3D Data Hack Dublin

Unity Starter Guide

Building City Dashboards

3D DATA HACK DUBLIN

NCG National Centre for Geocomputation An tIonad Náisiúnta Geoiriomhaireachta

Maynooth University National University of Ireland Maynooth Social Sciences Institute

Maynooth University National University of Ireland Maynooth

Science Foundation Ireland sfi For what's next

dashboards.maynoothuniversity.ie
dashboards@mu.ie
@dashbuild

3D Data Hack Dublin

- The following guide has been prepared as part of the Building City Dashboard project, a Science Foundation Ireland initiative based at Maynooth University, Ireland.
- The guide outlines how the resources provided for the 3D Data Hack Dublin can be used with a game engine to facilitate real-time interaction and visualization.
- Following the guide is expected to take between 45 mins and 1 hr 30 mins to complete.
- This guide is not intended as a comprehensive instruction manual.
- It has been provided to help those who are new to real-time, interactive visualisation to get up and running quickly so that they can start exploring their own ideas.
- Suggestions for next steps are provided toward the end of the guide.

NOTE: This guide was tested with Unity version 2019.1.0f2. As functionality and menu options can change between versions, please be prepared to refer to online help:

- Documentation: https://docs.unity3d.com/Manual/index.html
- Forums: https://forum.unity.com/

Download the 3D Data Hack Dublin Resources

3D Data Hack Dublin Resources are available in the following location:
https://data.smartdublin.ie/dataset/3d-data-hack-dublin-resources

3D Data Hack Dublin Resources

- Contents
  - **SDZ_Model_ITM_20190424.FBX** – The 3D model we will be using in this guide. This file it suitable for use in many 3D modelling packages such as 3ds Max or Blender, but also in game engines like Unity or Unreal Engine.
  - **SDZ_Model_ITM_Textures_20190424.zip** – A folder containing textures that can be used to enhance the FBX model's appearance.
  - **SDZ_Model_ITM_24.max** (Not used in this guide) – The original Autodesk 3ds Max project used to assemble the 3D data in the FBX file.
  - **Move_File_ITM.txt** (Not used in this guide) – A file describing the spatial offset (in metres) which has used in the 3ds Max project to bring original survey data in the Irish Transverse Mercator (EPSG:2157) coordinate projection system to the world origin in 3ds Max for modelling.

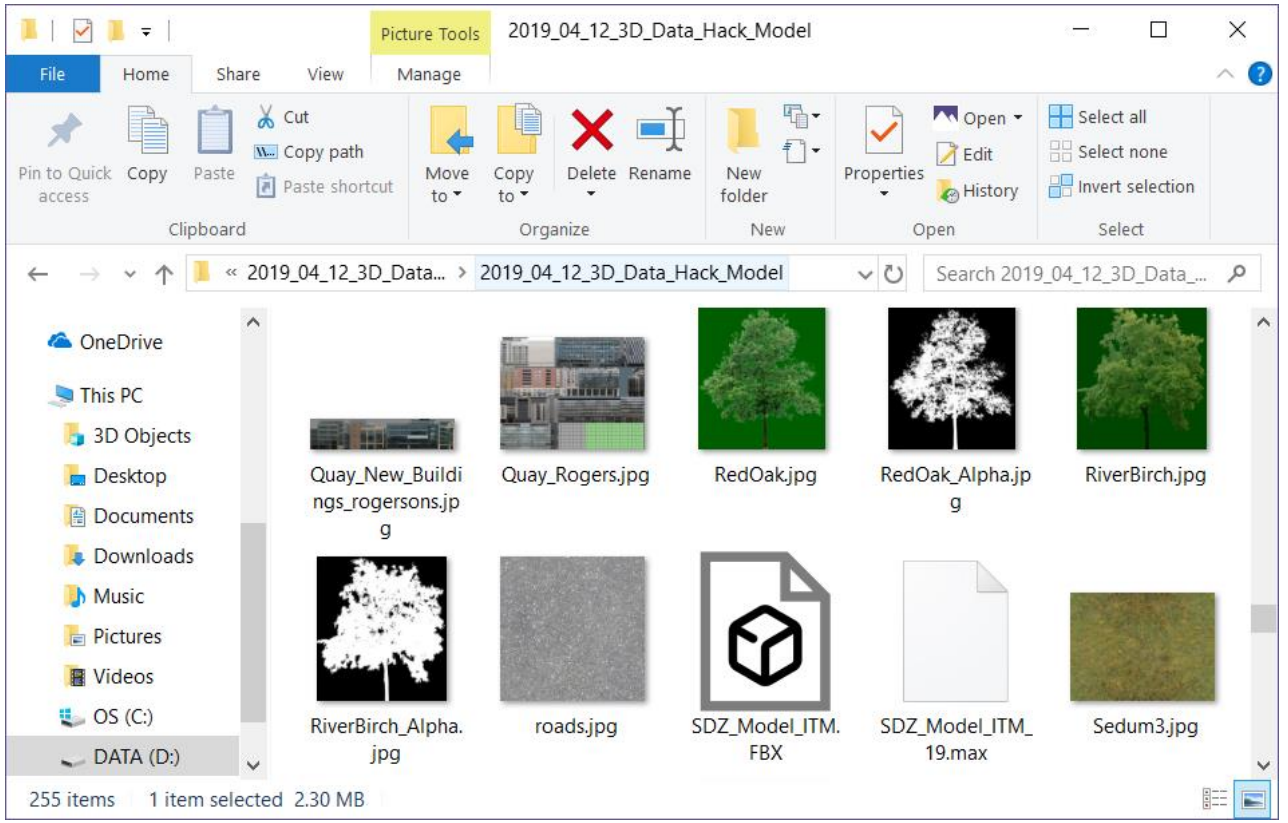
Technical Note:

The spatial offset described by the move file can be used to determine the real world coordinates of objects that have been placed in the 3ds Max project. The offset is required because 3D modelling and visualisation software has tended to use a single precision floating point number format to describe spatial location: https://en.wikipedia.org/wiki/Single-precision_floating-point_format. This is commonly done to help improve computational performance, but entails a tradeoff in loss of spatial precision as objects move further away from the world origin (0,0,0). Simply put, single precision floating points do not provide sufficient precision over great enough distances to describe real world geographic coordinates. Attempting to do so can result in visible jitter of objects due to spatial uncertainty, or else their failure to render, resulting in a blank screen. One solution to enable rendering of objects with positions described in a real word geographic coordinate system is to apply an offset to their coordinate position that brings them back toward the world origin.

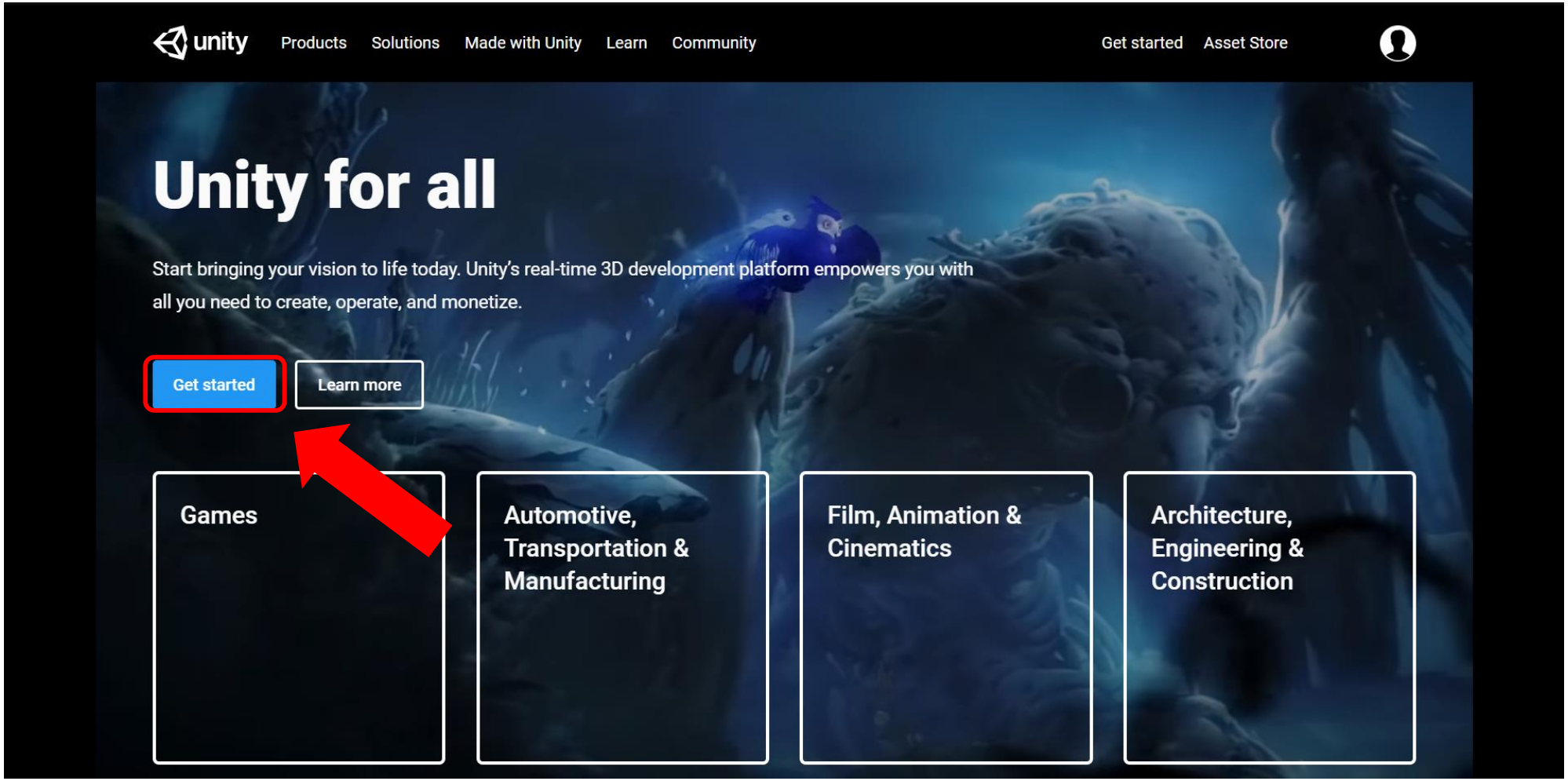
Preparing your files for this tutorial

- Download the FBX file and the zip file containing the textures.
- Unzip the textures.
- Place the FBX and textures together in the same folder on your computer (any location of your choice is fine).
- Remember the location of the folder as you will need to access it later to import the 3D model into Unreal Engine.

NOTE: You can download the other resources but they will not be used in this guide.

