Part 3: 3D Animation in Autodesk MAYA

Intro to Animation

for Science Communication

Jessica Kendall-Bar

LAST WEEK'S AFTER EFFECTS WORKSHOP REVIEW

- Defining Animation v. Motion Graphics
- Adobe workflows: choosing software to fit your needs
- After Effects Animation Examples
- Tutorial Linking CSV data to After Effects Animations
- Take home practice: syncing timeseries data to videos

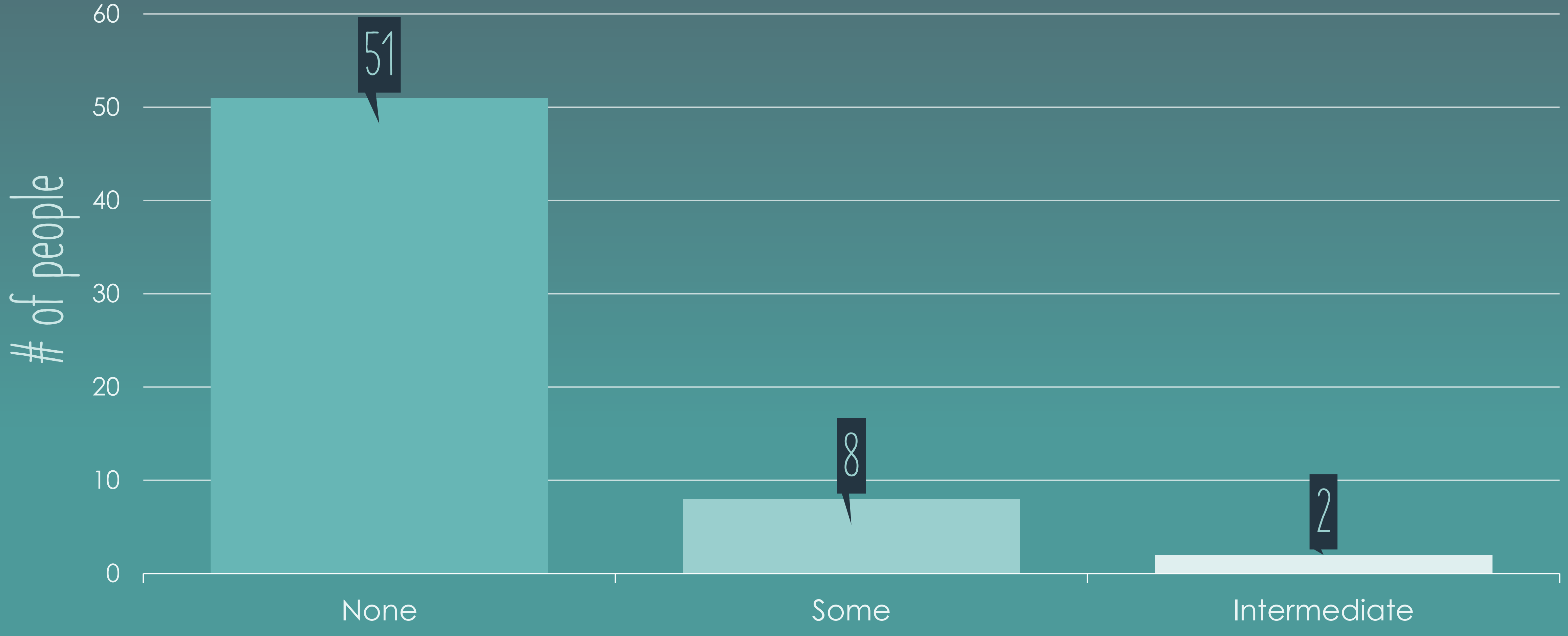
Key words and concepts:

Design:
- Animation
- Motion Graphics

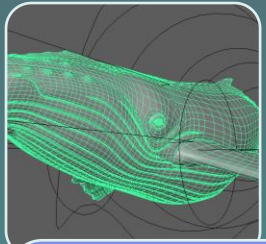
Shortcuts and Tools:
- Duplicate
- Align
- Add Keyframes
- Add Slider Controls
- Using expressions
- Using the Pick Whip

WHERE YOU'RE AT :

Your self-described experience level in Autodesk MAYA

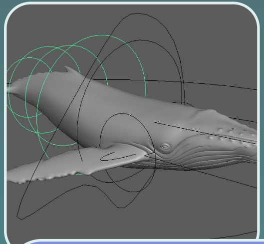


3D ANIMATION WORKFLOW



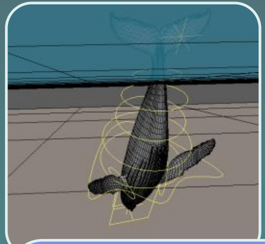
MODEL

Create 3 dimensional models using polygon primitives



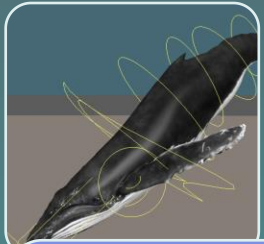
RIG

Rig a skeleton to constrain and direct motion of your model during animation.



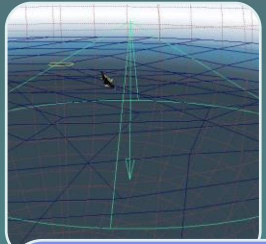
ANIMATE

Animate the position and rotation of your model or its skeleton over time.



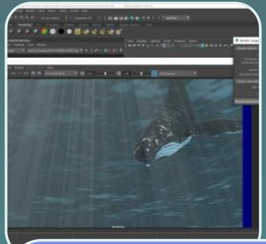
TEXTURE

Wrap models in UV textures to add color and detail.



LIGHTS, CAMERA, ACTION!

Add lighting, add and animate cameras.



RENDER

Once your 3D scene is ready, render high resolution 2D images for each frame.

Disclaimer: experts specialize in each of these fields as **professions**, don’t be discouraged if these steps are hard, because they are! This broad overview is just to give you a sense of what’s possible in the 3D realm!

3D Modeling

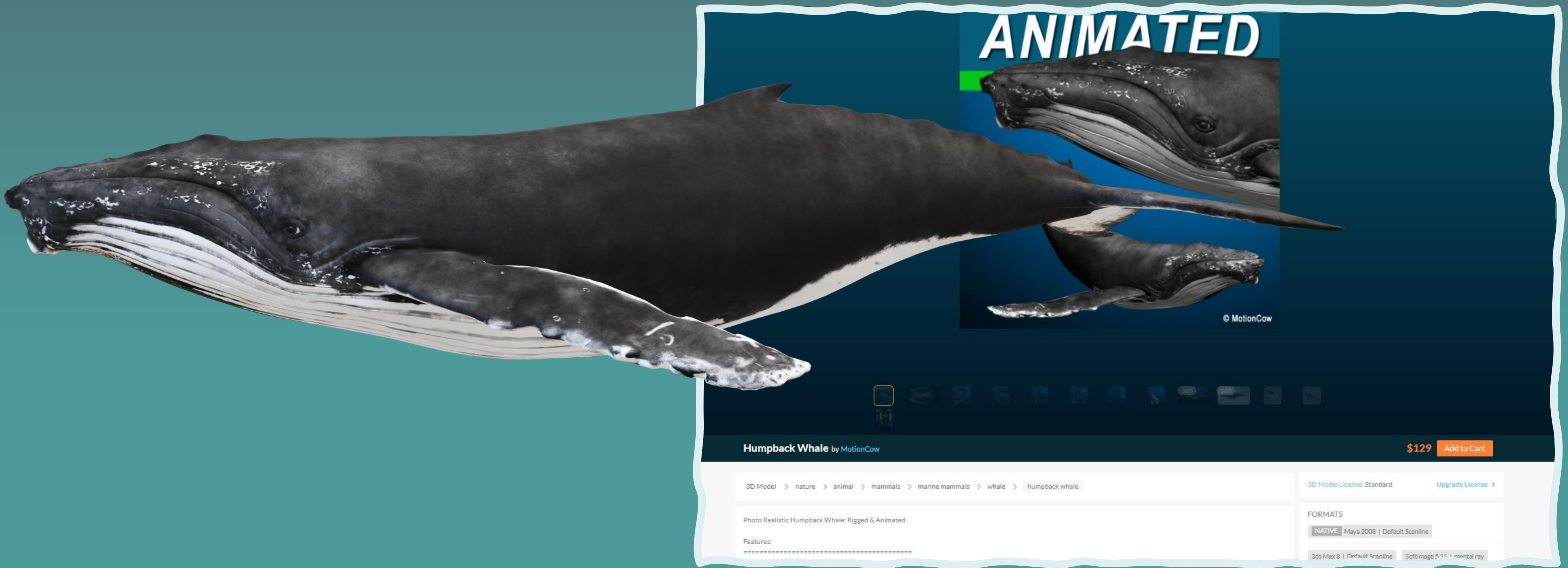
Creating a 3D character for your 3D animation using 3D shapes and surfaces.

OPTION 1) PURCHASE A 3D MODEL

Websites: Turbosquid, Sketchfab, CGTrader, etc!

A 3D model I purchased from:

https://www.turbosquid.com/3d-models/3d-humpback-whale-hump/597221



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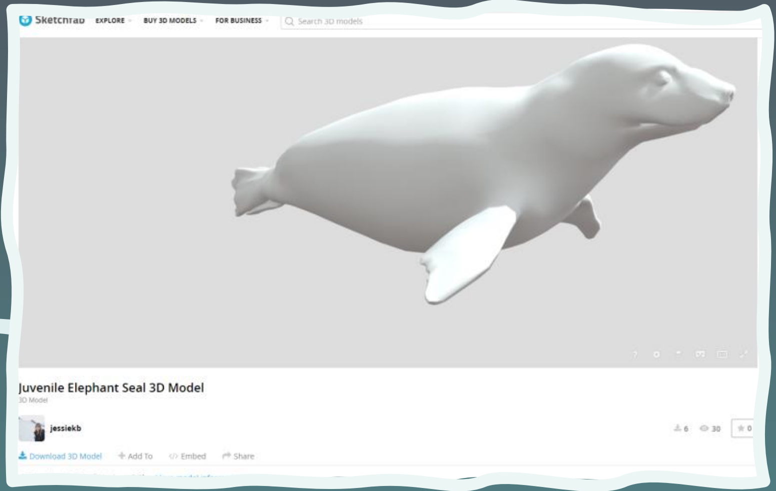
OPTION 2) DOWNLOAD A FREE 3D MODEL



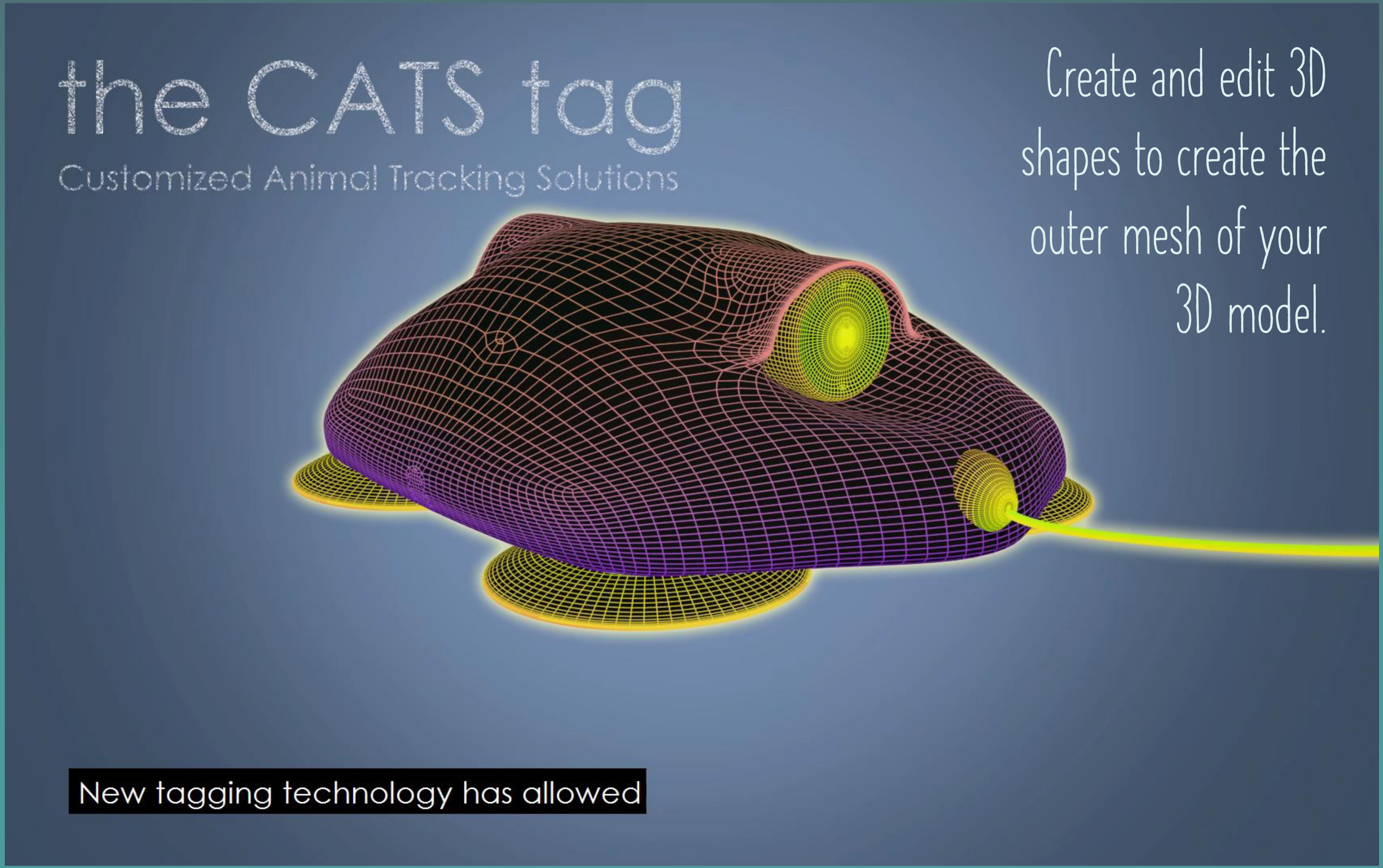
Websites: Turbosquid, Sketchfab, CGTrader, etc!

Free model I made:

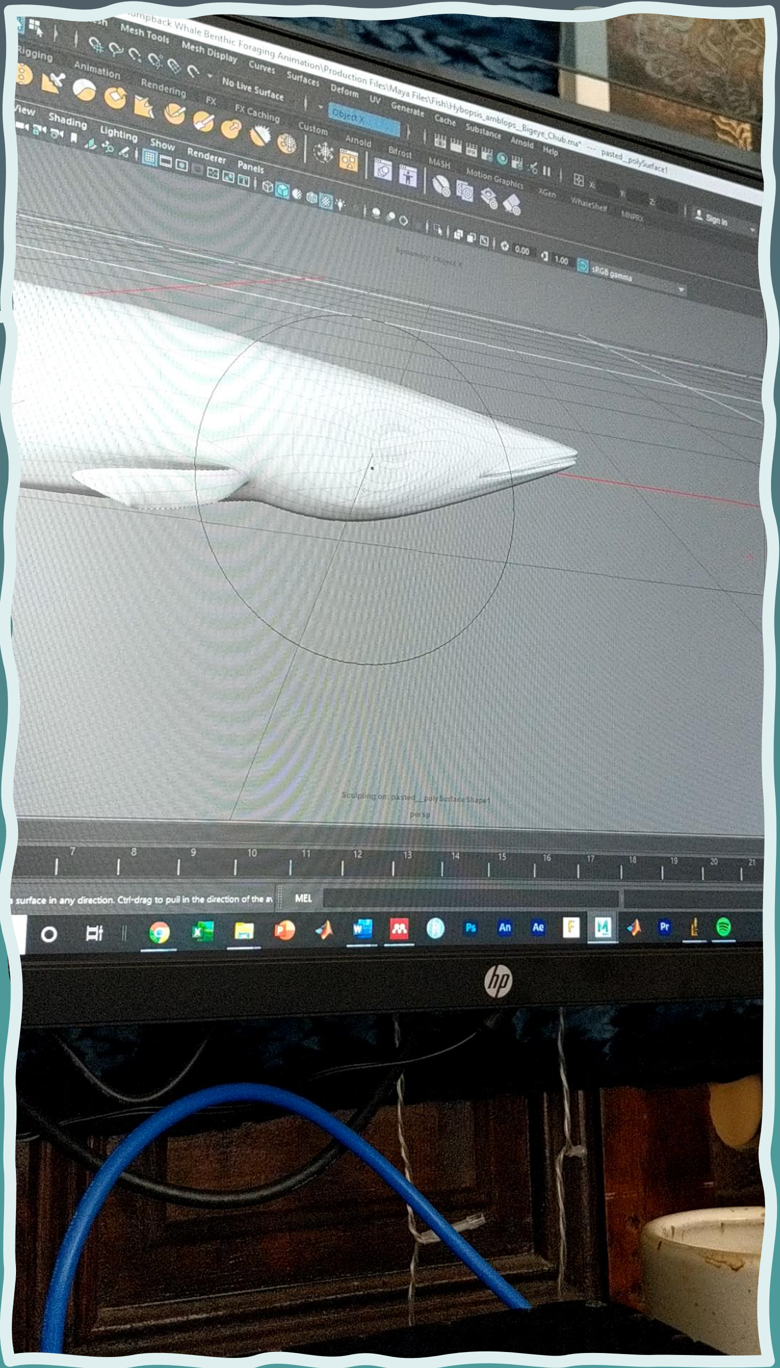
https://skfb.ly/6WSIz

For this workshop, feel free to download and use a 3D model I modified from a free 3D model of a harp seal using photos and measurements of a juvenile elephant seal.

OPTION 3) MAKE YOUR OWN FROM SCRATCH!



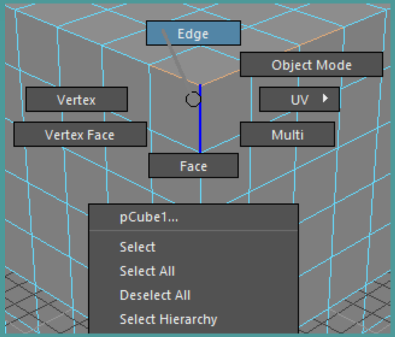
Create and edit 3D shapes to create the outer mesh of your 3D model.



OPTION 3) MAKE YOUR OWN FROM SCRATCH!

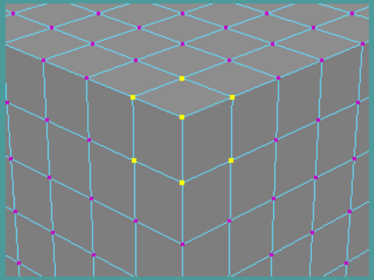
Make spheres, cubes, cylinders, cones, donuts, planes or discs.

Mirror Smooth Extrude Bevel

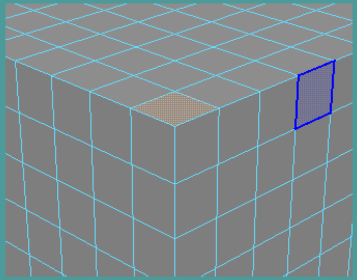


Change selection mode by right clicking, holding, and toggling selection modes:

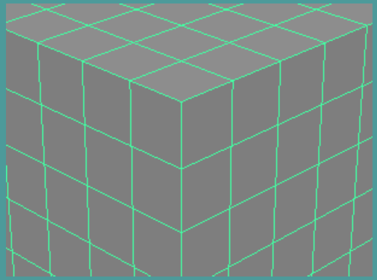
Vertex mode



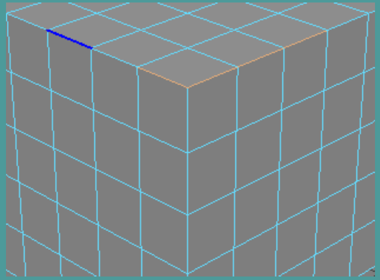
Face mode



Object mode

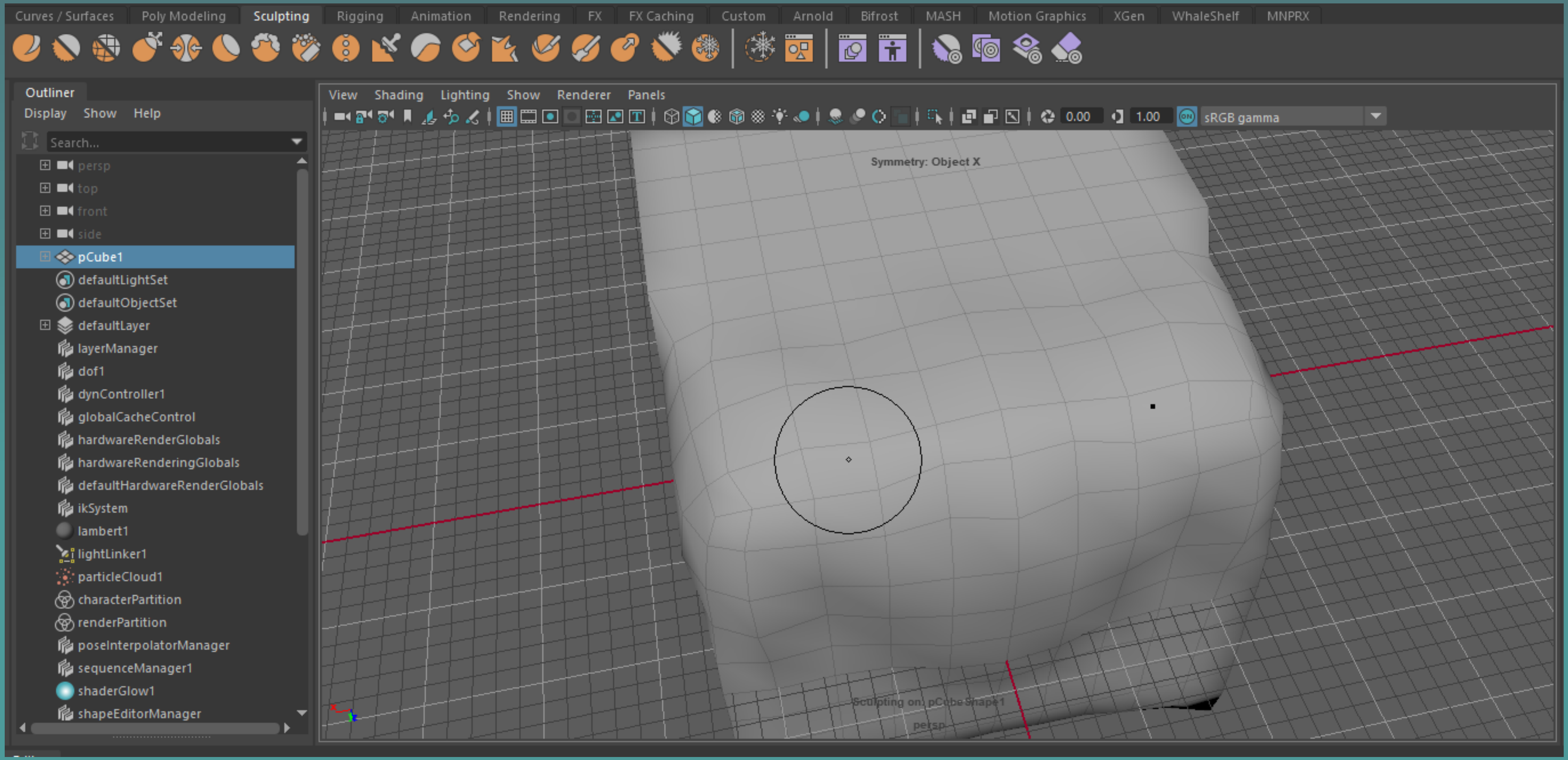


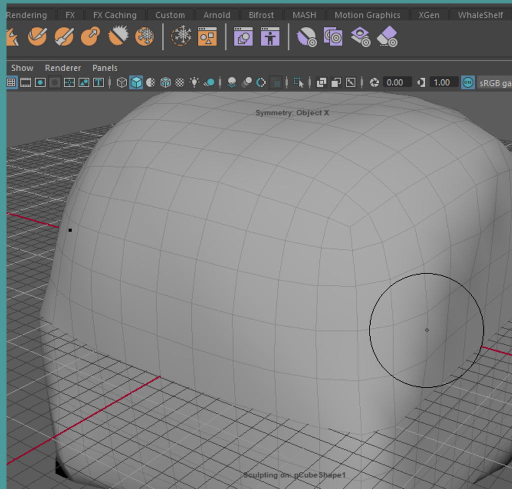
Edge mode



OPTION 3) MAKE YOUR OWN FROM SCRATCH!

To achieve smooth organic shapes, you can use the sculpting tools.





