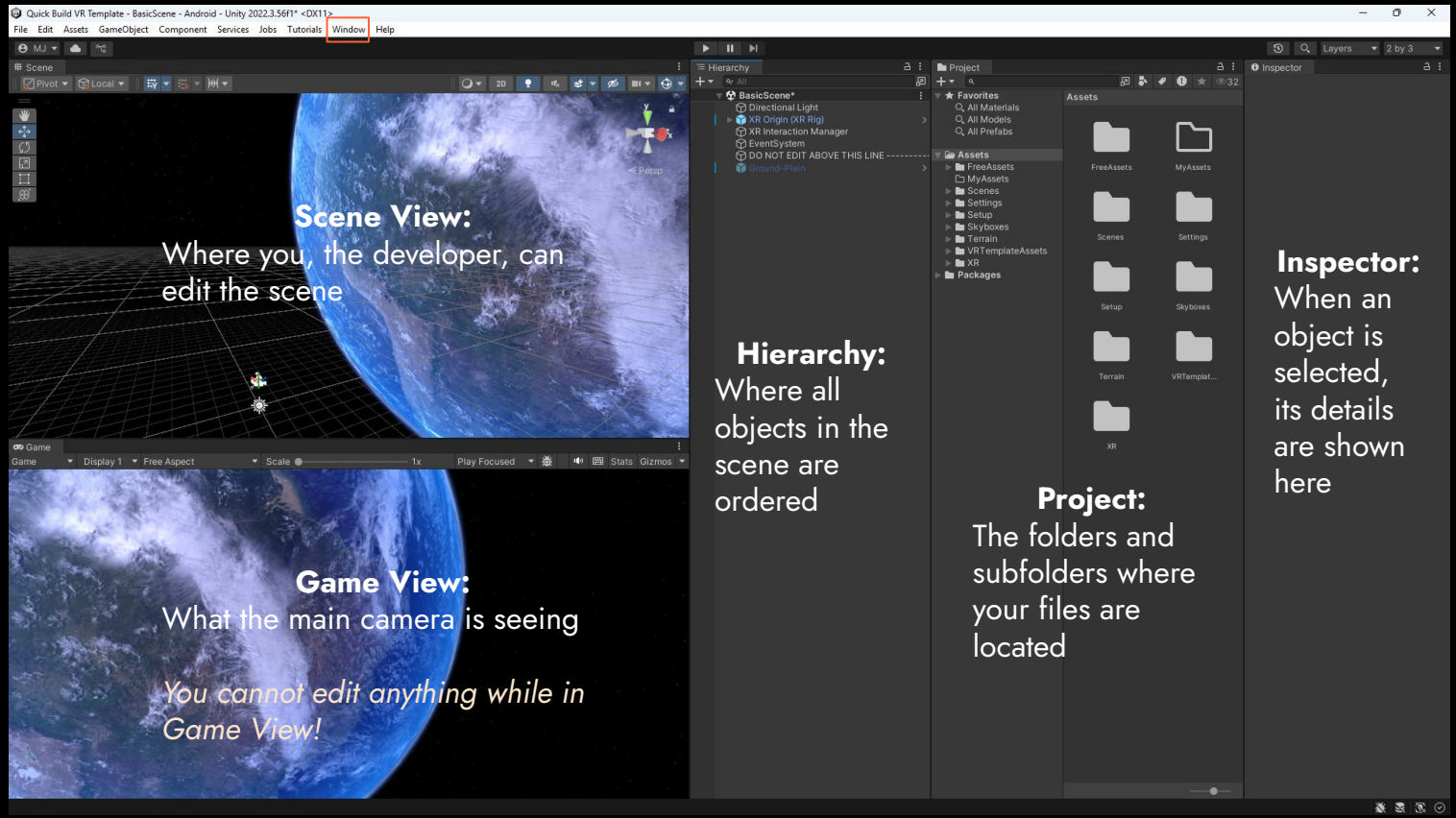


Caveat: Unity is used by professional game developers and thus has a LOT of different features, which can be overwhelming. This tutorial template is only meant to teach the very basic fundamentals of Unity.

02 Unity Basics

Layout

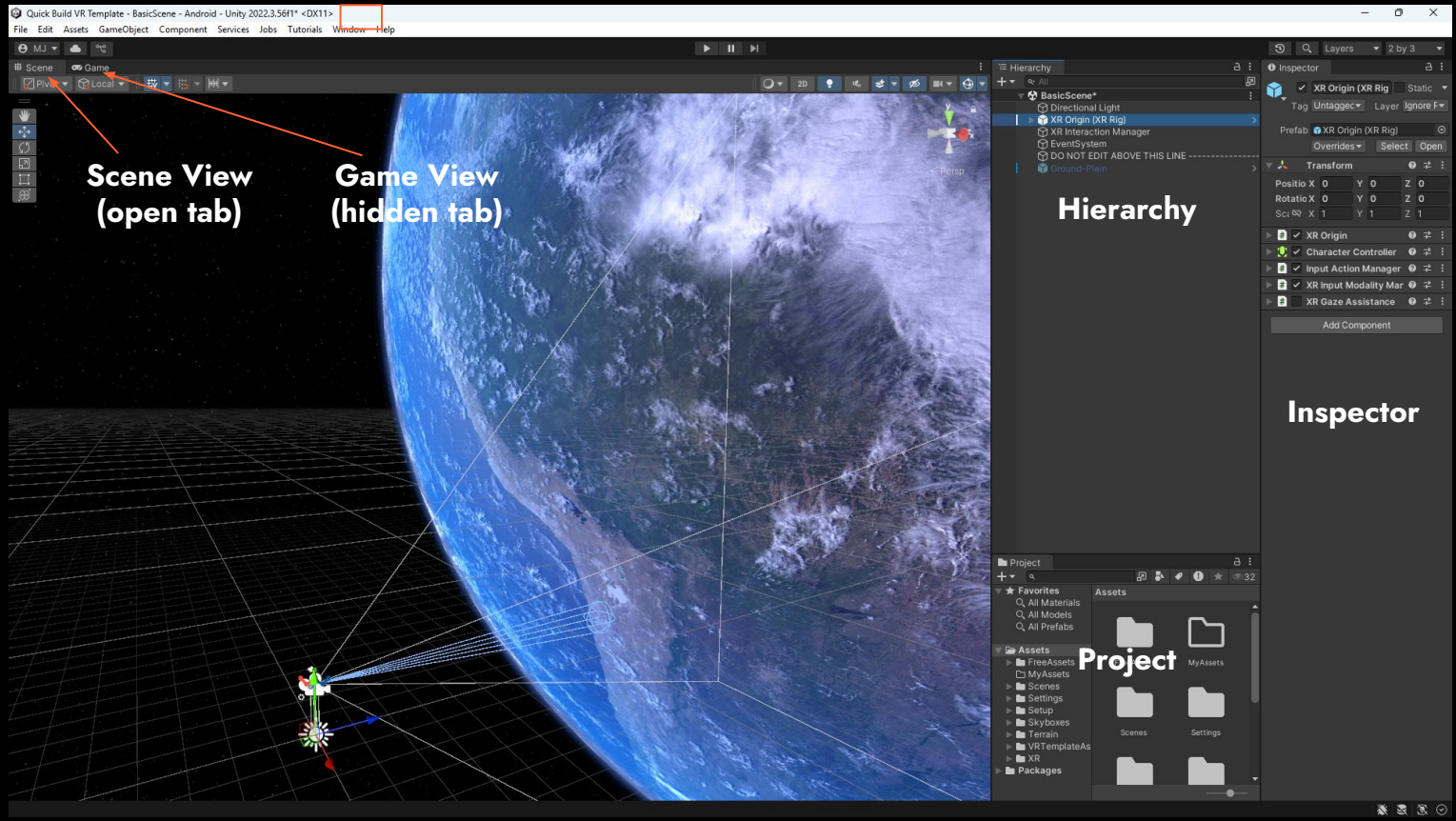
Go to the toolbar at the top and select Window > Layouts > 2 by 3



Layout

You can drag tabs and rearrange to your preference

💡Tip: Hide the Game View next to the Scene View to avoid having to render both at the same time on your computer



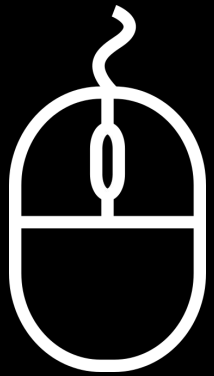
Scene View

This is where you can add objects, position/rotate objects, and assemble your scene.