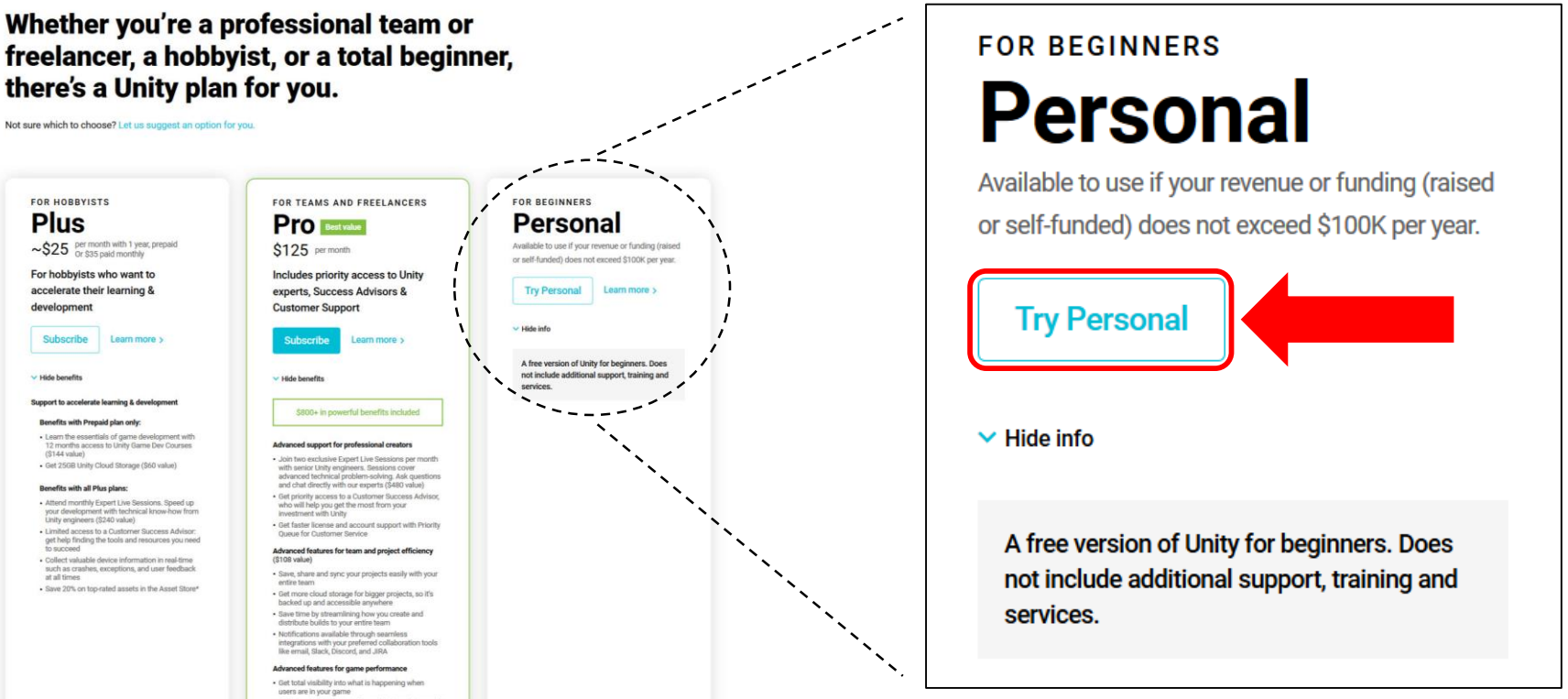


How to get Unity

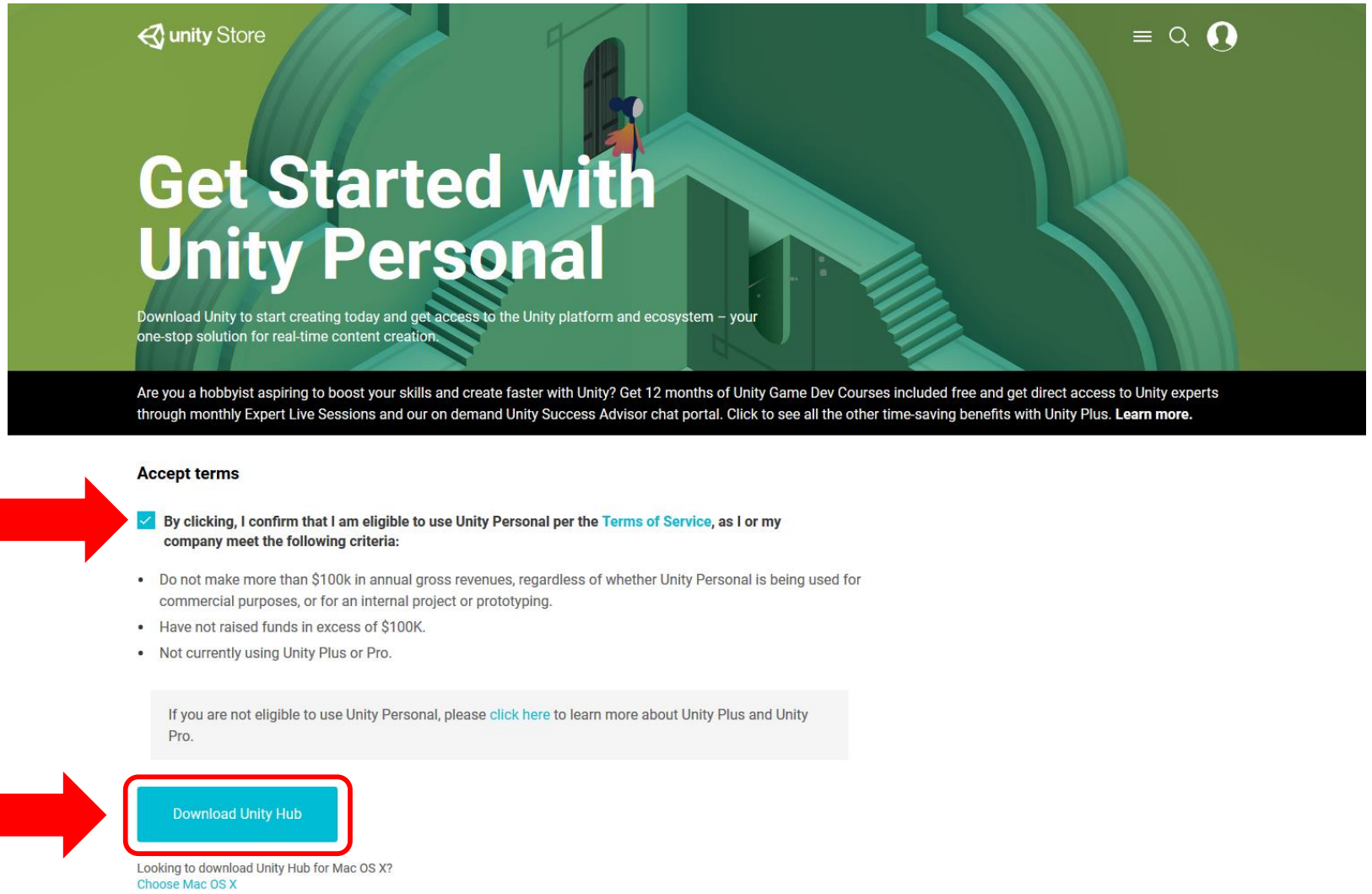


Unity: https://unity.com/

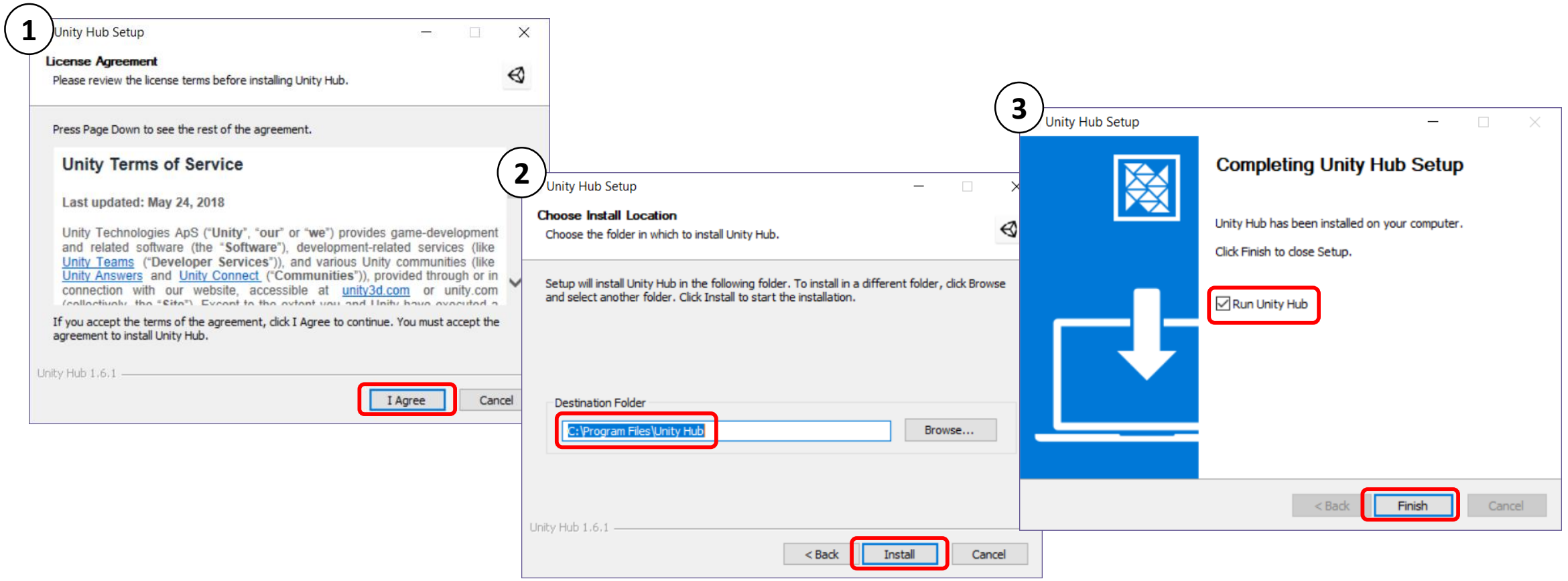
Select a Licence



Accept the Terms and Download Unity

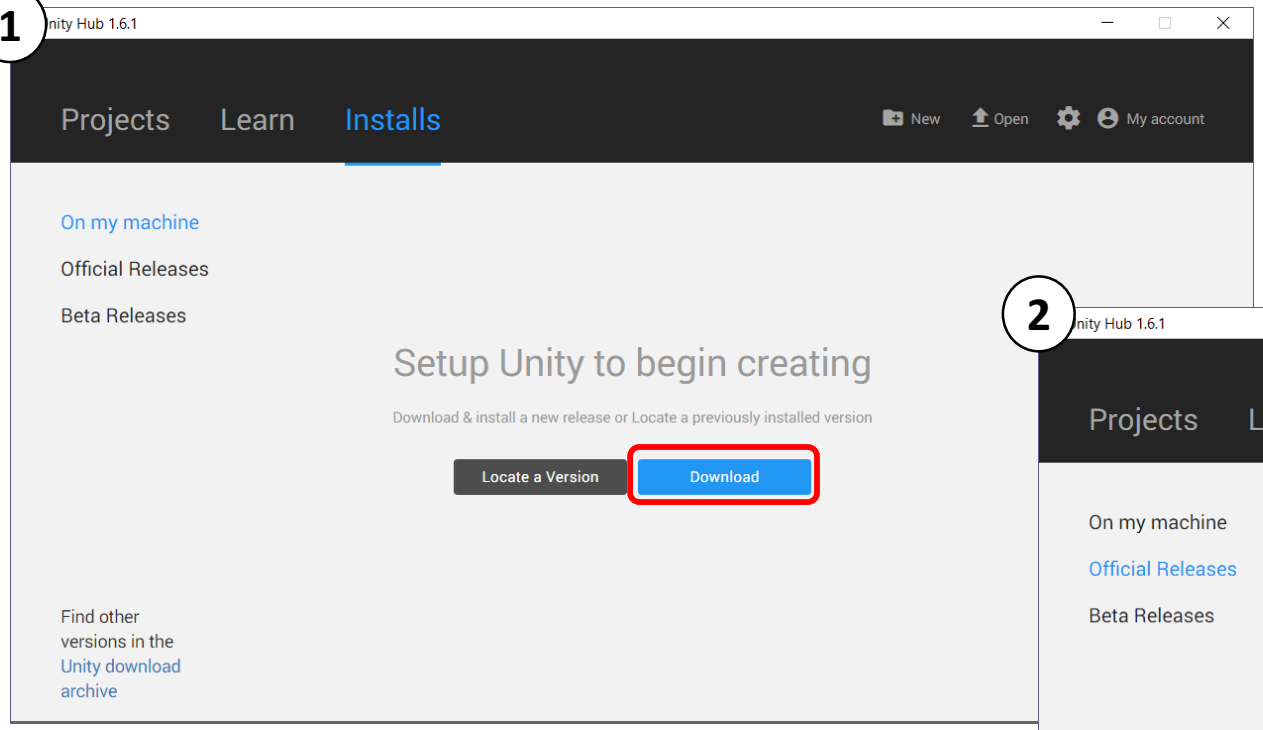


Install Unity Hub

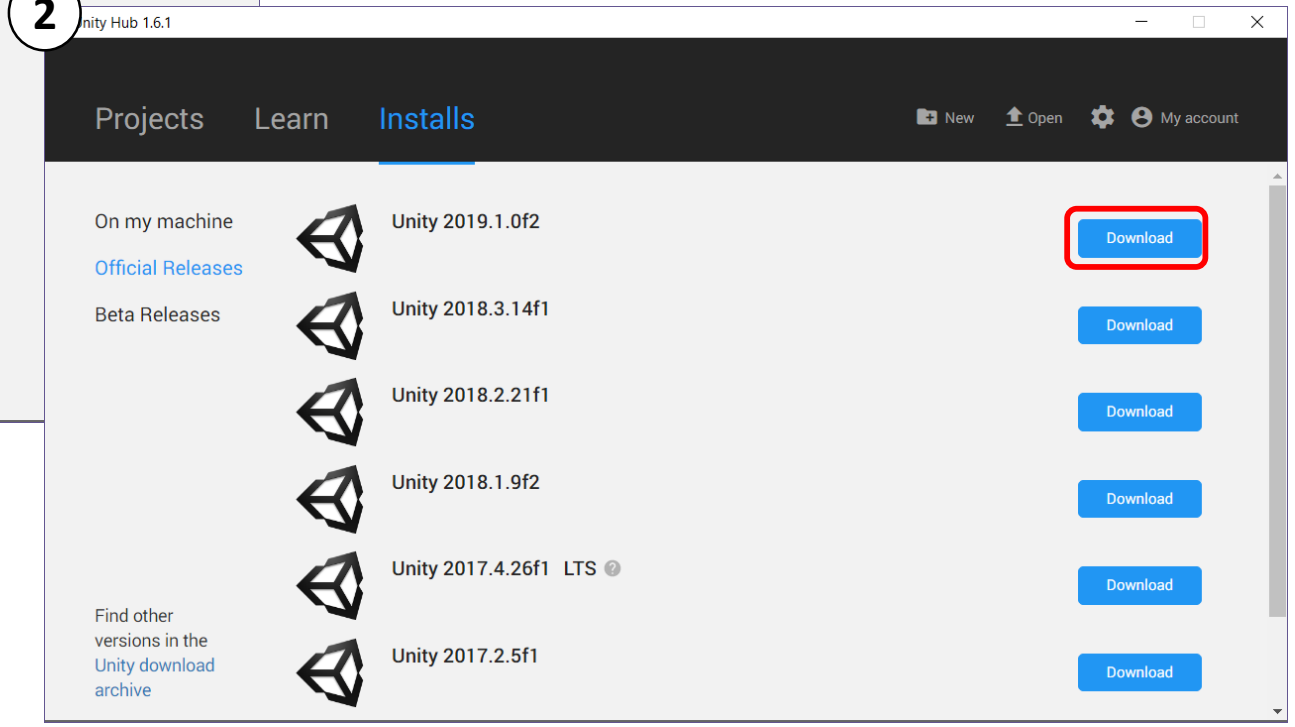


Install the latest version of Unity

1

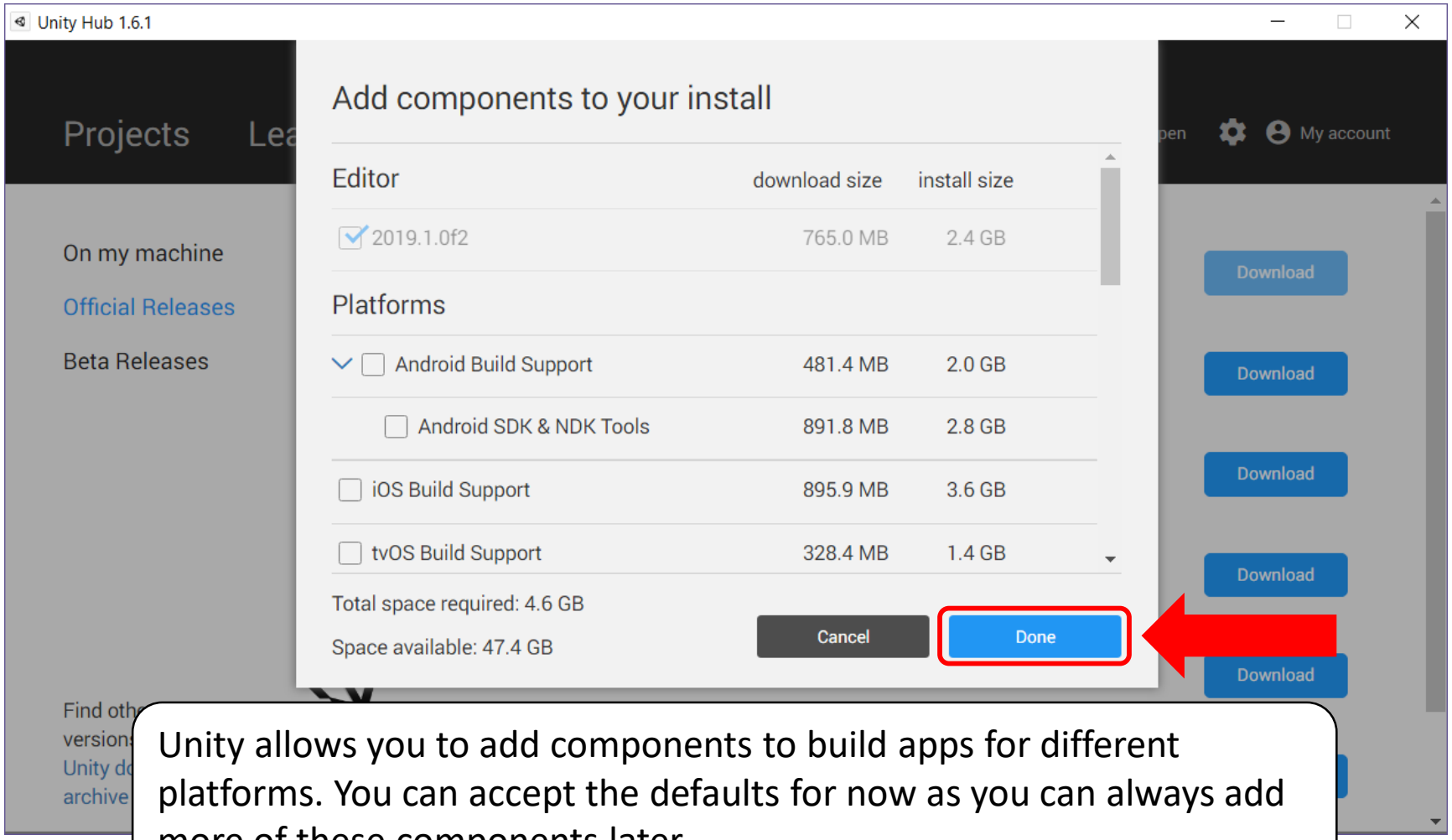


2



Unity Hub is useful for managing your projects and multiple versions of the Unity Editor.

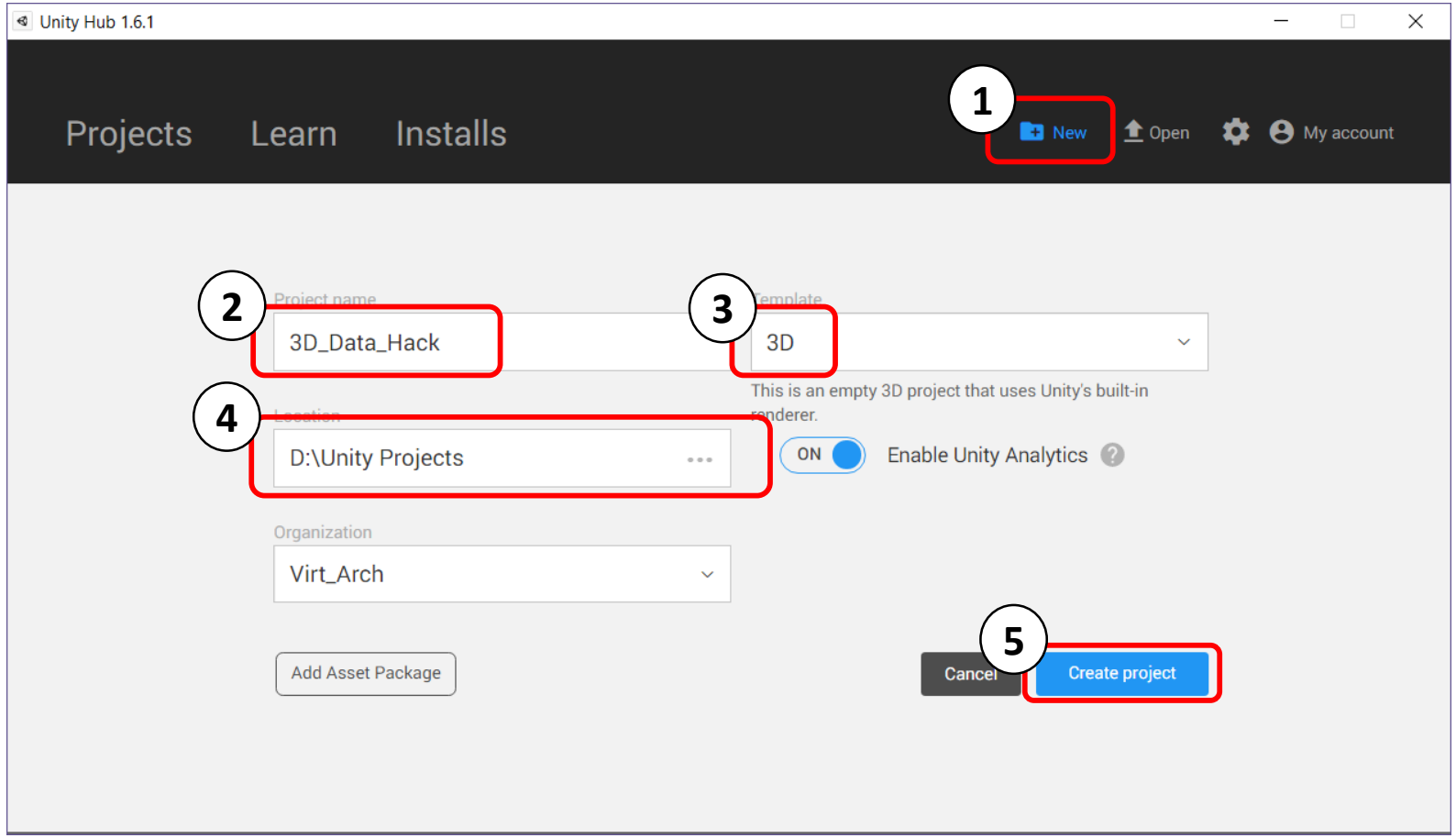
You can select components to install



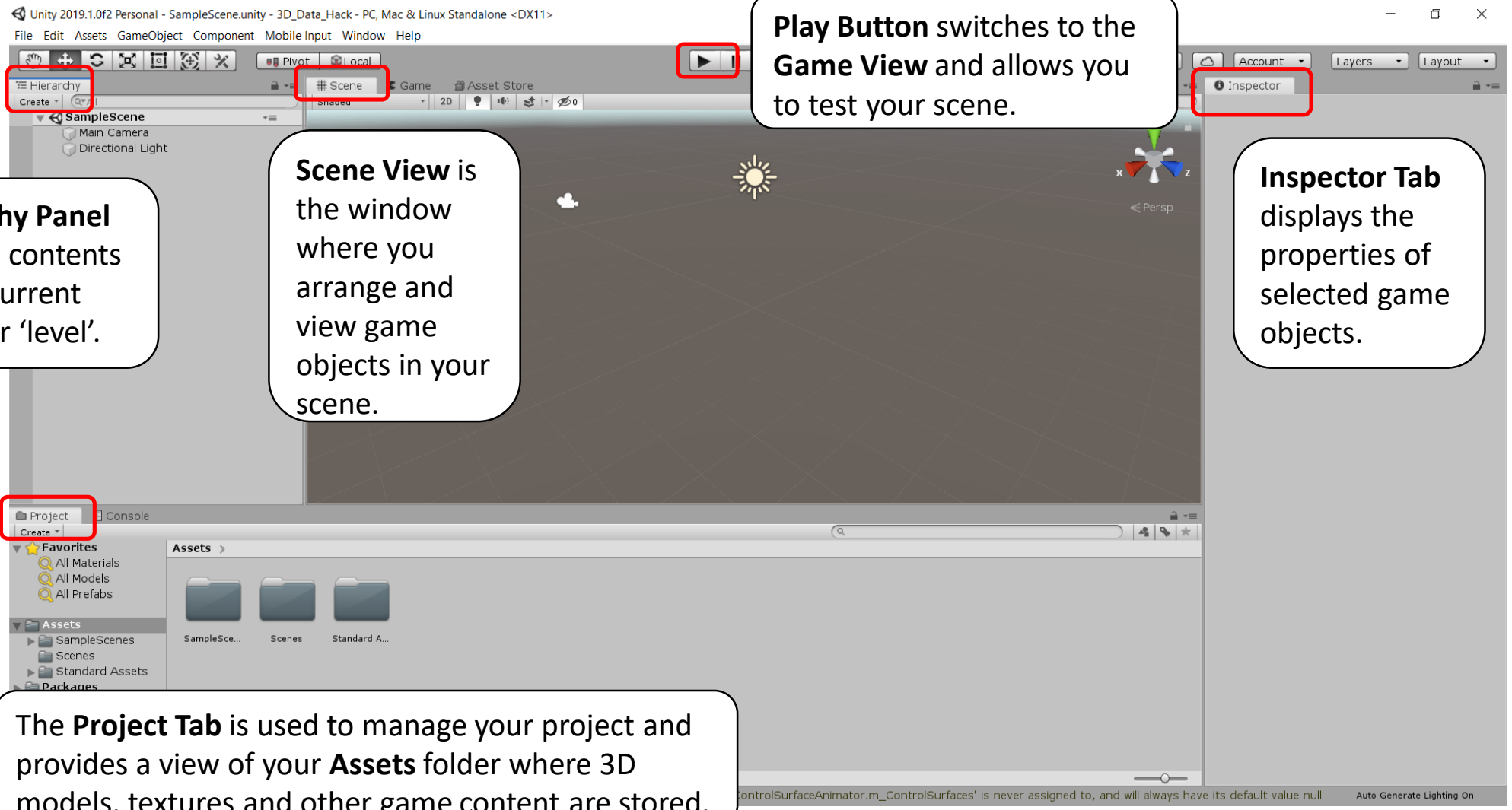
Unity allows you to add components to build apps for different platforms. You can accept the defaults for now as you can always add more of these components later.

Create a new project

1. Start a ‘New’ project.
2. Give the project a name.
3. Choose the ‘3D’ project template.
4. Specify the location on your computer to store the project.
5. Click ‘Create Project’.



The Unity User Interface



Play Button switches to the **Game View** and allows you to test your scene.