SOME WILD STUFF

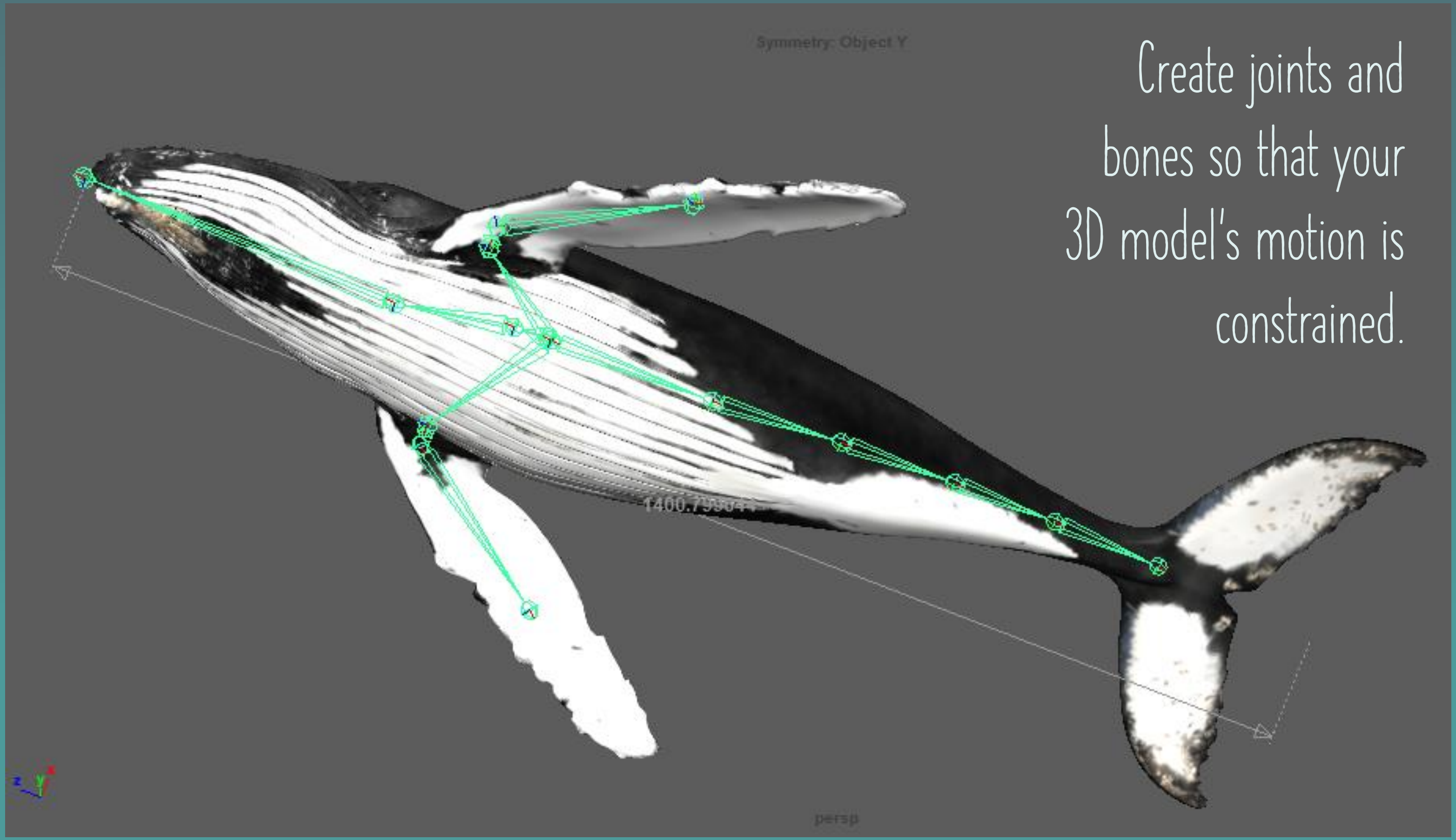
Entering virtual reality to use Oculus medium to sculpt characters!

https://youtu.be/qmuwXr3bNBY

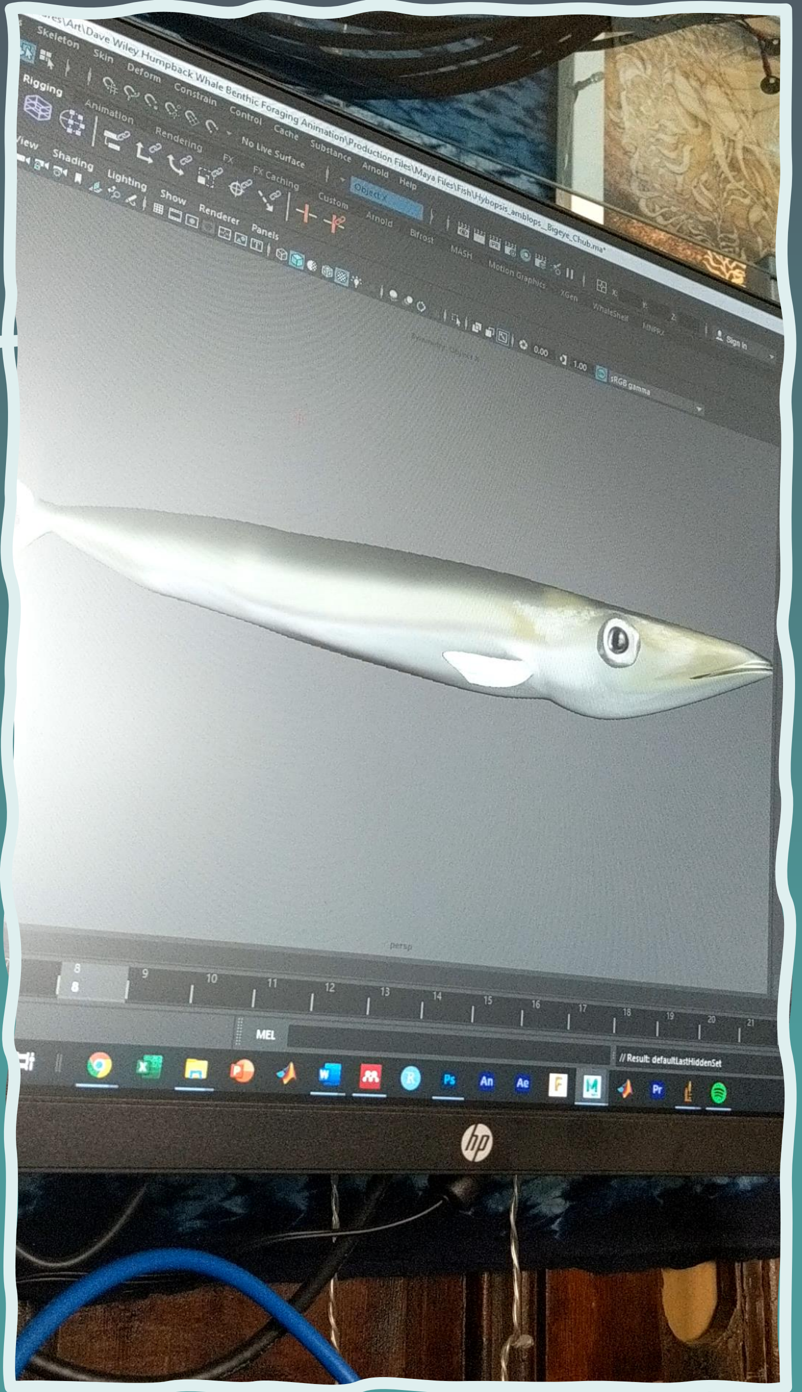
Rigging

Creating a skeleton to constrain the motion of your 3D model.

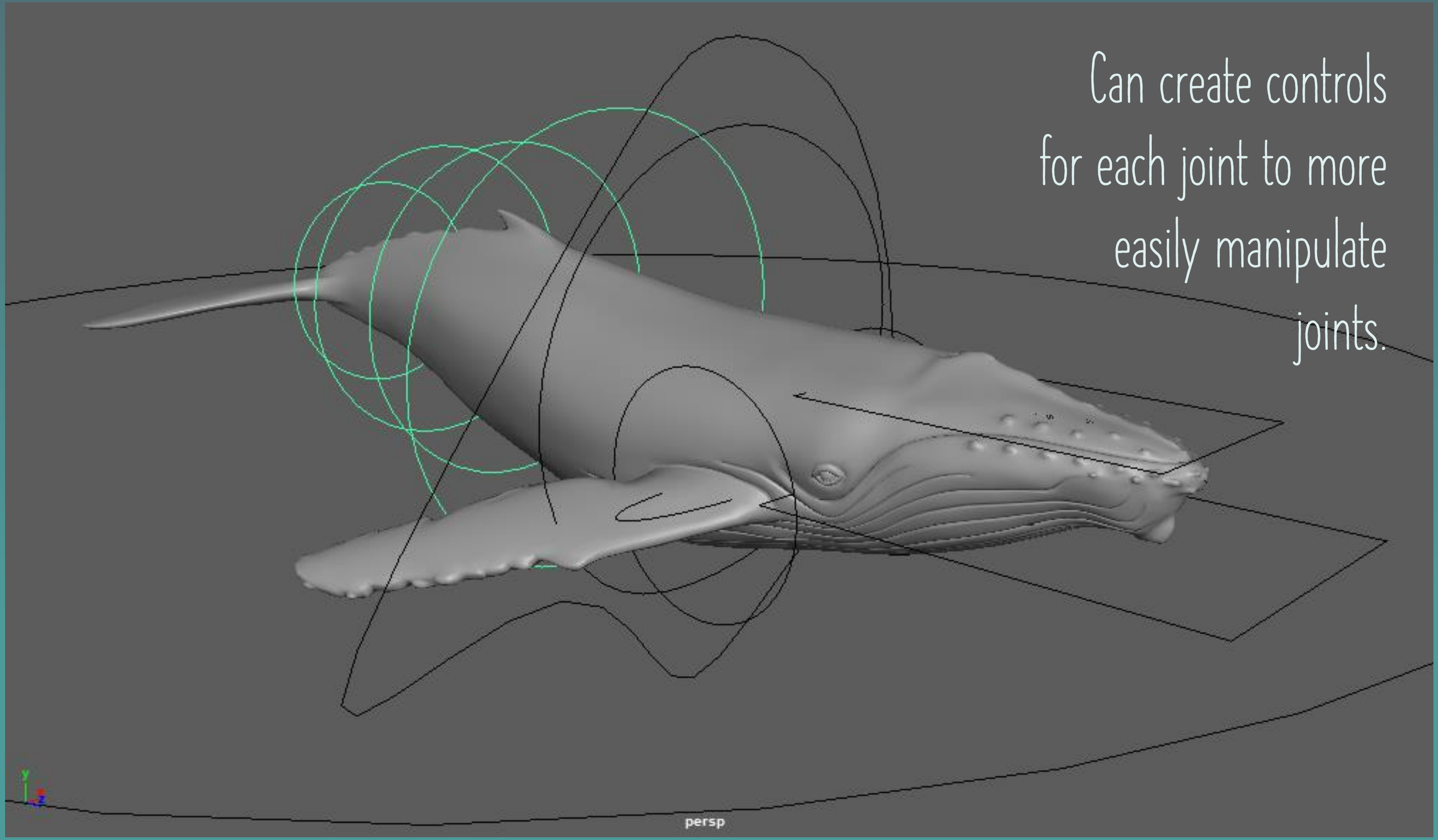
RIGGING



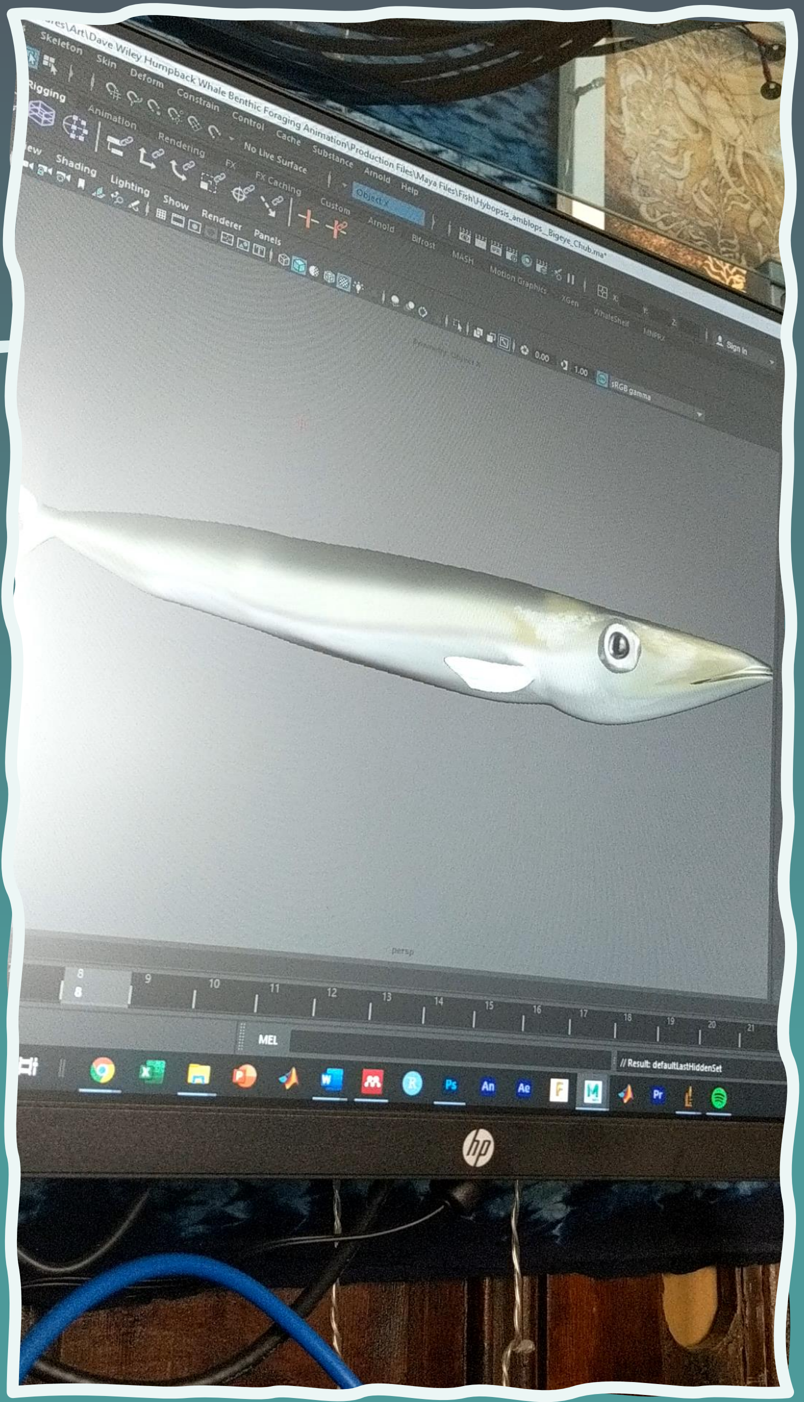
Create joints and bones so that your 3D model's motion is constrained.



RIGGING



Can create controls for each joint to more easily manipulate joints.

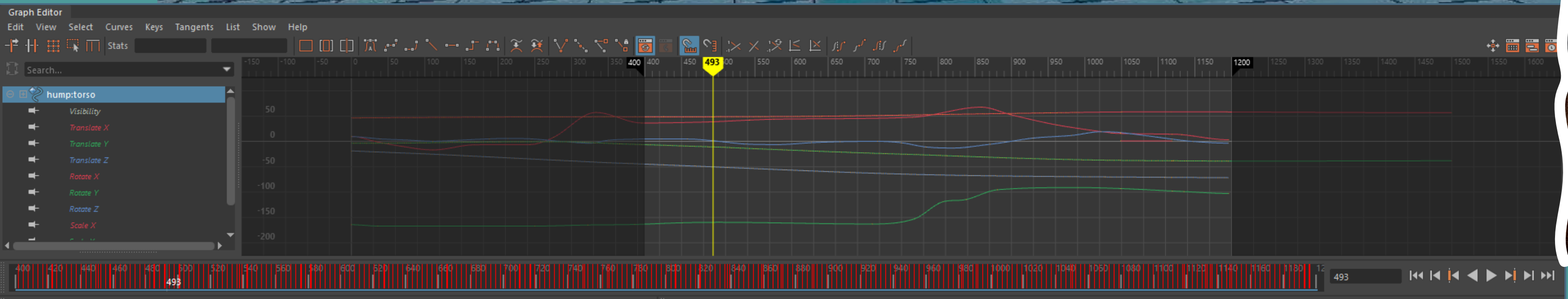


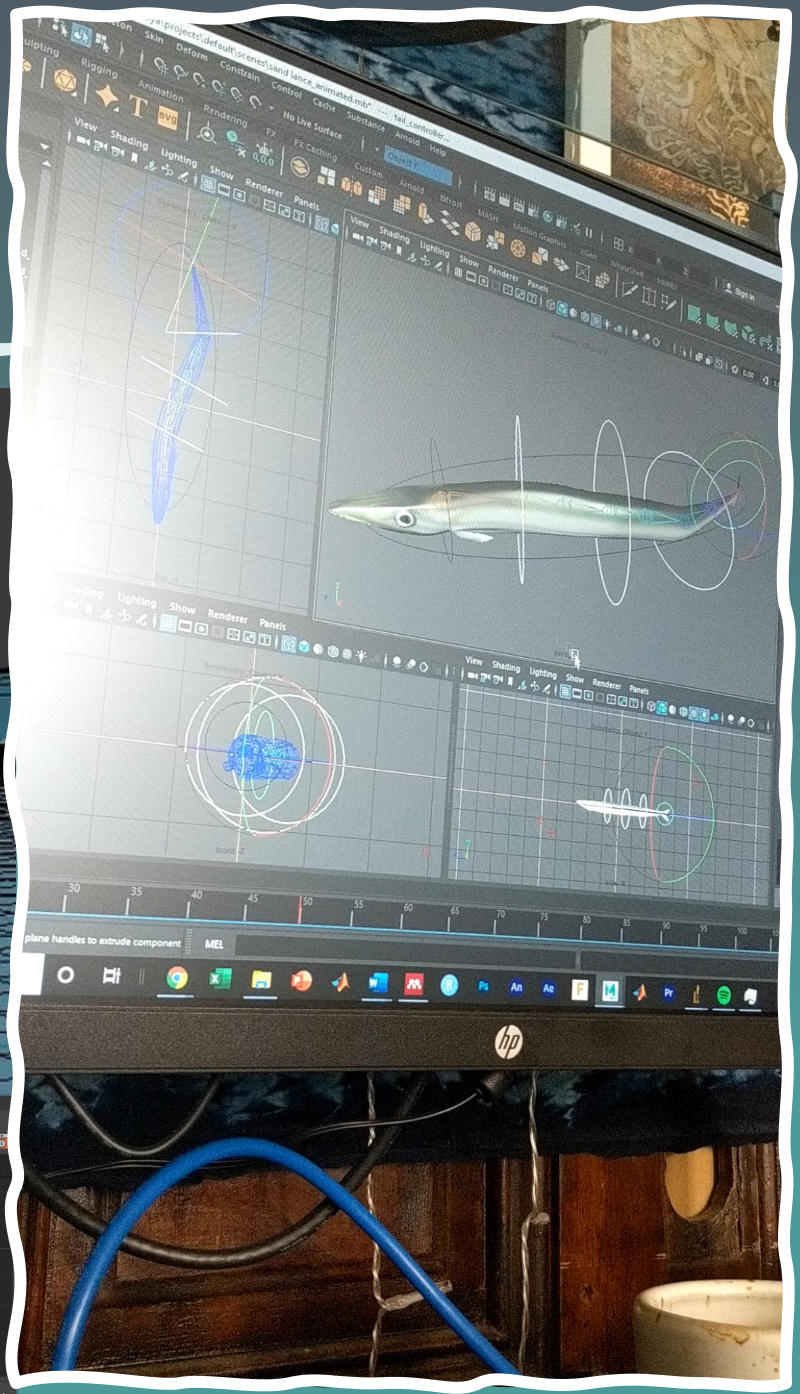
Animation

Creating keyframes to define the position and rotation of each object (including controls within a skeleton rig) over time

ANIMATION

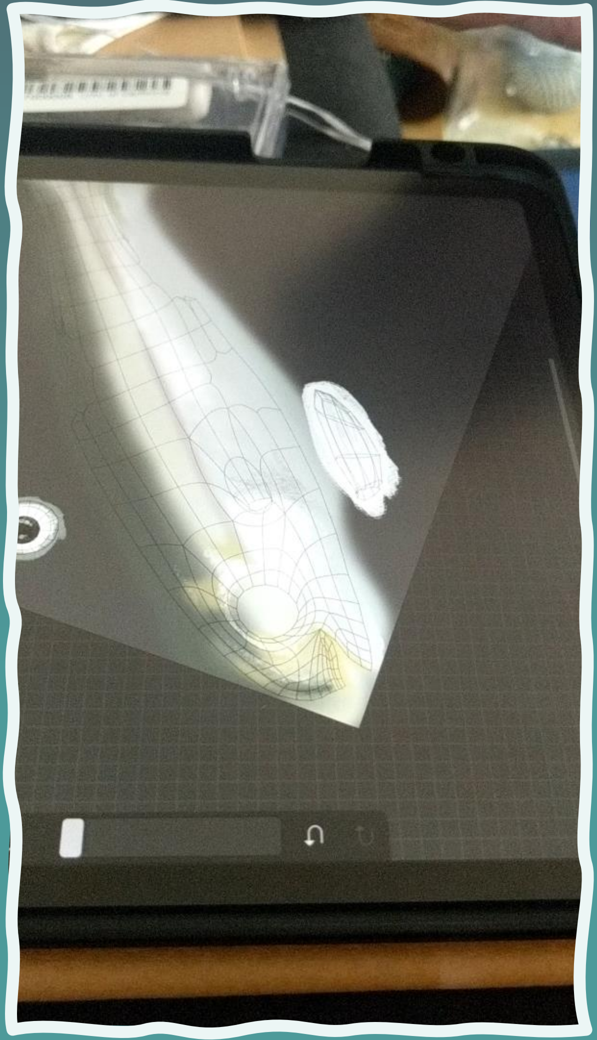
Set keyframes to define the position and rotation of your character and each of its joints.

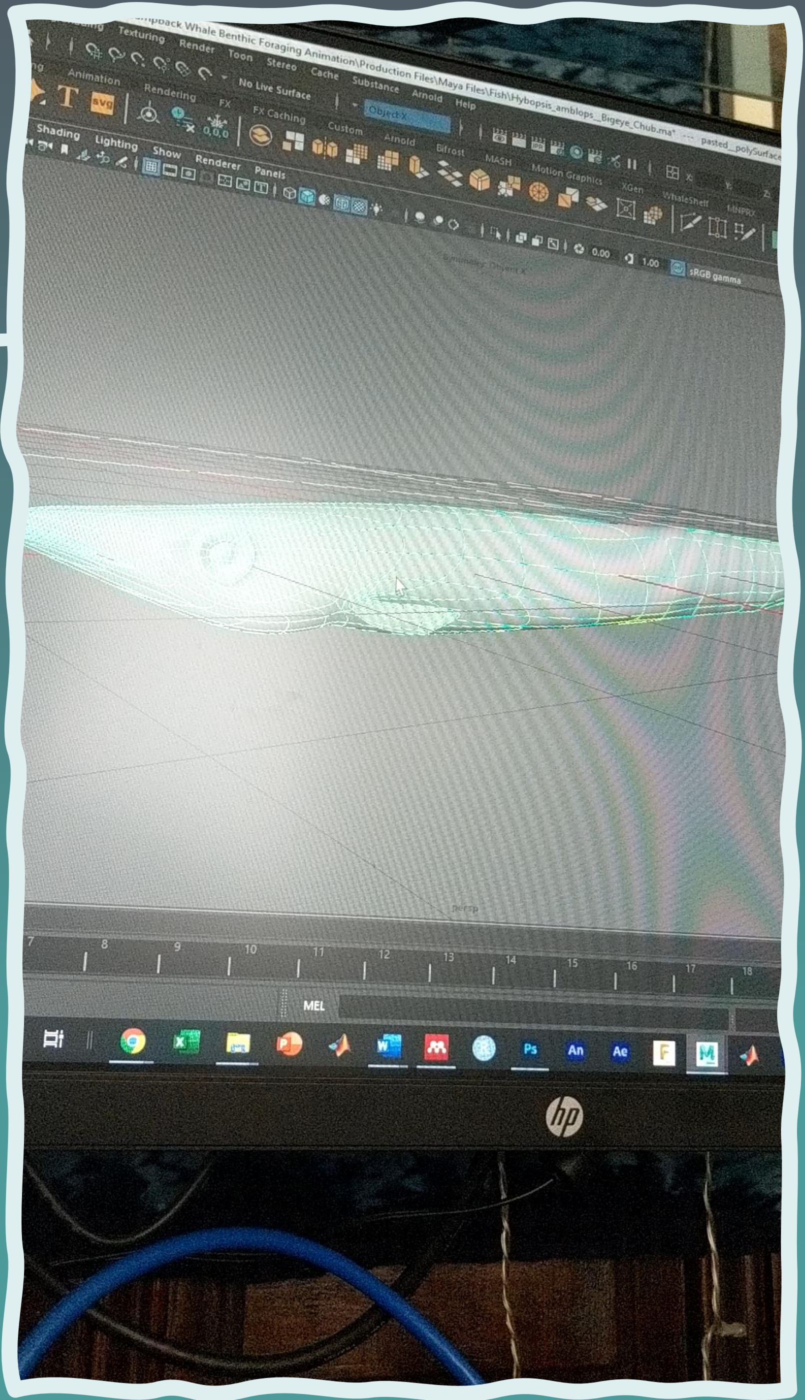




TEXTURE

Export UVs, paint and create textures, and then apply those to your 3D model.





TEXTURE

More complex example:

Tutorial

Linking CSV Motion Data to 3D Animation

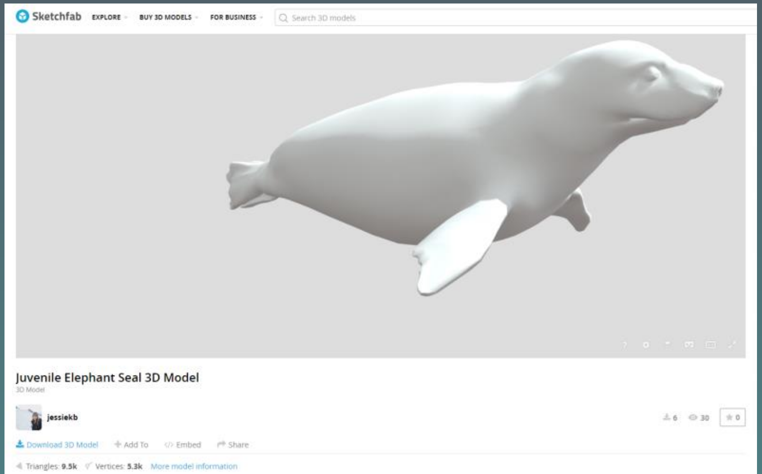
Using sample dataset that can be found under Autodesk Maya Tutorial Resources at jessiekb.com/resources passcode ucsc

1. DOWNLOAD & STORE 3D MODEL

Find a free 3D model online with an .obj download option.