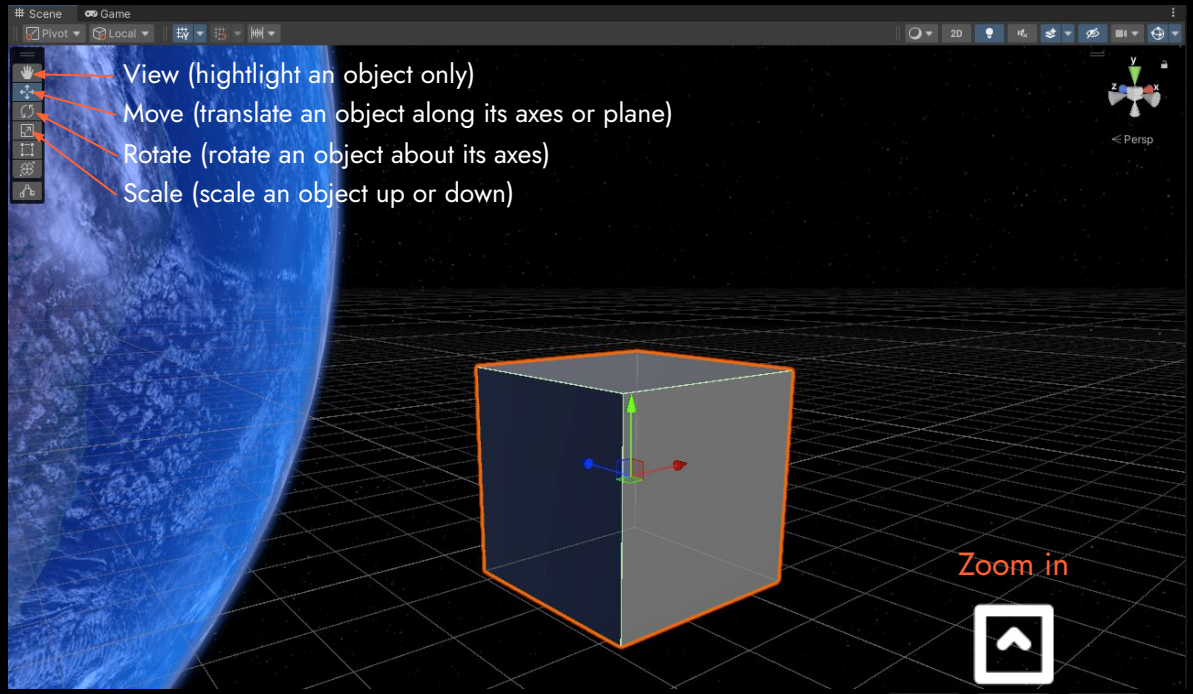
Middle click: pan around

Middle scroll: zoom in/out

Left click: select GameObject



Right click: rotate your view



Zoom in

Pan left

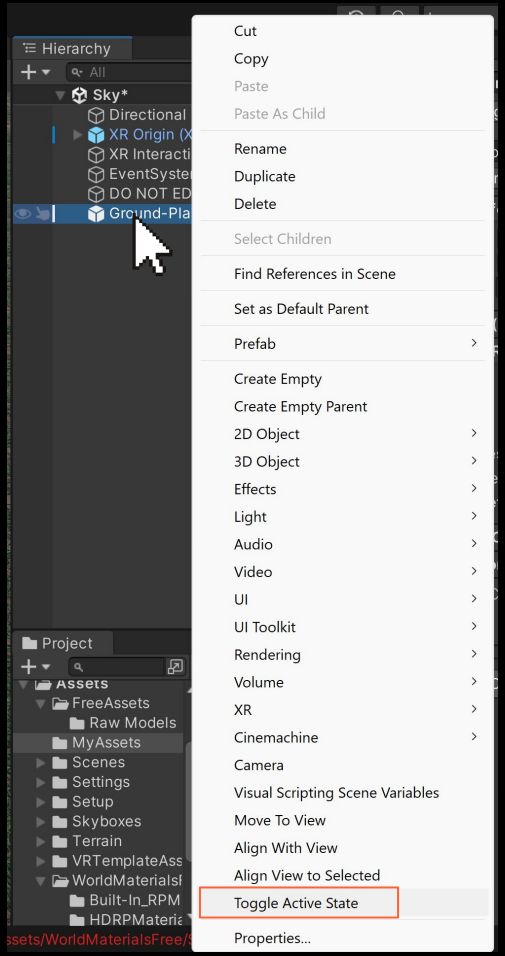
Pan right

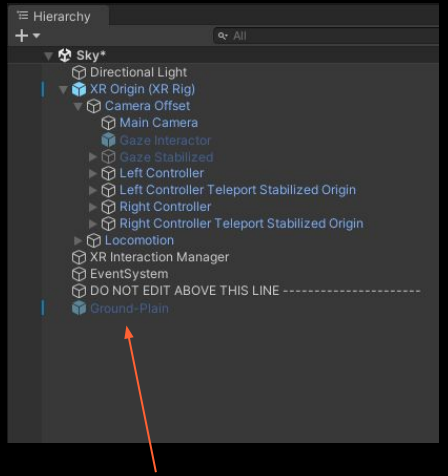
Zoom out

💡Key tip: if you get lost in your scene, select an object in the Hierarchy and press “F” to jump to that object in the scene

Hierarchy

- Everything in the scene is listed in the Hierarchy, like a family tree or an outline
- GameObjects can be added to the scene by clicking and dragging from the Project view to the Hierarchy
  - Alternatively, they can also be clicked and dragged directly into the Scene view
- The list is ordered to show the structure of the scene
  - Objects at the bottom are rendered on top of the objects at the top
- To keep a GameObject in the scene but leave it hidden/deactivated, right click on the object and choose “Toggle Active State”
  - This will set your object to Inactive, hiding it from the scene without deleting it entirely





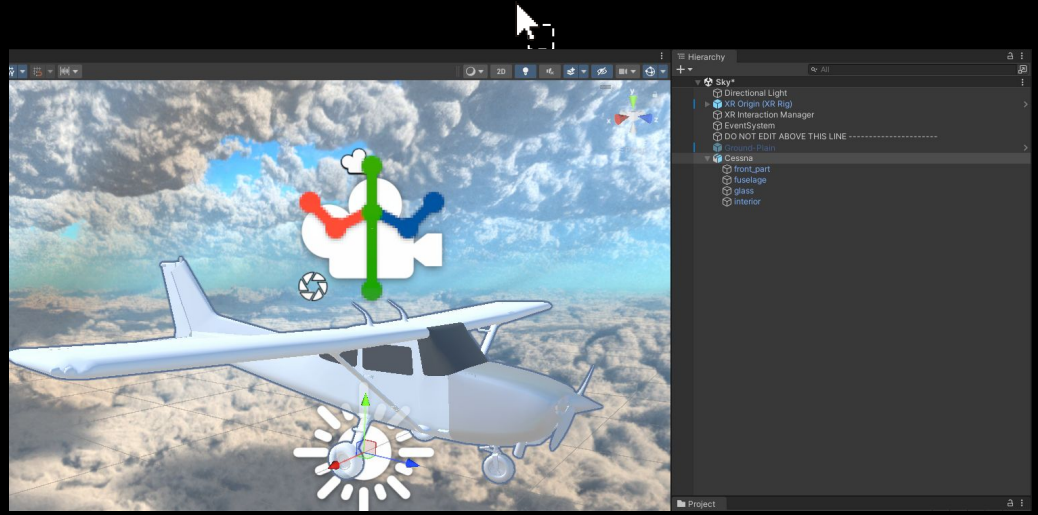
Now this GameObject is Inactive– In the scene files, but not rendered in the built scene

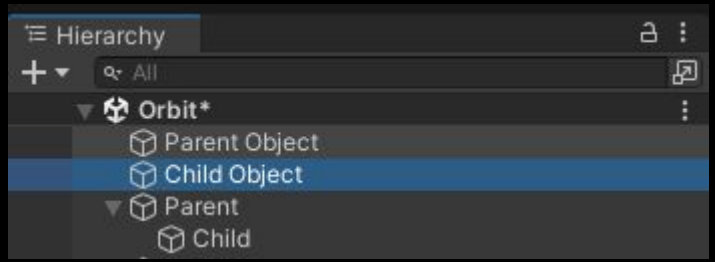
Hierarchy

- GameObjects in Unity can carry hierarchical **parent-child relationships**
    - **Parent object**: The main object that controls position, rotation, and scale.
    - **Child object**: An object that is attached to the parent. It "follows" the parent's movement, rotation, and scale, but can still have its own unique properties.

This can be thought of as *parts* and *assembly*– the main assembly [Cessna] is the parent object of the child objects [front_part, fuselage, glass, interior]. When [Cessna] is affected, [front_part, fuselage, glass, interior] are affected as well.

- To make an object a child of another, click and drag the child in the Hierarchy into the parent object. You can nest multiple pairs as needed



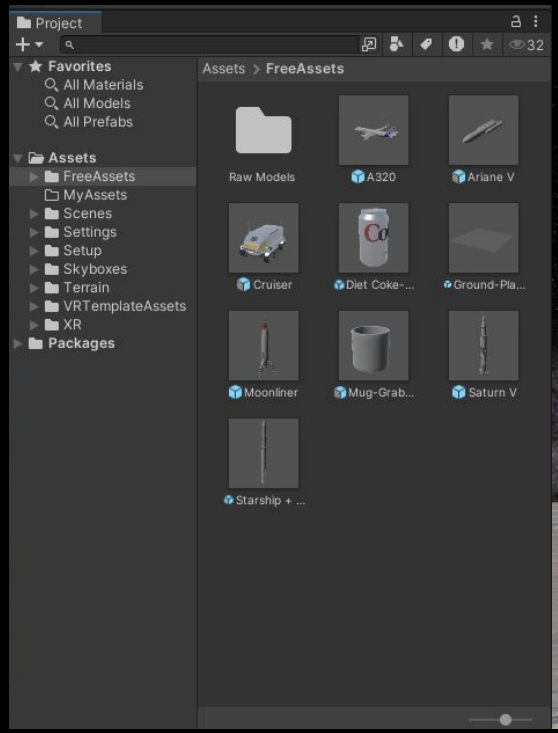


Project

In the Project view, find the following:

- **FreeAssets**: pre-loaded objects for you to use in your scene as decorations
- **MyAssets**: location to add your own custom models
- **Scenes**: pre-configured scenes to use (see next section)
- **Skyboxes**: air and space-related backgrounds (see next section)
- **Terrain**: location of the terrain assets used in the scenes

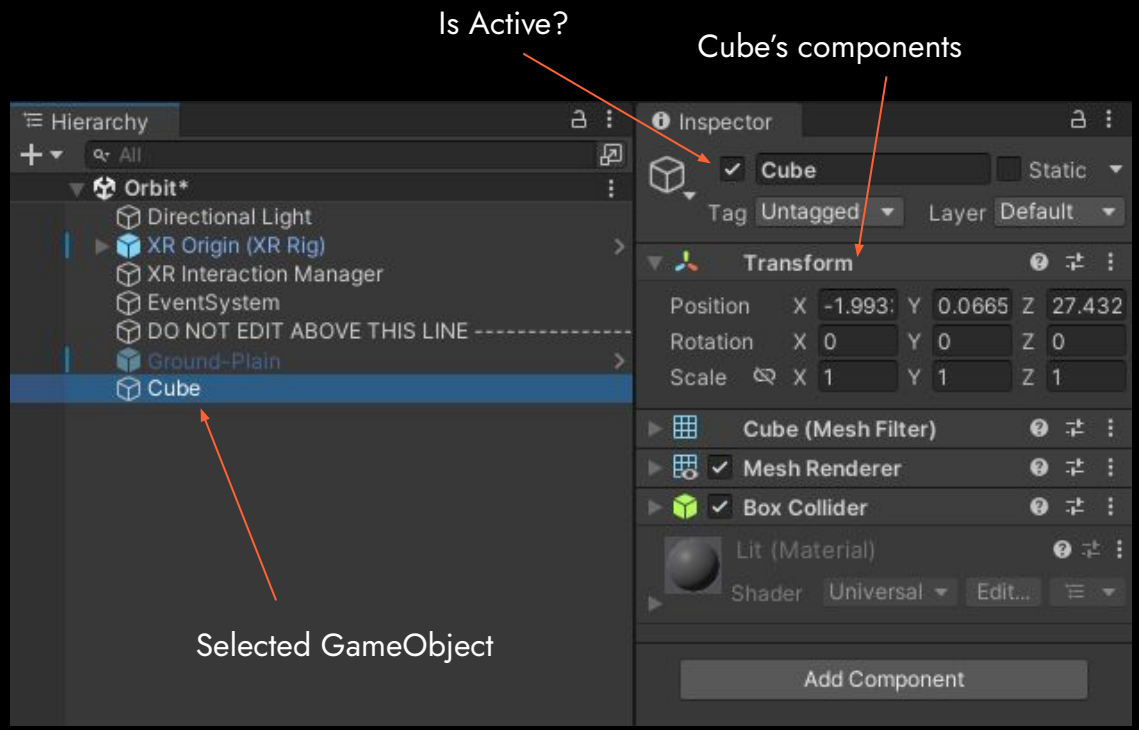
⚠️ Do not edit/modify any of the other Asset or Package folders– these are auto-generated to build the scene!



Inspector

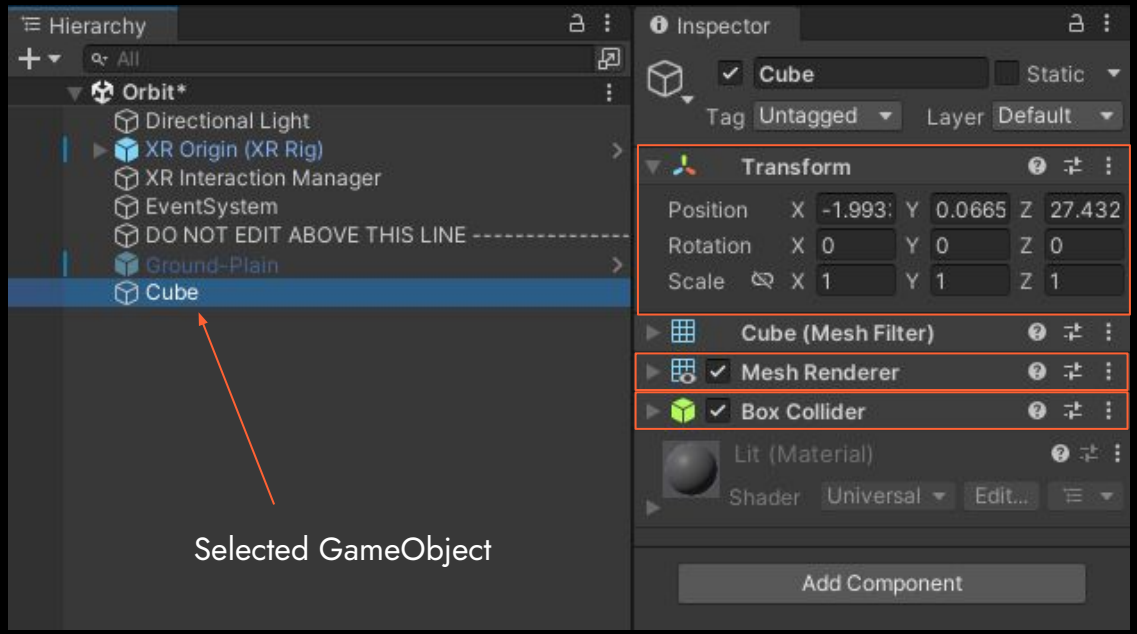
- **Inspector window**: shows all the details and settings of the selected object in the scene or hierarchy
- Every GameObject is made up of **components**
- Components change how an object behaves once the simulation starts to run
- Components can be edited, added, or removed in the inspector window

For this tutorial, only focus on Transform, Mesh Renderer, and Collider– ignore everything else.



Inspector

- **Transform**: the GameObject's position coordinates in the scene, its rotation orientation, and its scale
  - 1 Unity unit = 1 meter
- **Mesh Renderer**: generate the "skin" of the object to make it appear in the scene
- **Collider**: generates a hitbox around the object to detect collisions and other events



In short, you can edit the objects within a scene solely in the Inspector tab if you prefer rather than rearranging objects in the Scene view. Every 3D model has a mesh that represents it (rather than rendering a solid chunk). A collider can detect if an object (or player) touches the object so that the object reacts accordingly (i.e. prevents the player from walking through).

03 Setting up the Environment

Choose A Scene

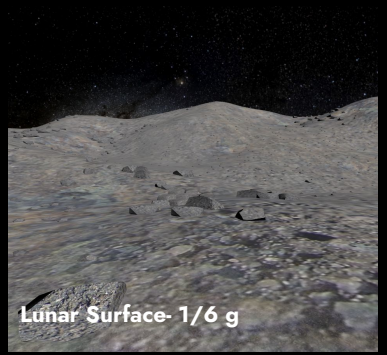
In the Project tab, navigate to Assets > Scenes

Choose your Scene Asset to build in and remember which scene you're building in!

Objects that are placed in a scene do not carry over between scenes– that's what the Project folder is for!