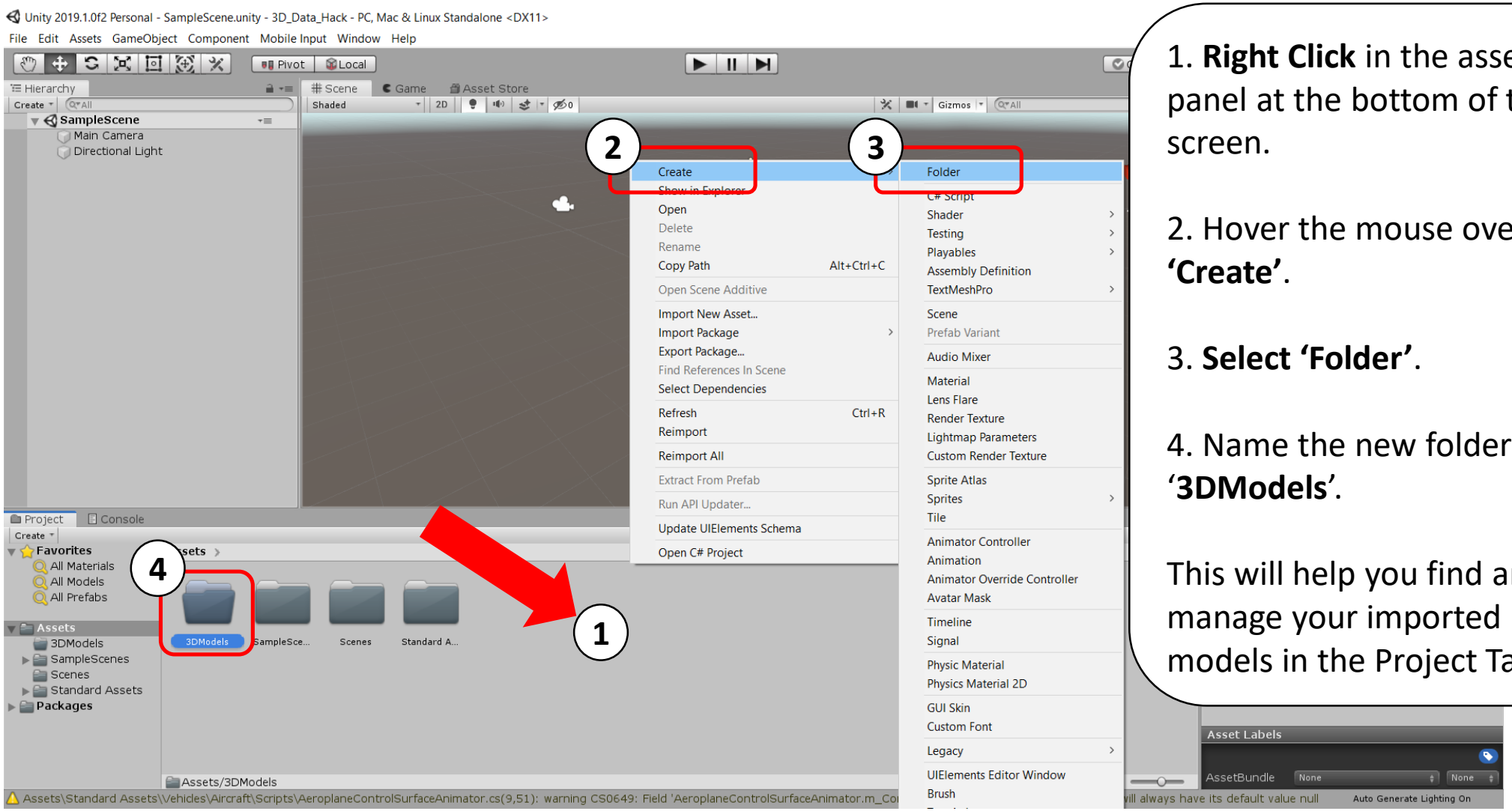
Hierarchy Panel lists the contents of the current scene or 'level'.

Scene View is the window where you arrange and view game objects in your scene.

Inspector Tab displays the properties of selected game objects.

The **Project Tab** is used to manage your project and provides a view of your **Assets** folder where 3D models, textures and other game content are stored.

Create a new 3DModels folder



1. **Right Click** in the assets panel at the bottom of the screen.

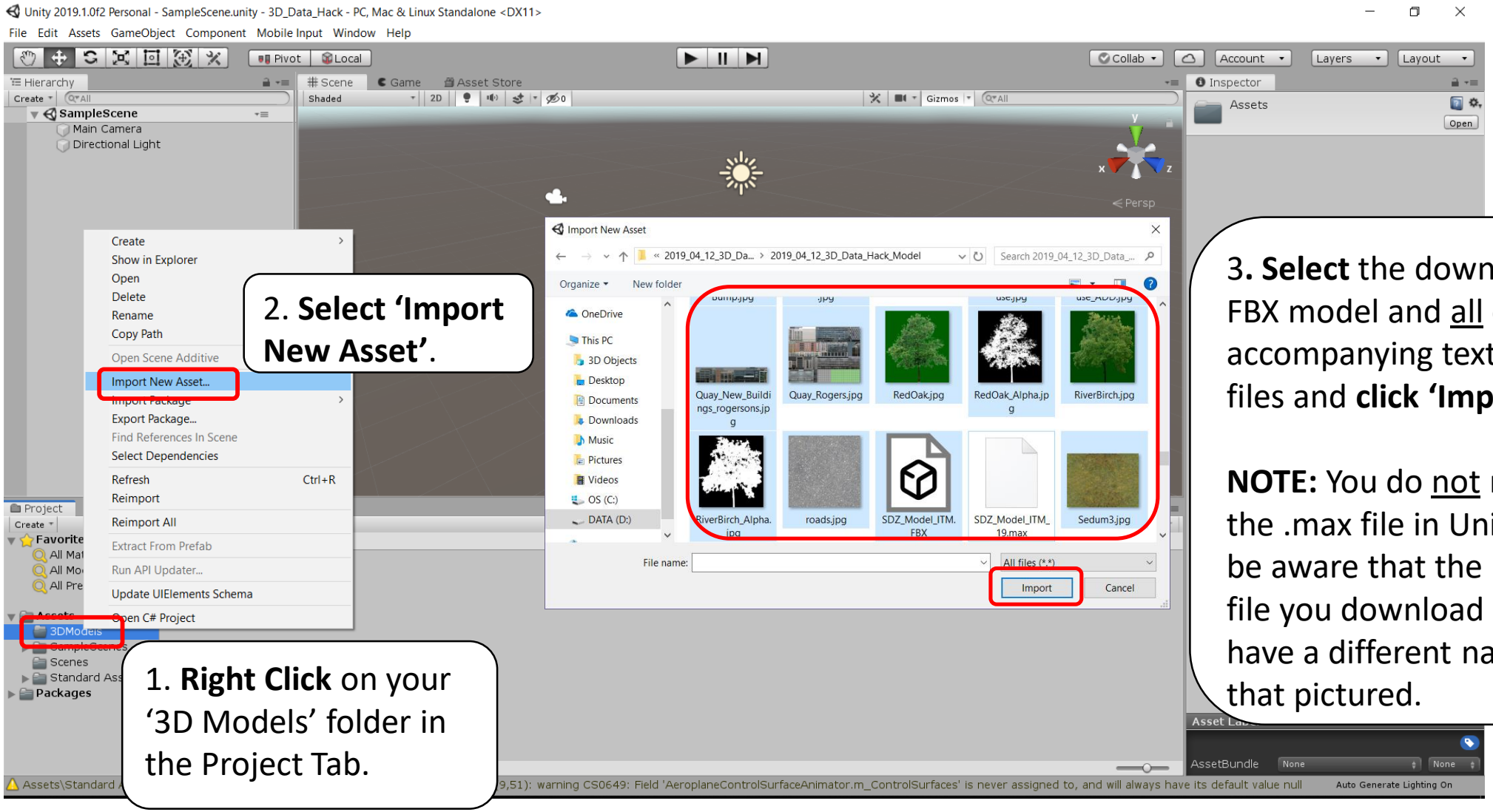
2. Hover the mouse over **'Create'**.

3. **Select 'Folder'**.

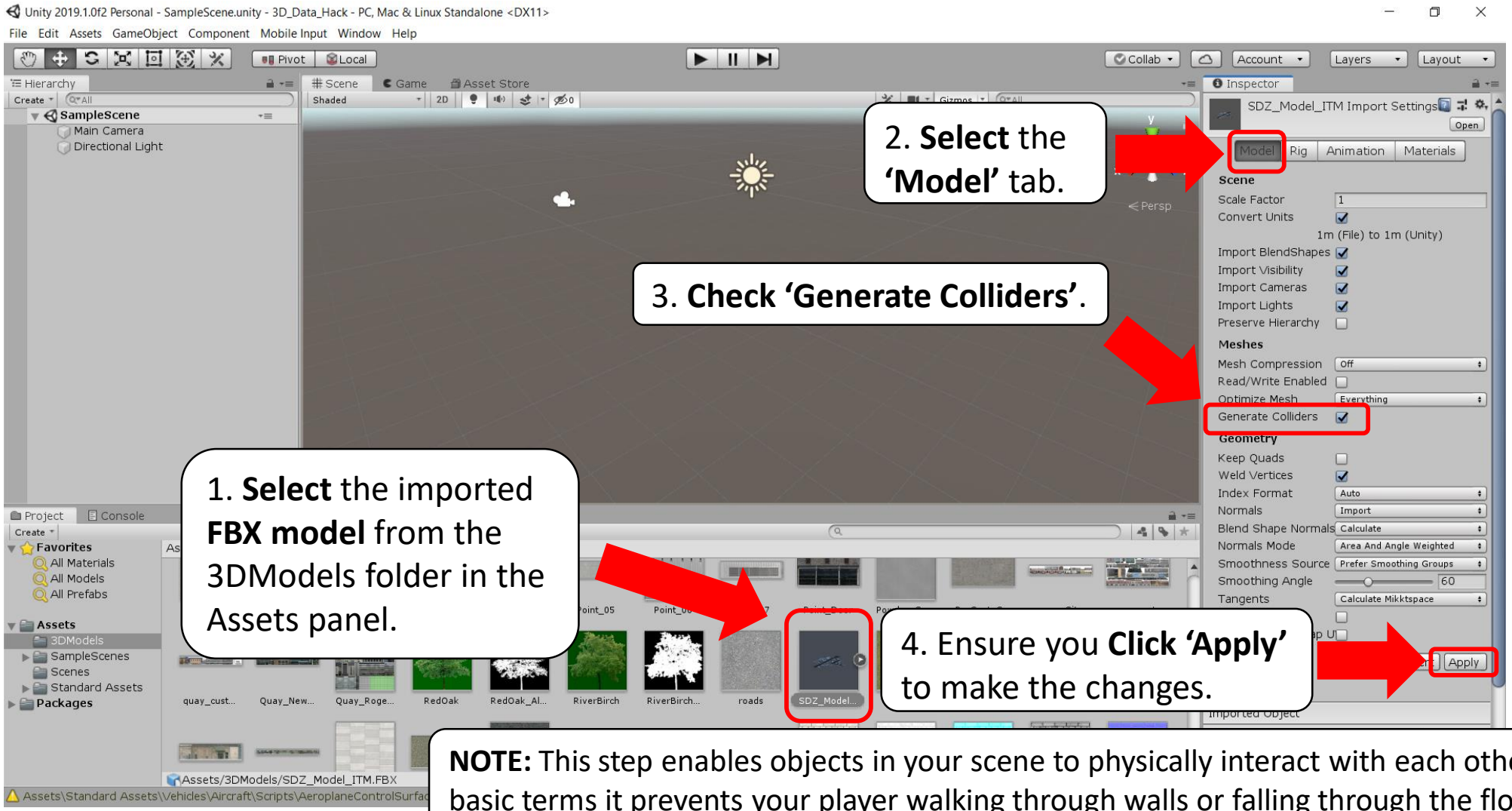
4. Name the new folder '**3DModels**'.

This will help you find and manage your imported models in the Project Tab.

Import 3D Model

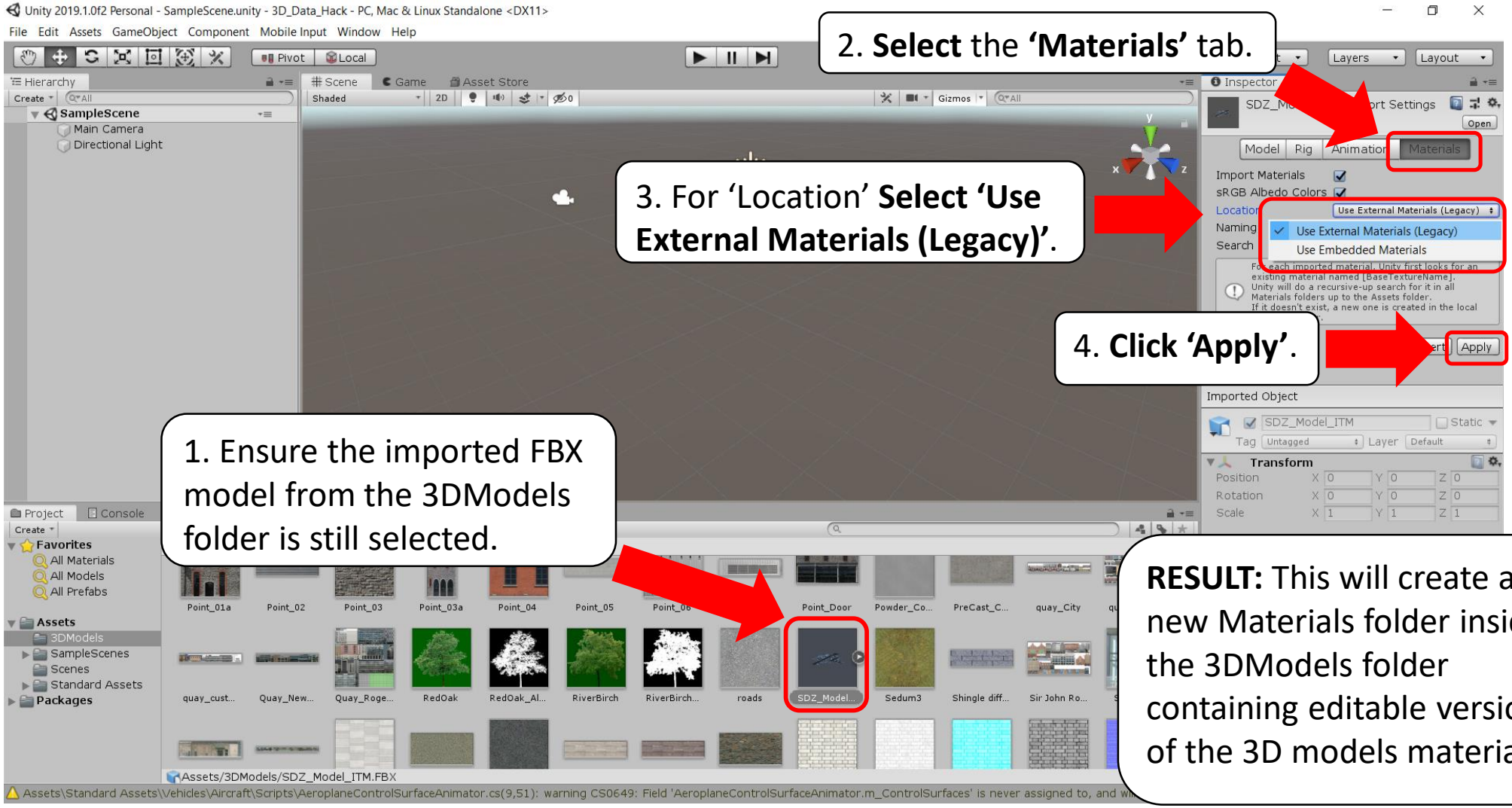


Generate Colliders for the model geometry



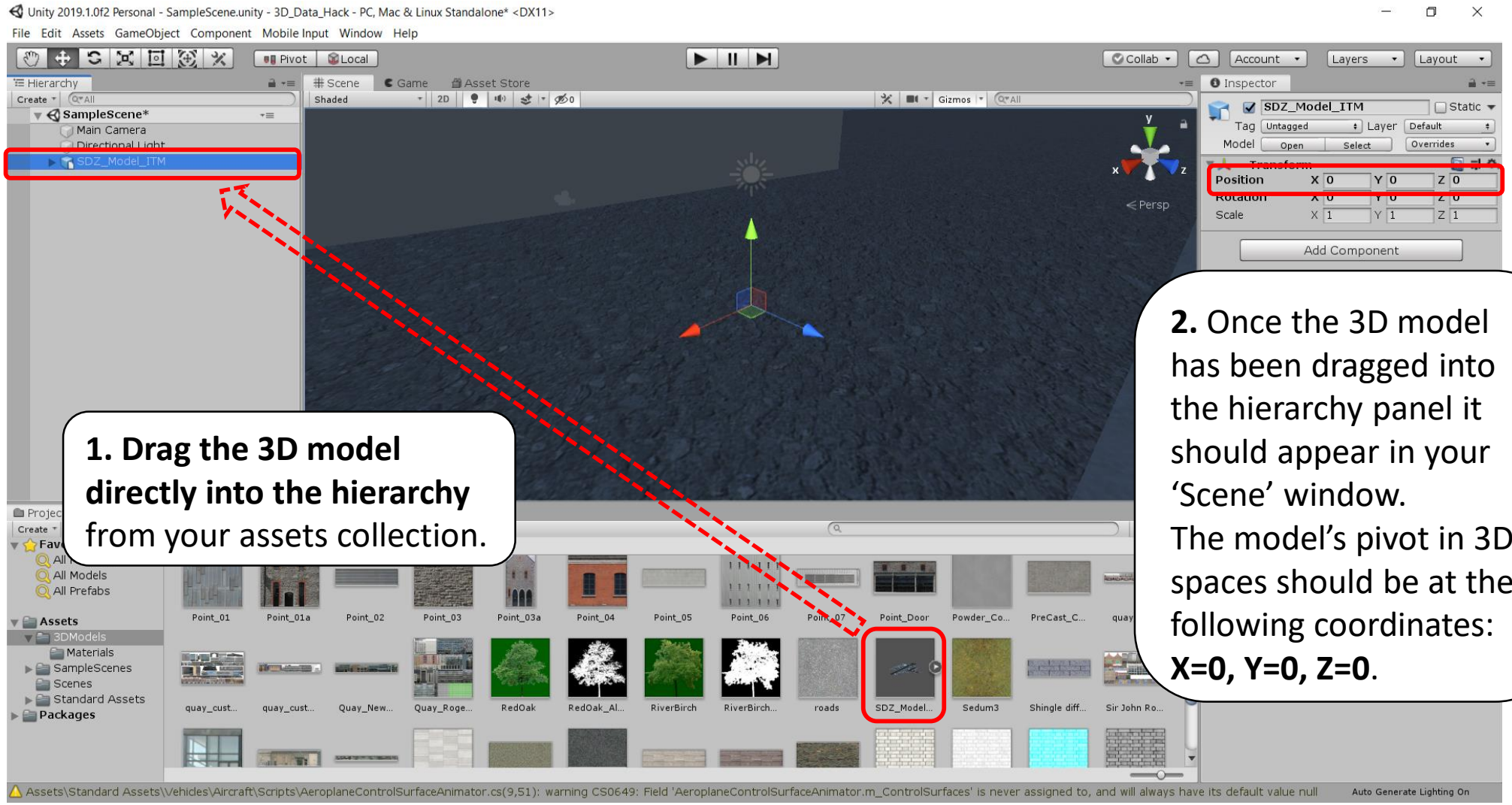
NOTE: This step enables objects in your scene to physically interact with each other. In basic terms it prevents your player walking through walls or falling through the floor.

Unpack the materials embedded in the model



RESULT: This will create a new Materials folder inside the 3DModels folder containing editable versions of the 3D models materials.

Drag the 3D Model into your scene hierarchy



1. Drag the 3D model directly into the hierarchy from your assets collection.

2. Once the 3D model has been dragged into the hierarchy panel it should appear in your 'Scene' window.
The model's pivot in 3D spaces should be at the following coordinates: **X=0, Y=0, Z=0**.