Can't decide on one? Download my free 3D seal here:

https://skfb.ly/6WSlz



FILE ORGANIZATION IN MAYA

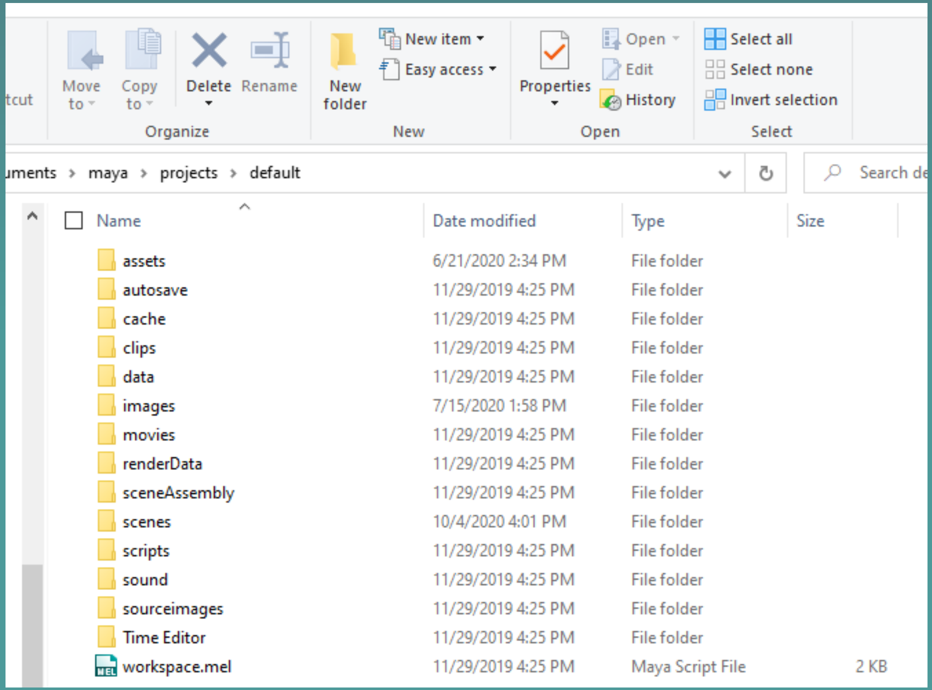
Put your seal .obj and .mtl files here

Documents > maya > projects > default > assets

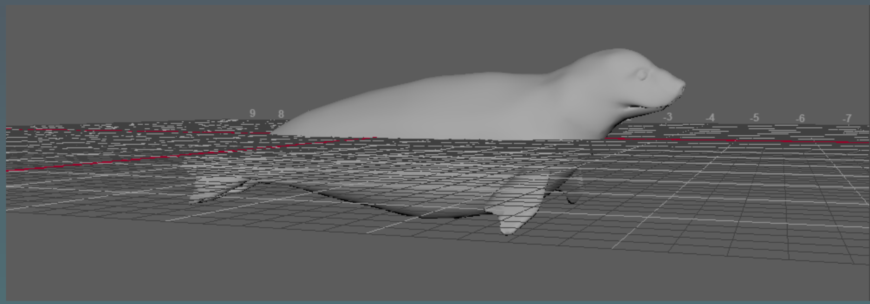
Folder created by default

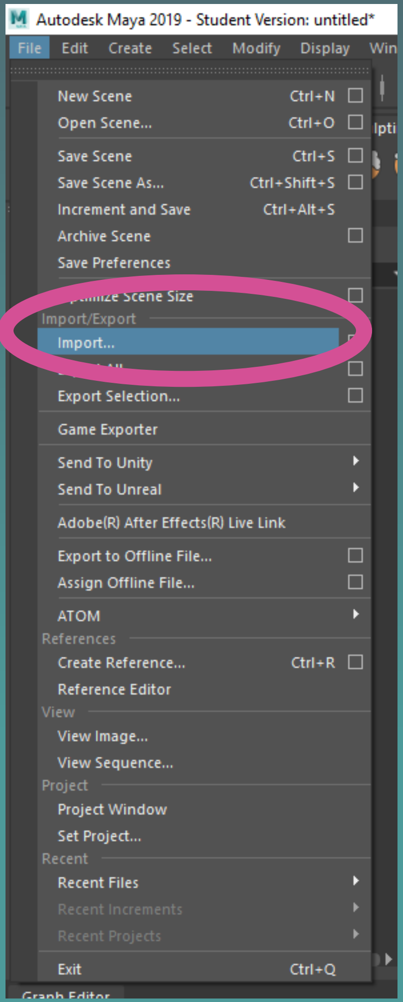
We will use default

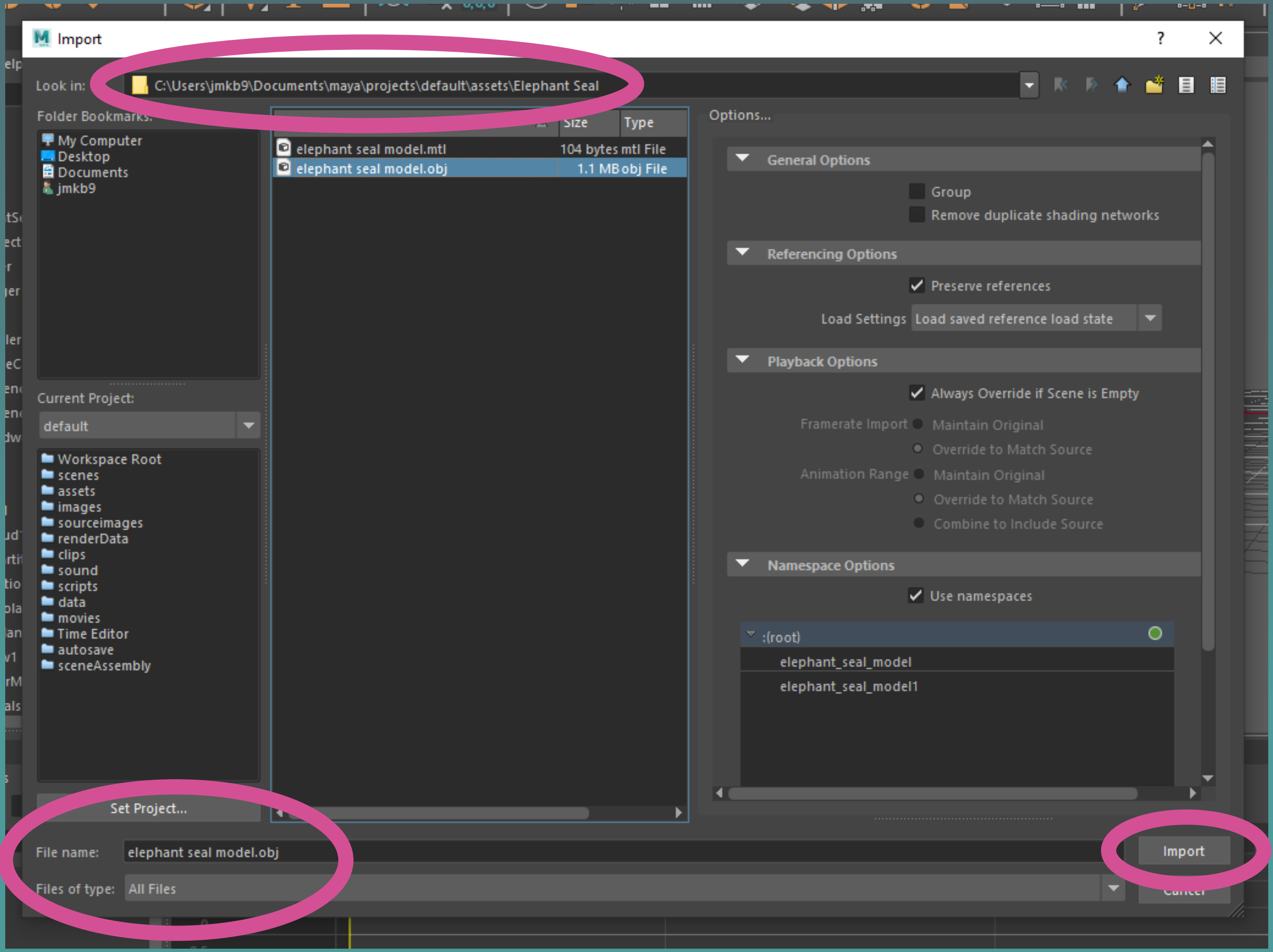
Where you store different projects



2. IMPORT 3D MODEL

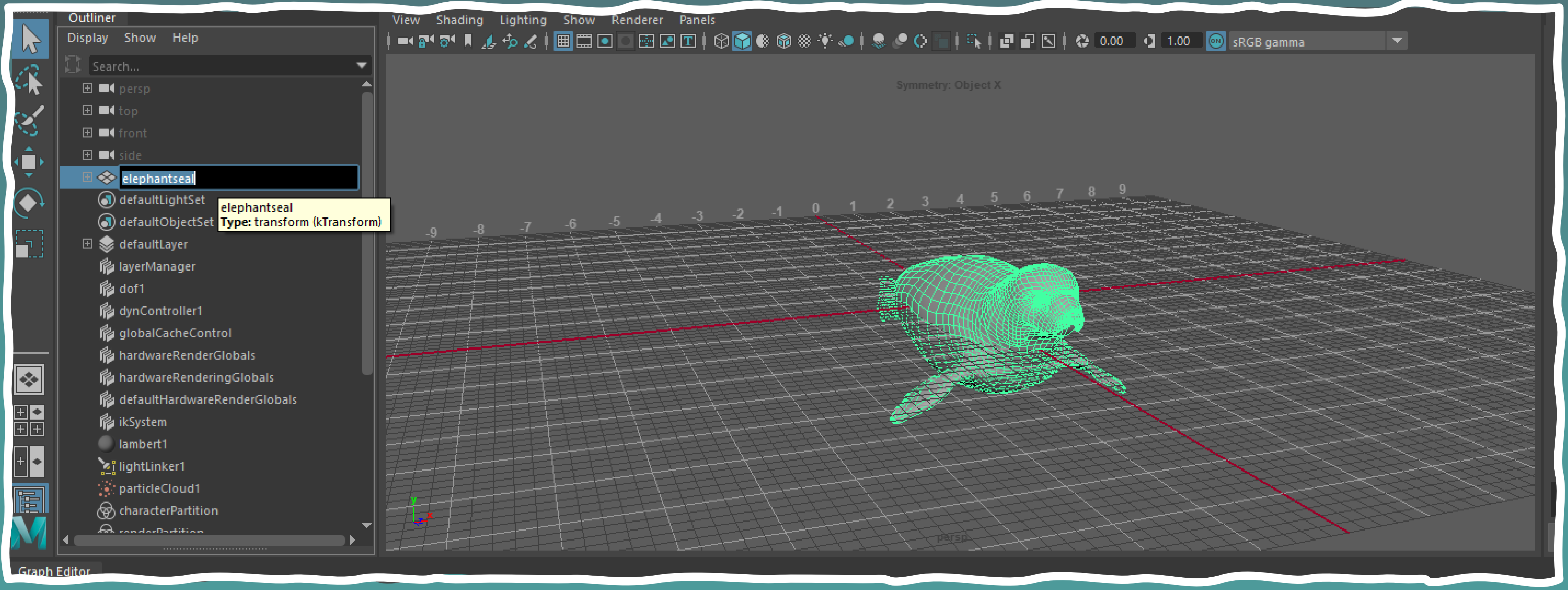






3. RENAME YOUR MODEL

Select your object in the outliner or by clicking on it (making sure you are in object mode).
In the Outliner, press Enter and type in the new name of your model.

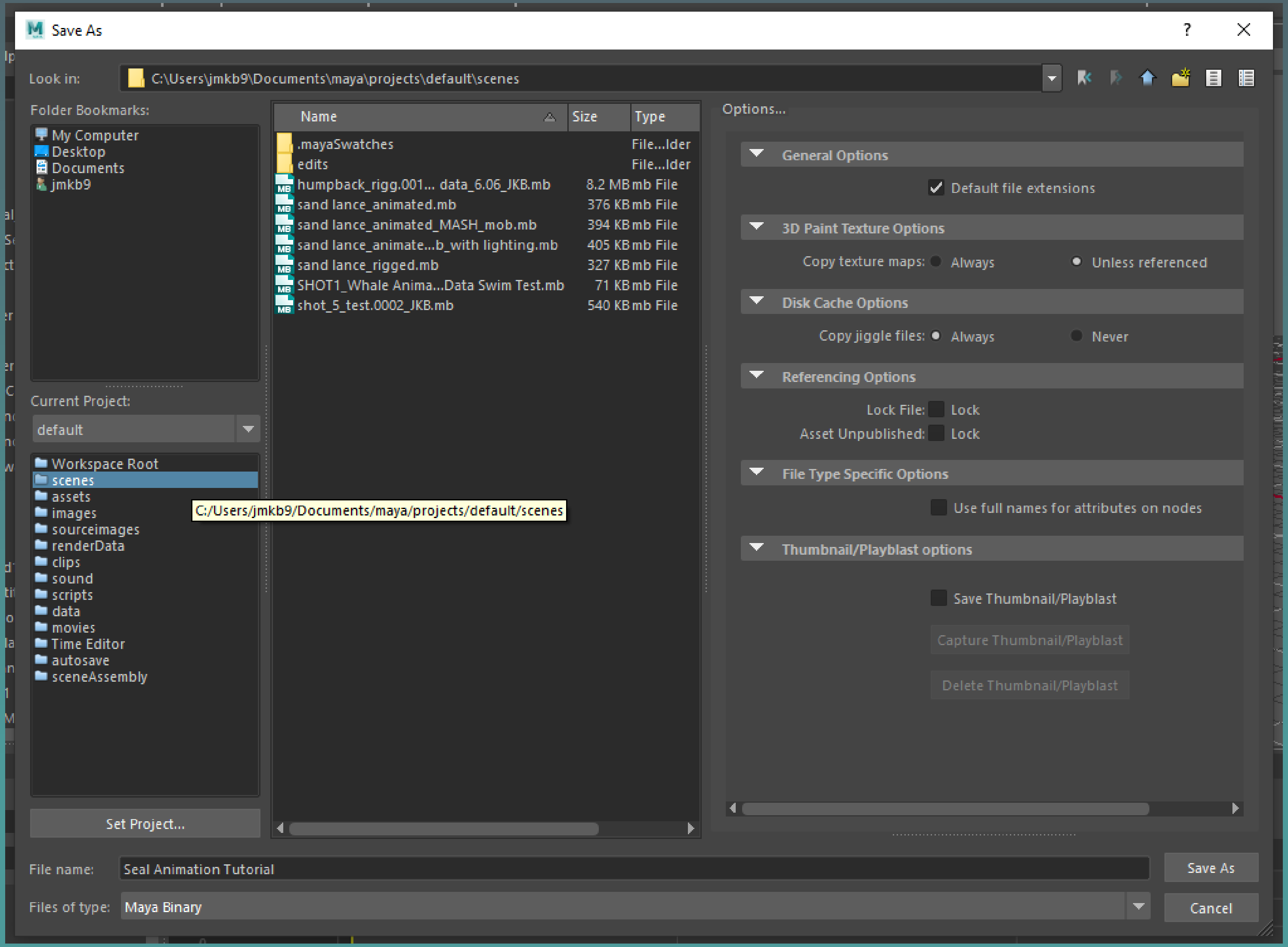


4. SAVE YOUR SCENE

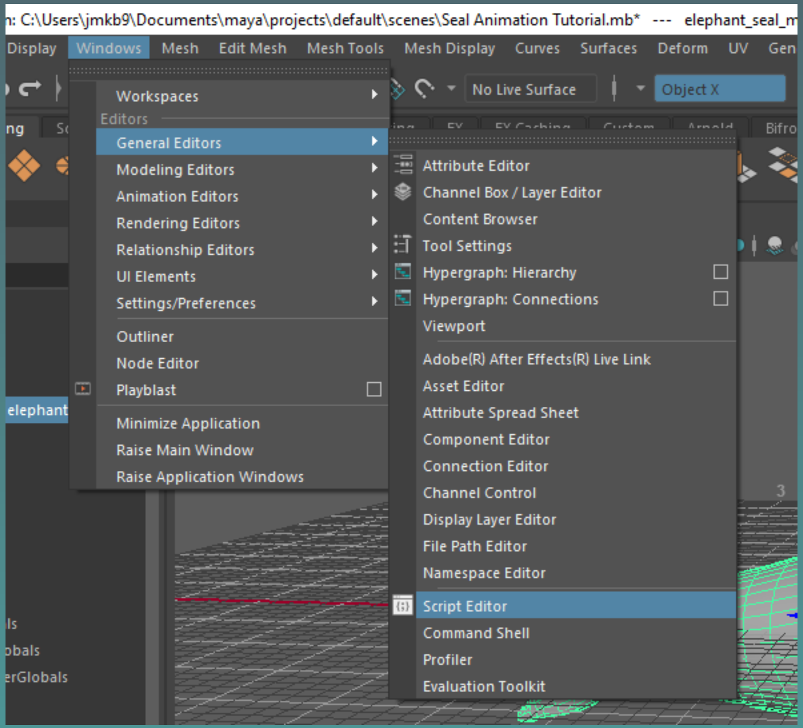
FILE ORGANIZATION IN MAYA

Put your scenes here:

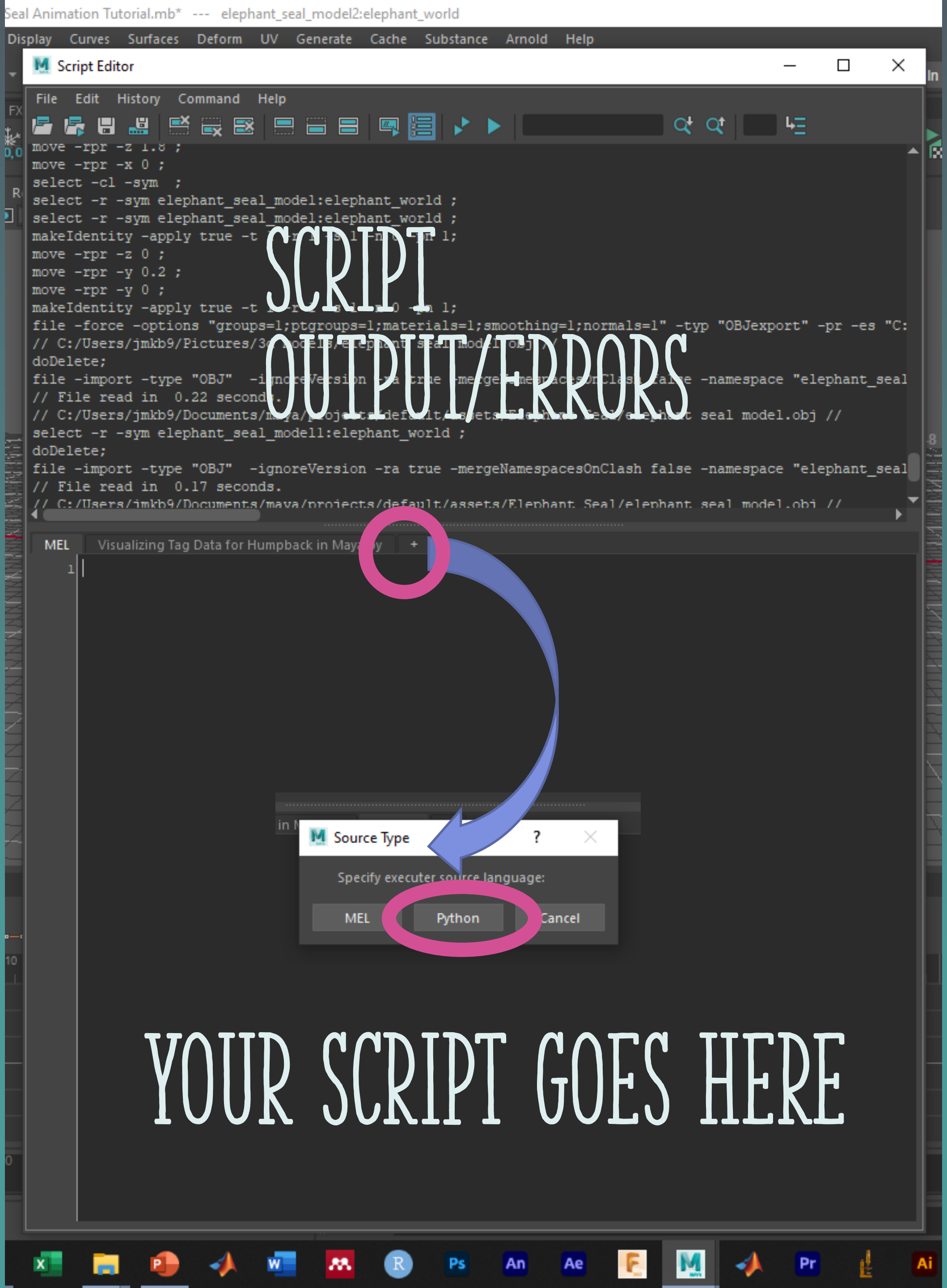
Documents > maya > projects > default > scenes



5. OPEN SCRIPT EDITOR



The script editor in Maya uses the coding language Python. Don't be afraid if you are not familiar– we will go over the code step by step.



Save your script!

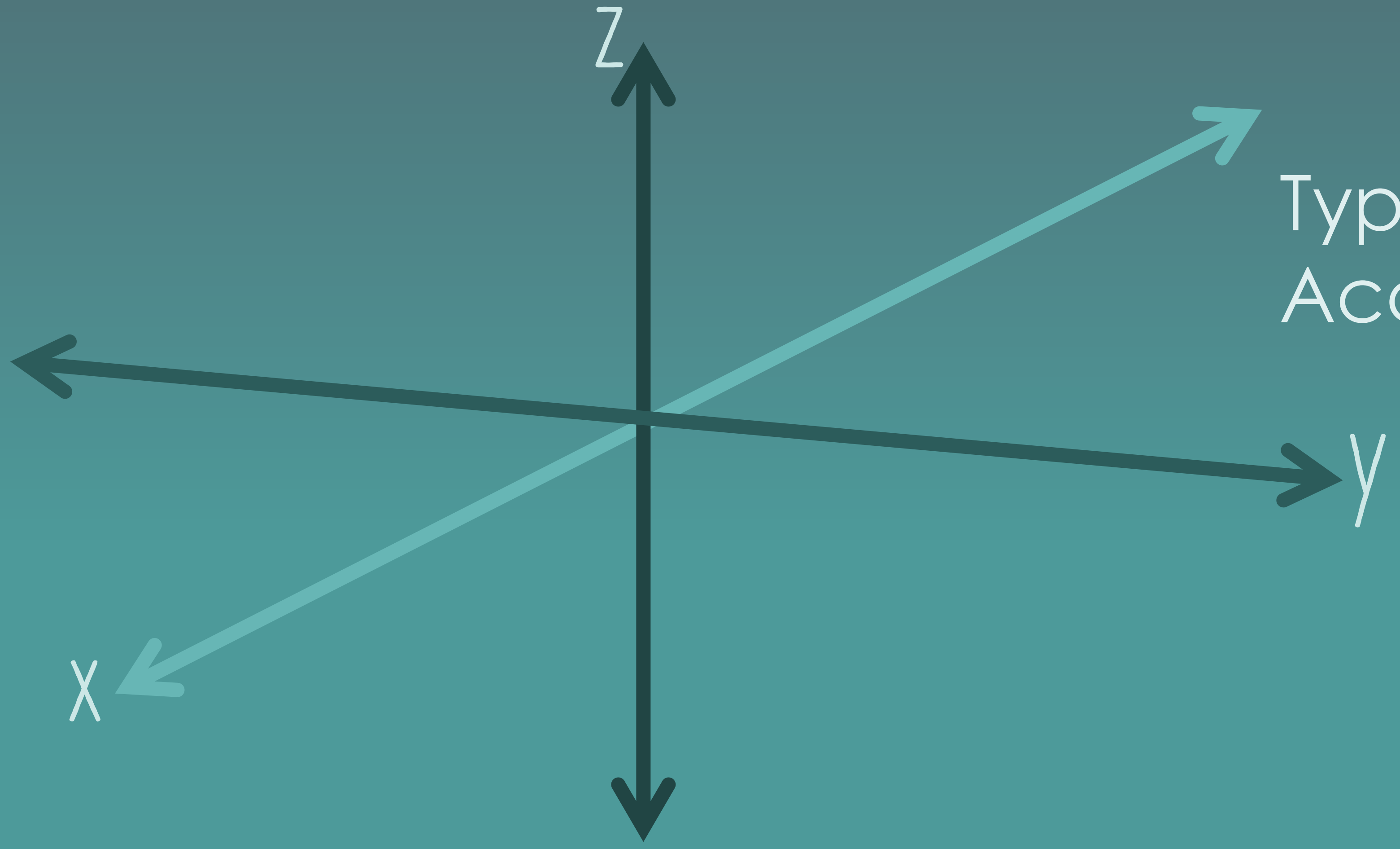
File > Save Script...