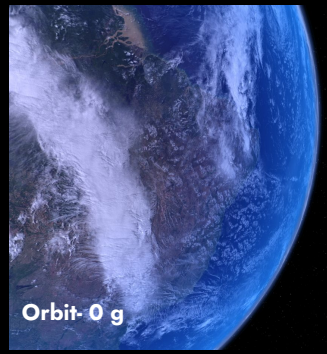
Players can walk around in these scenes

Aircraft Hangar- 1 g


Lunar Surface- 1/6 g


Mars Surface- 1/3 g

Deep Space- 0 g

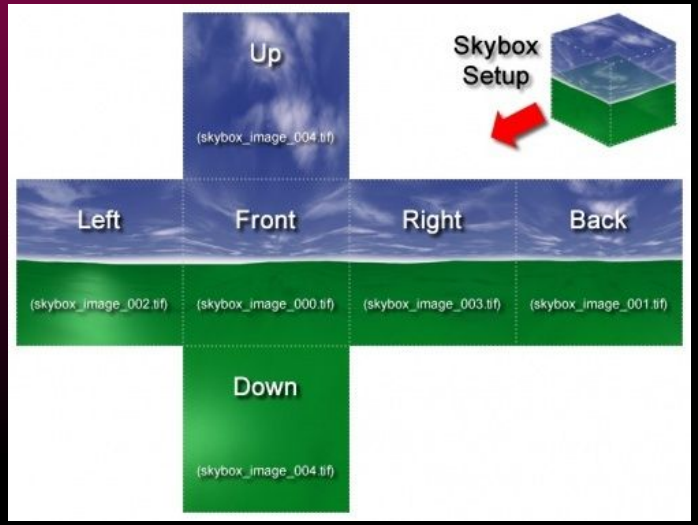

Orbit- 0 g


Open Sky- No gravity

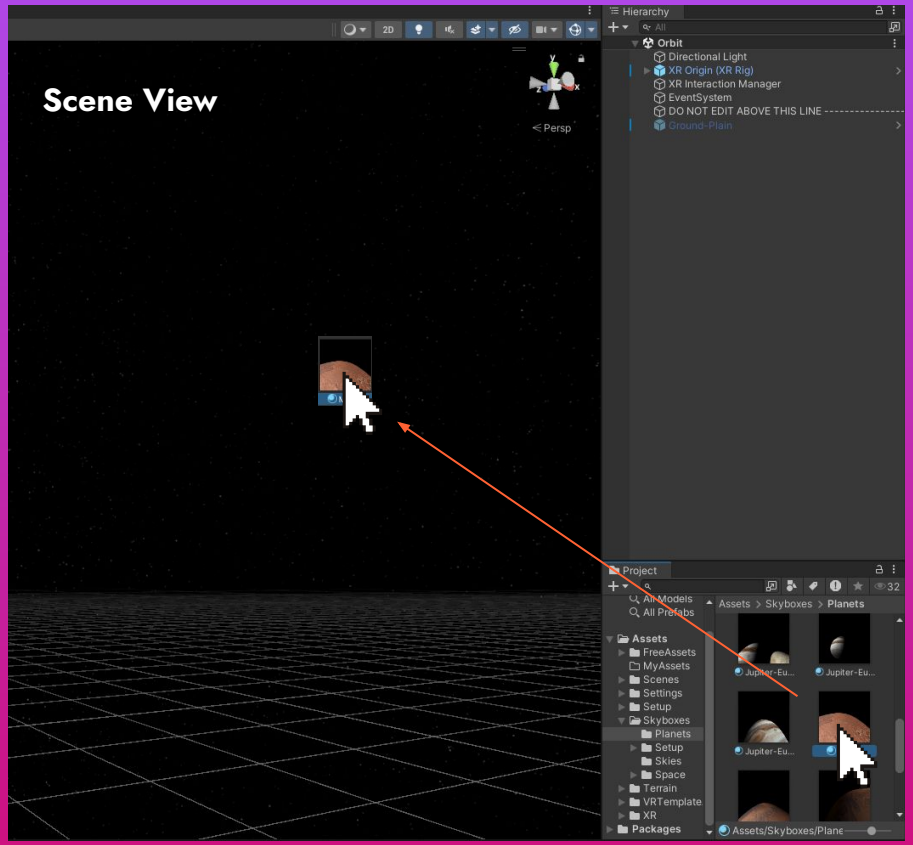
Players can fly around freely in these scenes

Skyboxes

Skybox: background that surrounds the entire scene in a “cube” or “sphere” to simulate the sky and background



Choose your skybox accordingly from the Assets > Skyboxes. To change the skybox in the scene, simply click and drag the one you want into the Scene view.

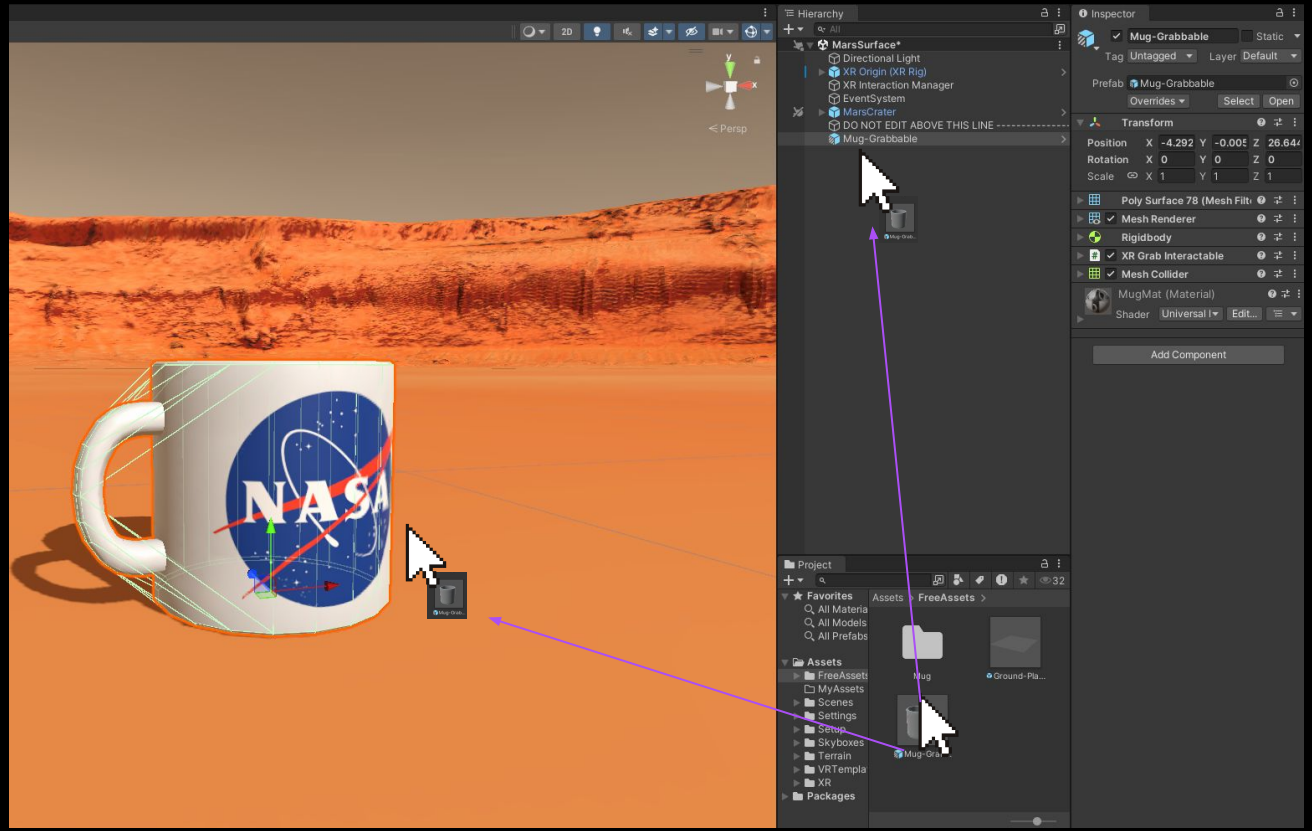


Add GameObjects to Scene

Two ways to add a GameObject from the Project folder to your scene:

Option 1: Click and drag object directly into Scene view

Option 2: Click and drag object into the Hierarchy, then adjust position in the Inspector

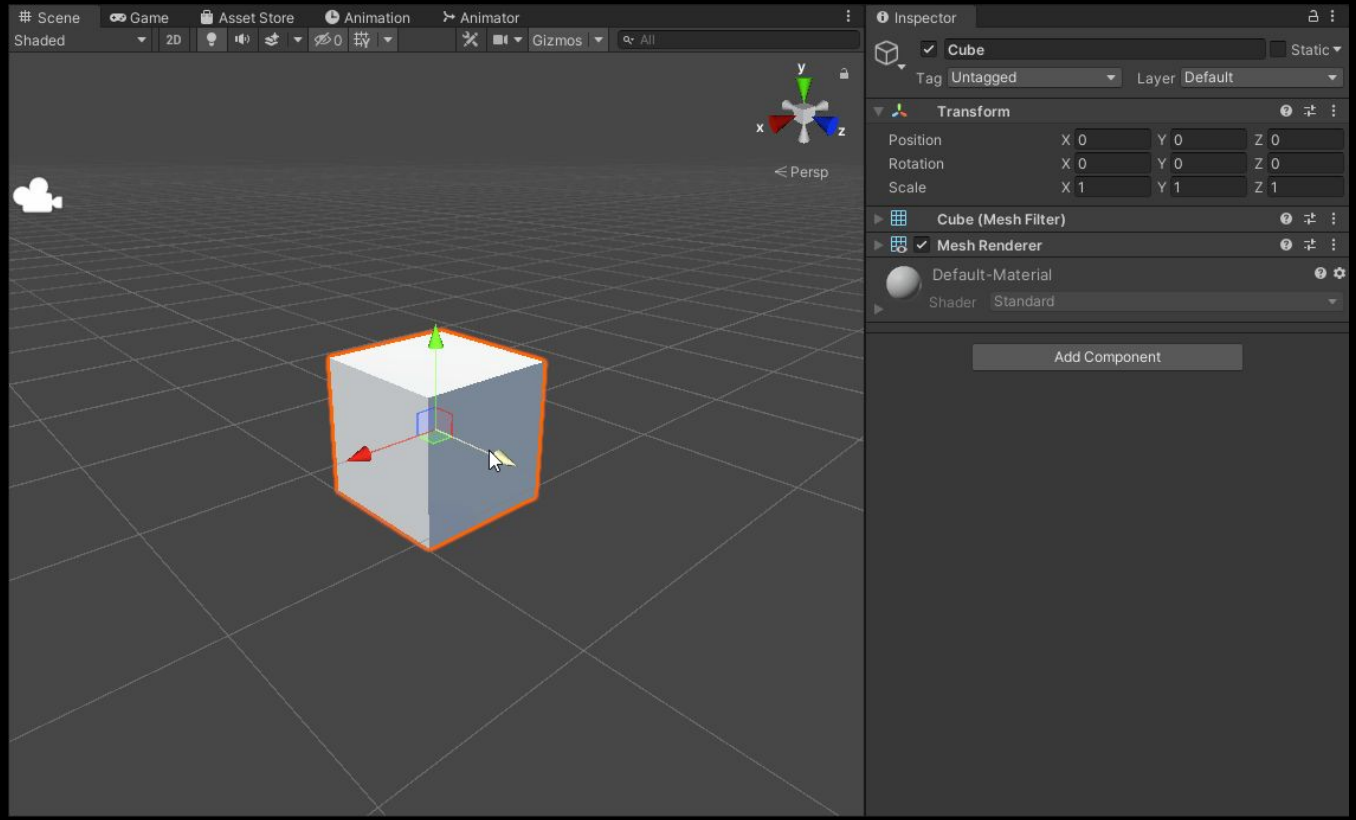


Edit GameObjects in Scene

Two ways to **translate** a GameObject in your scene:

Option 1: Use the Transform option in the Scene view and drag the object along its axes or planes.