Download Unity Standard Assets

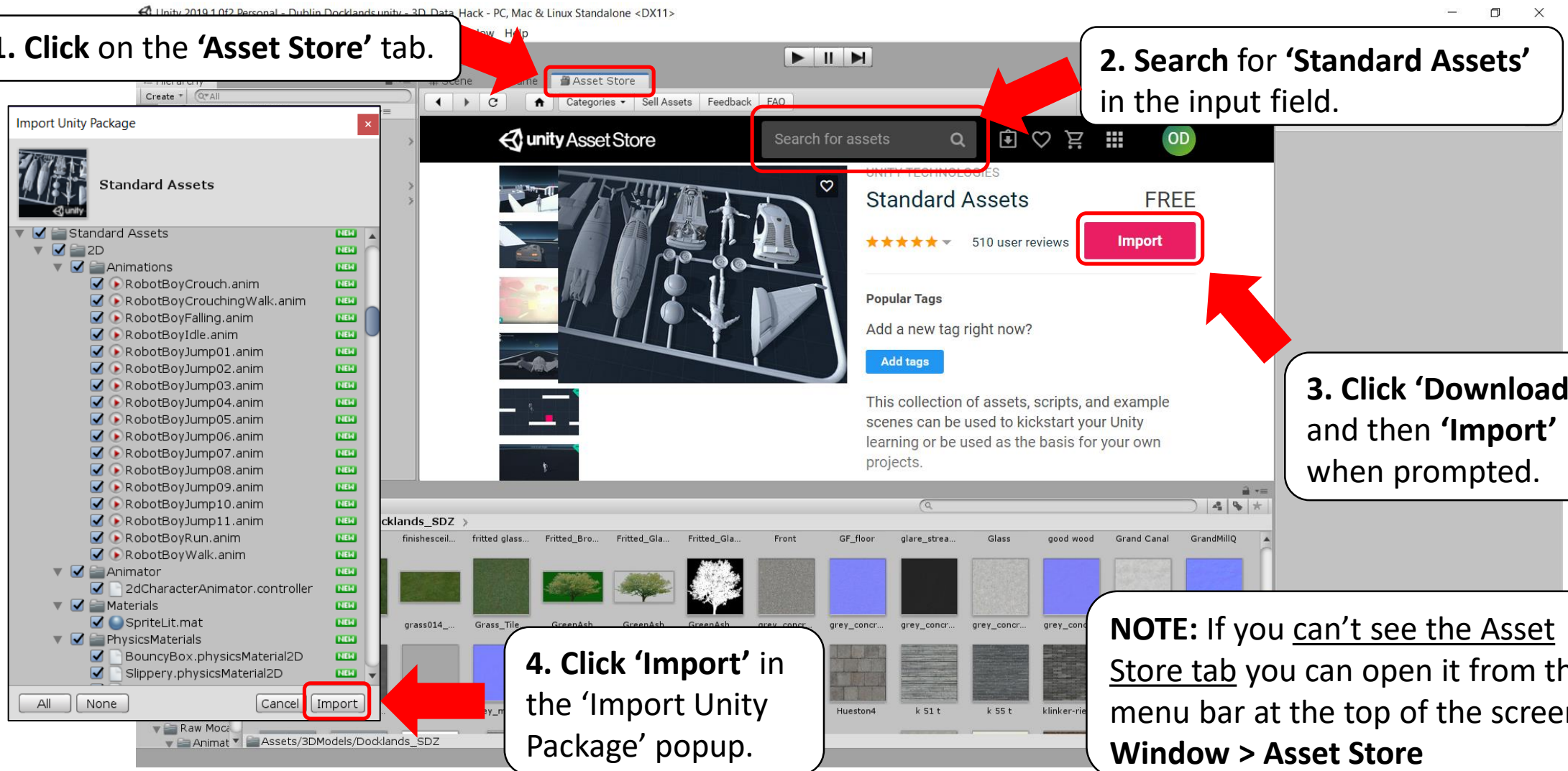
1. Click on the **'Asset Store'** tab.

2. Search for **'Standard Assets'** in the input field.

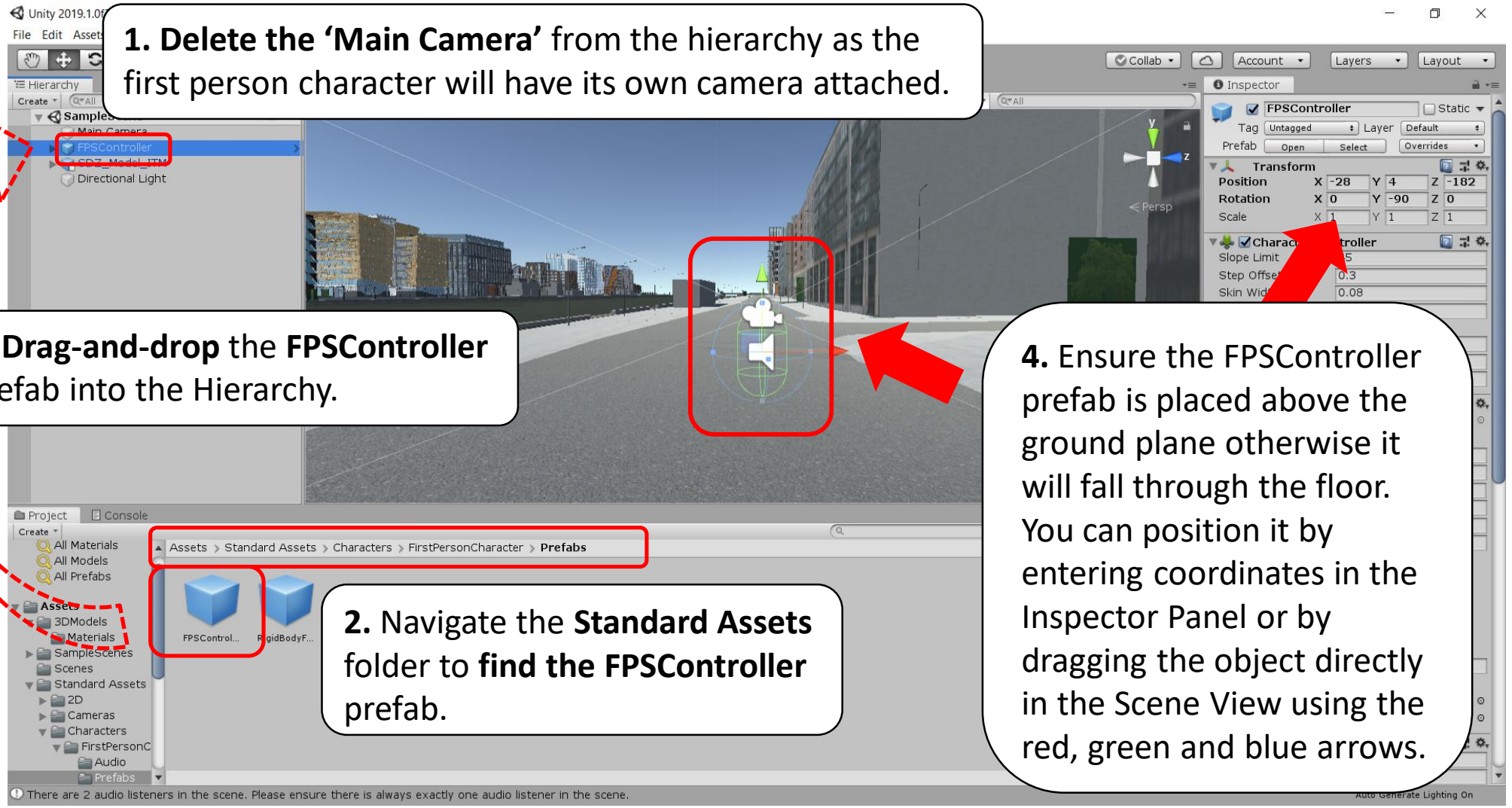
3. Click 'Download' and then **'Import'** when prompted.

4. Click 'Import' in the 'Import Unity Package' popup.

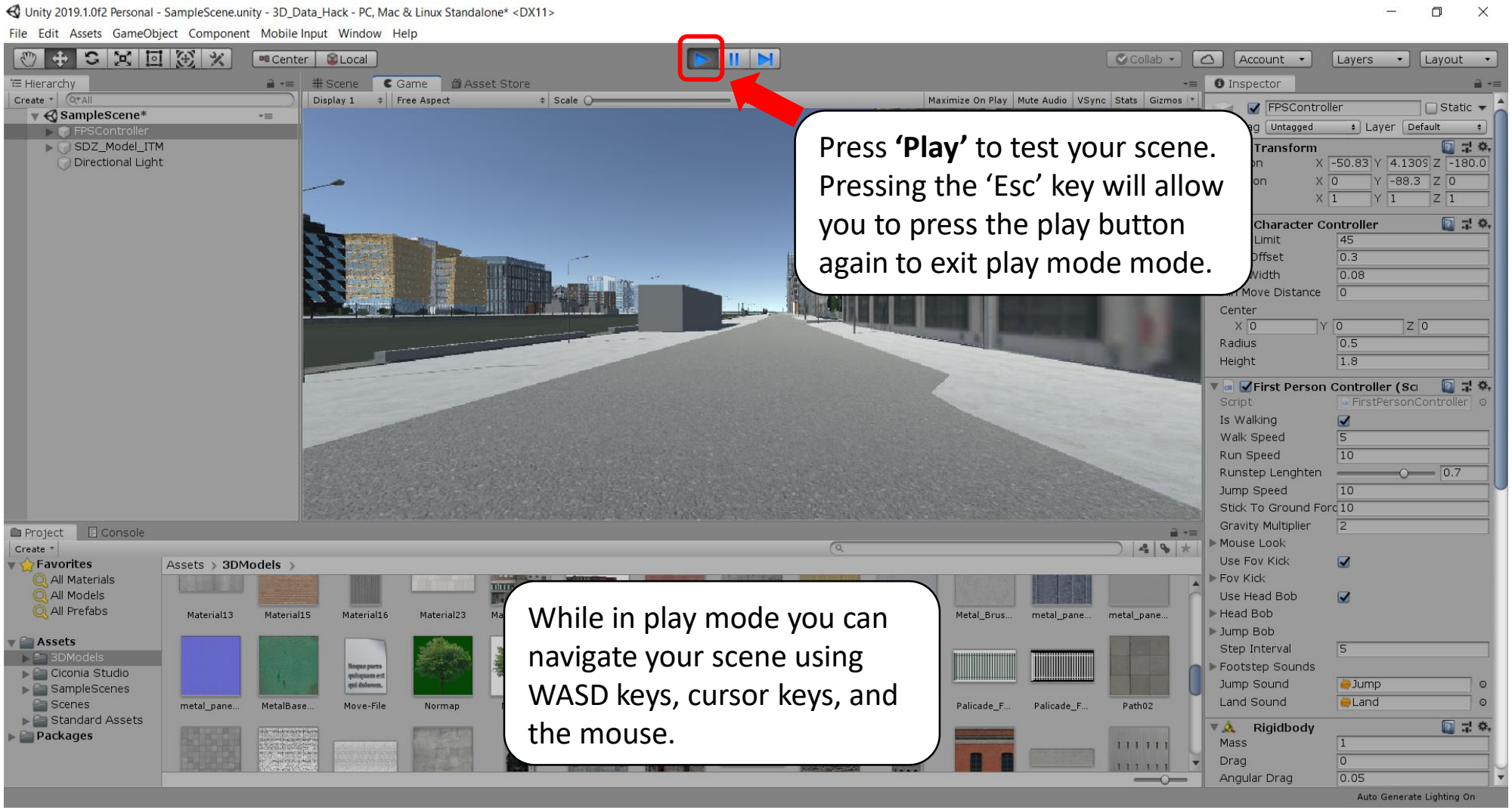
NOTE: If you can't see the Asset Store tab you can open it from the menu bar at the top of the screen: **Window > Asset Store**



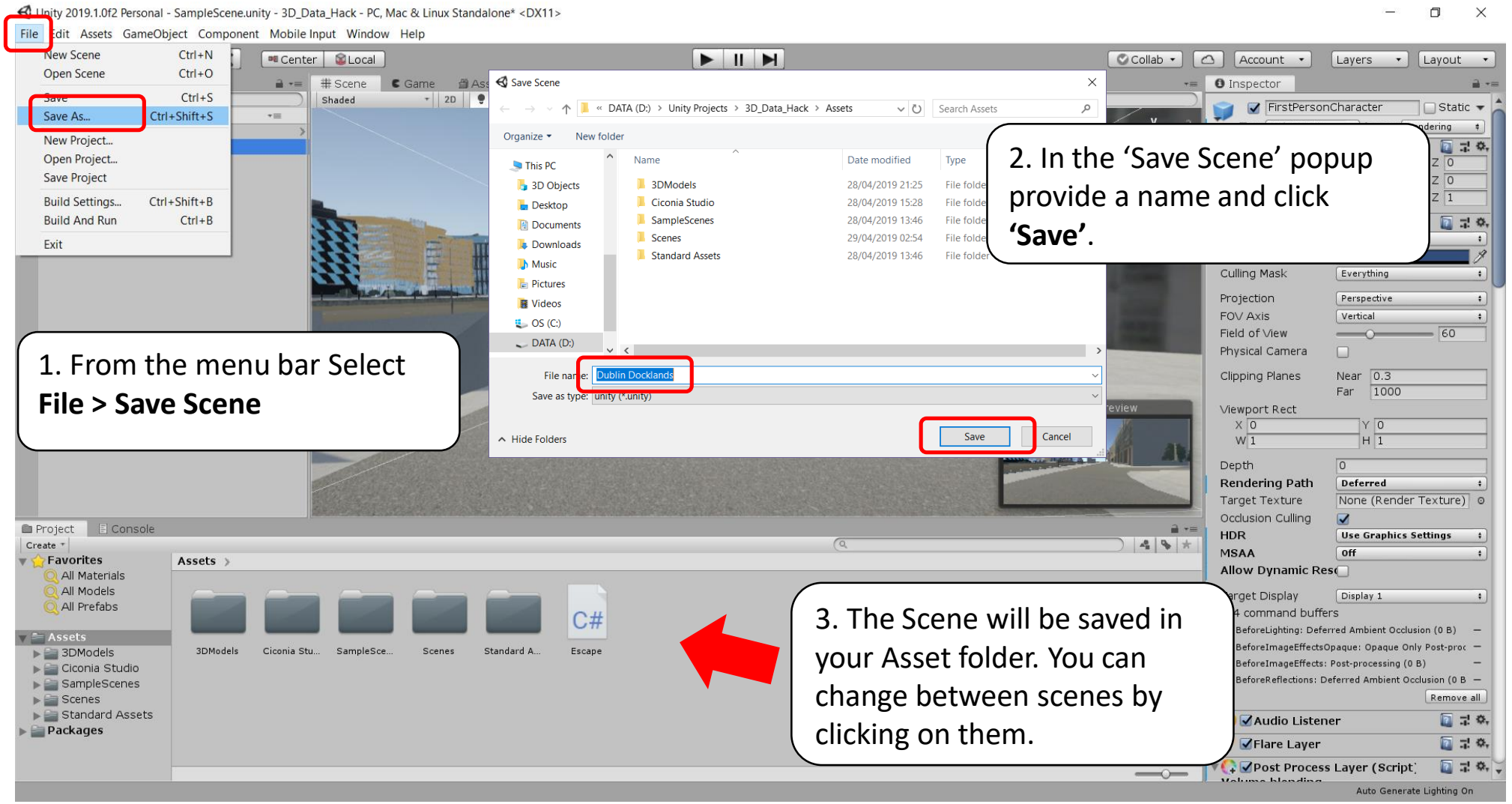
Add the first person character to your scene