Save in:

default > scripts

6. UNDERSTANDING 3D DATA

Seconds	pitch_deg	roll_deg	head_deg	x_position	z_position	Depth (y_pos)



Typical Accelerometer Axes

6. UNDERSTANDING 3D DATA

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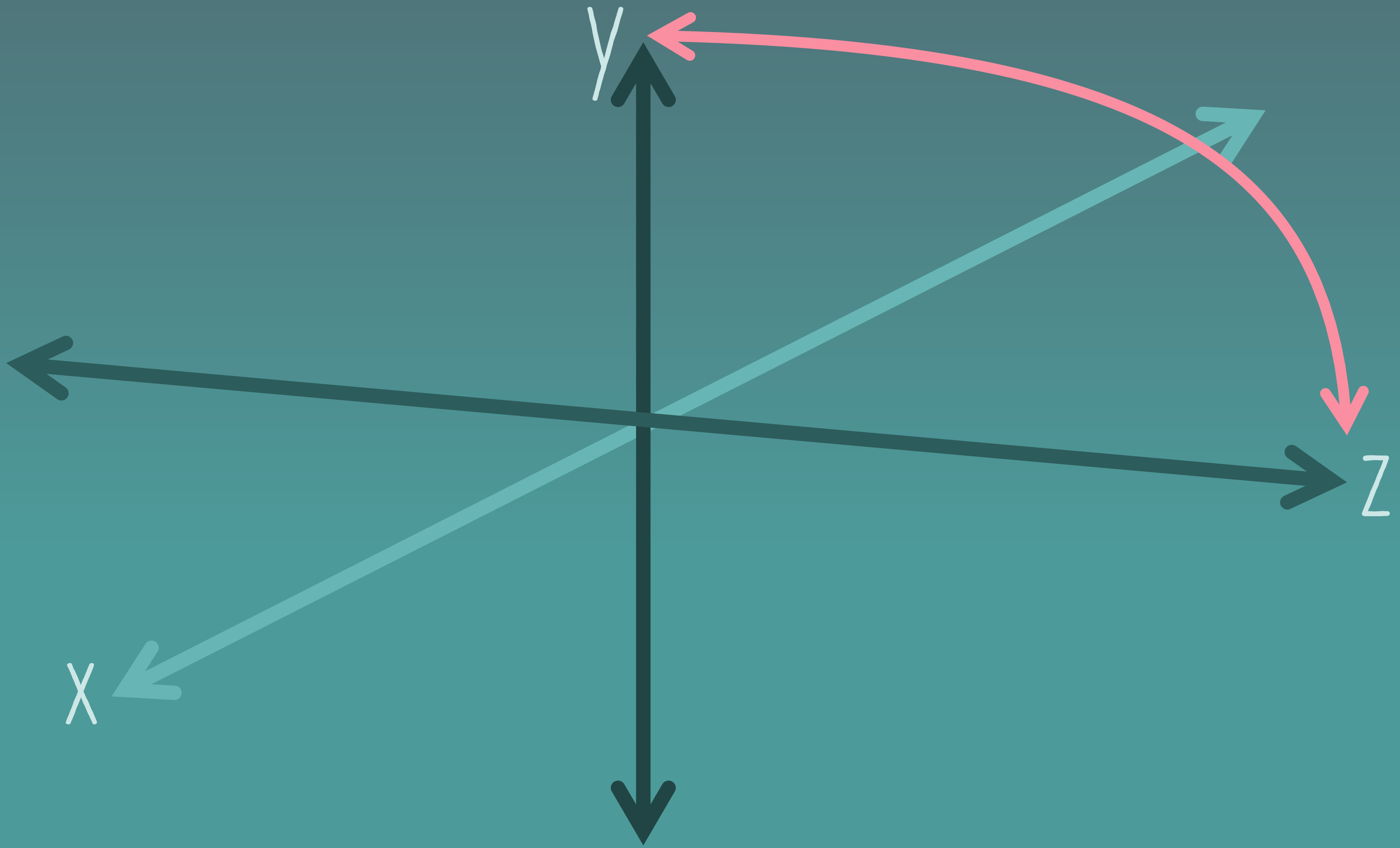
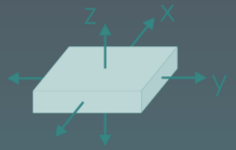


Default
Maya Axes

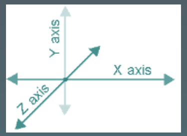
(y and z switched so vertical direction is y)
Don't ask me y!

6. UNDERSTANDING 3D DATA

accel



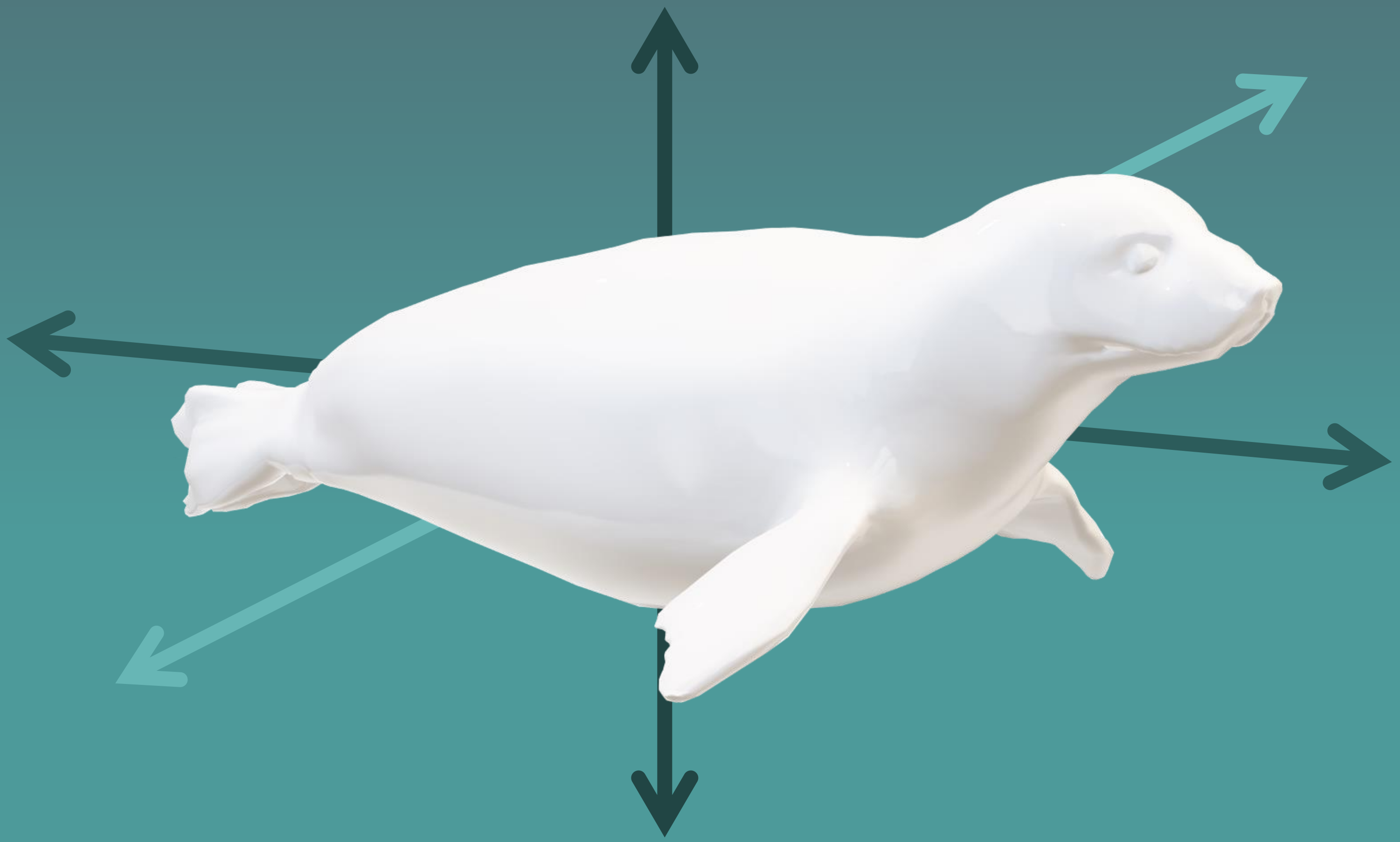
Maya



y_position on accelerometer, translates to z position in Maya

Depth (vertical position) is associated with y direction in Maya

Seconds	pitch_deg	roll_deg	head_deg	x_position	z_position	Depth (y_pos)



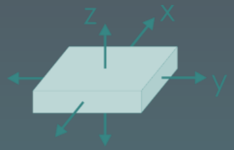
Pitch = 0°

Roll = 0°

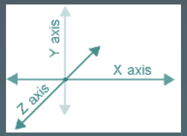
Heading = 0°

6. UNDERSTANDING 3D DATA

accel



Maya



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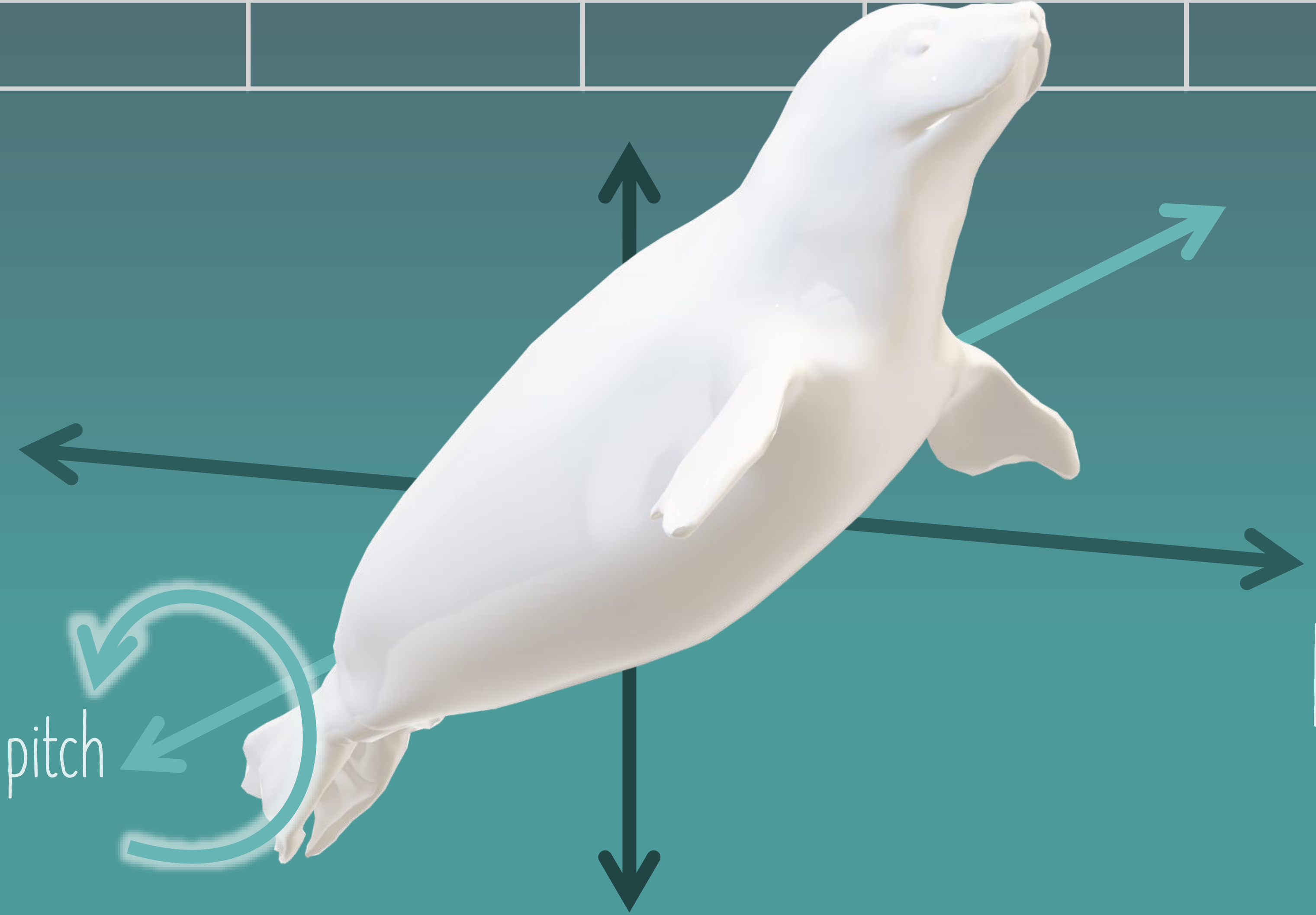
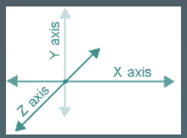


Pitch = **45°**

Roll = **0°**

Heading = **0°**

6. UNDERSTANDING 3D DATA



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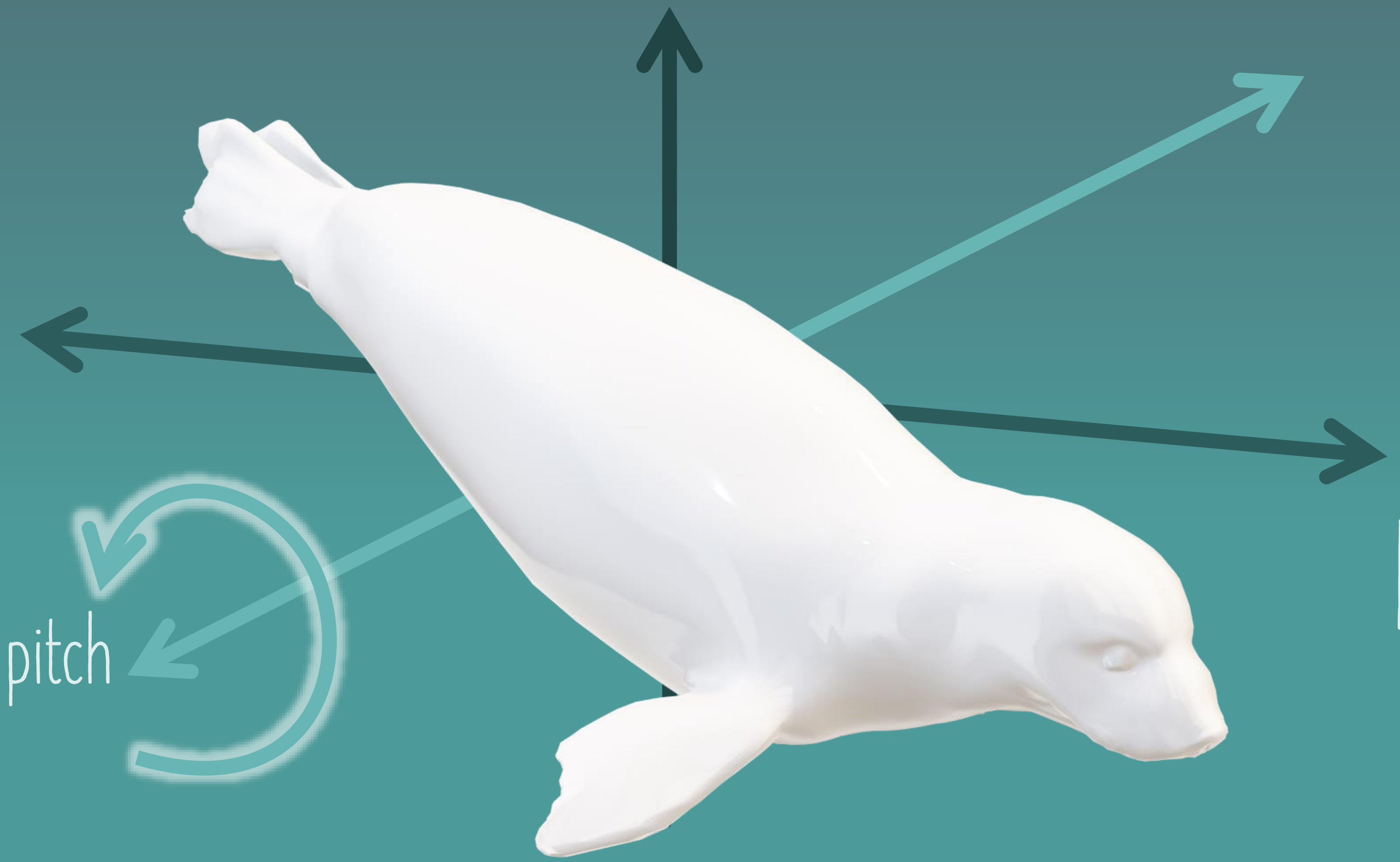


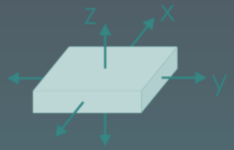
Pitch = -45°

Roll = 0°

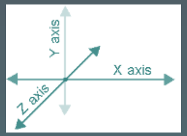
Heading = 0°

6. UNDERSTANDING 3D DATA

accel



Maya



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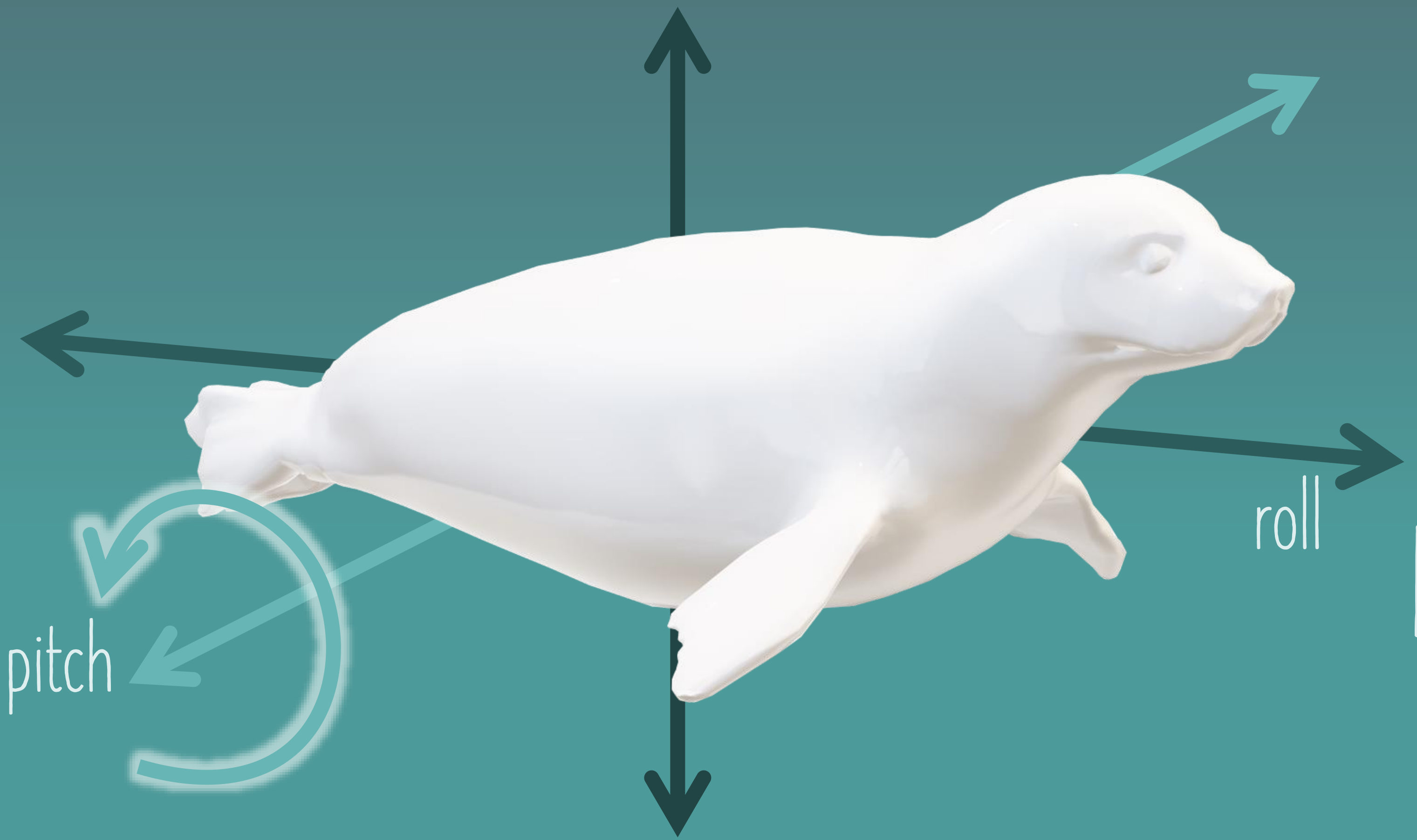


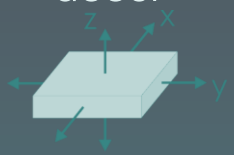
Pitch = 0°

Roll = 0°

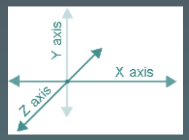
Heading = 0°

6. UNDERSTANDING 3D DATA

accel



Maya



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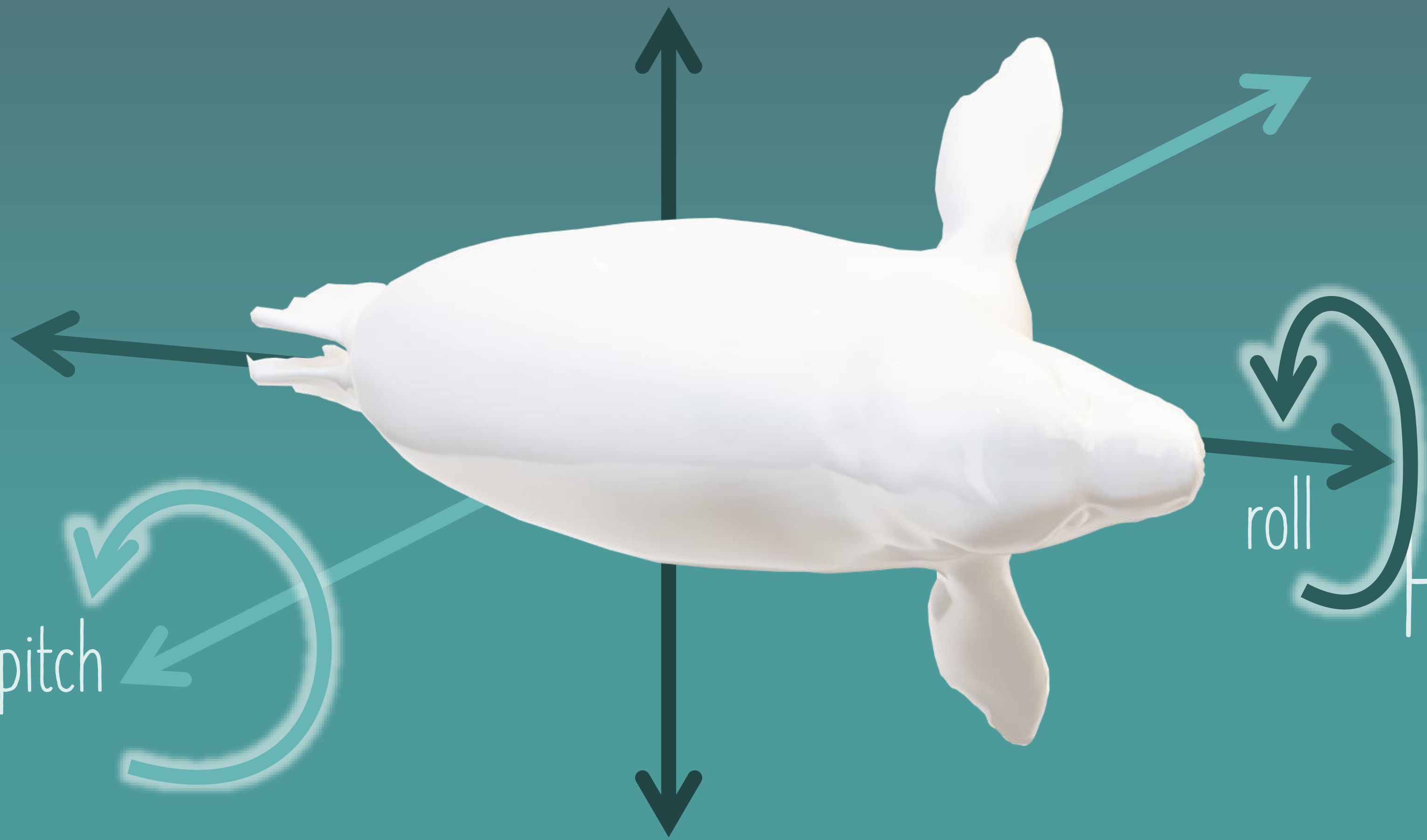


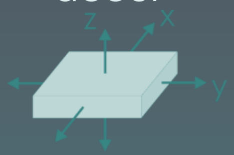
Pitch = 0°

Roll = 90°

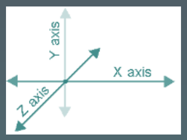
Heading = 0°

6. UNDERSTANDING 3D DATA

accel



Maya



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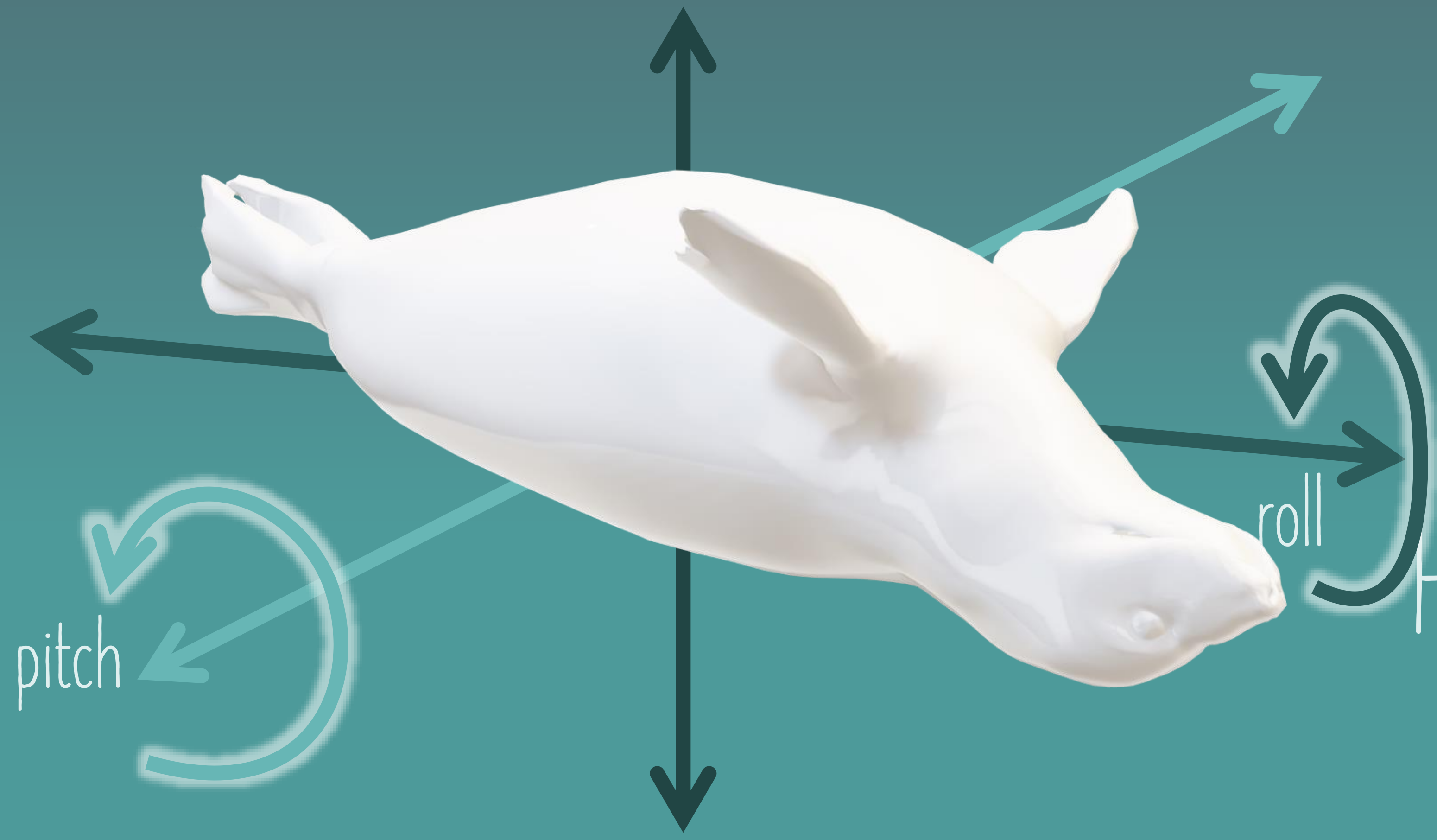
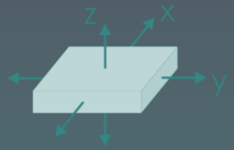