Option 2: Edit the position directly in the Transform component in the Inspector.

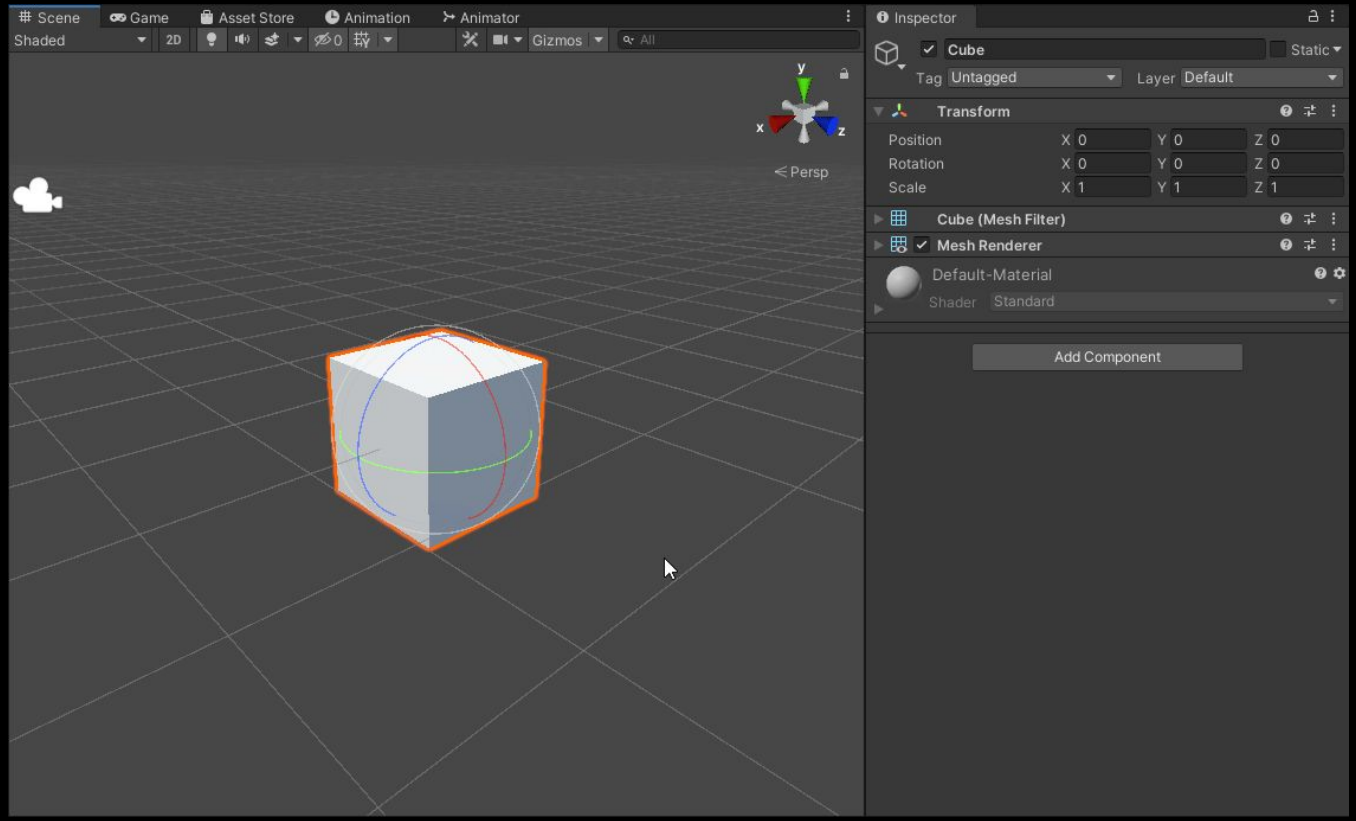


Edit GameObjects in Scene

Two ways to **rotate** a GameObject in your scene:

Option 1: Use the Rotate option in the Scene view and rotate the object along its axes by dragging along the rings.

Option 2: Edit the rotation directly in the Transform component in the Inspector.

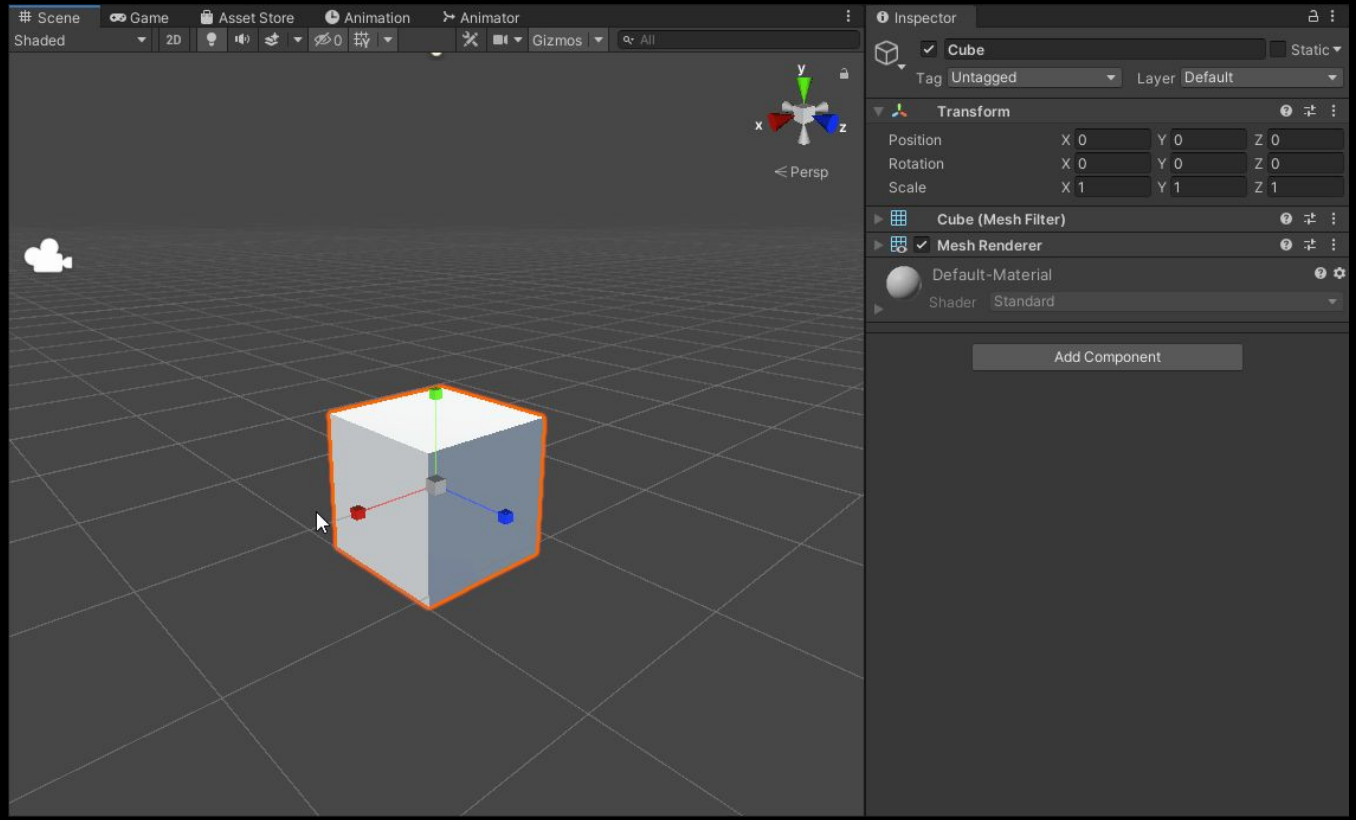


Edit GameObjects in Scene

Two ways to **scale** a GameObject in your scene:

Option 1: Use the Scale option in the Scene view and scale an object by clicking and dragging along its axes.

Option 2: Edit the scale directly in the Transform component in the Inspector.