Press Play to test your scene

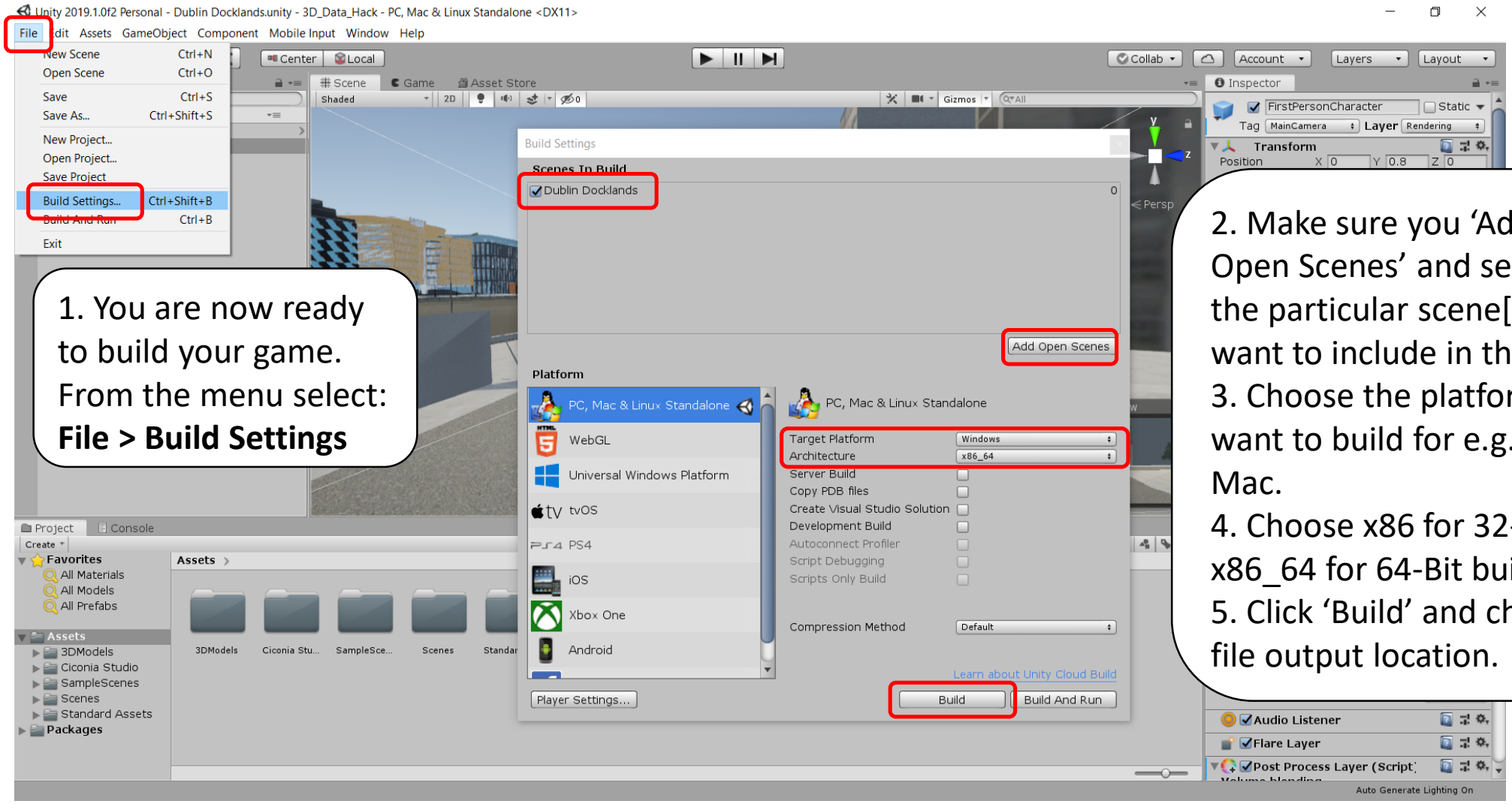


Save your Scene(s) as you update them

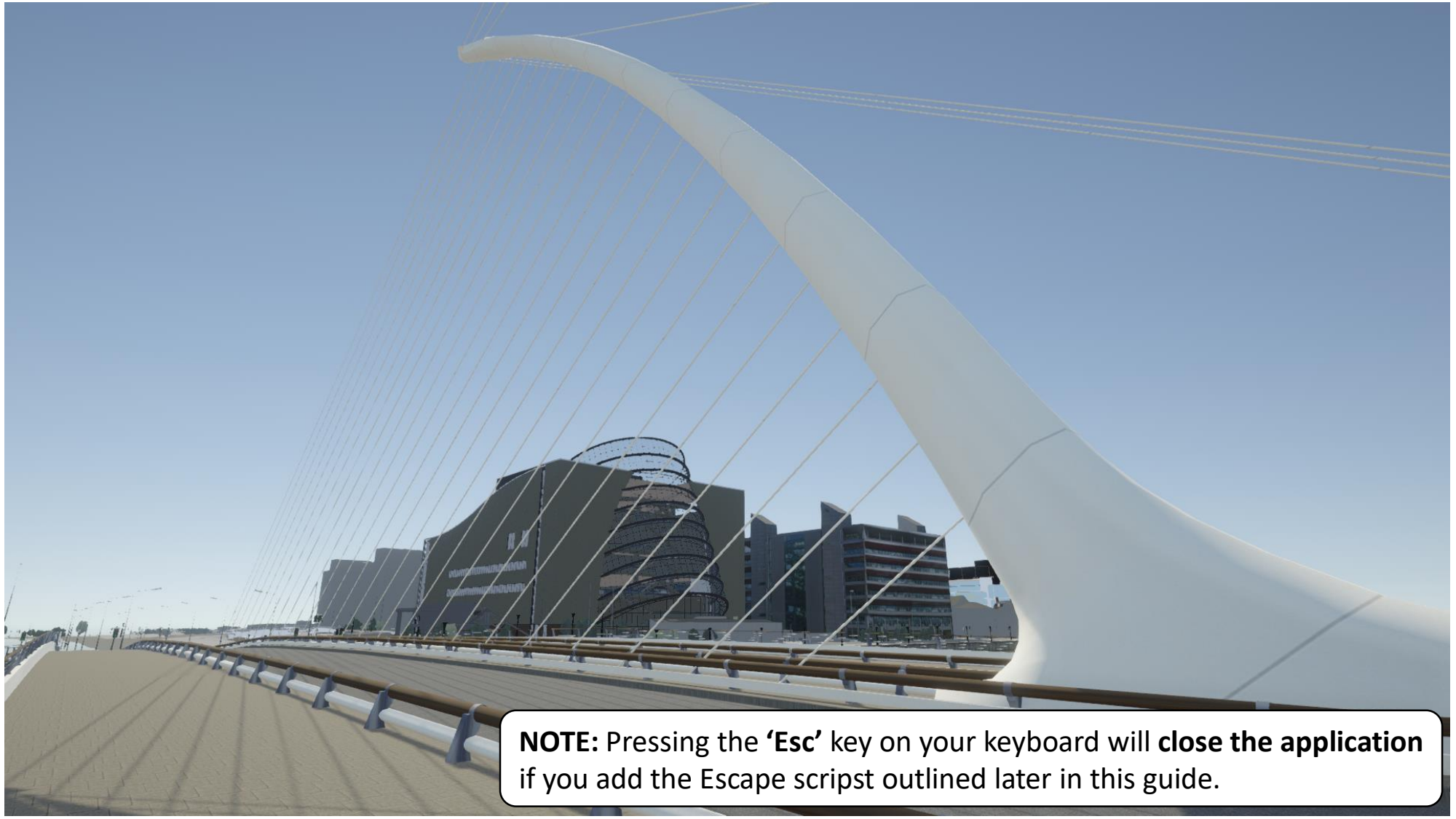


Save the Overall Project

Save the Overall Project



Run your application .exe to test



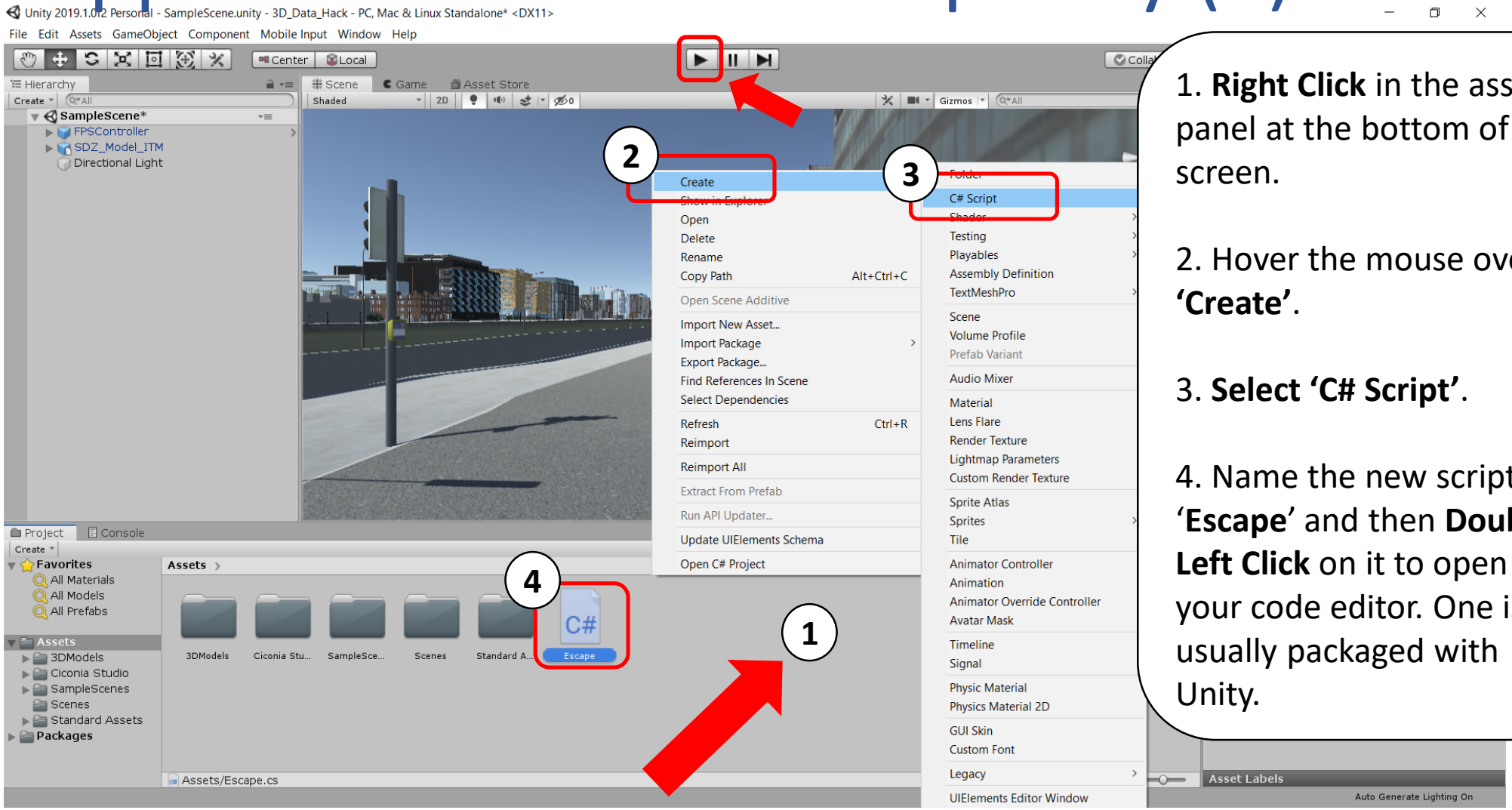
Trouble Shooting

- My character controller passes through the floor or walls when I press play
  - Ensure that the character controller is positioned fully above the ground plane.
  - Check that you correctly generated colliders for your models when you imported them as indicated earlier in the guide.
- I can’t exit the application I built
  - Add the ‘Escape’ script to your project that is outlined further on in this guide.
- The model doesn’t look how I’d expect
  - Experiment with the Unity Post Processing Stack as outlined later in this guide.
  - Try adjusting the model’s materials and experiment with the ‘Normal’ maps provided for some of the textures: https://docs.unity3d.com/Manual/StandardShaderMaterialParameterNormalMap.html
- I can’t edit the materials on my model or they appear to be missing
  - Not all of the buildings in the model have photoreal textures for their facades.
  - Ensuring that you selected ‘Use External Materials’ when you imported the model should ensure the inclusion of any textures for those buildings that do have them. This will enable you to edit and adjust all of the materials that come with the model: https://docs.unity3d.com/Manual/Shaders.html
- Trees and Railings look like billboards when they should be transparent
  - Use the process for adding transparency outlined later in this guide.
  - Alternatively you could try to create your own shader.
- My Trees or Railing are only visible from one side
  - Apply a double sided shader like the Ciconia Double Sided shader indicated later in this guide.

Further ways to enhance your scene

- Look at the other assets in the Standard Assets collection and use them to enhance your scene: https://assetstore.unity.com/packages/essentials/asset-packs/standard-assets-32351
- Use other free assets from the Unity Asset Store: https://assetstore.unity.com/
- Use shaders and take advantage of the Unity Post Processing Stack to improve the visual appearance of your scenes. Examples follow in subsequent slides.
- Add interactivity and further functionality through scripting in the C# language. A very brief but useful example follows on the next slide.
- Experiment with AR and VR in Unity.
- Make use of the extensive learning materials and tutorials provided on the Unity website: https://unity.com/learn

Add a script to close your built desktop application with the Escape key (1)



1. **Right Click** in the assets panel at the bottom of the screen.

2. Hover the mouse over **'Create'**.

3. **Select 'C# Script'**.

4. Name the new script '**Escape**' and then **Double Left Click** on it to open your code editor. One is usually packaged with Unity.

Adding a script to close your built desktop application with the Escape key (2)

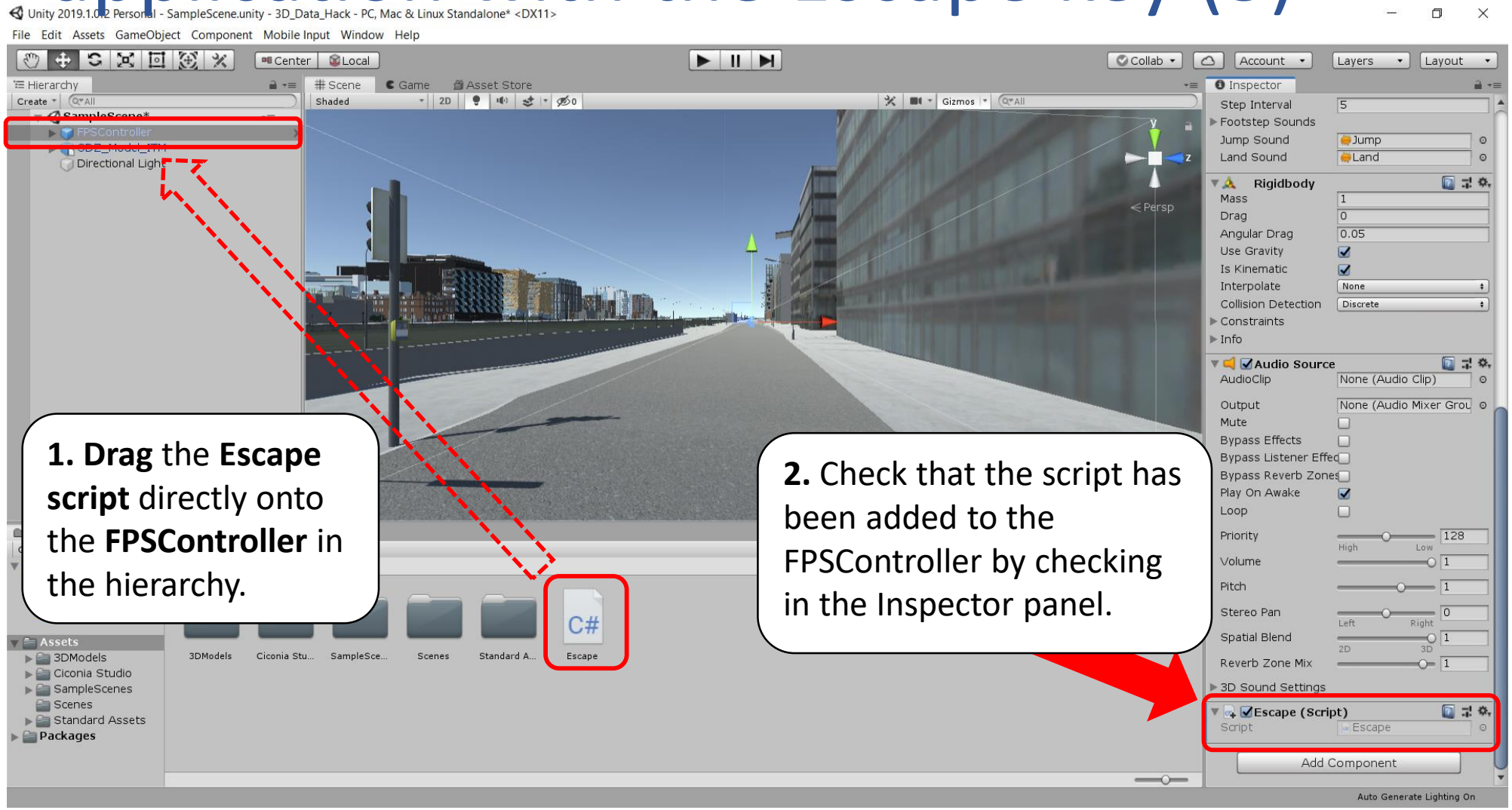
The name of the class has to match the name of the script file, otherwise there will be an error.

```
using UnityEngine;
using System.Collections;

// This script exits the application upon pressing the Esc key
public class Escape : MonoBehaviour {

    // The default Start function is used for initialization
    private void Start ()
    {

    }

    // The Update function is called once per frame
    void Update ()
    {
        if (Input.GetKey(KeyCode.Escape))
        {
            Application.Quit();
        }
    }
}
```

NOTE: Make sure to **save changes** to your script before adding it to a game object in your scene or pressing play.

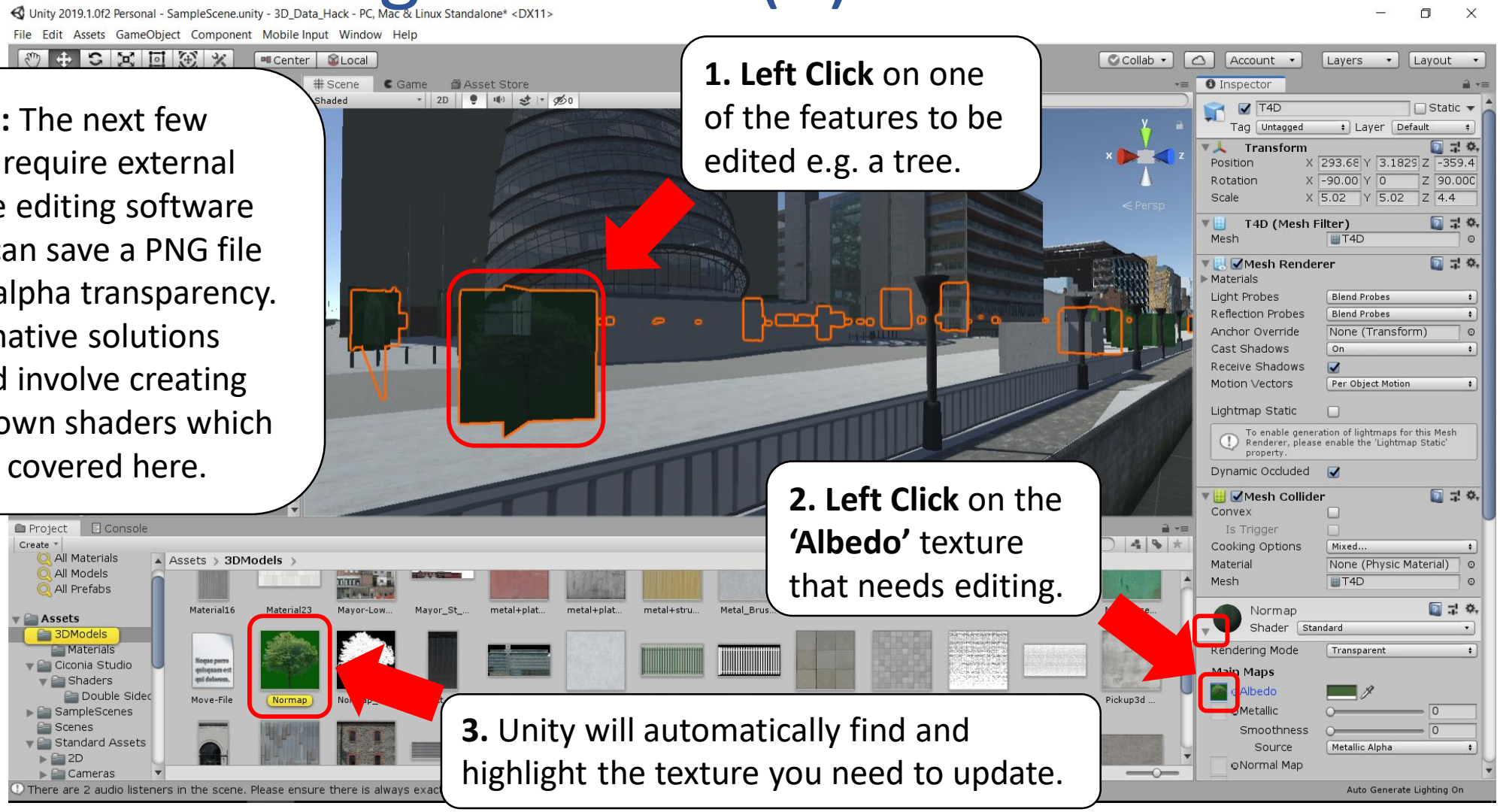
The code in the Update function waits for the Escape key to be pressed and then quits the application.

Add a script to close your built desktop application with the Escape key (3)

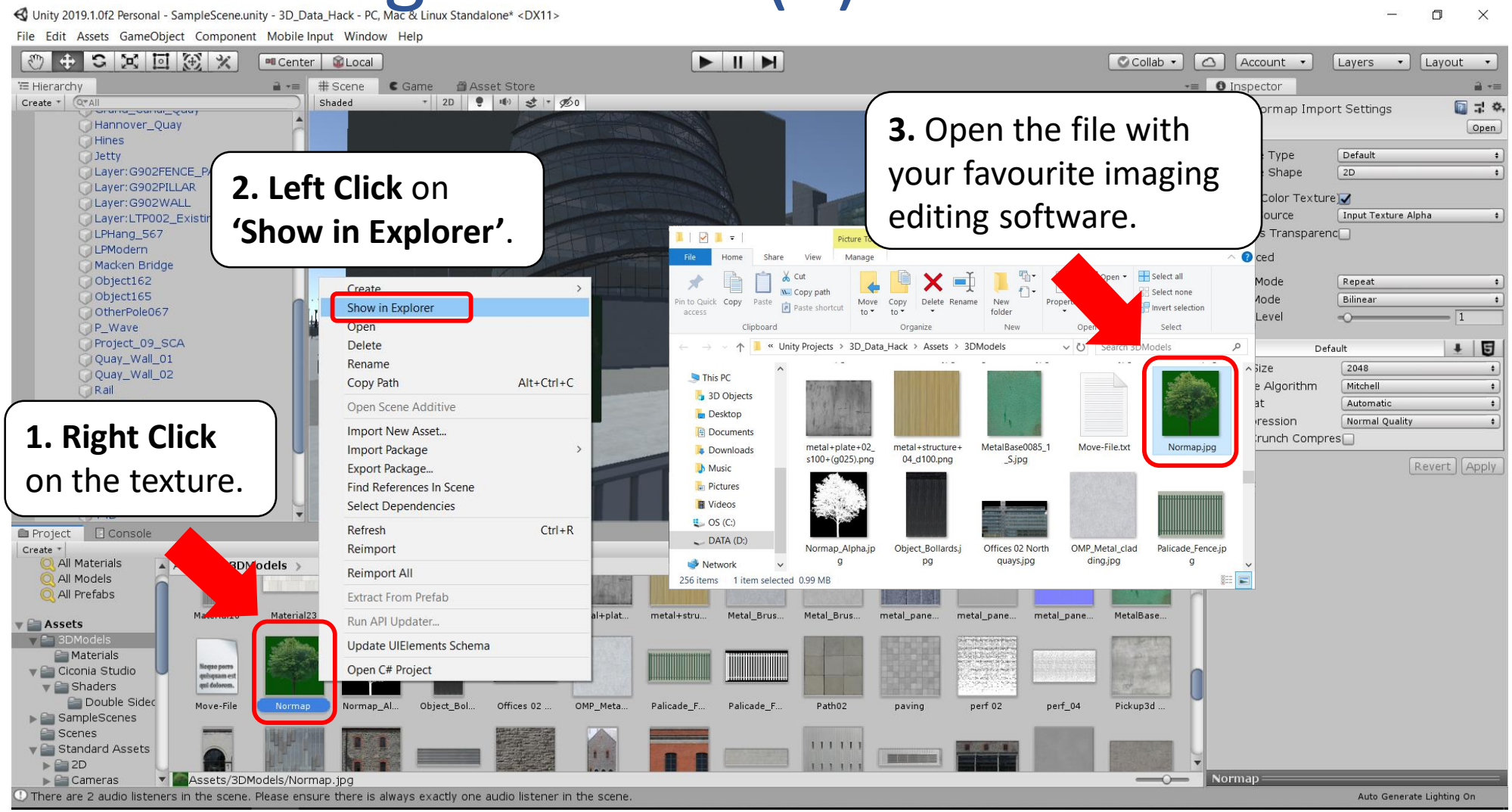


Quick solution for transparency on trees and railing textures (1)

NOTE: The next few steps require external image editing software that can save a PNG file with alpha transparency. Alternative solutions would involve creating your own shaders which is not covered here.