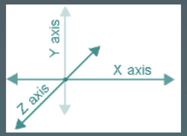
Pitch = 0°

Roll = 180°

Heading = 0°

6. UNDERSTANDING 3D DATA





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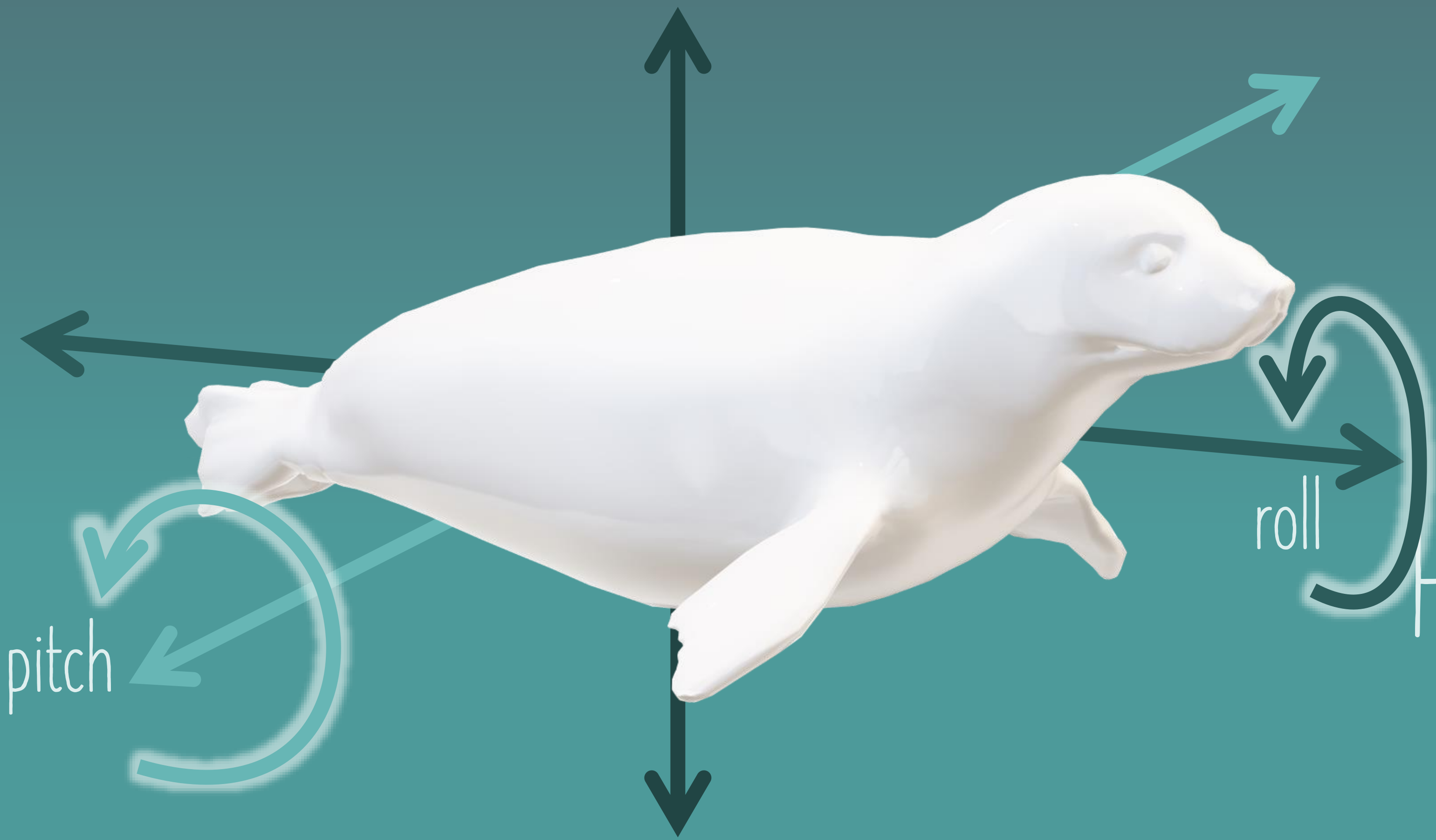


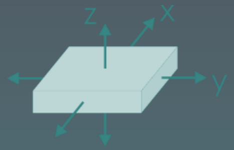
Pitch = 0°

Roll = 0°

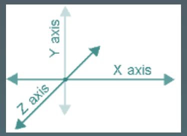
Heading = 0°

6. UNDERSTANDING 3D DATA

accel



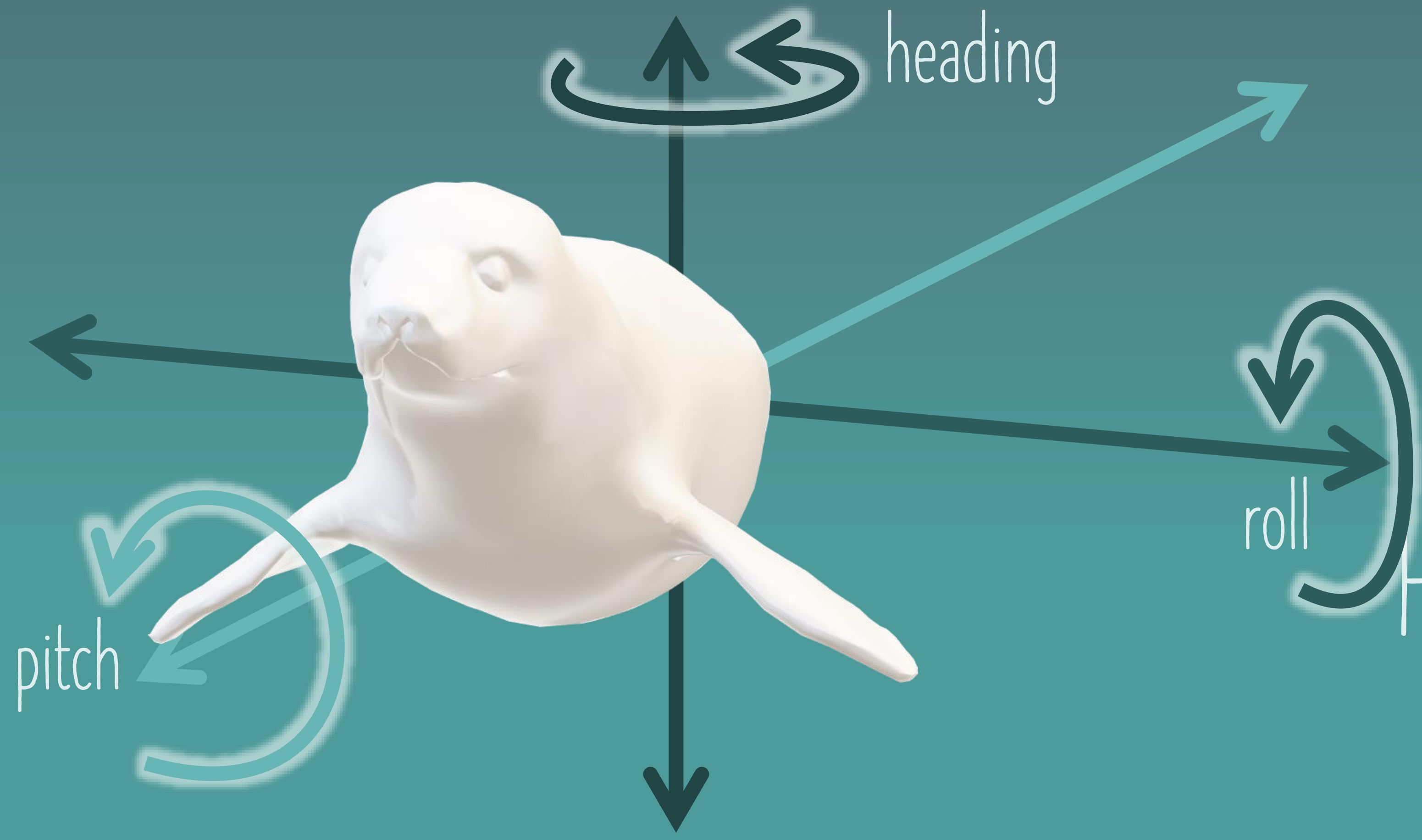
Maya



y_position on accelerometer, translates to z position in Maya

Depth (vertical position) is associated with y direction in Maya

Seconds	pitch_deg	roll_deg	head_deg	x_position	z_position	Depth (y_pos)



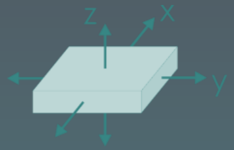
Pitch = 0°

Roll = 0°

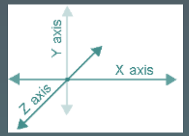
Heading = -45°

6. UNDERSTANDING 3D DATA

accel



Maya



y_position on accelerometer, translates to z position in Maya

Depth (vertical position) is associated with y direction in Maya

Seconds	pitch_deg	roll_deg	head_deg	x_position	z_position	Depth (y_pos)
10 Hz 0	-40	0	0	0	0	0
sampling rate 0.1	-40	0	0	**0** 0	**0** 1	**0** -1
(10 samples 0.2	-40	0	0	meters left/right 0	2	-2
per second) 0.3	**-40°** -40	**0°** 0	**0°** 0	0	3	-3
0.4	-40	0	0	0	4	-4
0.5	Pitching body -40	Rolling body 0	Pointing body 0	0	5	-5
0.6	40 degrees -40	0 degrees to 0	0 degrees to 0	0	6	-6
0	below horizon -40	either side 0	the right or left 0	0	0	0
0.1	-40	(not rolled 0	(12 o'clock 0	0	1	-1
0.2	-40	over) 0	position) 0	0	2	-2
…	…	…	…	…	…	…
4.4	-6	0	0	0	**46** 44	**-40** -39.9
4.5	-4	0	0	0	45	-40
4.6	-2	0	0	0	meters forward 46	meters down -40
4.7	0	on belly 0	0	0	46	-40
4.8	0	(prone) 0	0	0	46	-40
4.9	0	**0°** 0	0	0	46	-40
5	0	0	0	0	46	-40
5.1	0	2	0	0	46	-40
5.2	0	4	0	0	46	-40
5.3	0	6	0	0	46	-40
…	…	…	…	…	…	…
13.7	0	174	0	0	46	-40
13.8	0	176	0	0	46	-40
13.9	0	**180°** 178	0	0	46	-40
14	0	180	0	0	46	-40
14.1	0	upside down (supine) 180	0	0	46	-40

7. ADD YOUR CODE

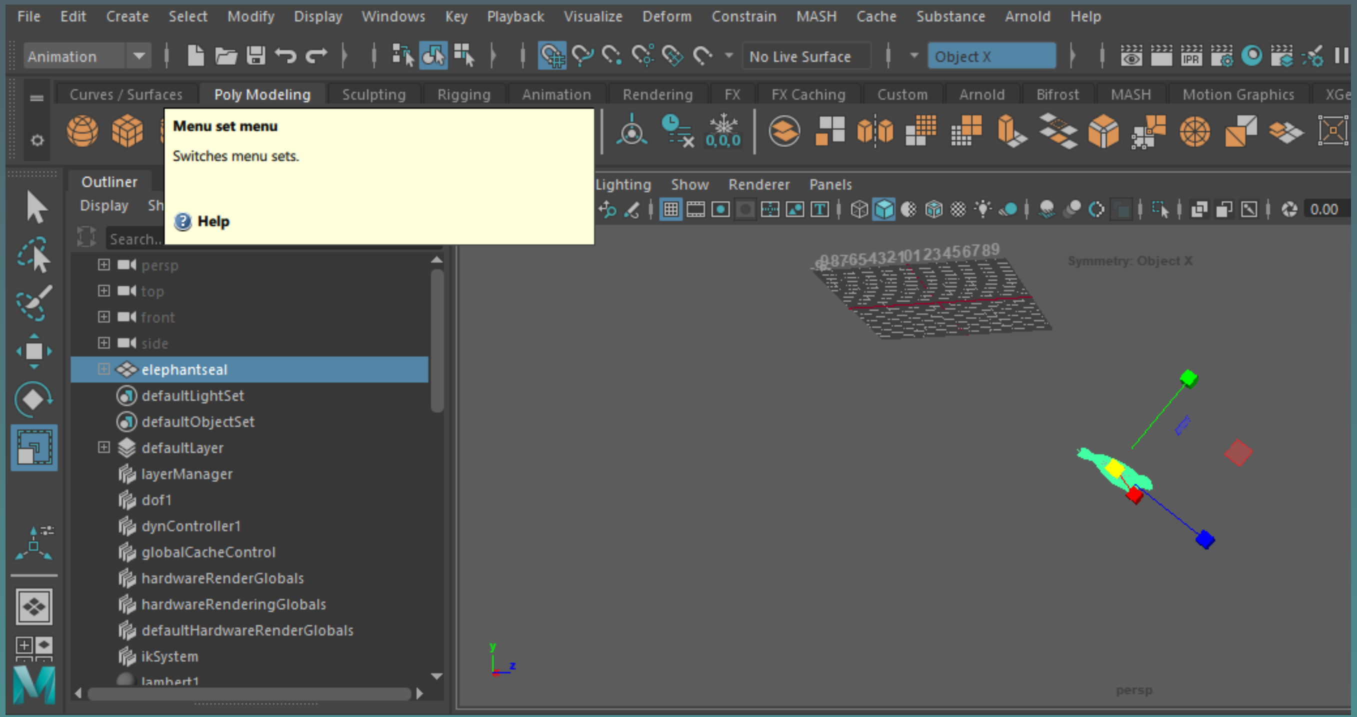
This code is in Python. You can find this script ("Seal Sample Data Input Code.py") in the Google Drive resources at jessiekb.com/resources passcode ucsc

It reads in your Sample 3D data from a CSV (Sample Seal Data.csv) and sets position and rotation keyframes for each datapoint. Replace the directory for the CSV file to reflect where it is stored on your computer and you should be to go! Press CTRL + ENTER to run your code.

```
import csv
import pymel.core as pm

#Defining variables which will be used as column indices (can check these in 'Sample Seal Data
Headers.csv')
SECONDS      = 0
PITCH_DEG    = 1
ROLL_DEG     = 2
HEAD_DEG     = 3
X_POS        = 4
Z_POS        = 5
DEPTH        = 6

#Defining two variables which will be used as indices where animation starts and ends
START = 0  #start time in sec
END   = 12 #end time in sec

fs = 10 #Sample frequency (in Hz or "samples per second")

#Reading in .csv file (update to reflect your own path)
with open('C:/Users/jmkb9/Pictures/Art/Workshops/Sample Seal Data.csv') as csv_file:
    data = csv.reader(csv_file, delimiter=',')

#For loop runs through all rows in data .csv file
    for i, row in enumerate(data):
        if i % 10000 == 0:
            print 'Processing row %s' % (i)
#If the row number is between the start and end indices of where we want to animate, run this.
        if i >= START*fs and i < END*fs:

#We will use the function float() to return floating point numbers (with decimals) for data values
            time = float(i) / fs - START #Translate .csv data time into animation time
            time = time * 24 #Get from frames to seconds

            translateX_value = float(row[X_POS])
            translateZ_value = float(row[Z_POS]) #fixed in newest version of model so don't need -
            depth_value      = float(row[DEPTH])

            pitch_value = -float(row[PITCH_DEG]) #add negative to fix orientation
            head_value  = float(row[HEAD_DEG])
            roll_value  = float(row[ROLL_DEG])

#Define which object will be transformed according to data (use name as described in "Outliner")
            object = pm.ls('elephantseal')[0]

#..setKey function sets a keyframe of the given value at the given time.
            object.translateX.setKey(value=translateX_value, time=time)
            object.translateZ.setKey(value=translateZ_value, time=time)
            object.translateY.setKey(value=depth_value, time=time)

            object.rotateX.setKey(value=pitch_value, time=time)
            object.rotateY.setKey(value=head_value, time=time)
            object.rotateZ.setKey(value=roll_value, time=time)

            print 'setting y= %s msw, x= %s, z= %s, rotX= %s, rotY= %s, rotZ = %s for time= %s frames' %
(depth_value , translateX_value , translateZ_value , pitch_value , head_value , roll_value , time)
```

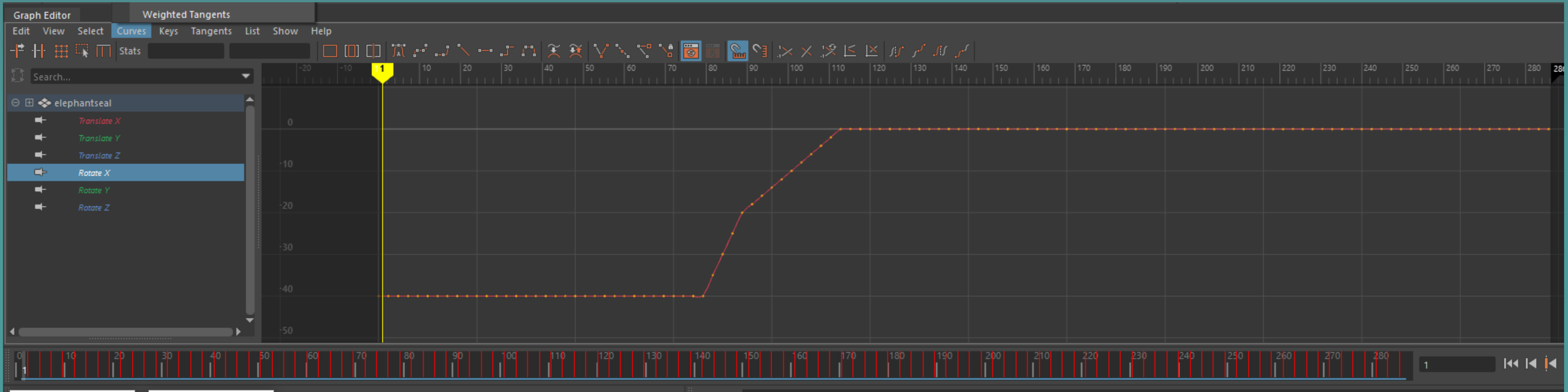
8. PREVIEW ANIMATION

Change to "Animation" workspace and then use ALT + V to toggle play/pause.



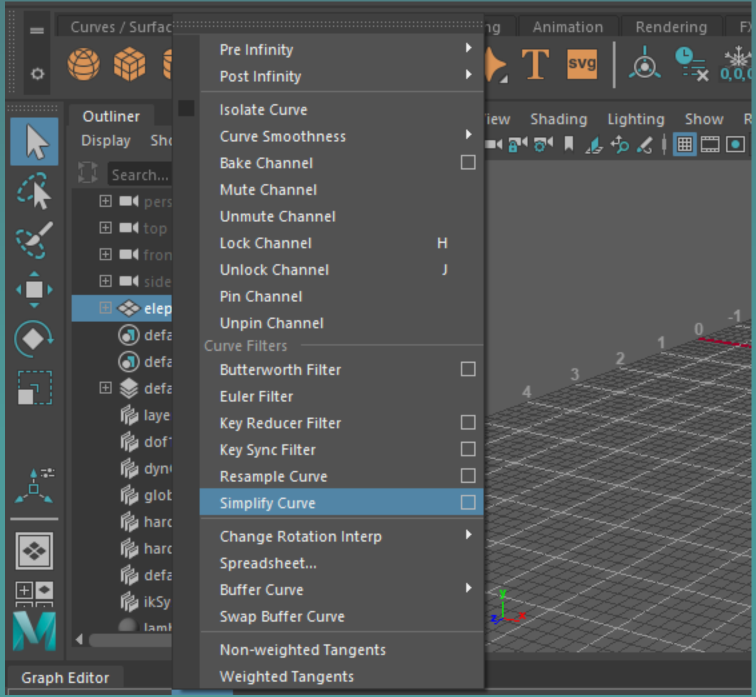
Scrub forward and backward using the yellow playhead in the Graph Editor (Windows>Animation Editors>Graph Editor)

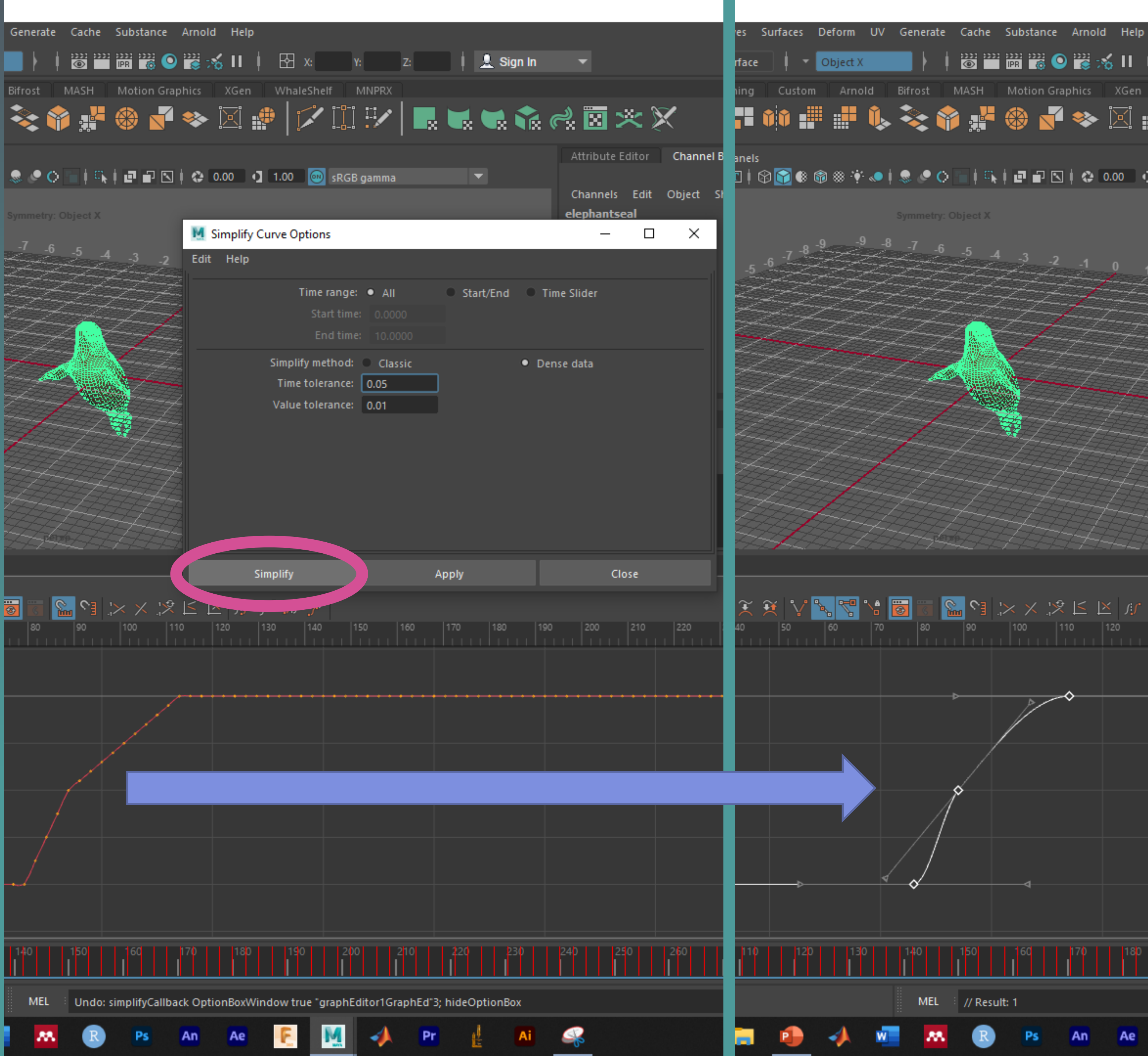
The code will have added many (120 in our case) red keyframes into the timeline, evenly spaced over 12 seconds (286 frames).



9. SMOOTH ANIMATION

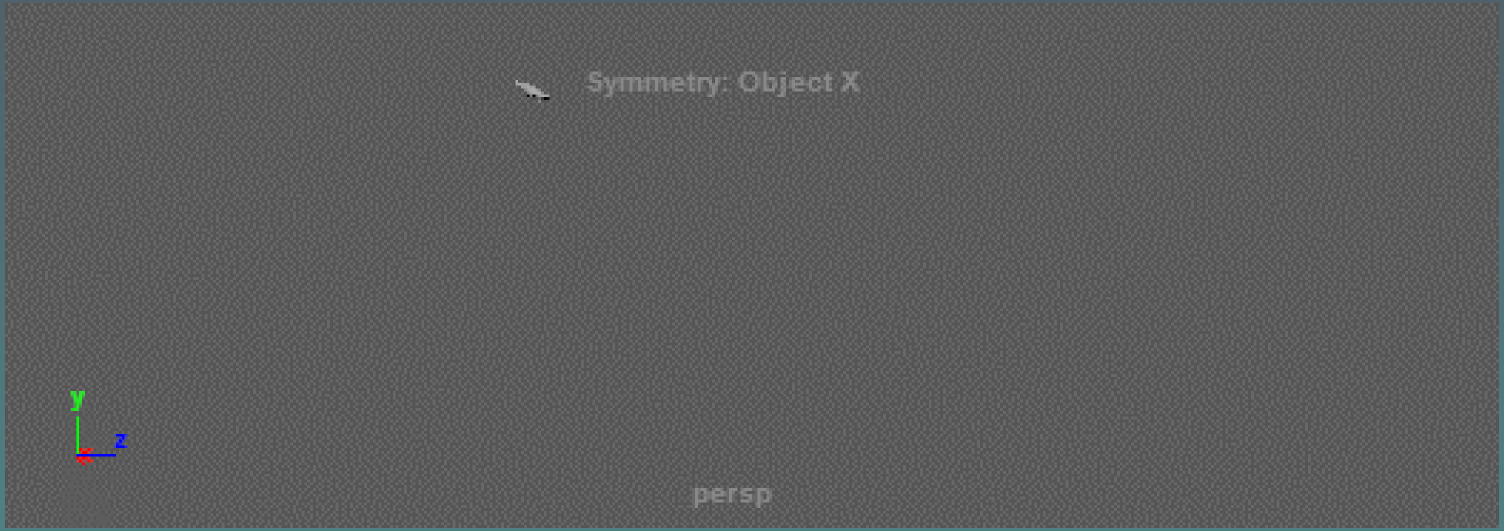
If the motion from your data is too choppy, you can reduce the number of keyframes by opening "Simplify Curve" options by clicking on the small box to the right of the option in the Curves menu.