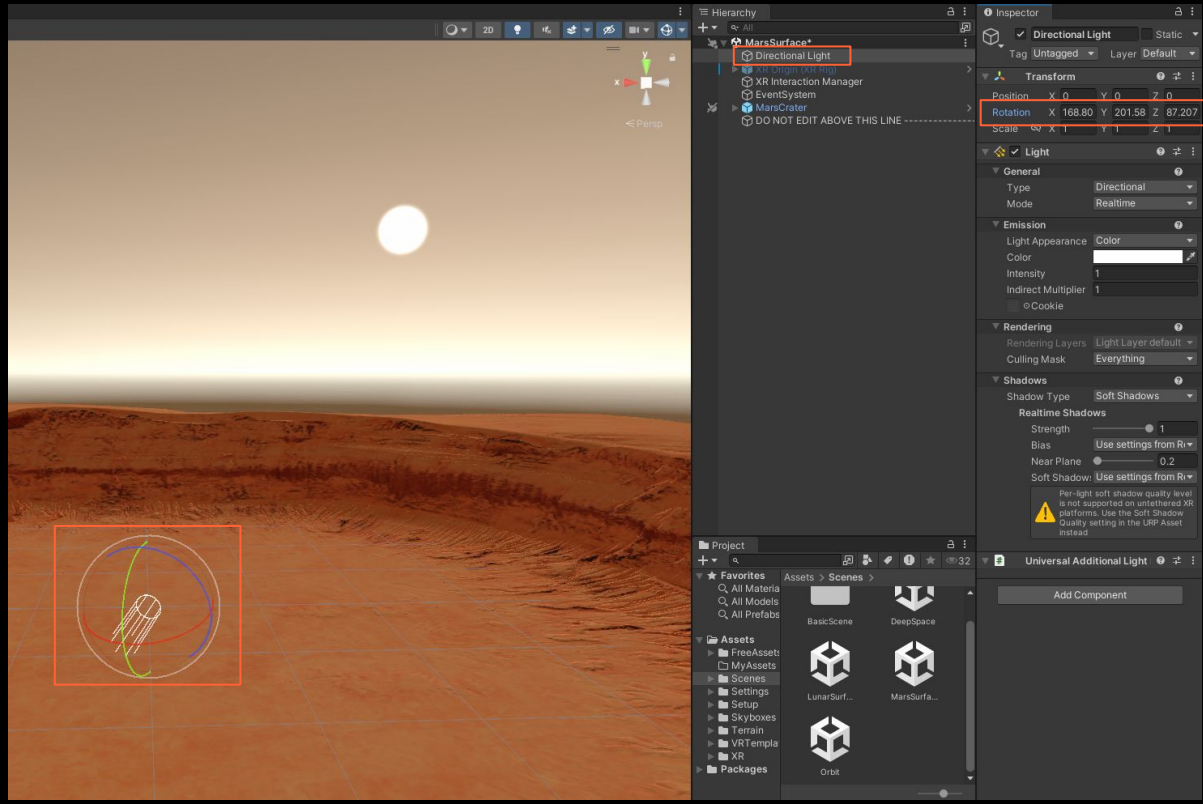


Directional Light

Change the direction that the light is coming from to add dramatic lighting to the scene.

In the Heirarchy, click on Directional Light and change its rotation values in the Transform component in the Inspector.

Changing position won't do anything!



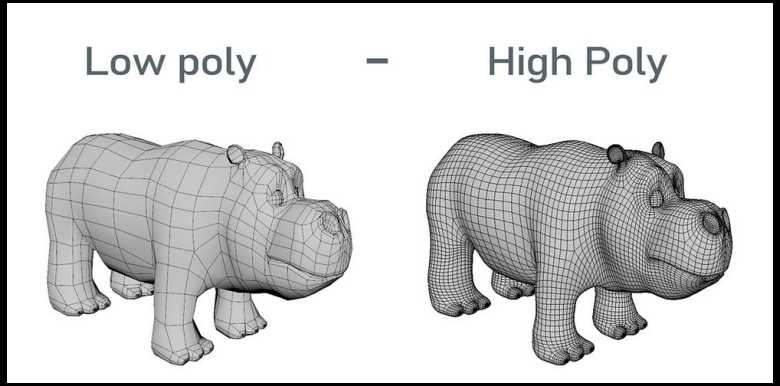
04 Importing Custom Models

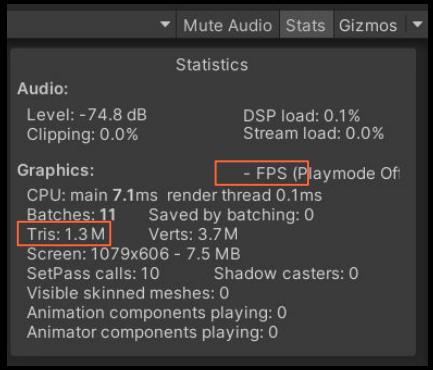
Headset Considerations

- Meta Quest headsets are **standalone**, meaning all computations happen in the headset without having to be plugged into a computer
    - As consequence, computing power is greatly diminished

- When possible, opt for simplified models that are easy to render (low-polygon)
    - This may require removing details

- Check how many triangles you are rendering in your scene by going to Game view > Stats. This shows how many triangles the Main Camera attached to the player has to generate. A good rule of thumb is to stay under 1-2 million triangles in the scene, otherwise you may experience lag.





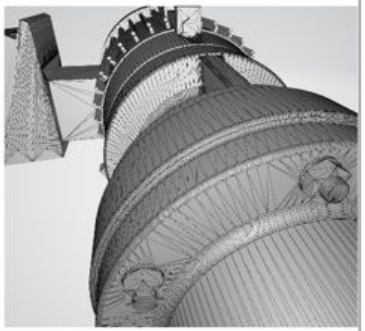
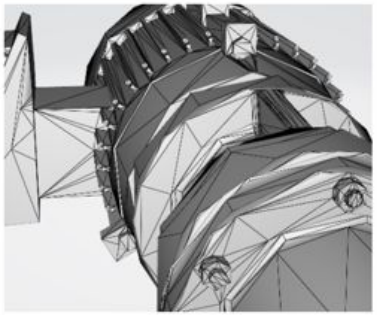
Your computer is probably much faster than the headset– what looks good on the computer will not look the same in VR!

Optimizing Your Model

Meeting the triangle count can be challenging for large, detailed builds. Consider the following methods of reducing your CAD model size BEFORE importing to Unity:

1. Remove excess details
2. Simplify details
3. Simulate in pieces rather than all at once
    a. i.e. A lunar city might need to show one building at a time to avoid loading the entire city
4. Use other software such as Blender to reduce your model

Reminder: this is an intro tutorial! 3D modelling is an entire career in itself.

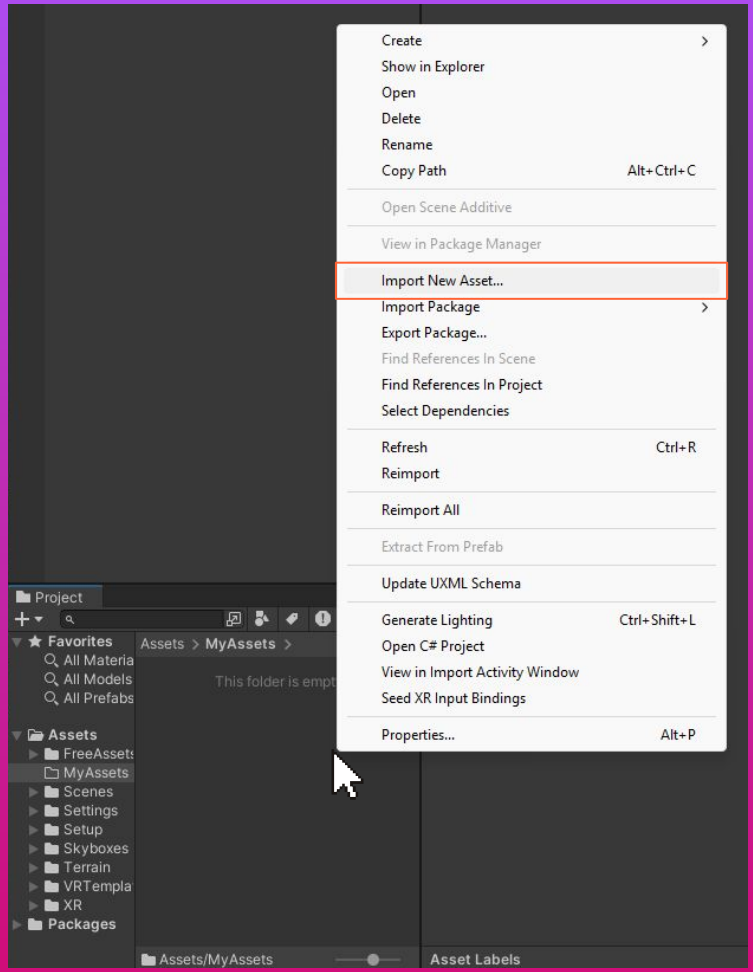
High-poly 3d model	Low-poly 3d model
	
52,000 triangles	**9,000** triangles

Import New Asset

In the Project tab, navigate to the Assets > MyAssets folder. This is where you will store the 3D models that you want to use.

To import a new asset, follow these steps:

1. In the MyAssets folder, right click and choose “Import New Asset”
2. Find the files that you want to add to your project in your computer’s File Explorer
3. Select all files for important click “Import”
    a. Make sure you include everything! If the 3D model comes with “textures” or “materials” files, include those too or your object will appear grey and lifeless
4. Object should appear in your MyAssets folder ready for use!