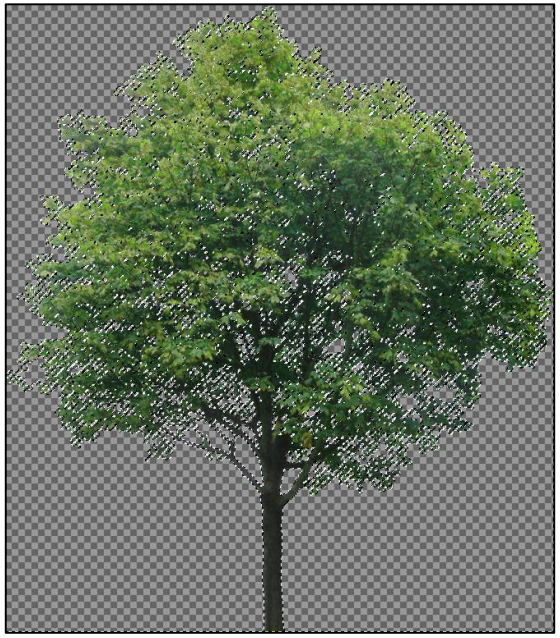


Quick solution for transparency on trees and railing textures (2)



Quick solution for transparency on trees and railing textures (3)

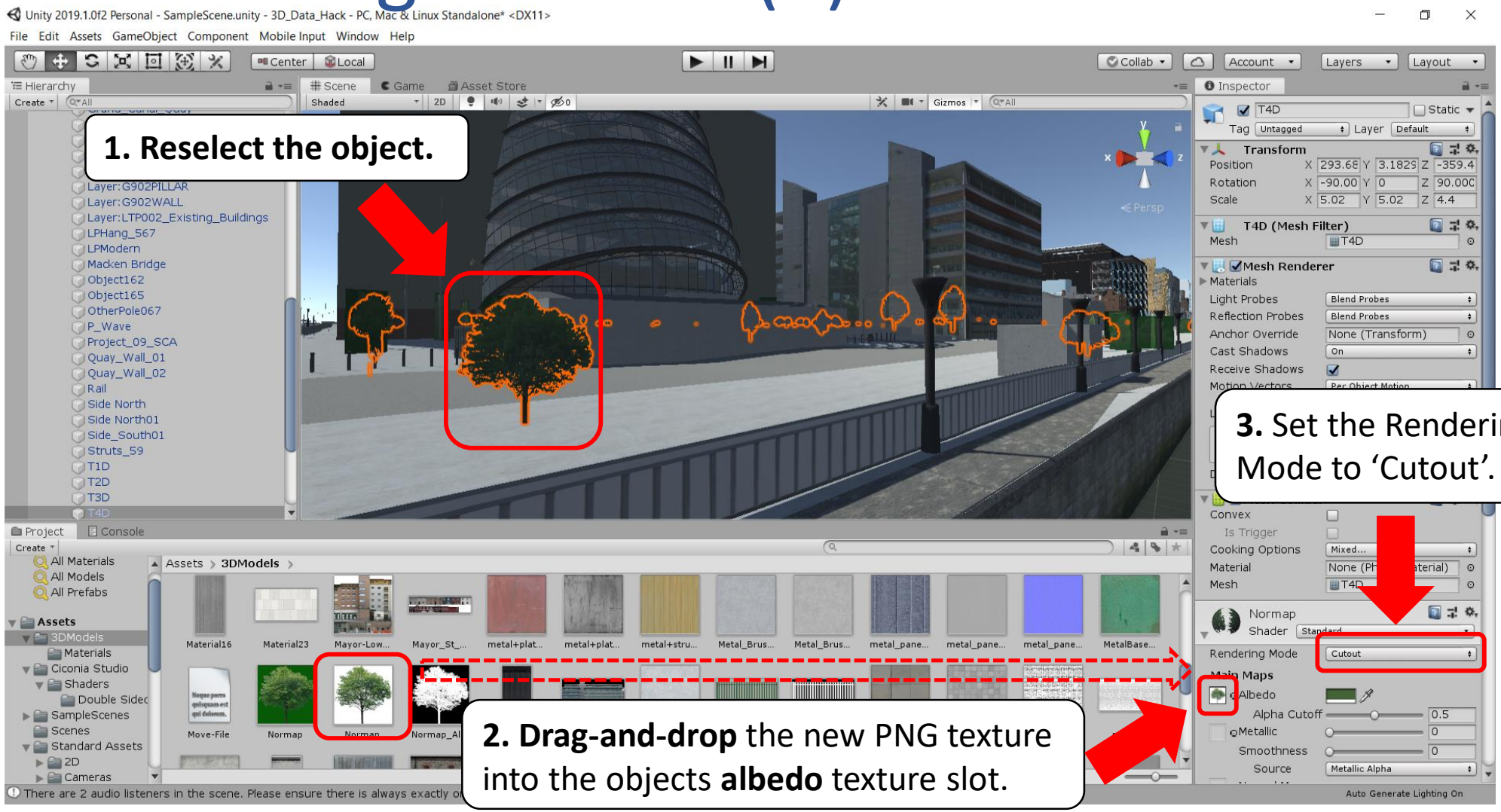


The precise process here will depend on the software you use. Suitable choices include Photoshop or the FREE & Open Source GNU Image Manipulation Program (GIMP). Generically the steps are:

(1) Import the JPEG image; (2) Select the background pixels by colour; (3) Delete the background pixels; (4) Add the background to a transparent alpha channel; (5) Export the file with alpha transparency as a PNG file; (6) Save it in the same location as your other model textures.

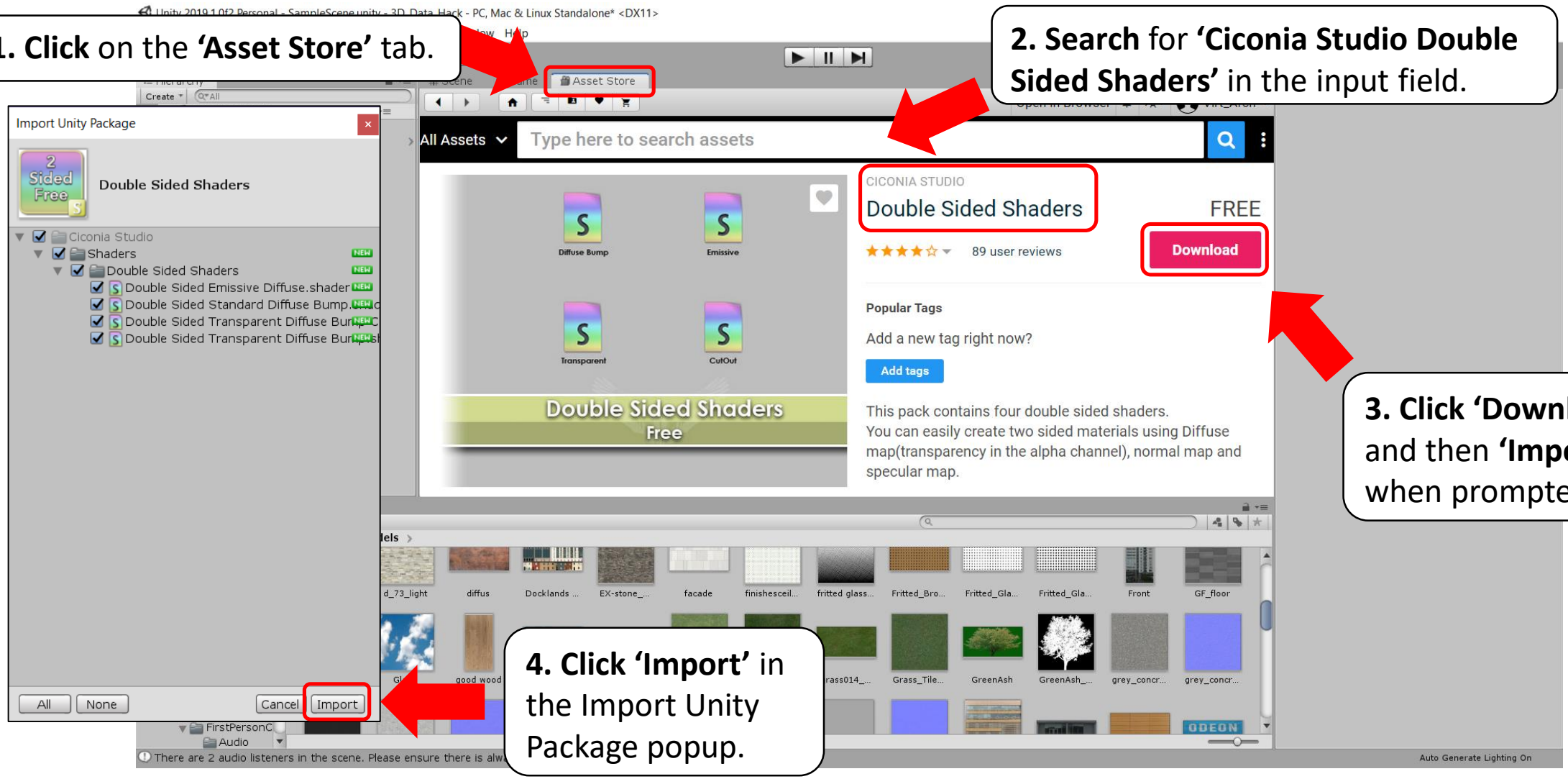
Quick solution for transparency on trees and railing textures (4)



Download a FREE double sided shader

1. Click on the **'Asset Store'** tab.

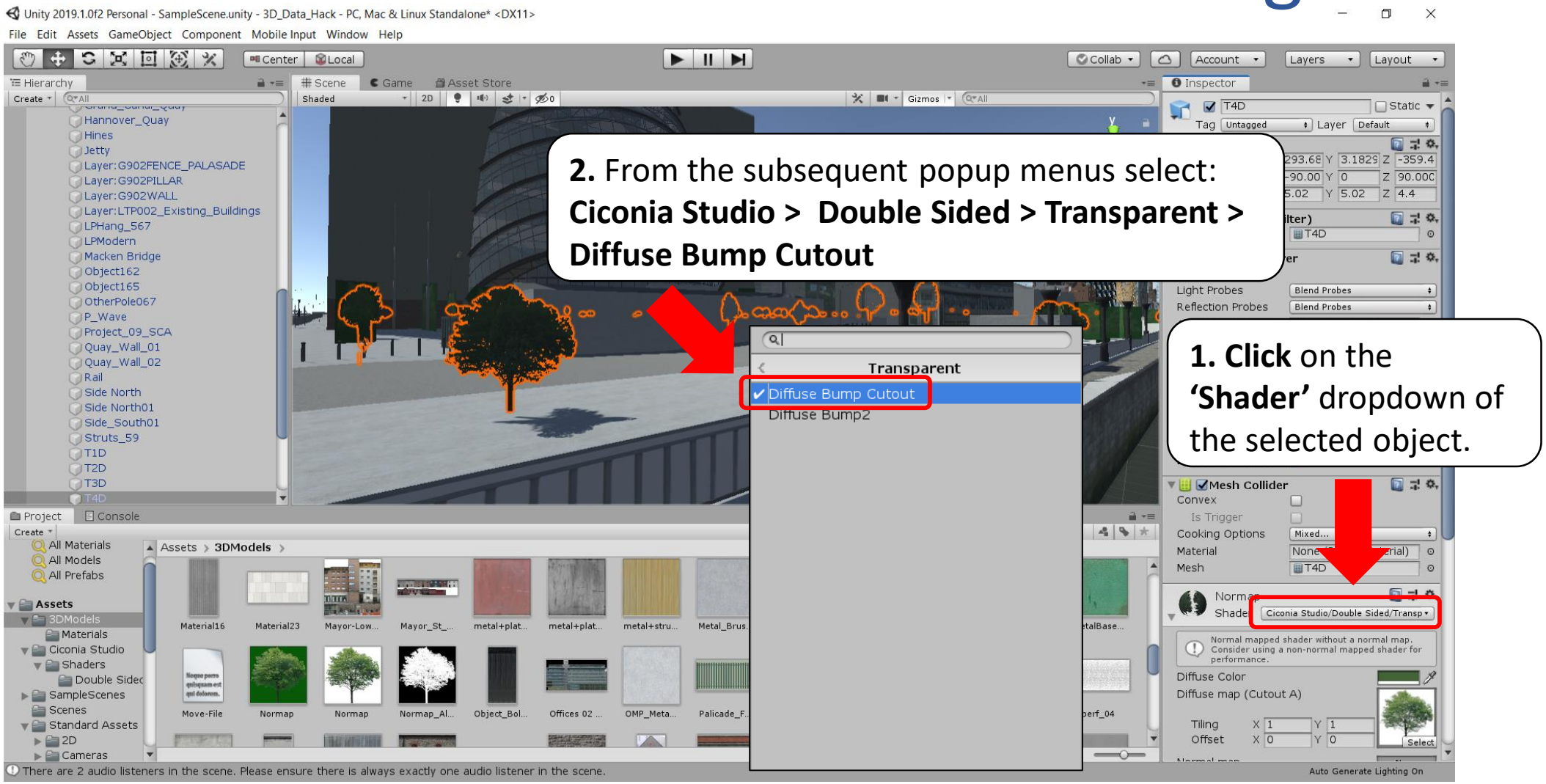
2. Search for **'Ciconia Studio Double Sided Shaders'** in the input field.



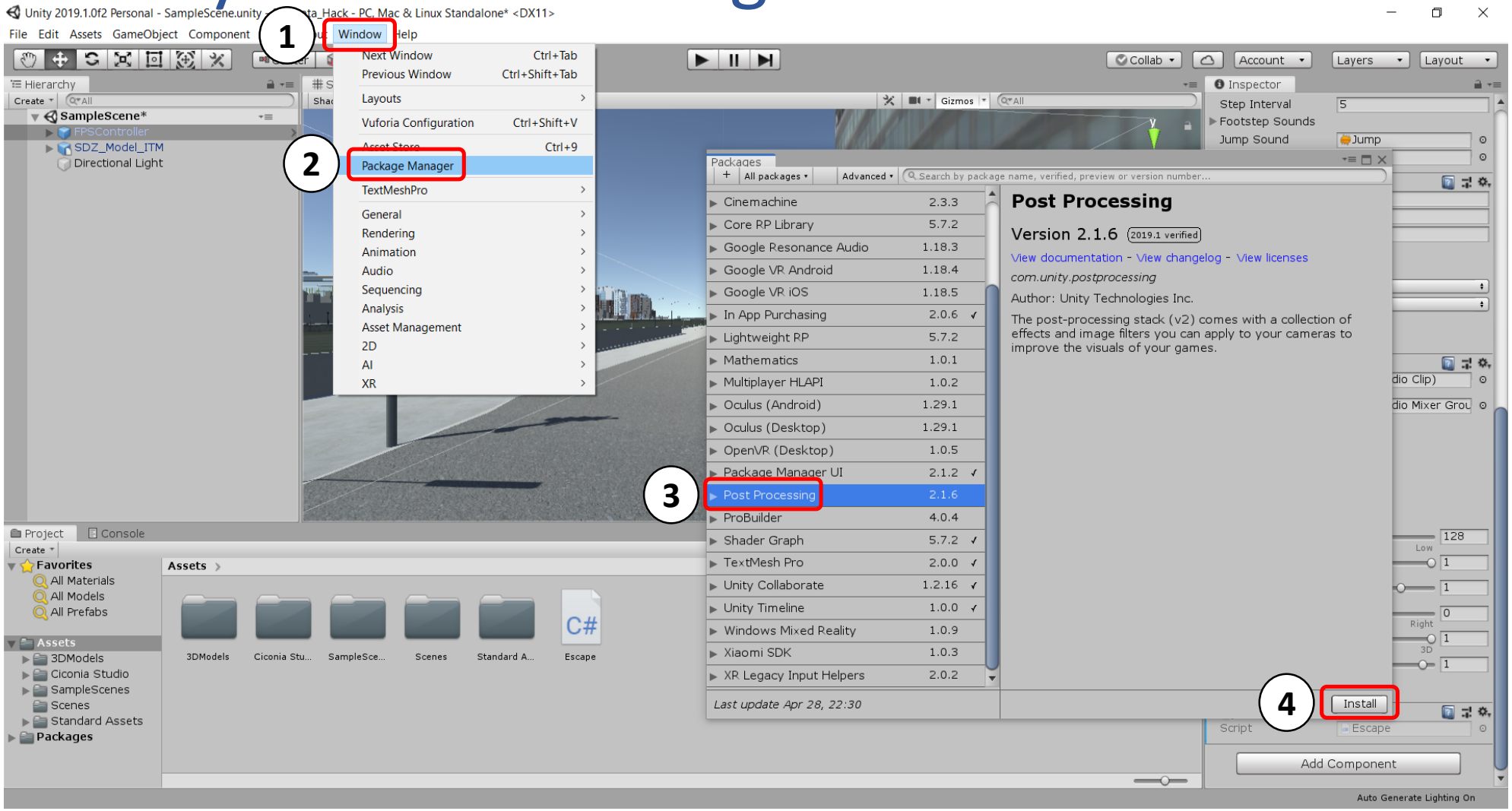
3. Click 'Download' and then **'Import'** when prompted.