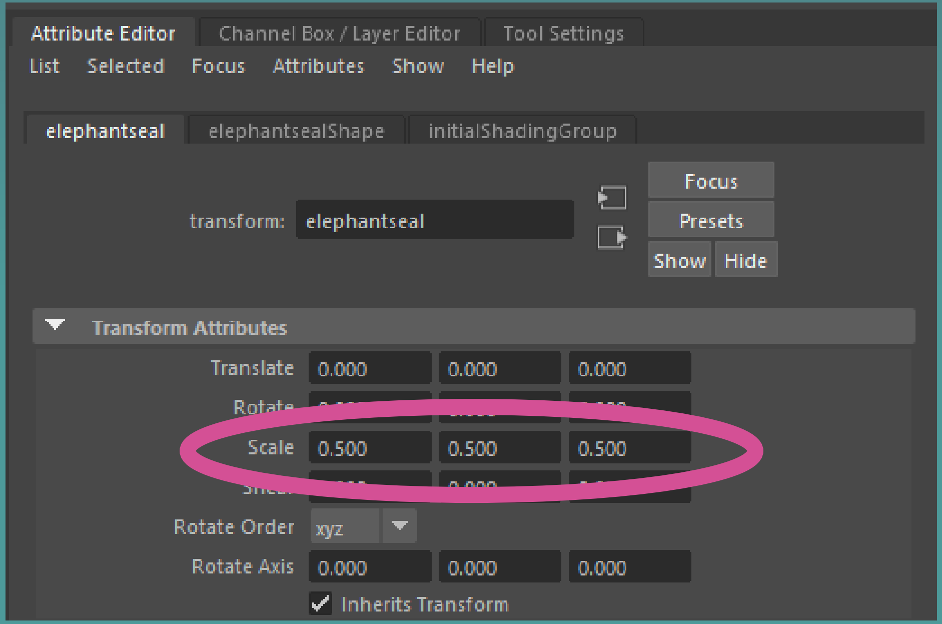
10. PLAYBLAST

You can export a quick, low resolution preview of your animation by going to Windows>Playblast



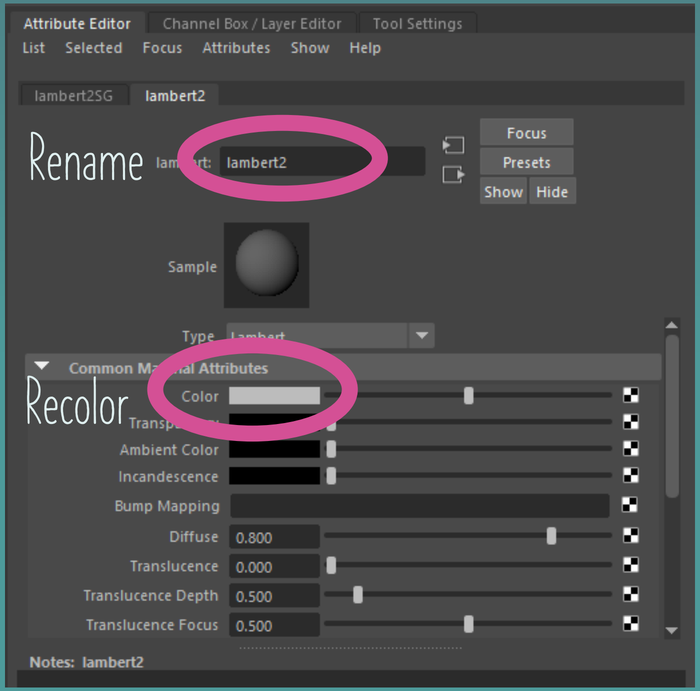
11. SCALE YOUR SCENE

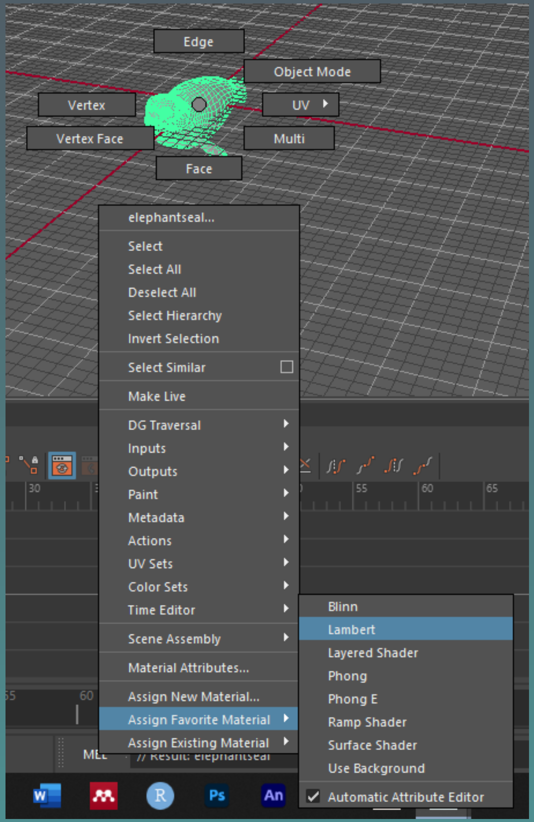
Make sure that the size of your character makes sense in relation to the size of the scene. In my case, I found that downscaling my elephant seal by 50% (Scale to 0.5 in 3 dimensions) makes it the right size compared to a max depth of 40 meters.



12. TEXTURE YOUR SEAL

We don't have a detailed texture to add here so we'll just add a solid color. Right click and hold on the elephant seal object, scroll down to "Assign Favorite Material", and select the "Lambert" material.

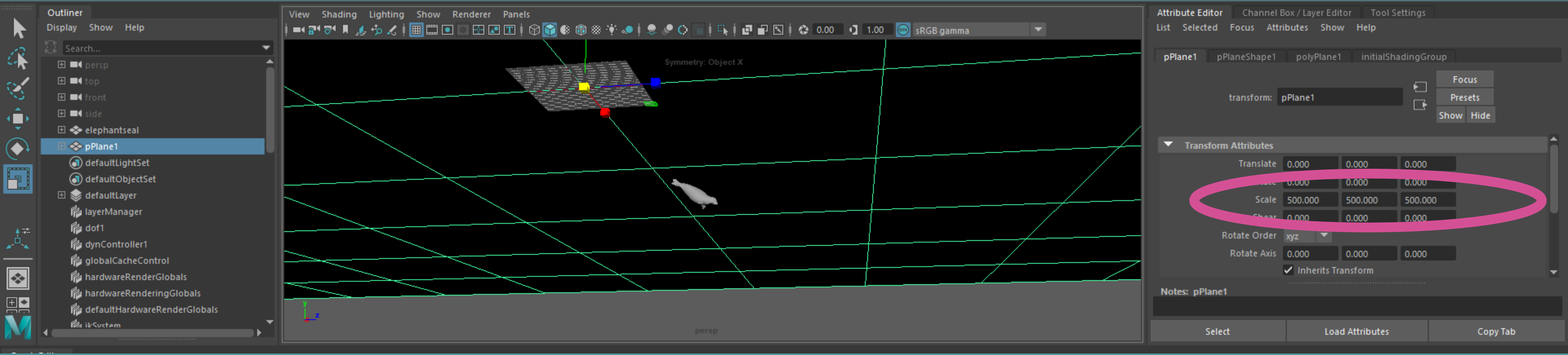




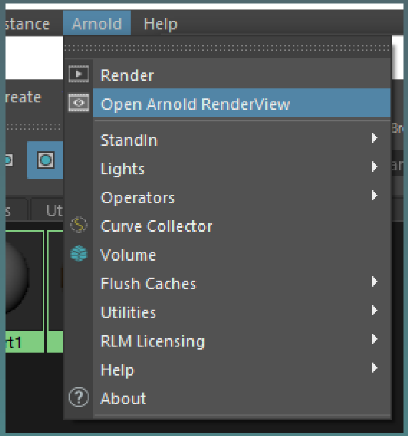
13. ADD SOME WATER

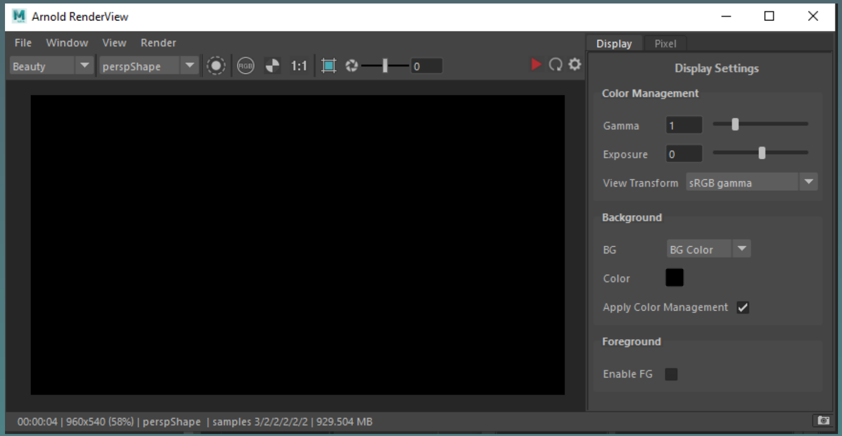
Create a plane and scale it up to 500 x 500 x 500

(don't ask me why there is a y [vertical] dimension to a plane!)



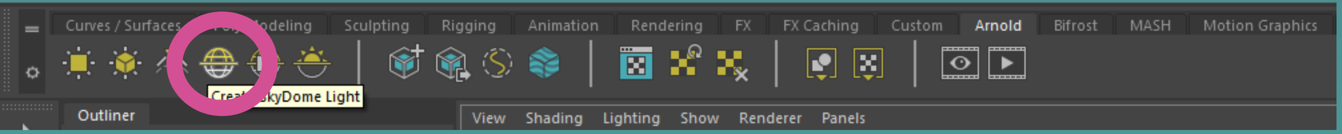
17. OPEN UP A RENDER PREVIEW



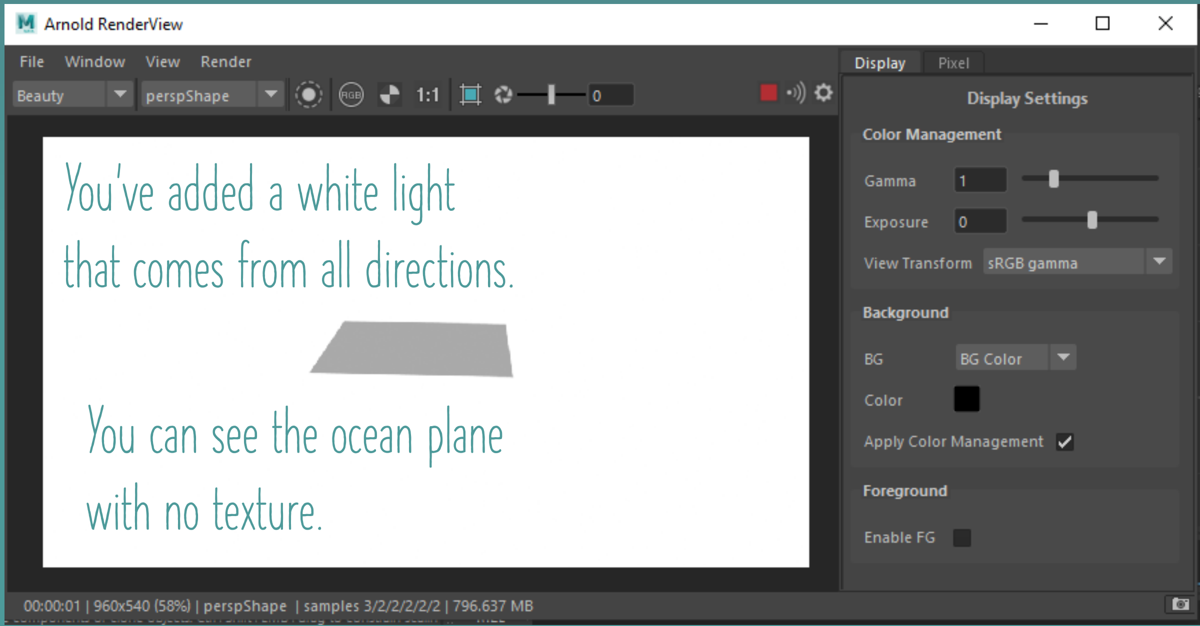


If you press the red play button to preview the scene, you'll see that you get an error message, saying there is no light in the scene. So let's add one!

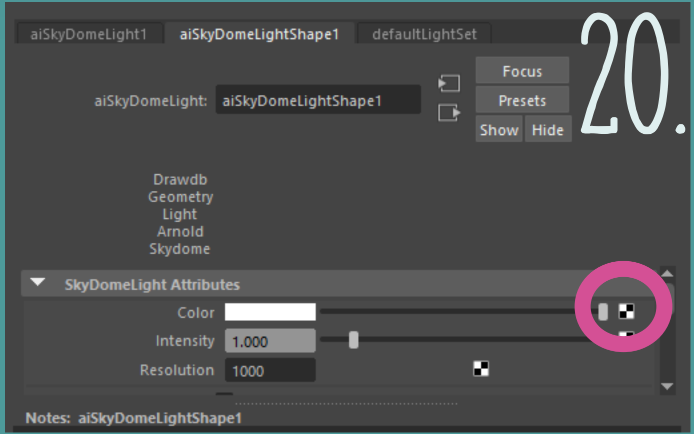
18. CREATE A LIGHT



19. PRESS PLAY NOW

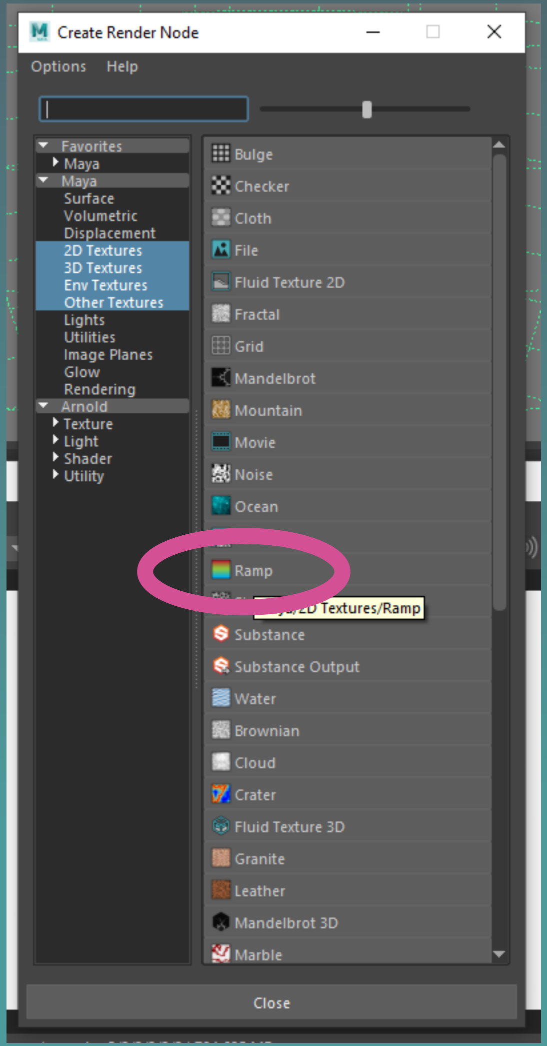


20. CREATE NODE

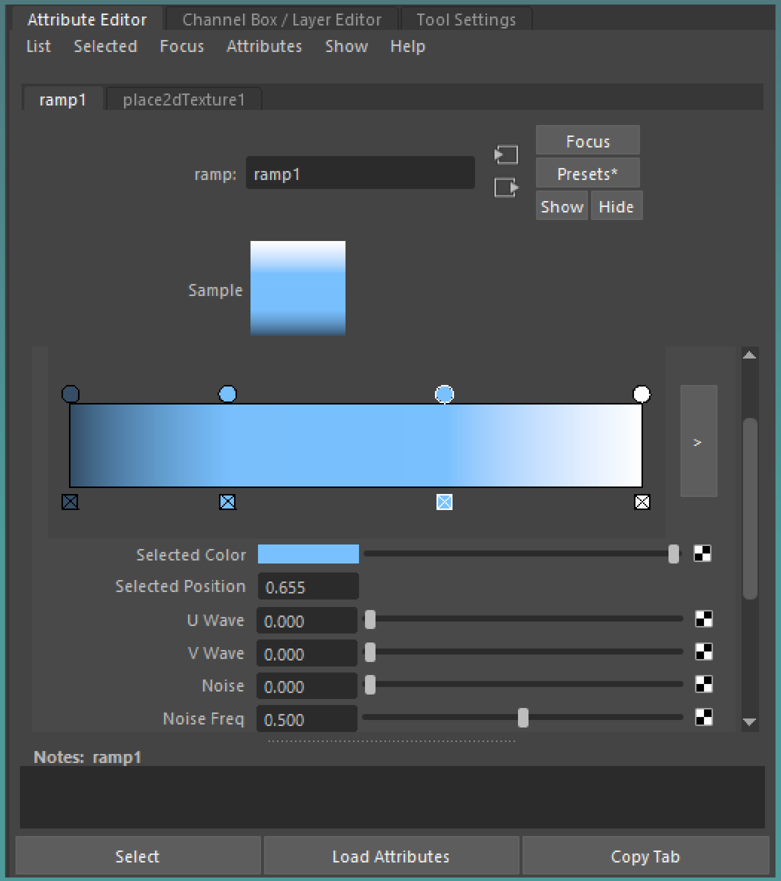


This opens a link from the color of the SkyDome Light to....

21. LINK RENDER NODE TO COLOR RAMP

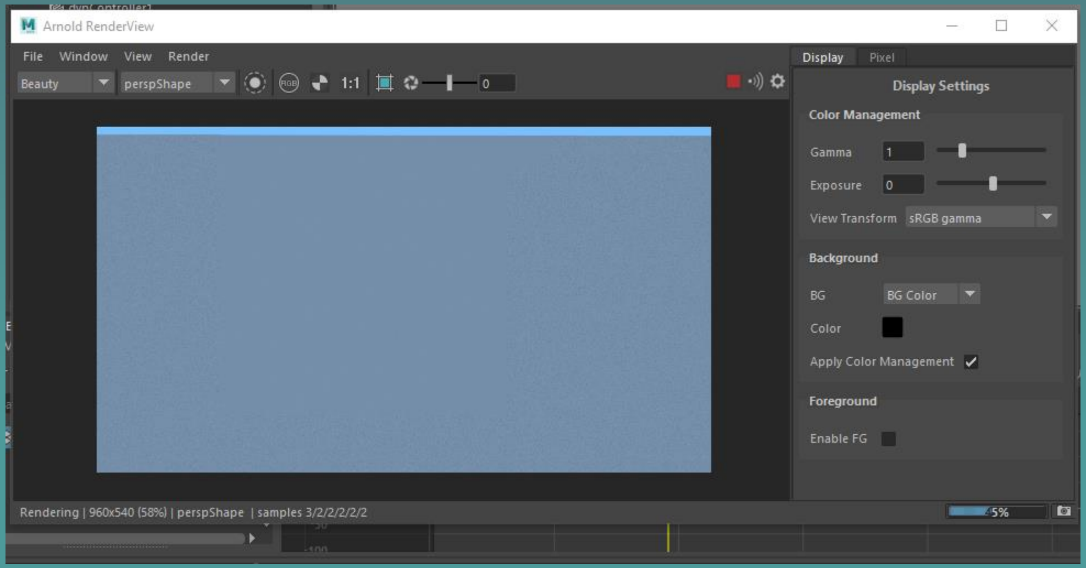


This step links the color of the SkyDome Light to this color gradient or "ramp".



22. PRESS PLAY AGAIN

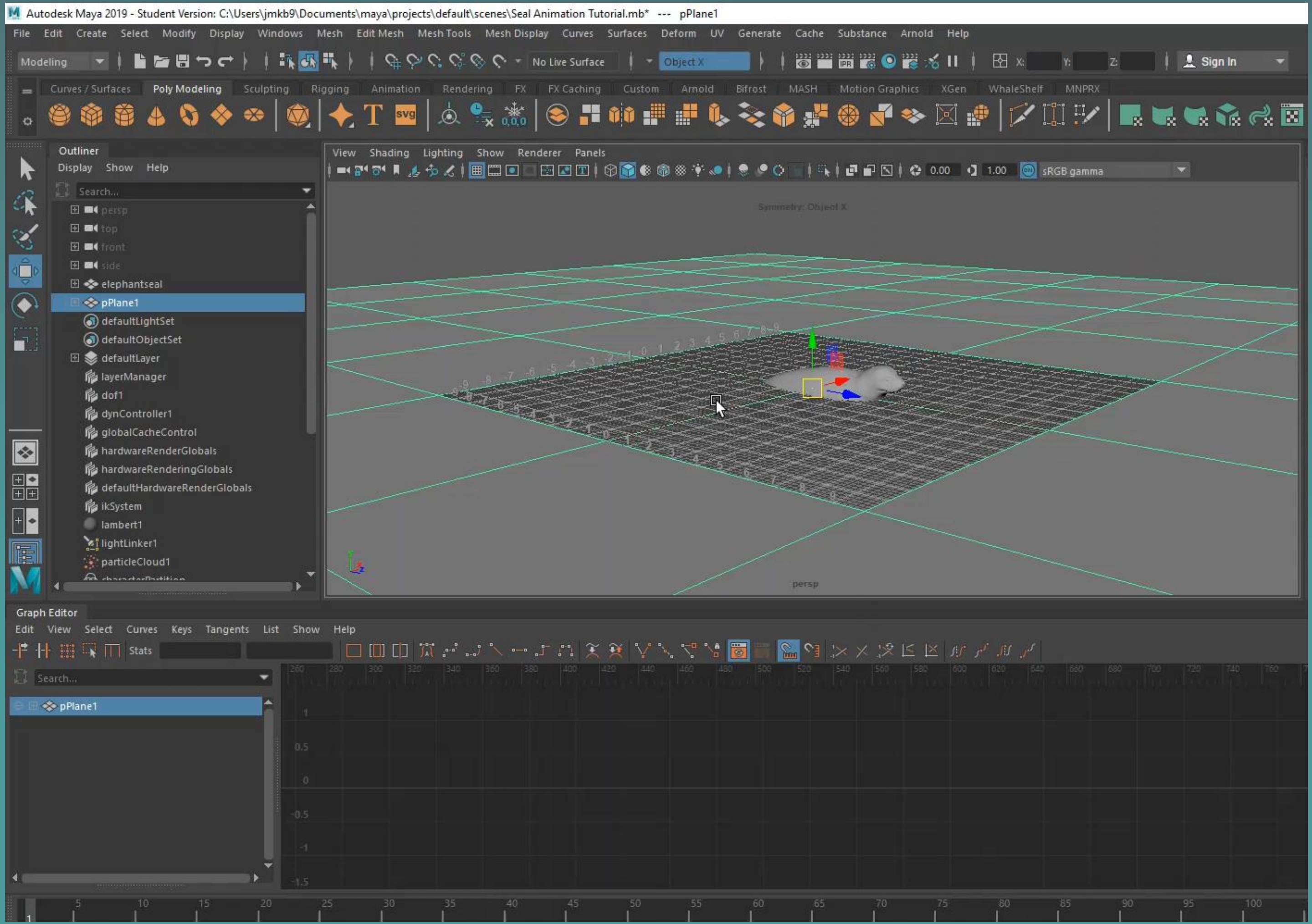
Now you have a blue sky around your scene. Next, we need to make the ocean look good!

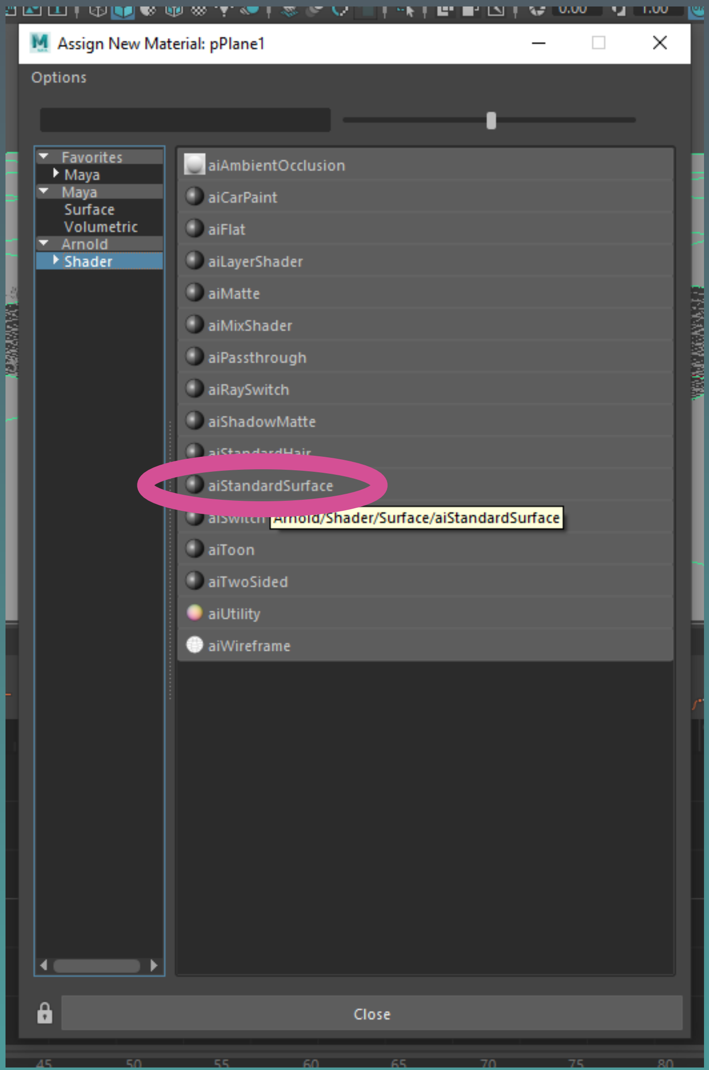


Any issues? Make sure your Renderer under Arnold>Render is set to "Arnold Renderer", refresh if needed.