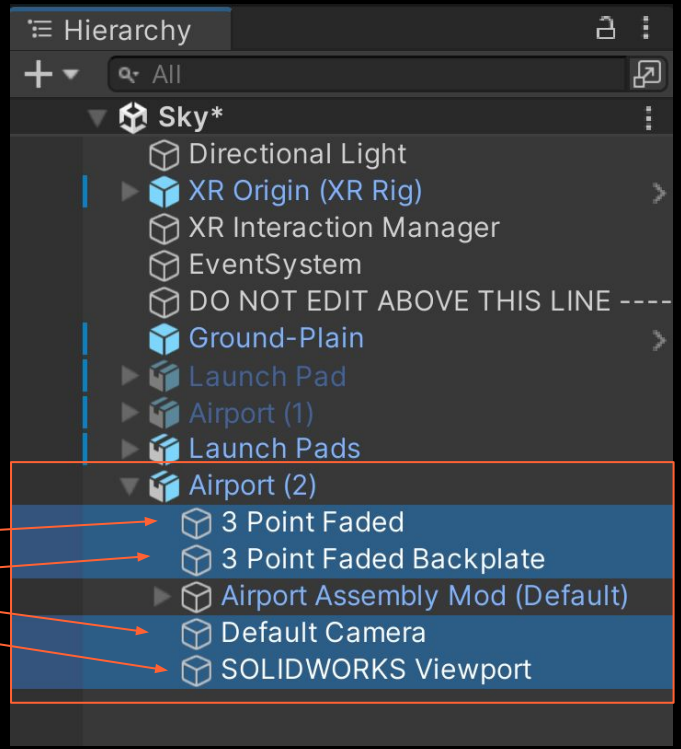


Configure New Asset

If you imported a .fbx file from Solidworks Visualizer, you should see colors appear on your model automatically.

Solidworks Visualizer will attach extra cameras to your model– these need to be deleted to avoid overriding the player's Main Camera. Ensure that all extra cameras are deleted.

These cameras in "Airport (2)" are generated automatically by Solidworks Visualizer-- delete by pressing the Delete key on your keyboard



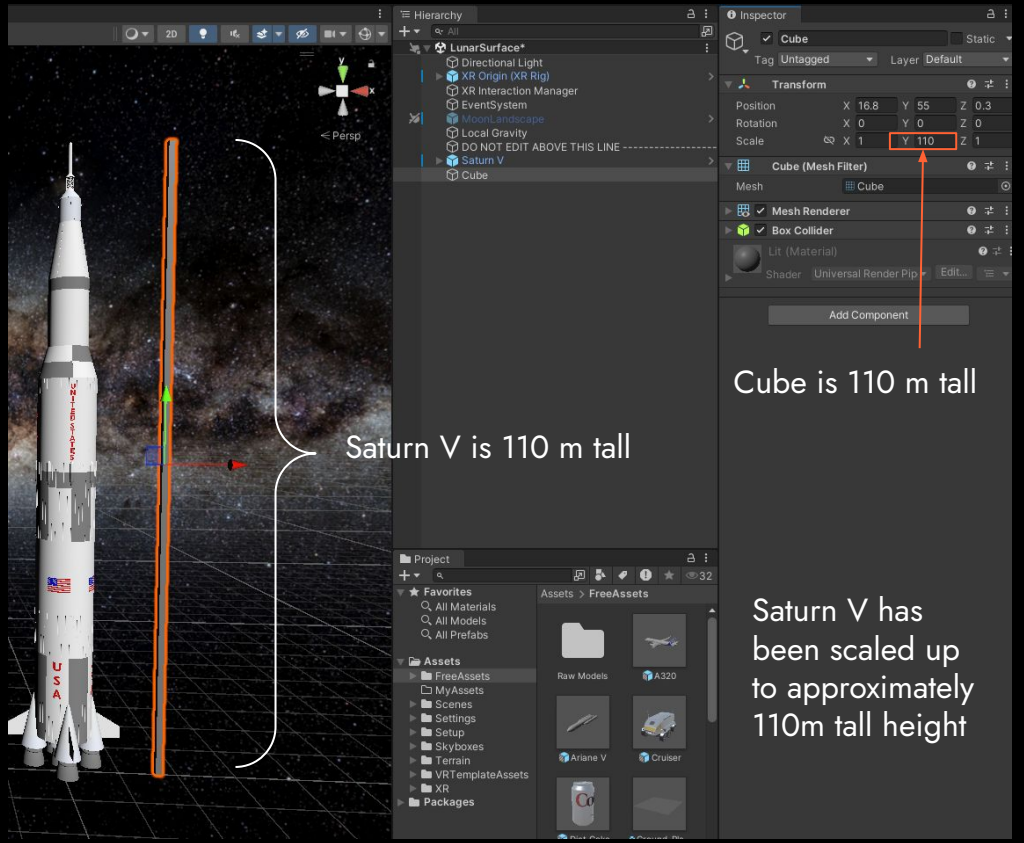
Check the Size

If you're unsure how large your model imported in as, you can check the relative size by creating a primitive GameObject.

Create a basic shape to use as a measuring stick:

1. Right click in the Hierarchy and choose 3D Object > Cube
2. Move the Cube close to the object you want to measure
3. Change the dimensions of the Cube by changing the Transform > Scala parameters in the Inspector. By default, a Cube is 1x1x1 meters.

1 unit in Unity = 1 meter



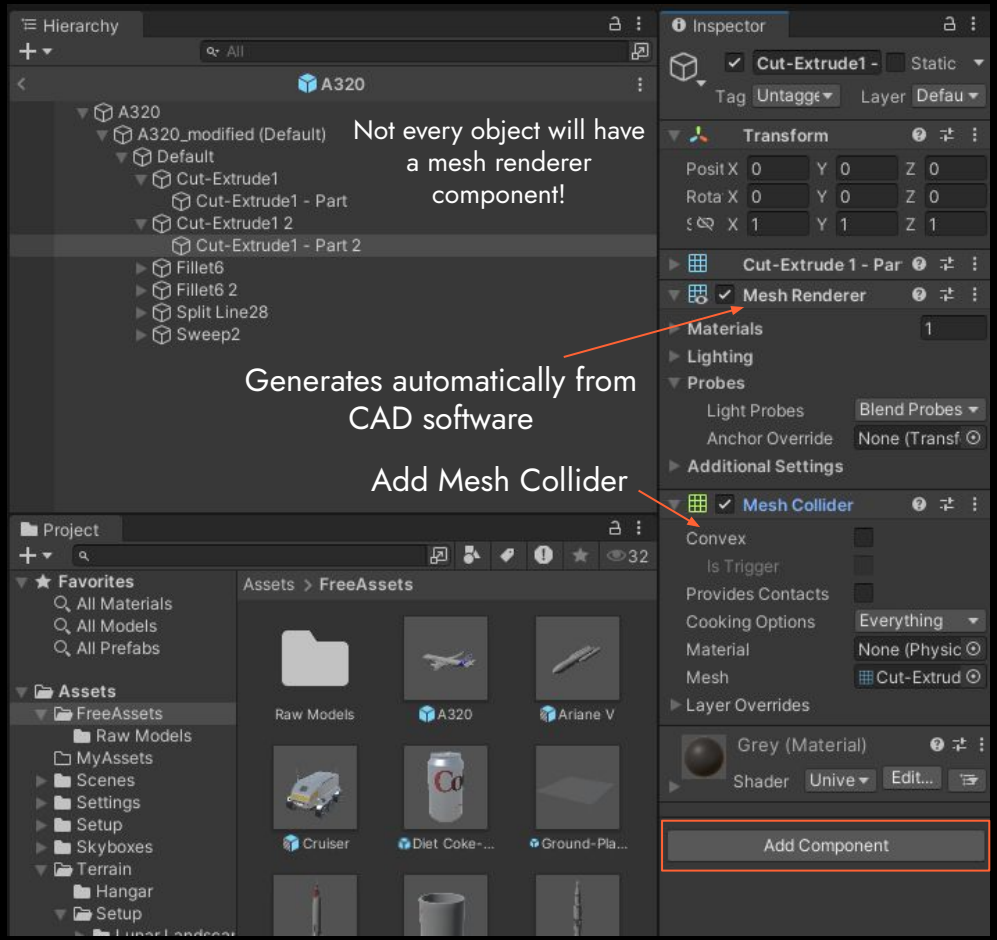
Add Colliders

Add a Mesh Collider component to your build to prevent the player from walking through your model.

Mesh Collider: When another Collider (i.e. the player's hitbox) touches the object's mesh, Unity registers this and prevents the two objects from phasing into each other

To add a mesh collider,

1. Select your model in the Hierarchy
2. For each child object with a Mesh Renderer component, click "Add Component" and search for "Mesh Collider"



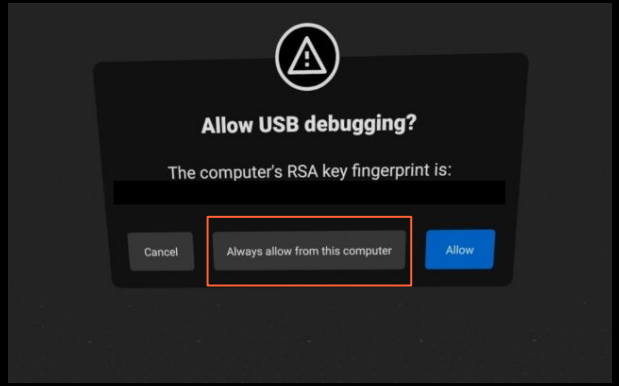
05 Building to Headset

Connect Headset

Connect the Meta Quest headset to your computer using a USB-C cable.

Inside the headset, you will be prompted to trust this computer. Select “Allow” for USB debugging.