4. Click 'Import' in the Import Unity Package popup.

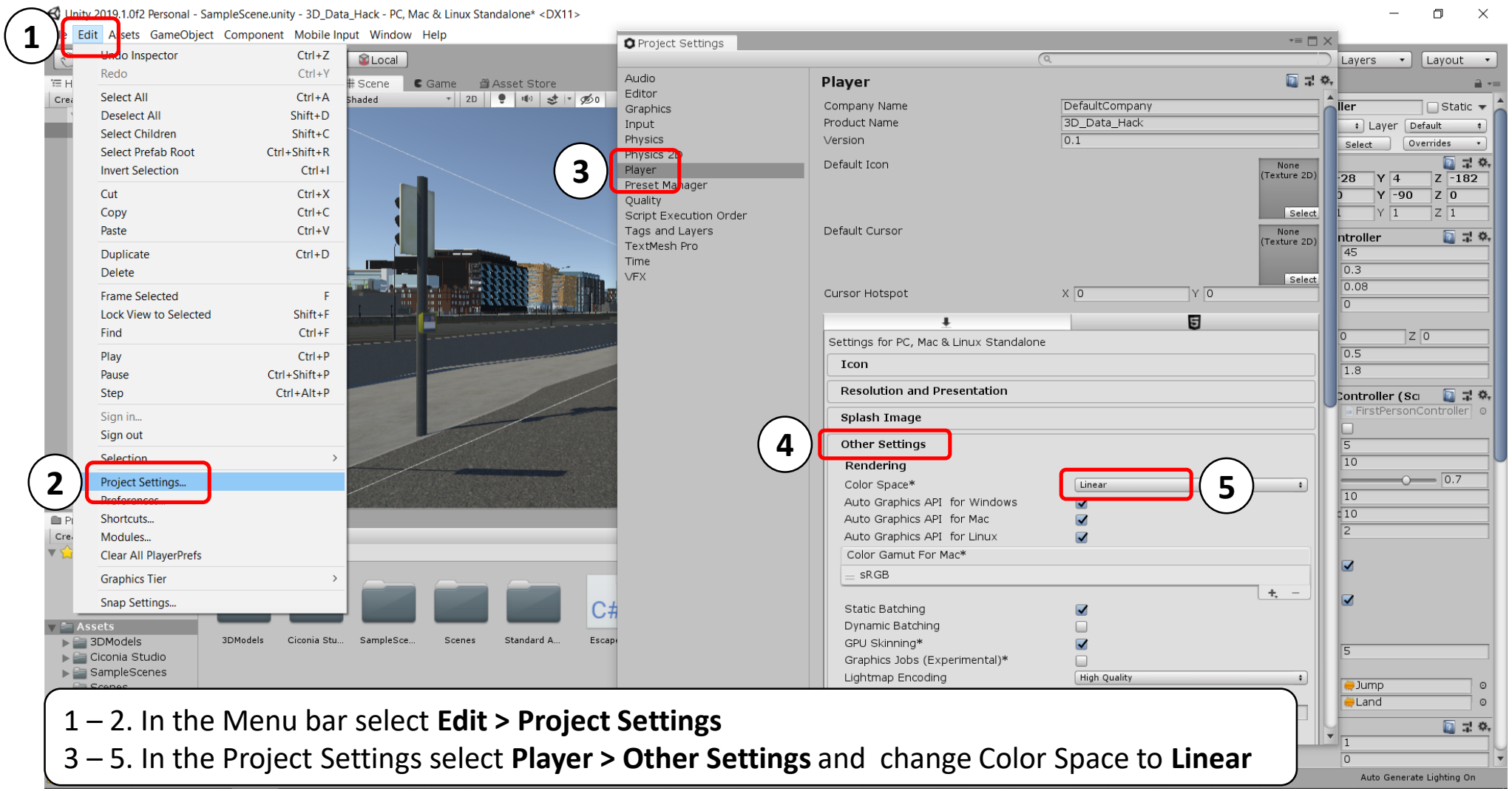
Add the double sided shader to features that need it like the trees and railings



Enhance the look of your scene with the Unity Post Processing Stack



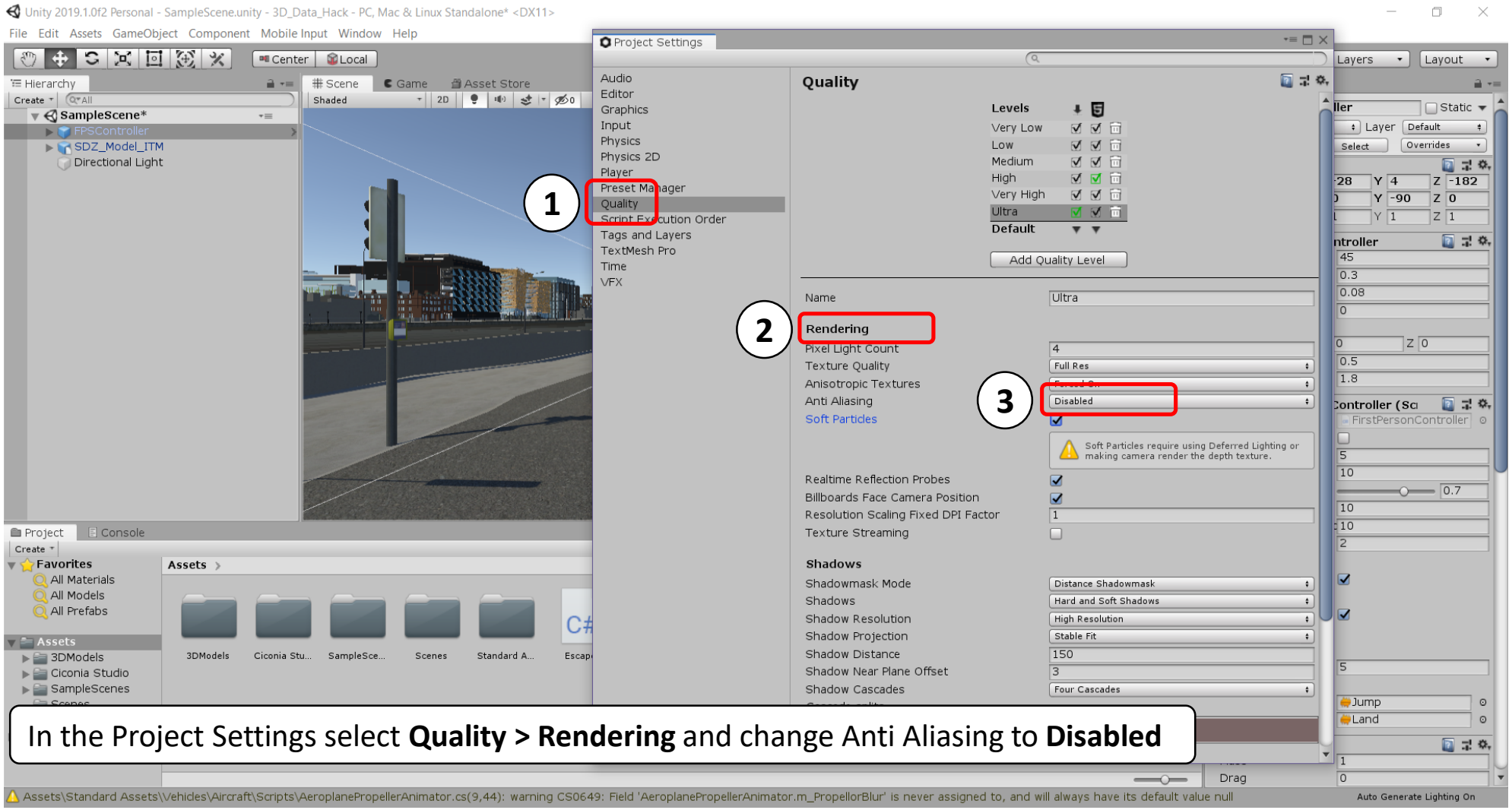
Change project colour space to Linear



1 – 2. In the Menu bar select **Edit > Project Settings**

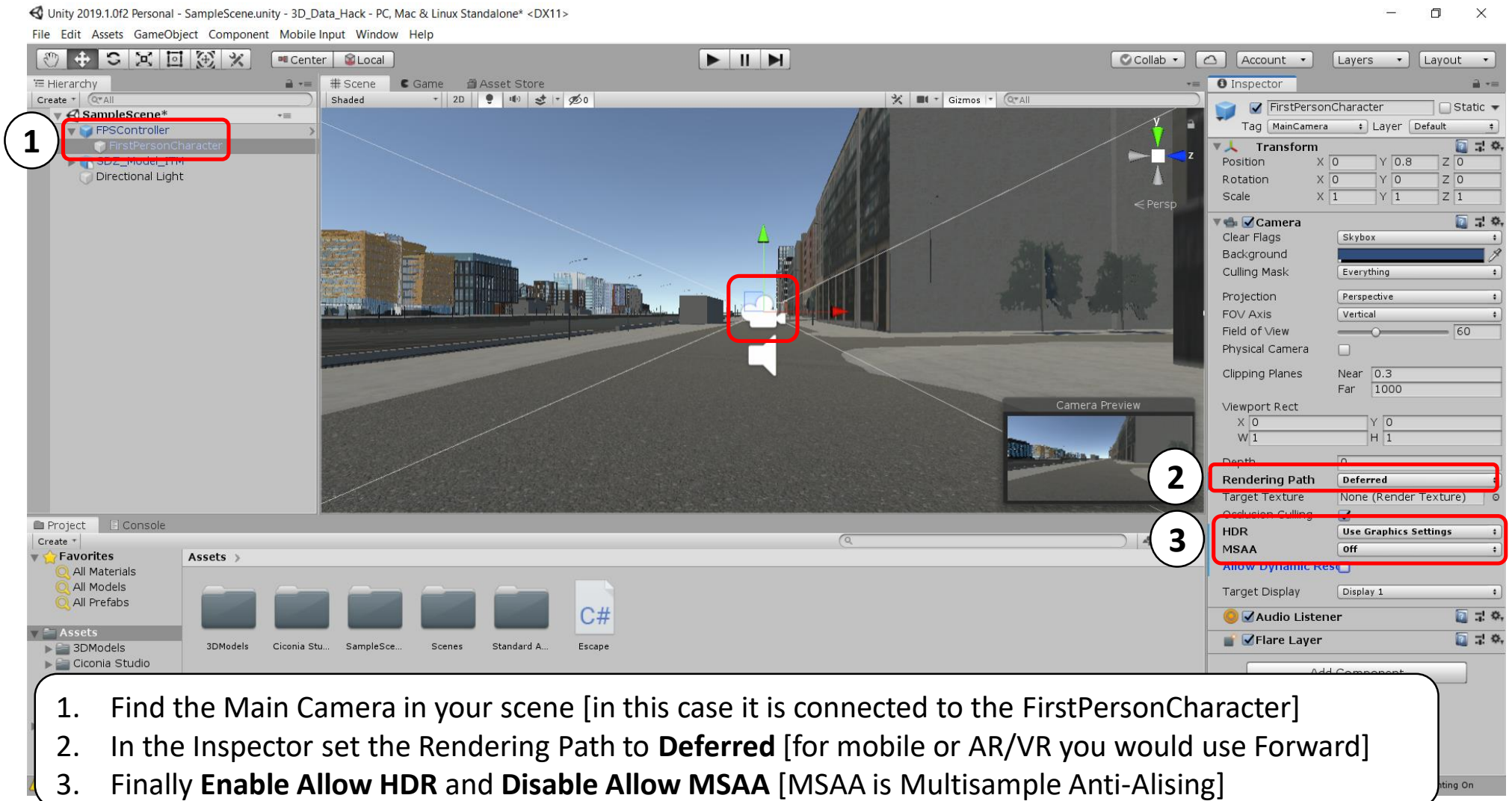
3 – 5. In the Project Settings select **Player > Other Settings** and change Color Space to **Linear**

Disable Anti Aliasing (to be reapplied later)



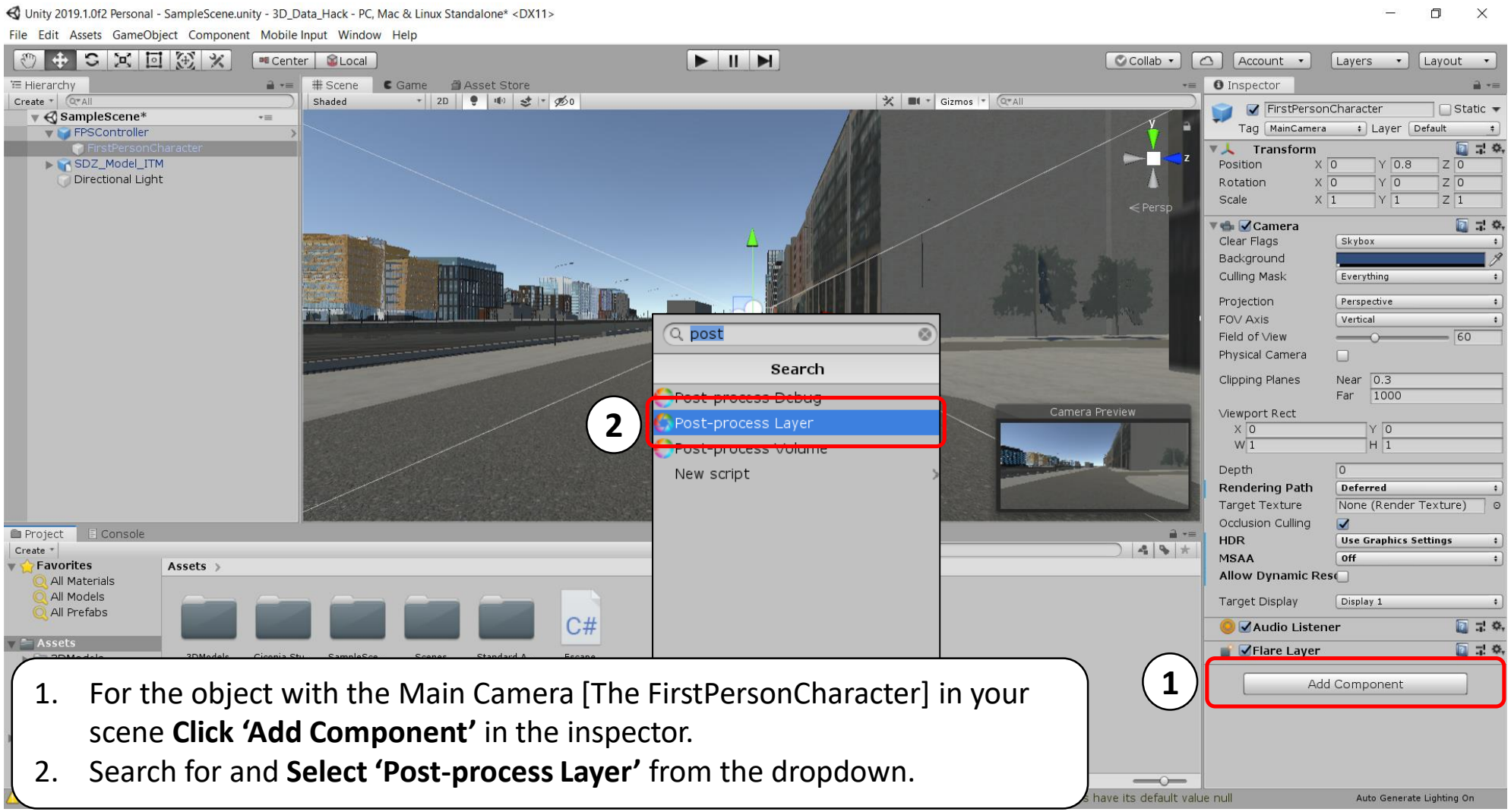
In the Project Settings select **Quality > Rendering** and change Anti Aliasing to **Disabled**

Set Rendering Path to Deferred (For Desktop)



1. Find the Main Camera in your scene [in this case it is connected to the FirstPersonCharacter]
2. In the Inspector set the Rendering Path to **Deferred** [for mobile or AR/VR you would use Forward]
3. Finally **Enable Allow HDR** and **Disable Allow MSAA** [MSAA is Multisample Anti-Alising]

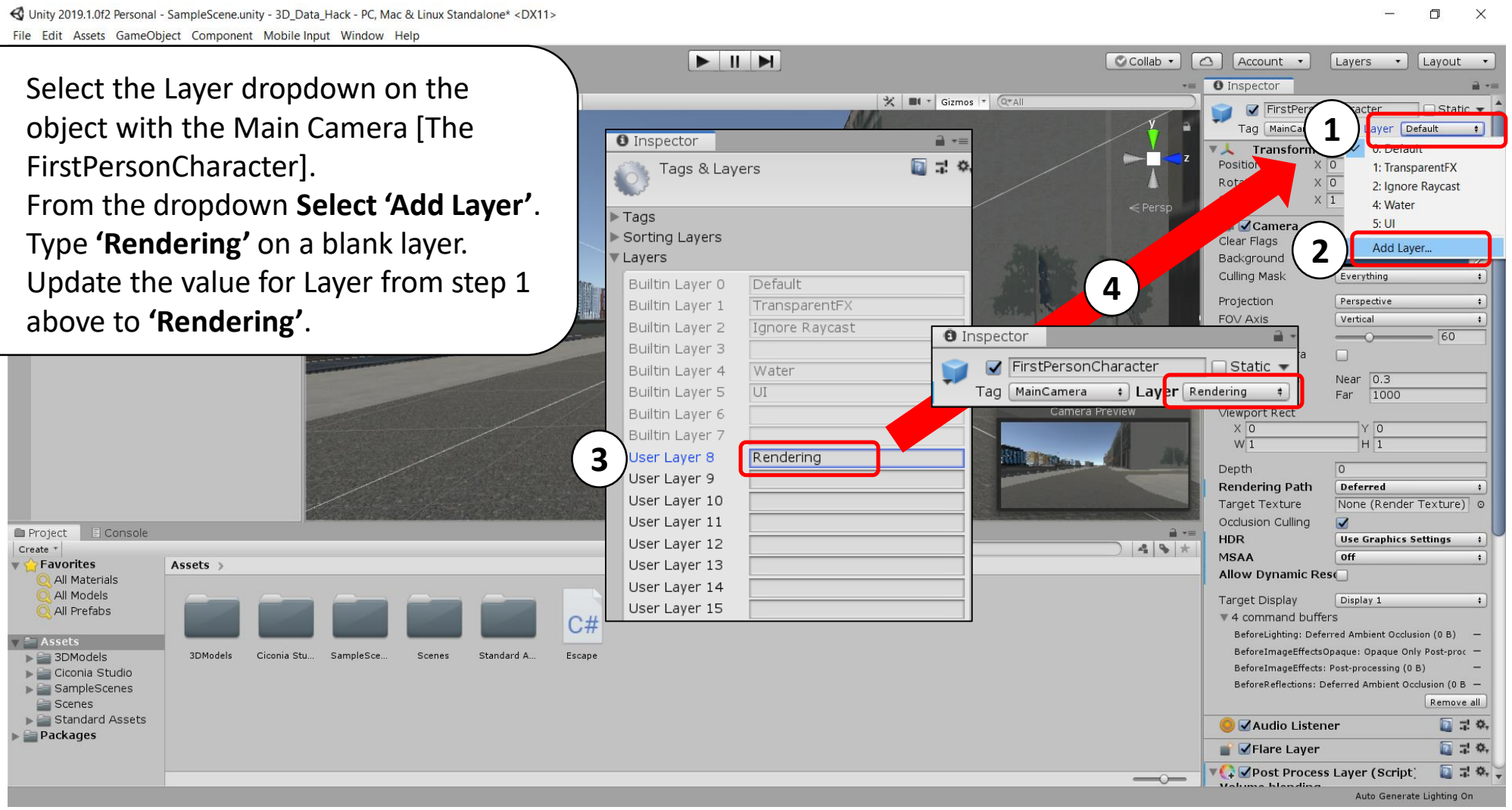
Add Post-process Layer to Main Camera



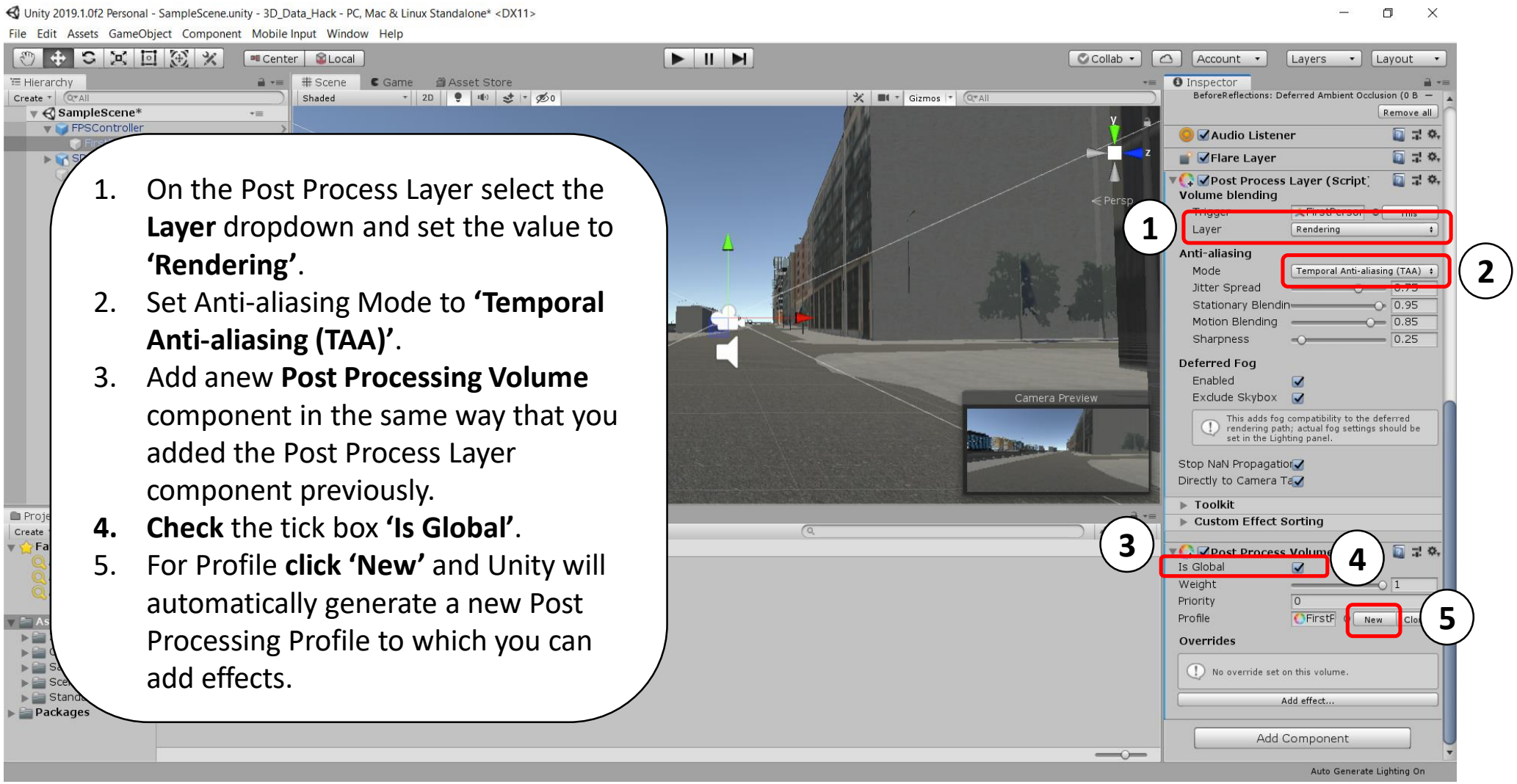
1. For the object with the Main Camera [The FirstPersonCharacter] in your scene **Click 'Add Component'** in the inspector.
2. Search for and **Select 'Post-process Layer'** from the dropdown.