23. ASSIGN OCEAN TEXTURE

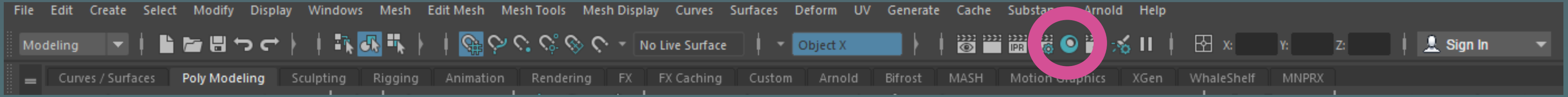
Assign a new material to the plane by right clicking and holding, scrolling down to "Assign New Material..." and then select aiStandardSurface from the Arnold > Shader menu (see right)





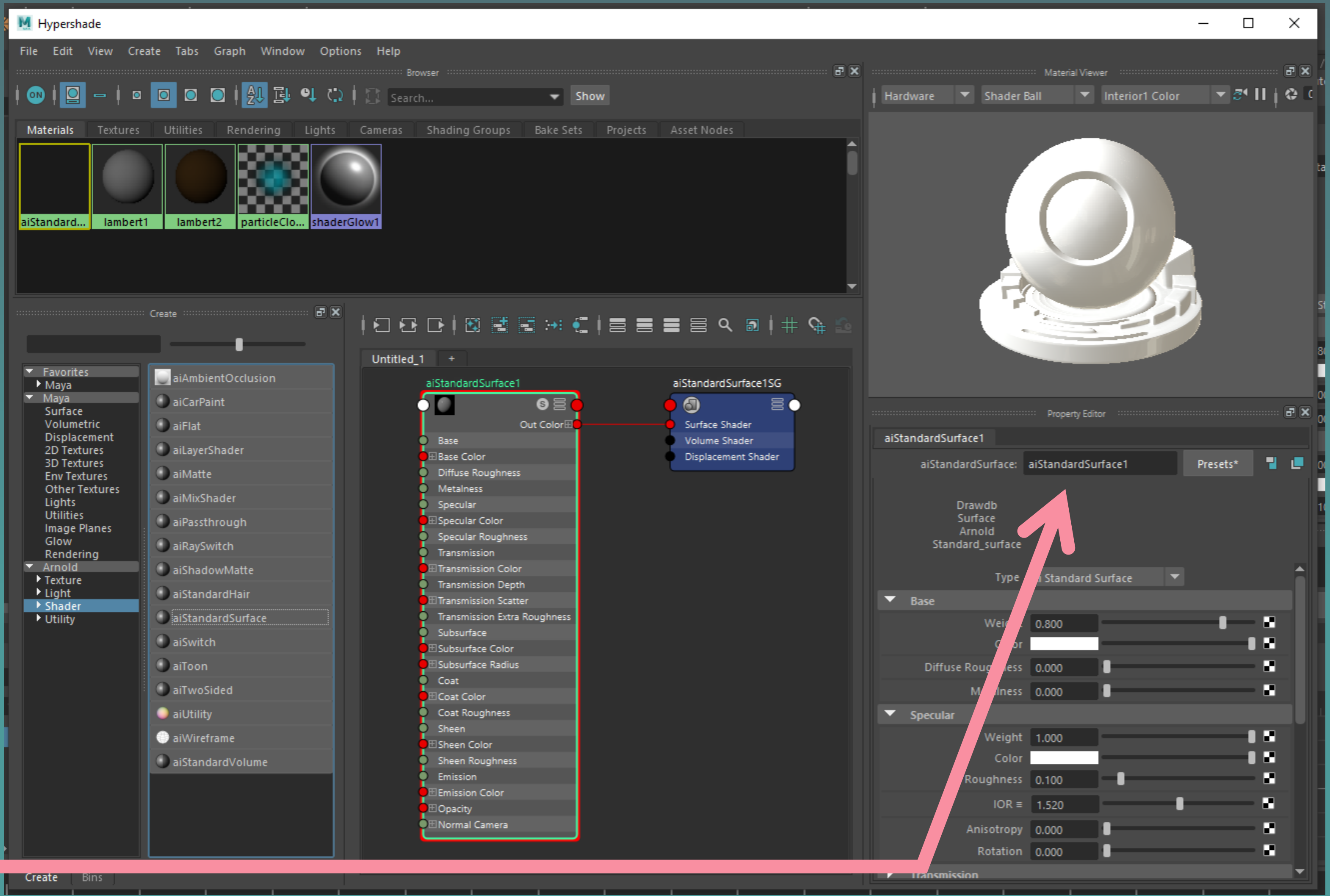
24. ANOTHER METHOD

Open the "Hypershade Editor"

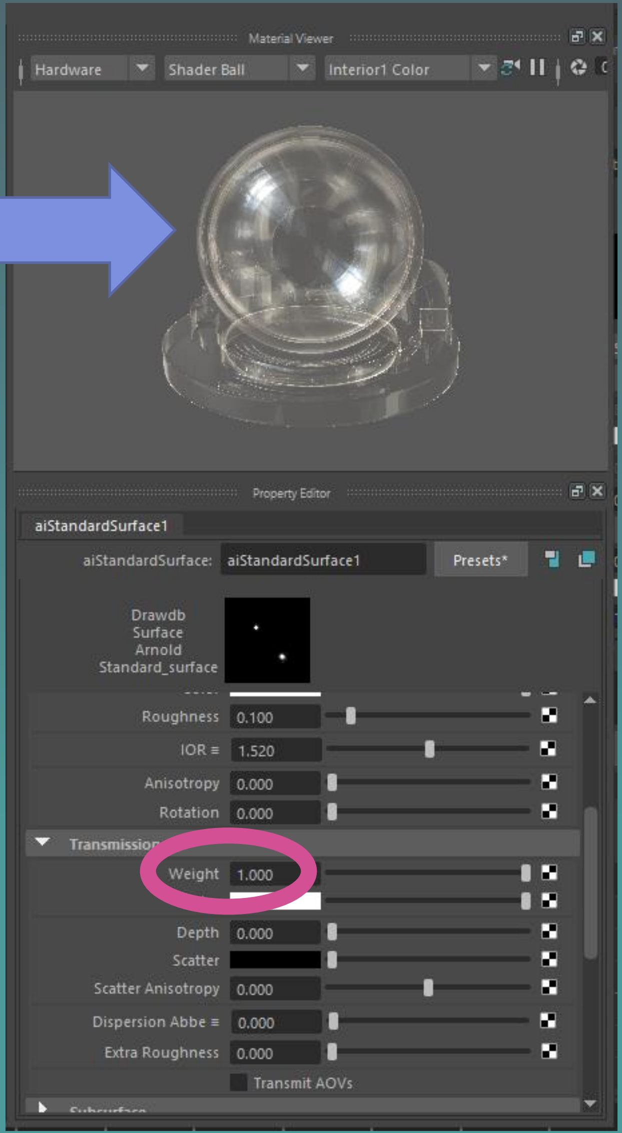


In the "Create" menu in the bottom left, navigate to Arnold>Shader> and click on "aiStandardSurface" to create a new texture. It will be added to the "Node Editor" to the right, where you can visualize each linked node of your texture.

Rename this texture to "Ocean Surface"



25. CUSTOMIZE OCEAN SURFACE TEXTURE

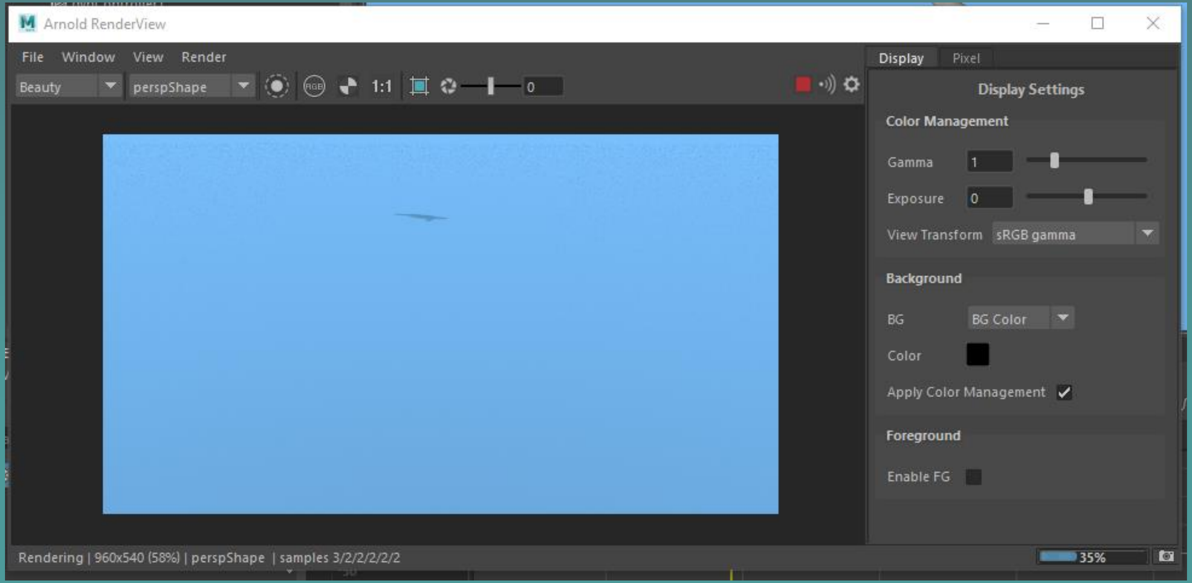


Make the ocean transparent, but reflective, by increasing Transmission Weight to 1 and keeping Specular Weight as is.

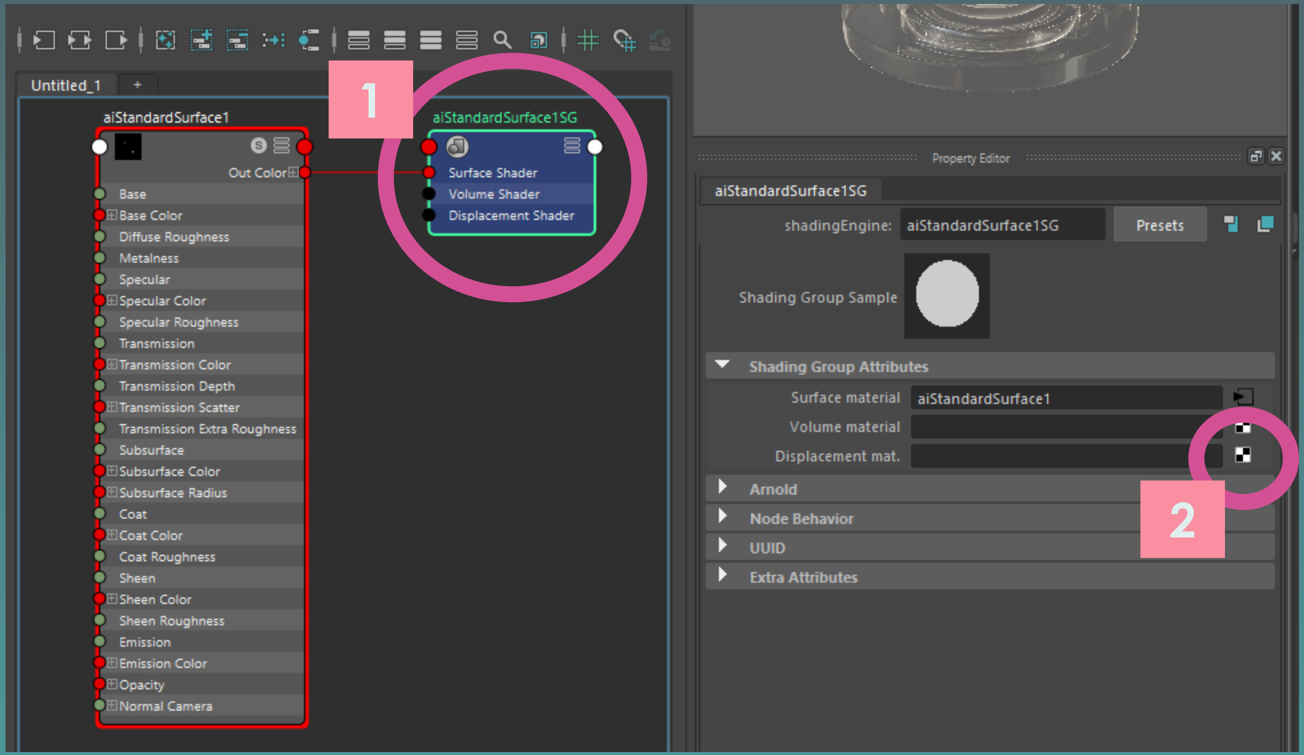
26. PRESS PLAY AGAIN

Now your ocean is transparent!

Pan around your scene in persp view to see the scene.

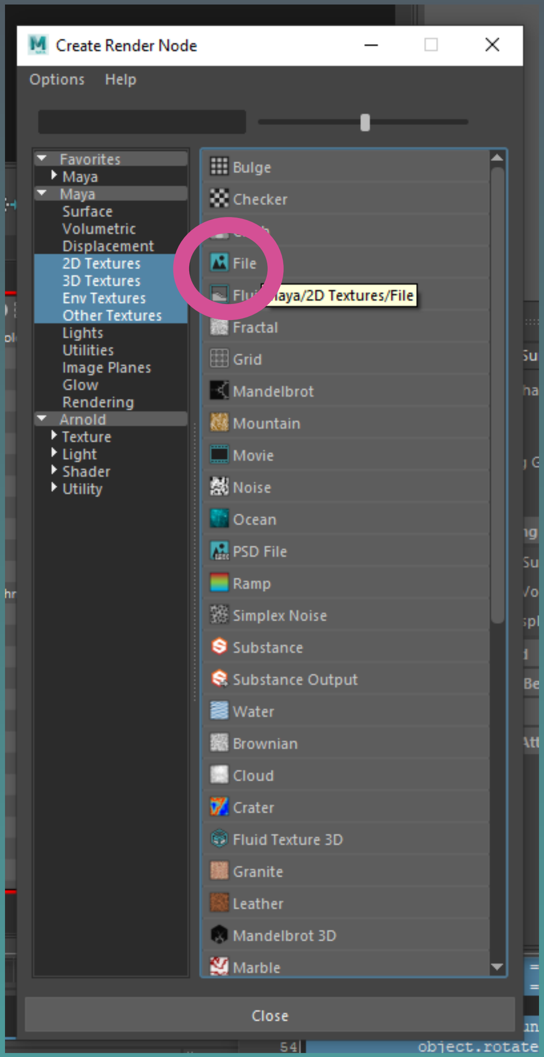


27. CUSTOMIZE OCEAN SURFACE TEXTURE

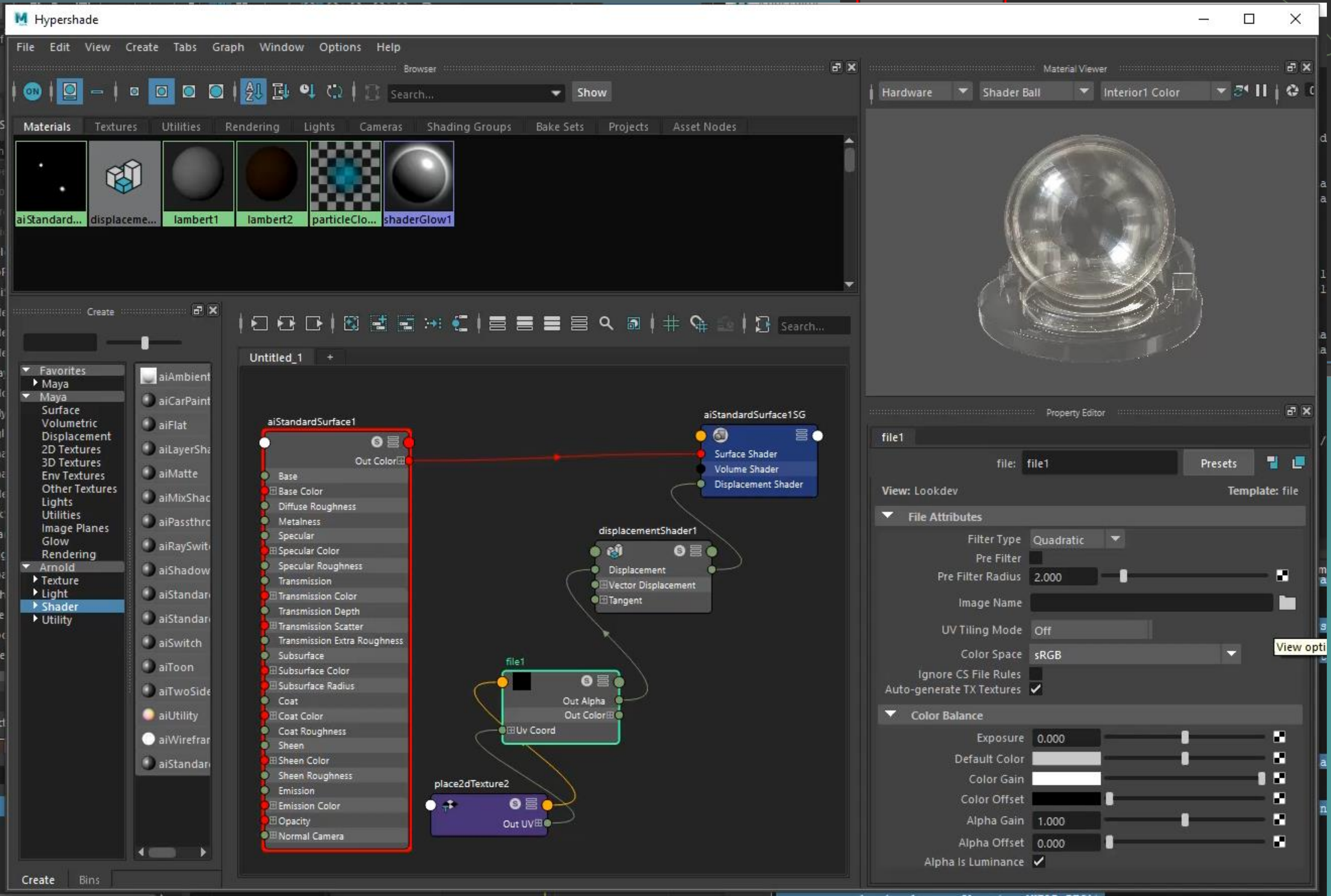


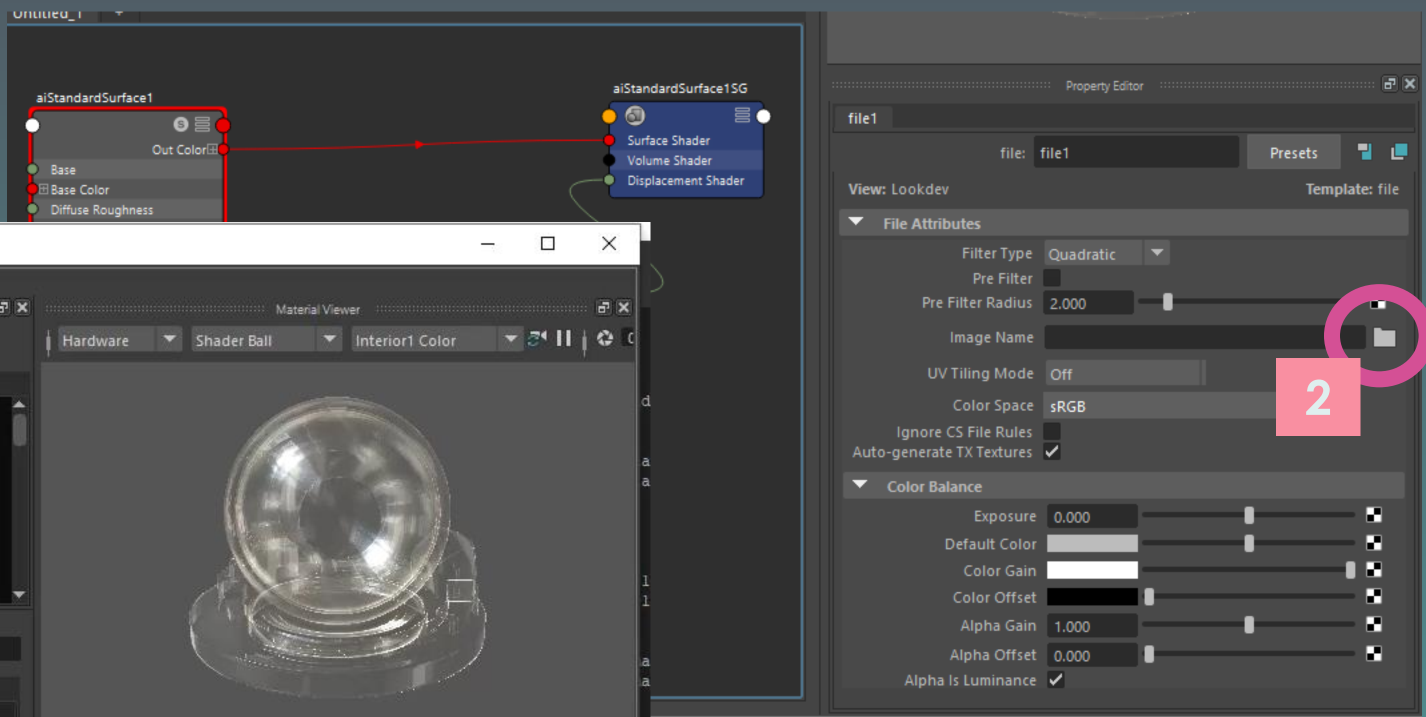
This opens a link from the displacement of this texture shader to...

a file:



28. OPEN THE FILE NODE

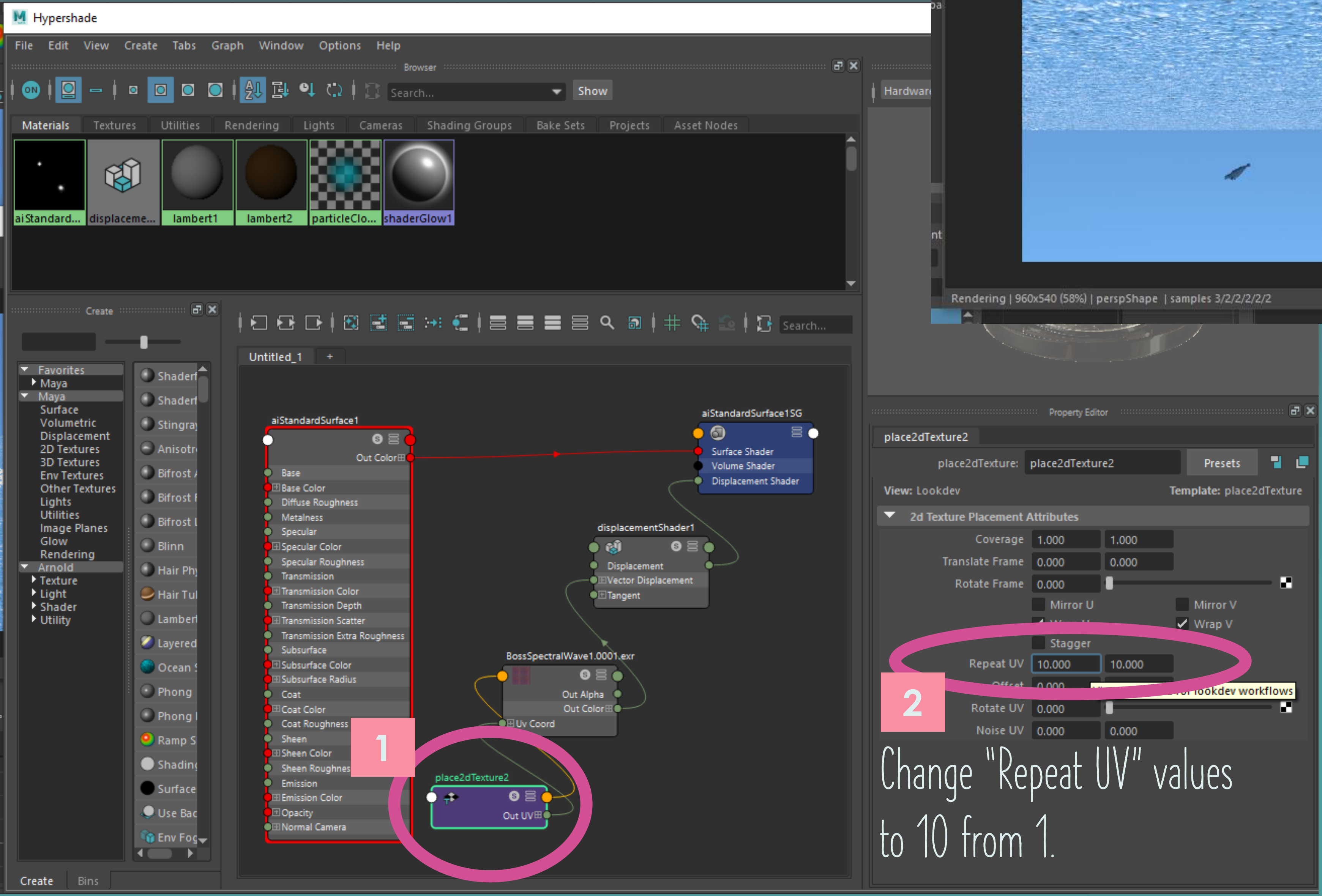


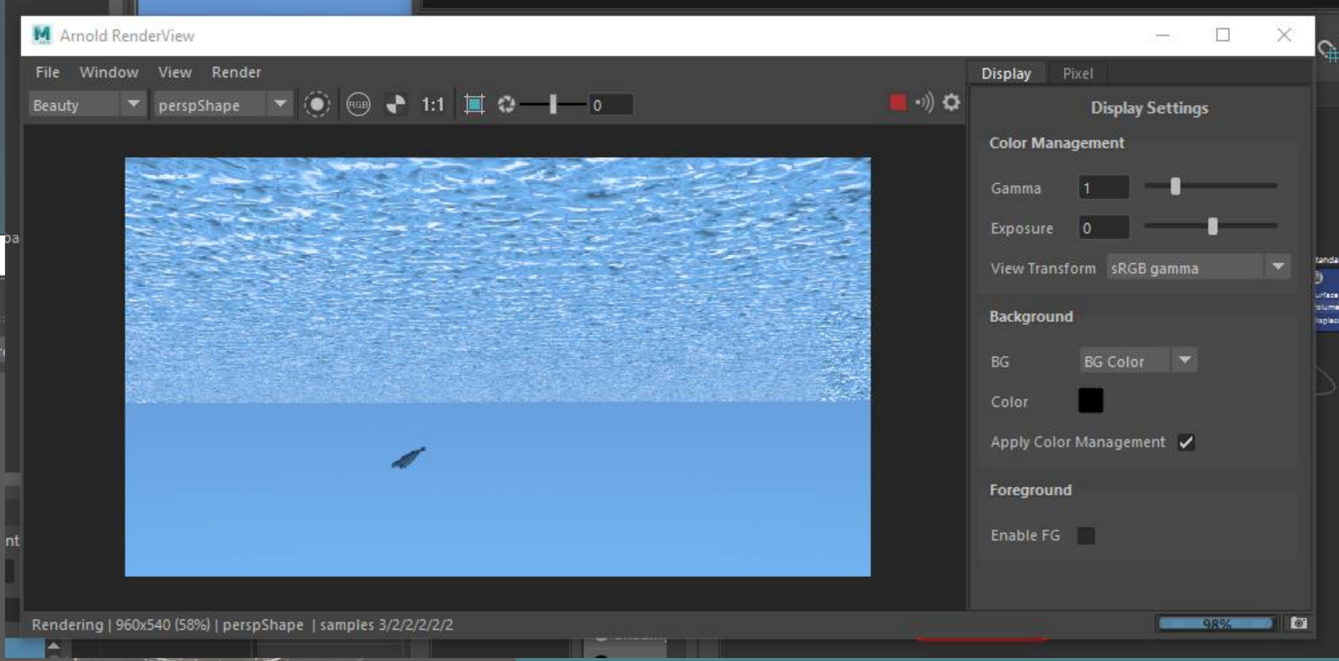


Then open the first .exr image of the Ocean Texture Images folder

Remove link from Displacement to Out Alpha and Create one from Vector Displacement to Out Color.