Your headset should be preconfigured to be ready to use in Developer Mode. If not, follow [these steps]



Build to Headset

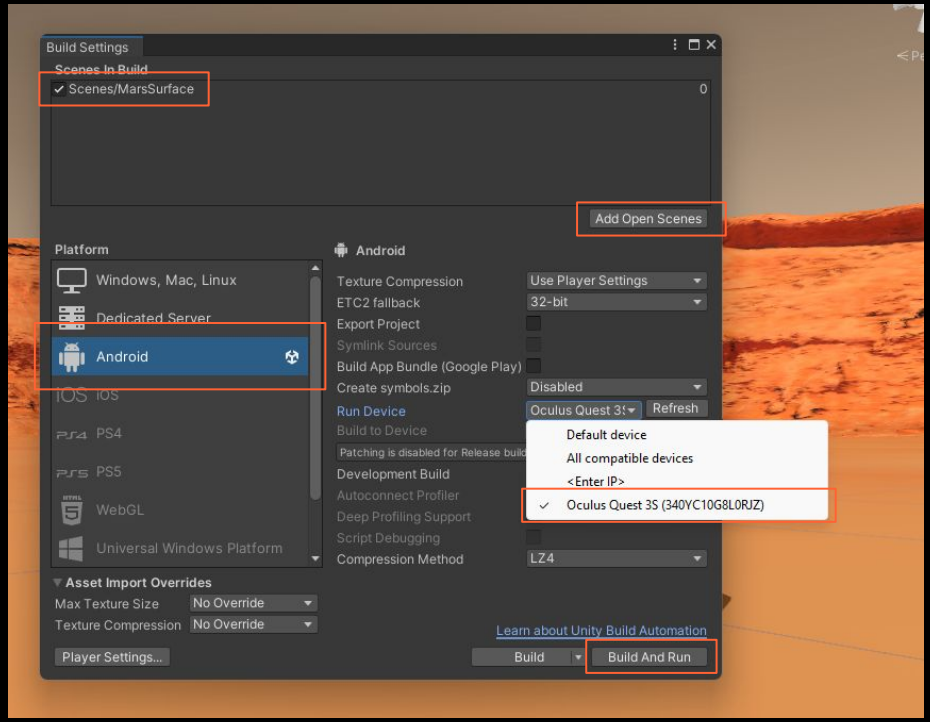
1. At the toolbar at the top of the screen, go to File > Build Settings.

2. Make sure “Android” is selected, and under “Run Device” choose the IP of your headset.

If your headset is connected to your computer and the IP is not showing, click “Refresh” to detect the device.

3. Make sure you have the scene you want to build open, then select “Add Open Scenes”. Only check the box next to the scene you want to build.

4. Click “Build and Run”. Save the simulation to your computer locally before exporting to the headset. This may take a while.

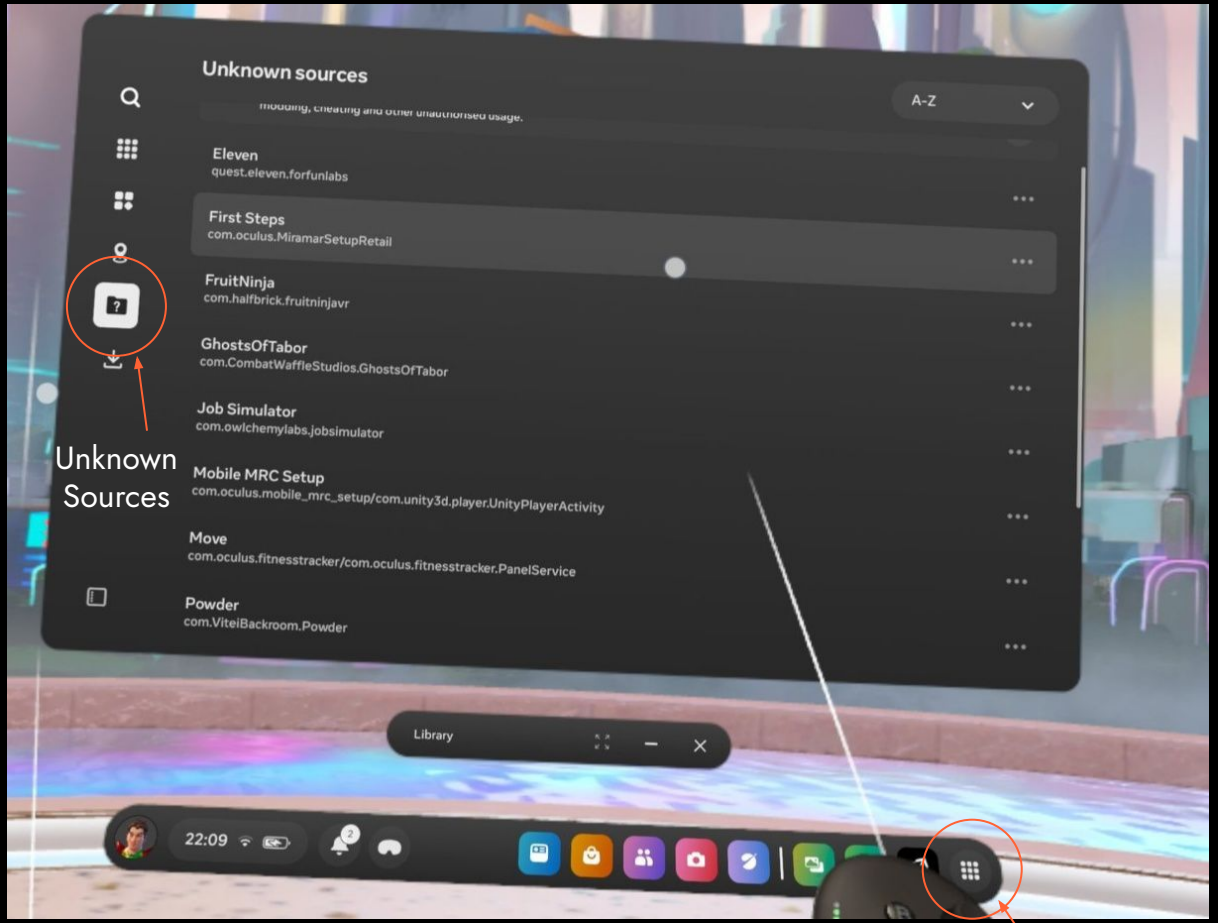


06 Exploring Your Simulation

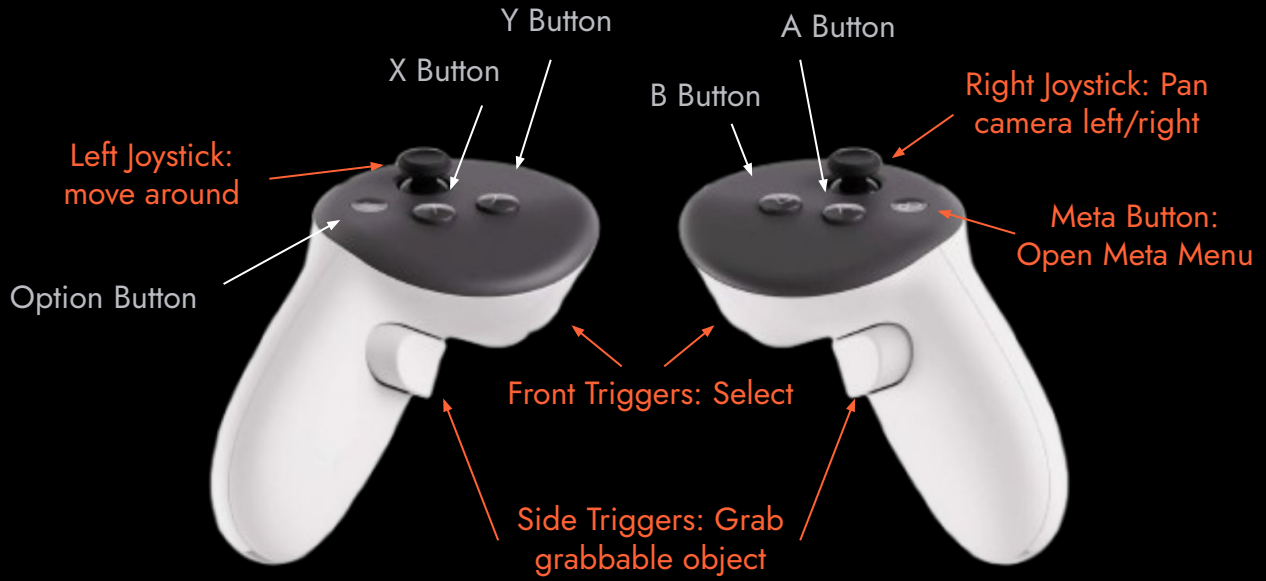
Launch Your Simulation

Once the sim is uploaded, you can launch the sim in the headset.

1. In the headset, press the Meta Button on the right controller to open the menu hot bar.
2. Select Library > Unknown Sources.
3. Your simulation should appear here as “Quick Build VR Template” once it is done uploading. Select to start!



Basic Controls



Troubleshooting

1. My simulation is really laggy and jerky/takes forever to load.
2. I can't see anything when I start the simulation.
3. When I turn my head, the camera movements are all wonky.
4. My player/object is falling through the floor/going through objects.

1. Your 3D model may contain too many details for the headset to render properly/quickly. Try reducing the level of detail in your model and re-import again. [See slide 23]
2. Ensure that nothing is covering your player ("XR Origin (XR Rig)") or your player's camera. You can rearrange the player's location in the scene as needed. Also ensure that no other cameras in the scene exist that might override your player's camera. [See slide 25]
3. Do NOT change the player's rotation in the X or Z directions. You may point them in another direction by rotating about Y only.
4. Make sure your player/object is not placed inside the floor and that every object with a Mesh Renderer has a Mesh Collider component. [See slide 27]