Create a new ‘Rendering’ layer

1. Select the Layer dropdown on the object with the Main Camera [The FirstPersonCharacter].
2. From the dropdown **Select ‘Add Layer’**.
3. Type **‘Rendering’** on a blank layer.
4. Update the value for Layer from step 1 above to **‘Rendering’**.

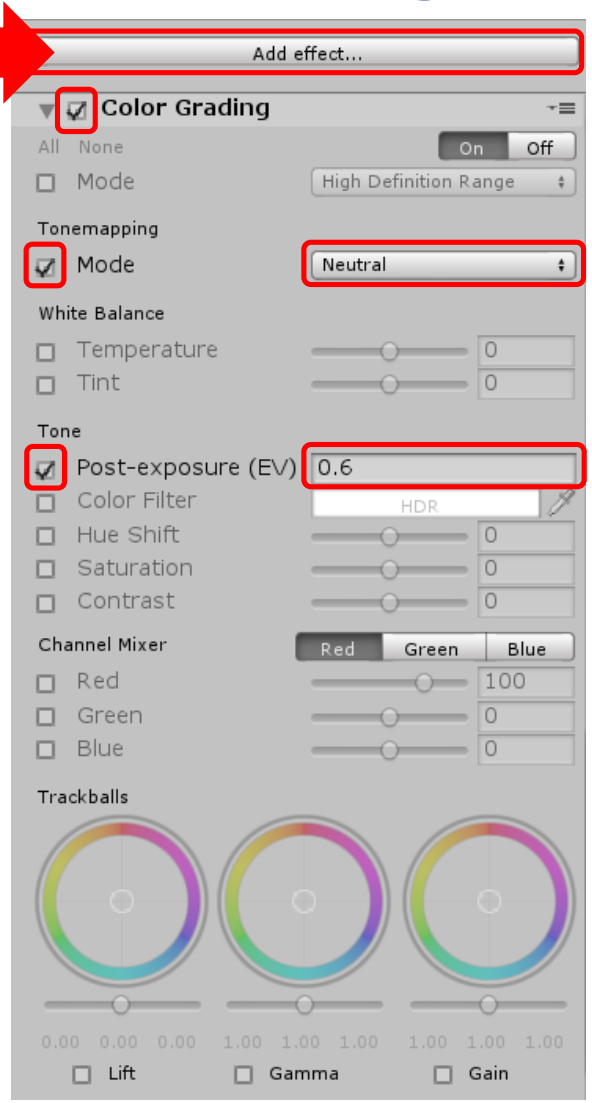


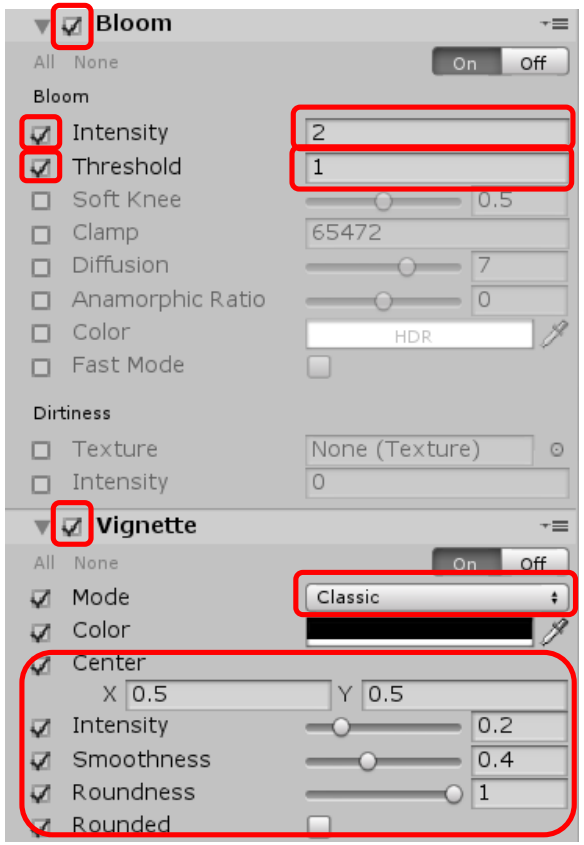
Setup Post Process Layer and add Volume

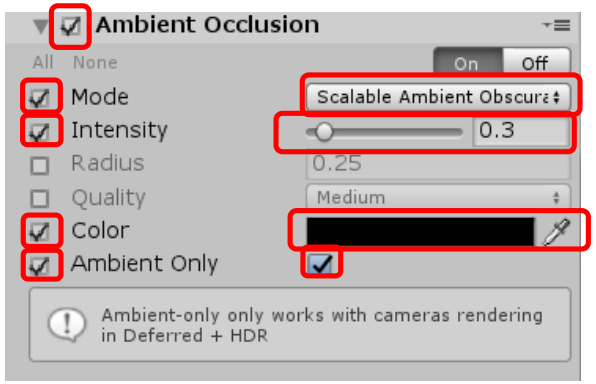


1. On the Post Process Layer select the **Layer** dropdown and set the value to **'Rendering'**.
2. Set Anti-aliasing Mode to **'Temporal Anti-aliasing (TAA)'**.
3. Add anew **Post Processing Volume** component in the same way that you added the Post Process Layer component previously.
4. **Check** the tick box **'Is Global'**.
5. For Profile **click 'New'** and Unity will automatically generate a new Post Processing Profile to which you can add effects.

Try experimenting with the following effects and settings



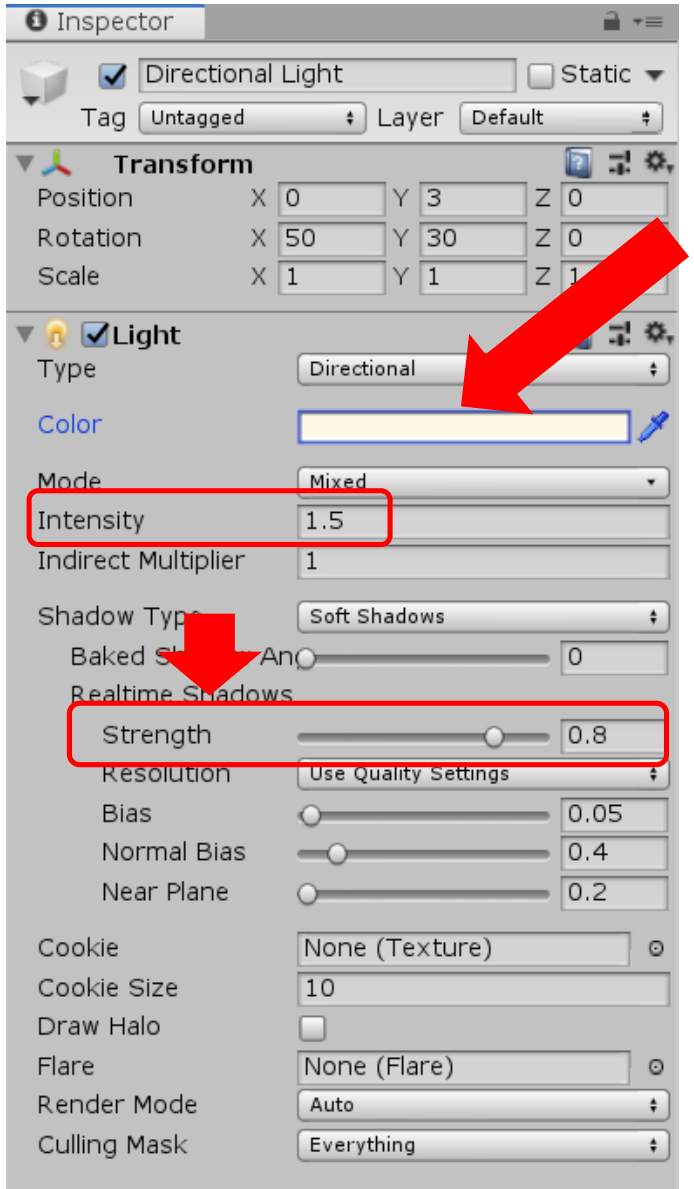




NOTE: Appropriate values for post-processing depend entirely on the nature of your scene and the effect you intend.

You may also need to adjust lighting and brightness levels (SEE NEXT SLIDE)

Experiment with the following values for lighting

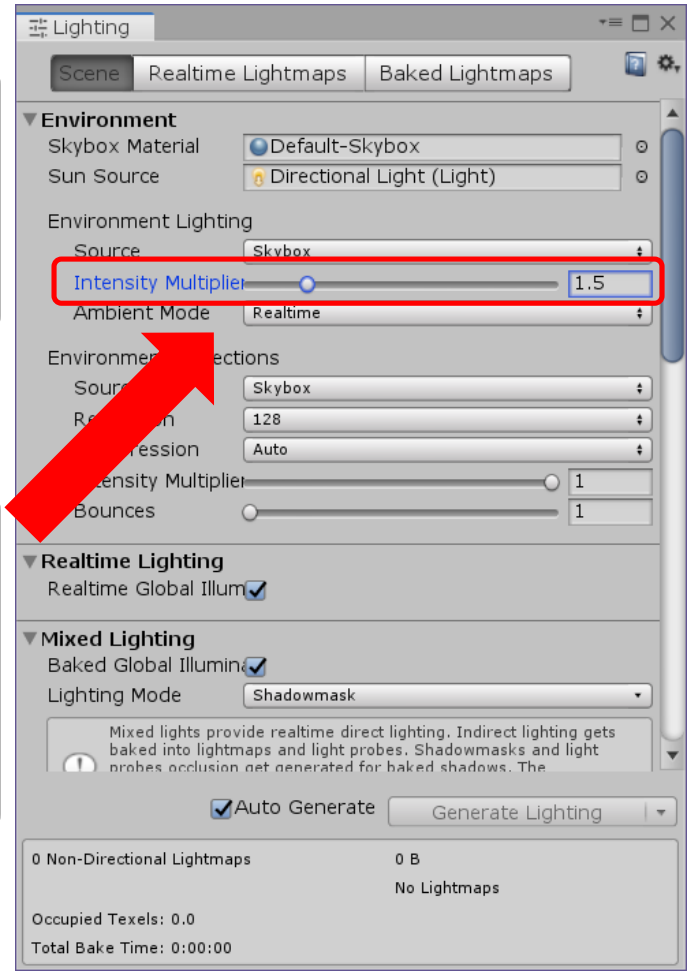


1. Go to main Directional Light and adjust Light Intensity
2. Slightly turn down shadow strength

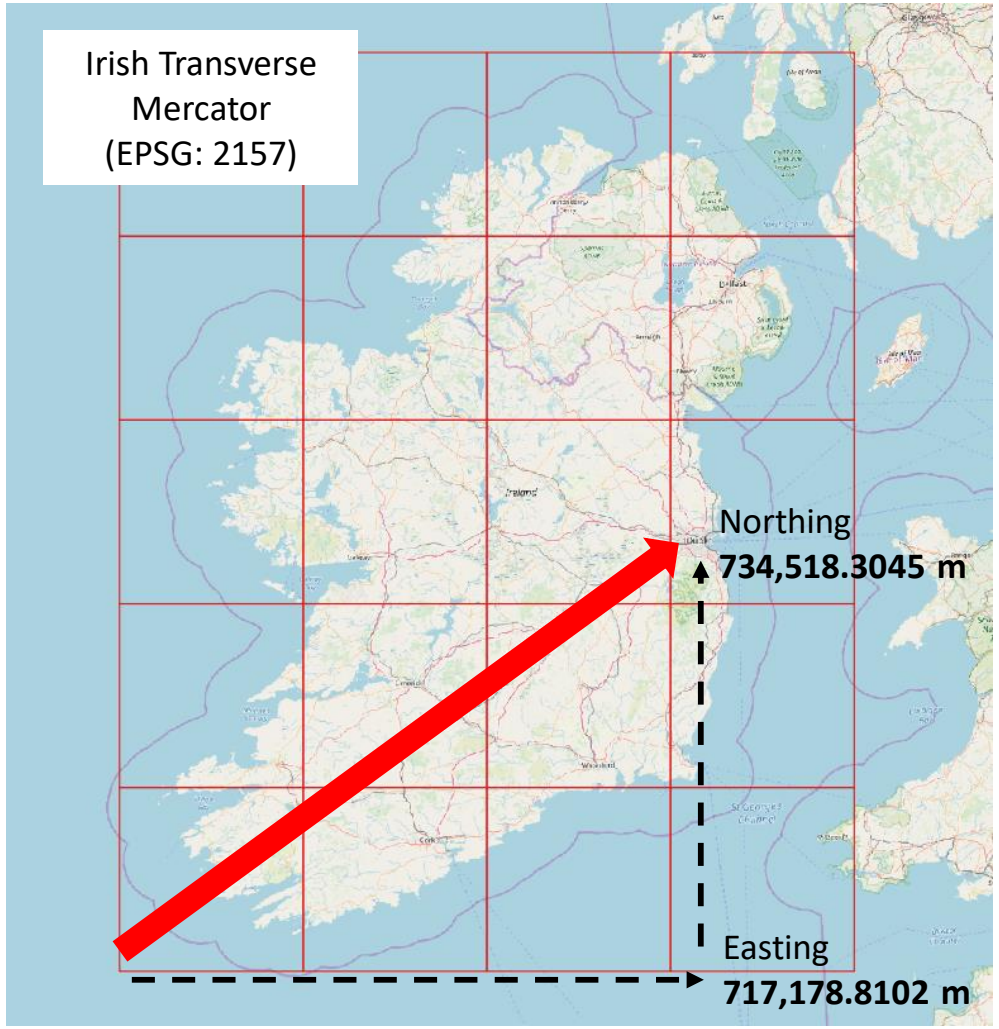
3. Go to lighting settings

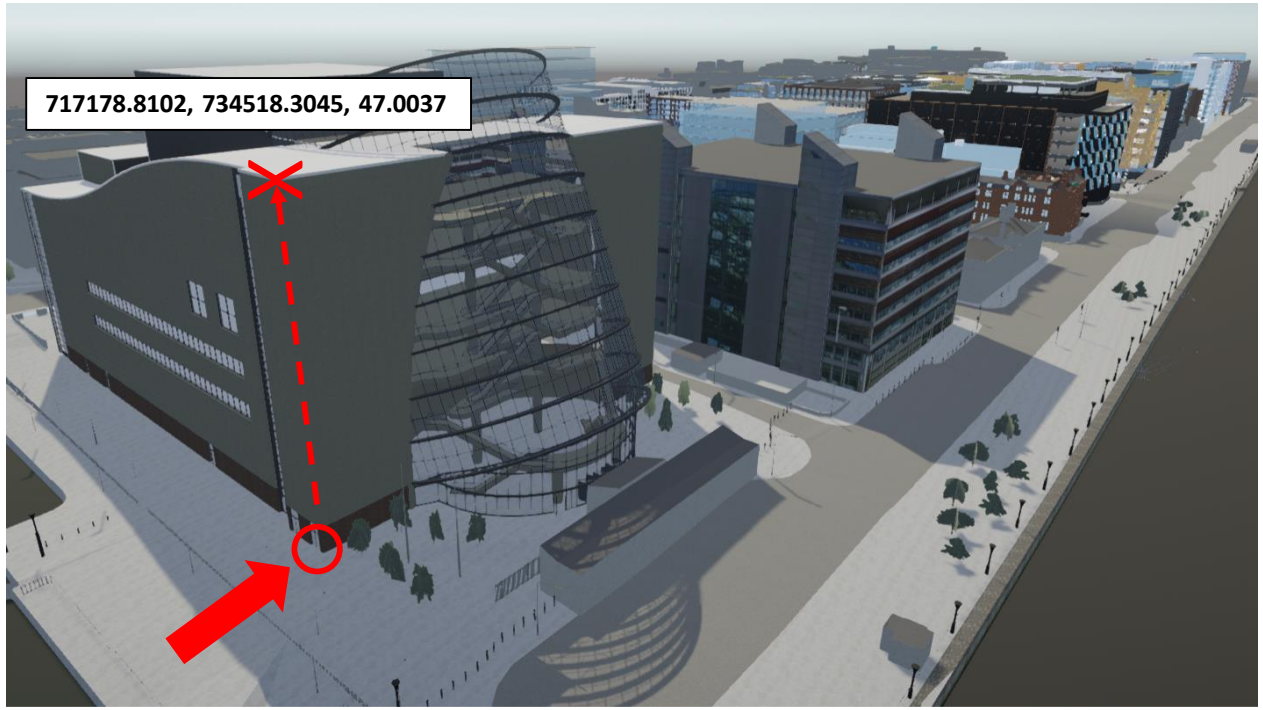
Window > Rendering > Lighting Settings

3. Turn up the Environment Lighting Intensity Multiplier



A spatial reference for geolocating data





Coordinates for the roofline on the south east corner of the Convention Centre Dublin (CCD) in ITM (EPSG: 2157) are:

E: 717178.8102 m / N: 734518.3045 m / Alt: 47.0037 m

See: https://en.wikipedia.org/wiki/Irish_Transverse_Mercator

Building City Dashboards

We gratefully acknowledge funding from

Science Foundation Ireland

under the Investigator's Award Program.

Award number: 15/IA/3090

National Centre for Geocomputation
An tIonad Náisiúnta Geoiriomhaireachta

Maynooth University
National University of Ireland
Social Sciences Institute

Maynooth University
National University of Ireland Maynooth

Science Foundation Ireland sfi For what's next

dashboards.maynoothuniversity.ie
dashboards@mu.ie
@dashbuild