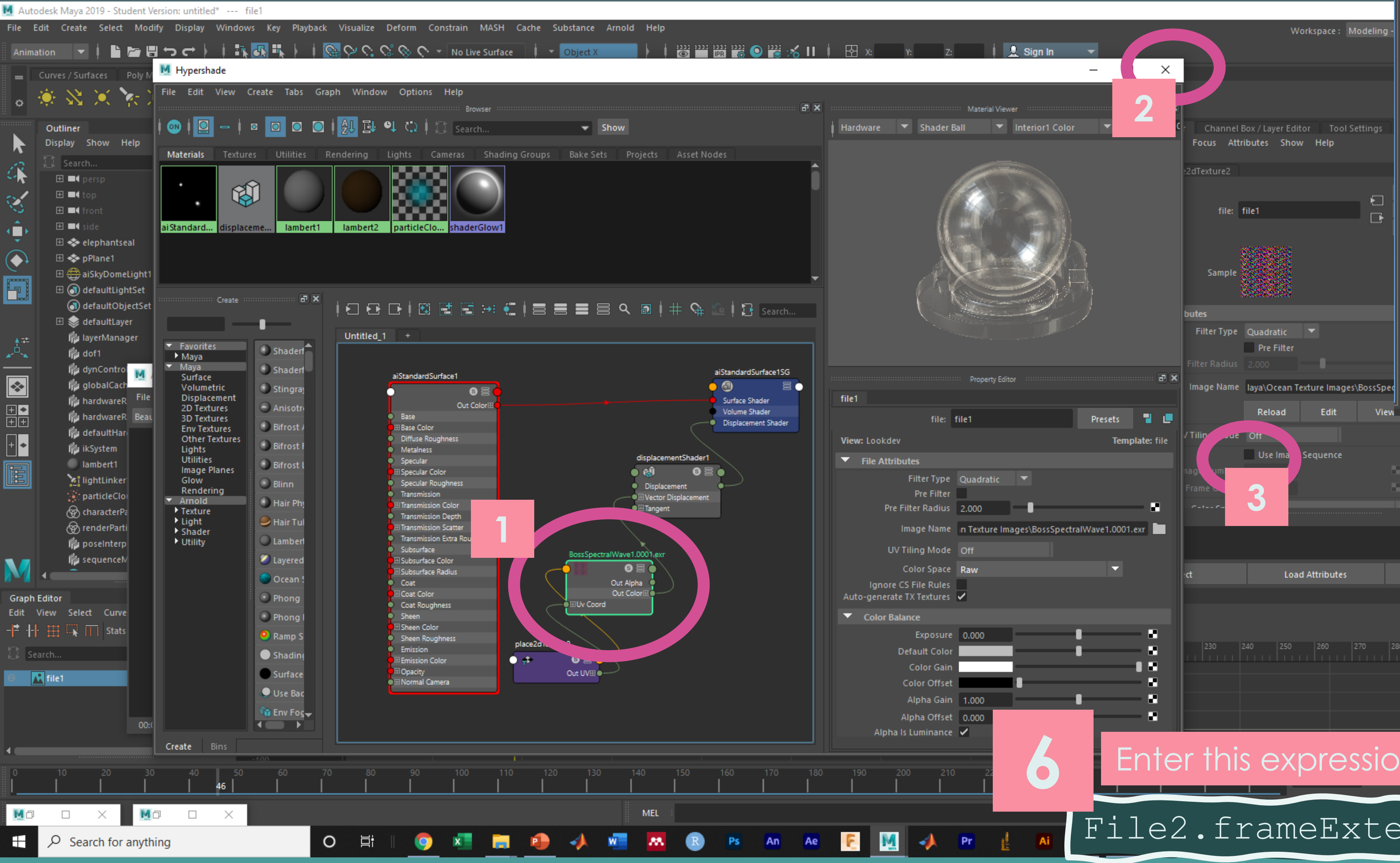
29. ADJUST TEXTURE SCALE

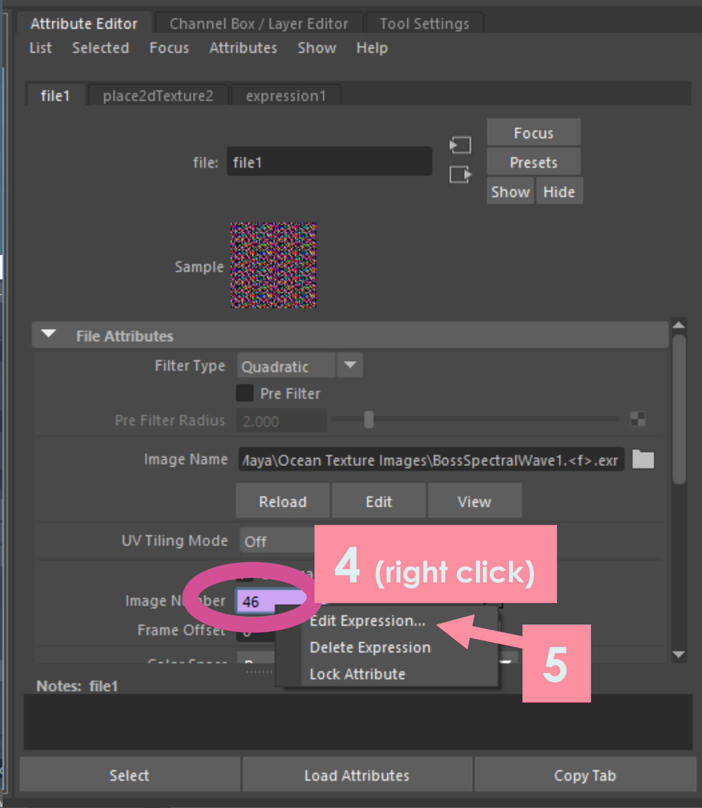




Change "Repeat UV" values to 10 from 1.

30. LOOP DISPLACEMENT MAP TEXTURES



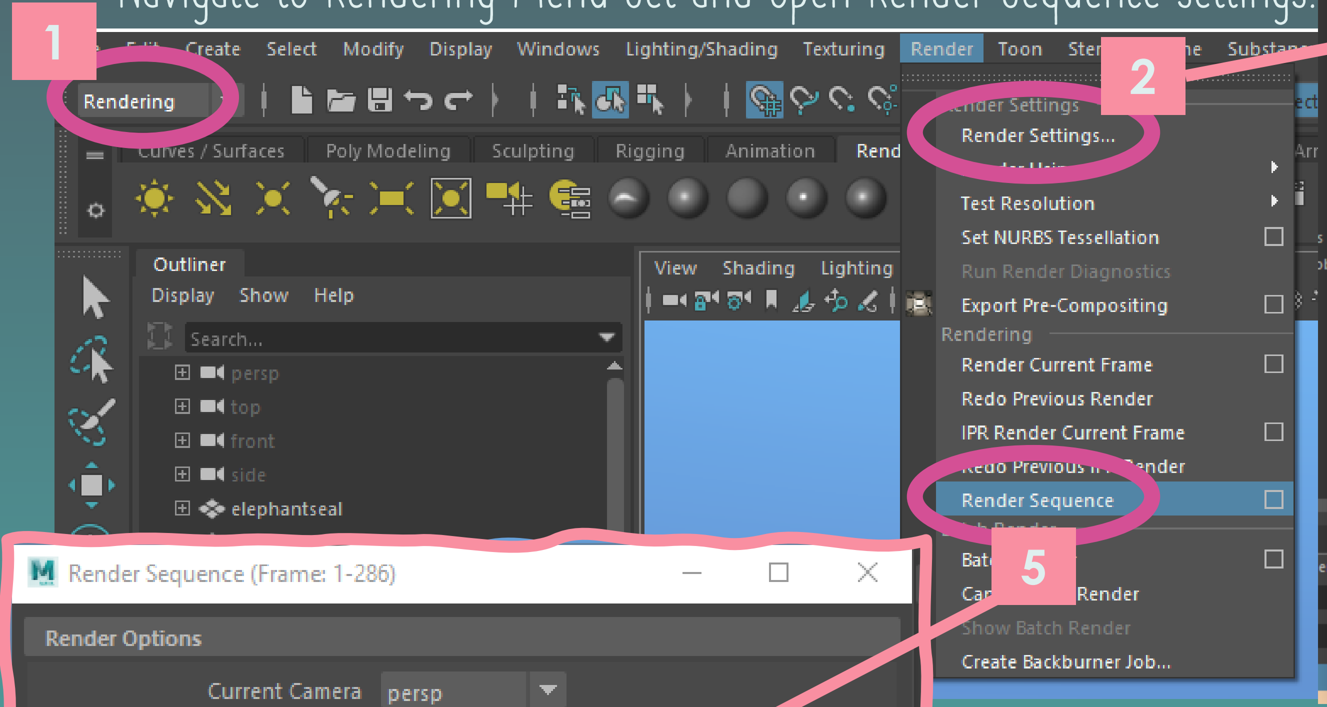


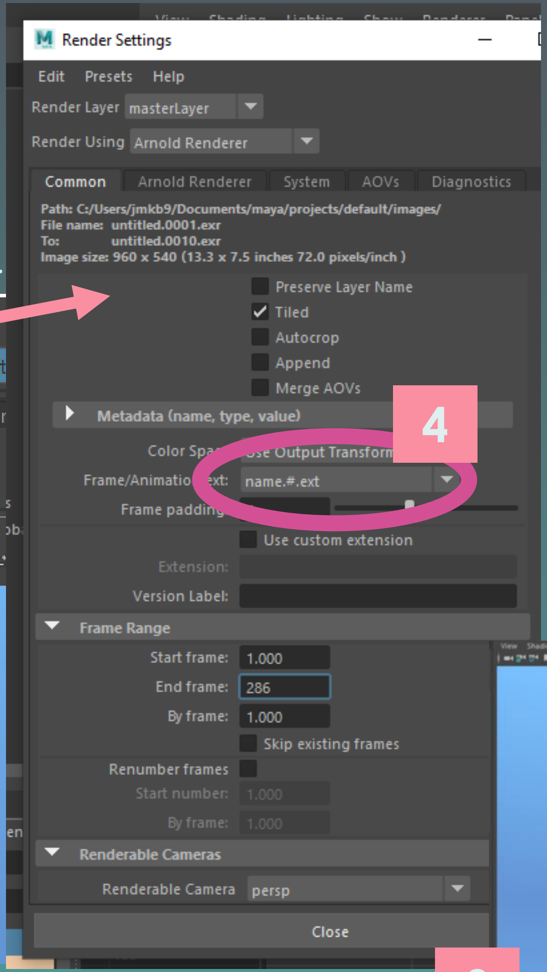
6 Enter this expression:

```
File2.frameExtensions=((frame%120)+1);
```

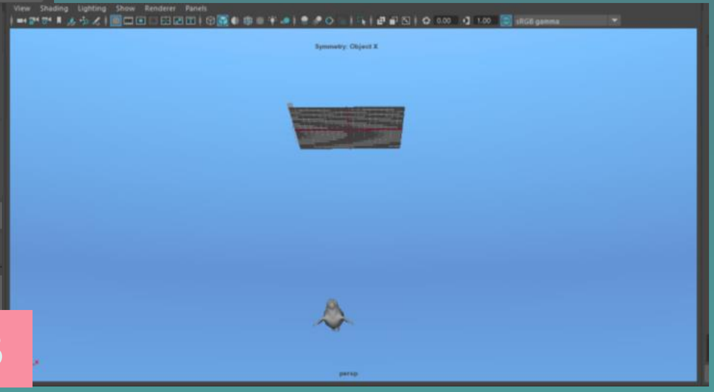
31. RENDER YOUR SCENE

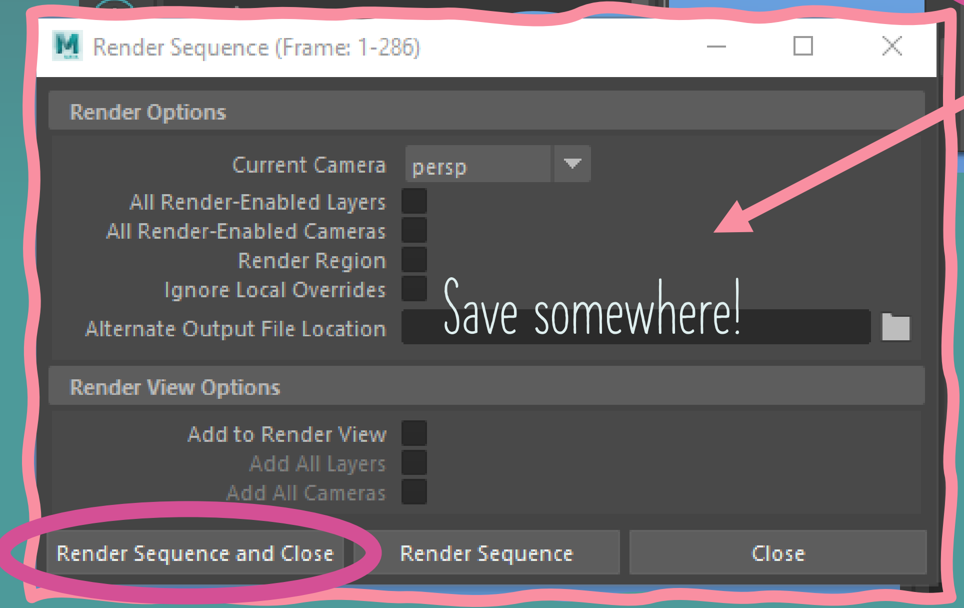
Navigate to Rendering Menu Set and open Render Sequence settings.





Important! Otherwise will only render 1 frame.





Arrange your perspective view so that the seal is in view the whole time. You can also use an animated camera but for our purposes this will be fine.

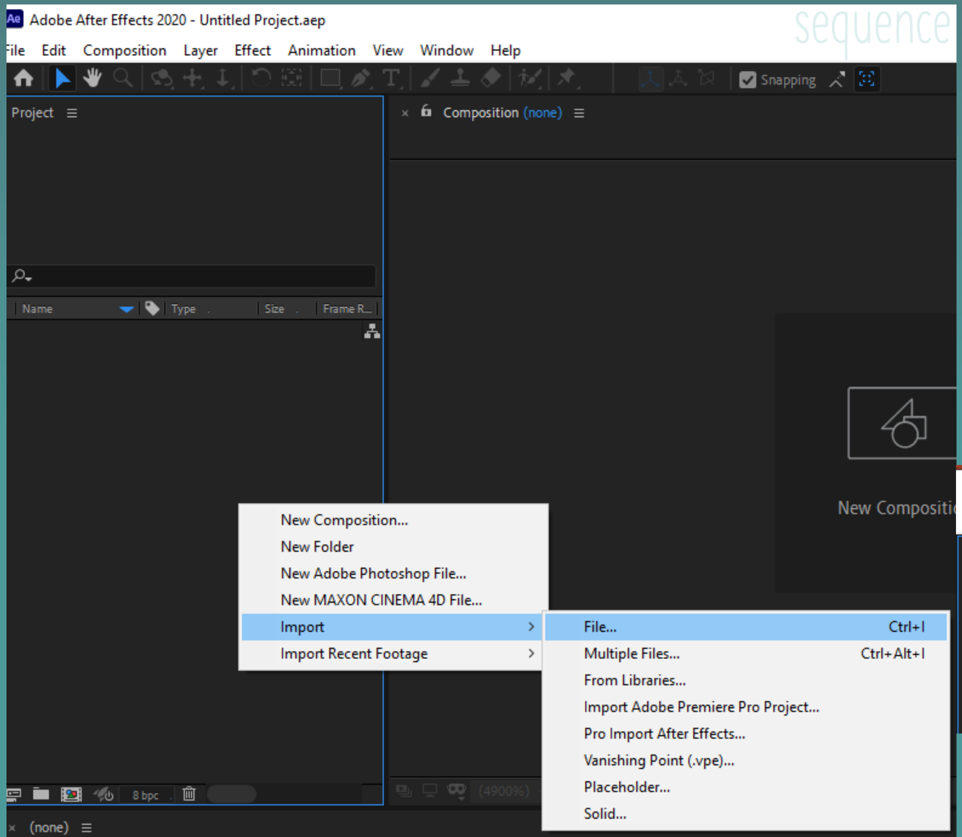
32. MAKE A VIDEO WITH YOUR SEQUENCE

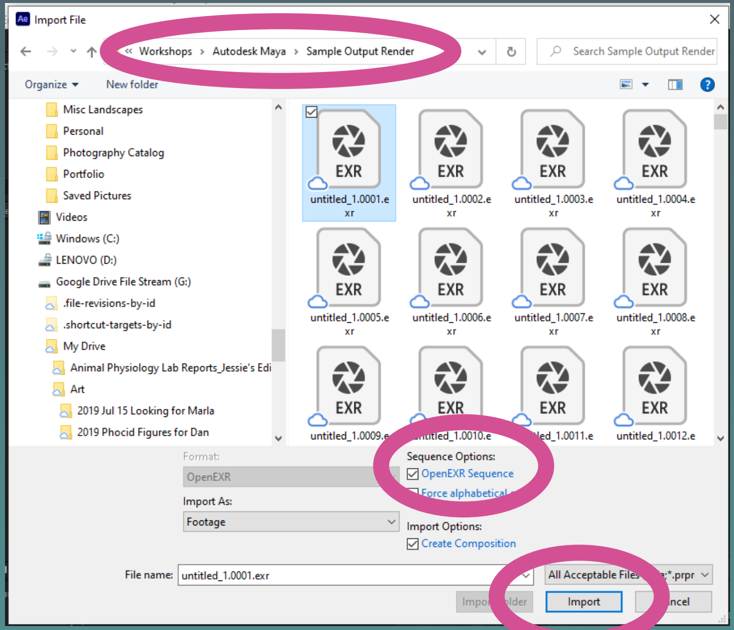
1 Open Adobe After Effects (now free for UCSC students)

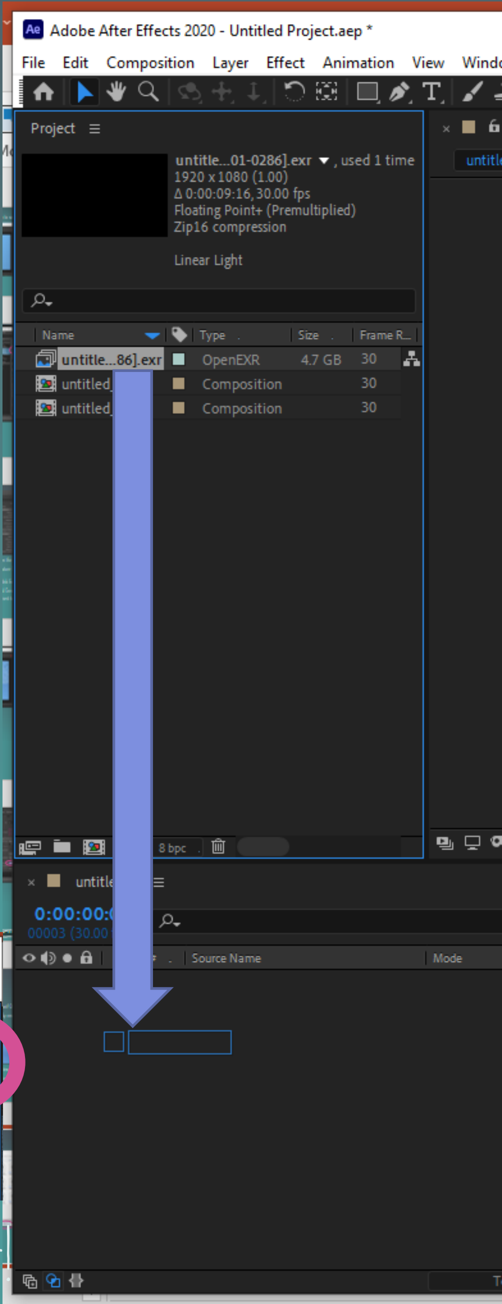
2 Right click in the project panel to Import a file.

3 Navigate to where you've saved your exported exr image sequence and import that image sequence

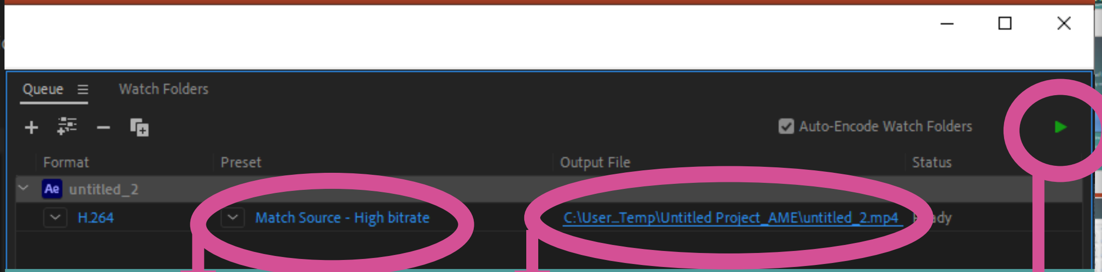
4 Drag and drop footage into timeline.







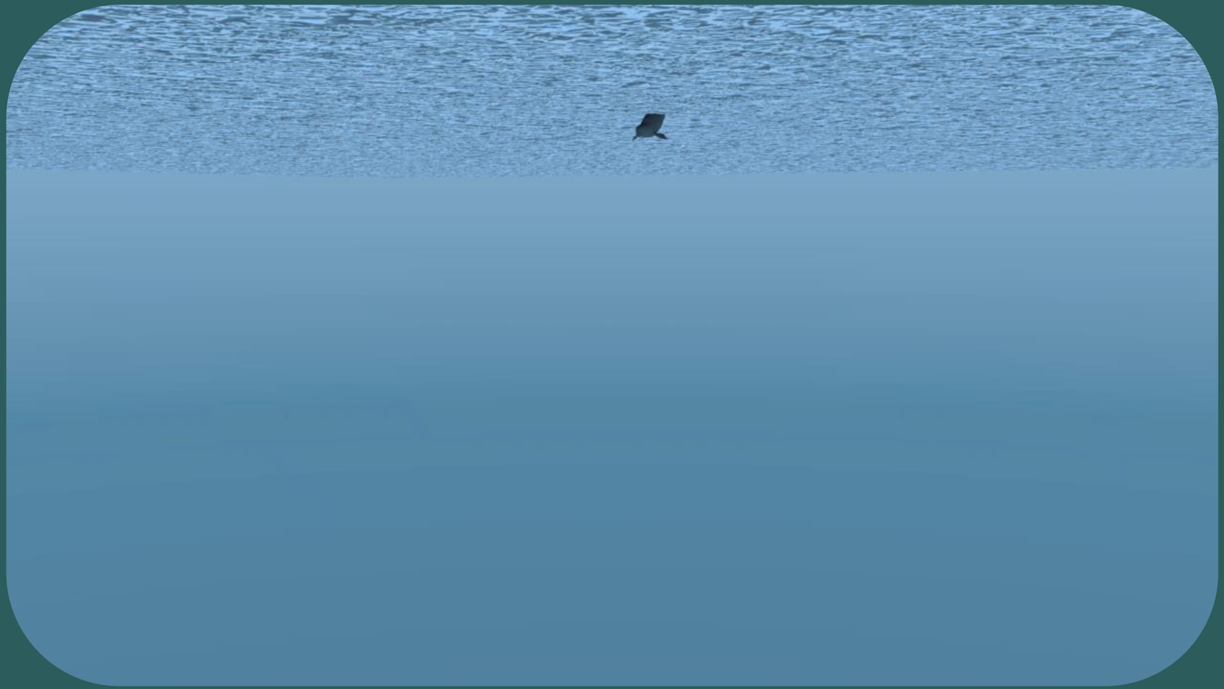
5 Export your video in File > Export > Add to Adobe Media Encoder Queue..



Change settings here

Change destination file here

Render!



33. ADMIRE YOUR OUTPUT