

WEEK 4

Bringing Motion and Data to Graphics

DATA VISUALIZATION

Digital storytelling at the confluence of science, art, and technology

AGENDA FOR TODAY

Uniting raster and vector graphics for our graphical abstract:

*Graphical Abstracts
Motion Graphics*

Graphical Abstracts

A critique and celebration

GRAPHICAL ABSTRACT

Critique/Celebration!

We will display a few graphical abstracts and discuss each one.

Some discussion points:

- 1) How do your eyes travel across the graphic and what story does the graphic tell?
- 2) How do the colors, style, text, and graphics influence the message?
- 3) If you were to describe the paper that the graphic accompanies, what is it like?
- 4) What questions are you still wondering after looking at the graphic?

Please be mindful and conscientious while providing feedback by participating in the discussion, turning on video whenever possible, and making space for everyone to be heard. We want to create a supportive environment where we feel comfortable sharing our work.

Motion Graphics

Basics of animation

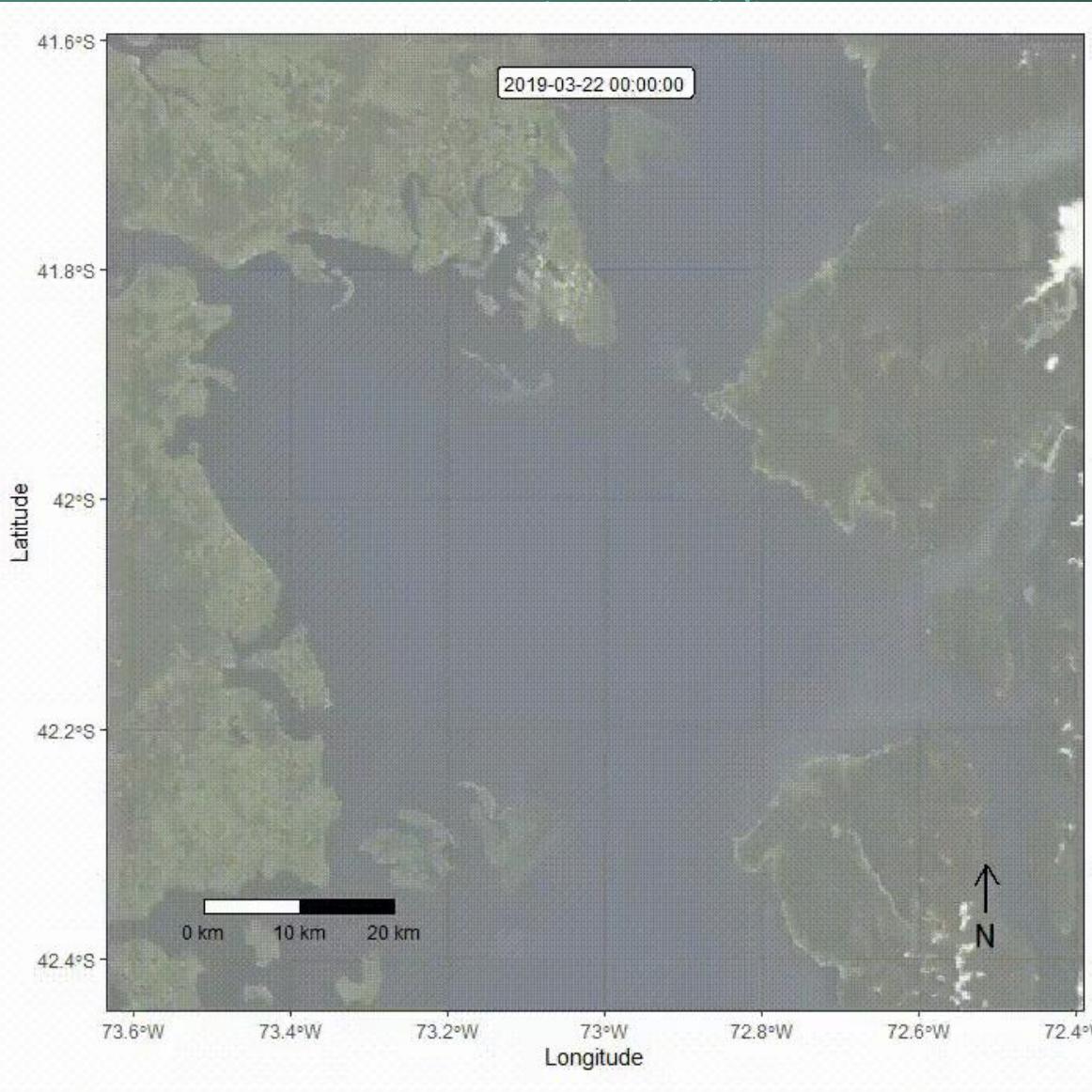
TUTORIALS: ANY QUESTIONS?

1. Animation in After Effects
 - Learning to link CSV data with 2D animation
2. Animation in Autodesk Maya
 - Learning to link CSV data with 3D animation

WHY ANIMATE?

Adding time to your data visualization can build anticipation, tension, and help tell your story, while making it more engaging.

This is approximately a 7 day period of Chile's Golfo de Ancud.
A couple comments have indicated this article as the source
study: <https://www.nature.com/articles/s41598-021-82220-5>



DEFINING SOME THINGS

ANIMATION

A method in which static figures appear as moving images, by changing the graphic in sequential frames

MOTION
GRAPHICS

Animations which mostly involve text and graphics

AFTER
EFFECTS

A “motion graphics and visual effects software”



WHAT ADOBE SOFTWARE SHOULD I USE TO CREATE A VIDEO?

Start in:

AFTER
EFFECTS

Creating a video with many motion graphics or visual effects

or

PREMIERE
PRO

Video editing with
multiple clips

And **then** link to an After Effects file for adding title
motion graphics or visual effects.

Within After Effects, you can link to updating Adobe files such as Photoshop and Illustrator Files.

PHOTOSHOP

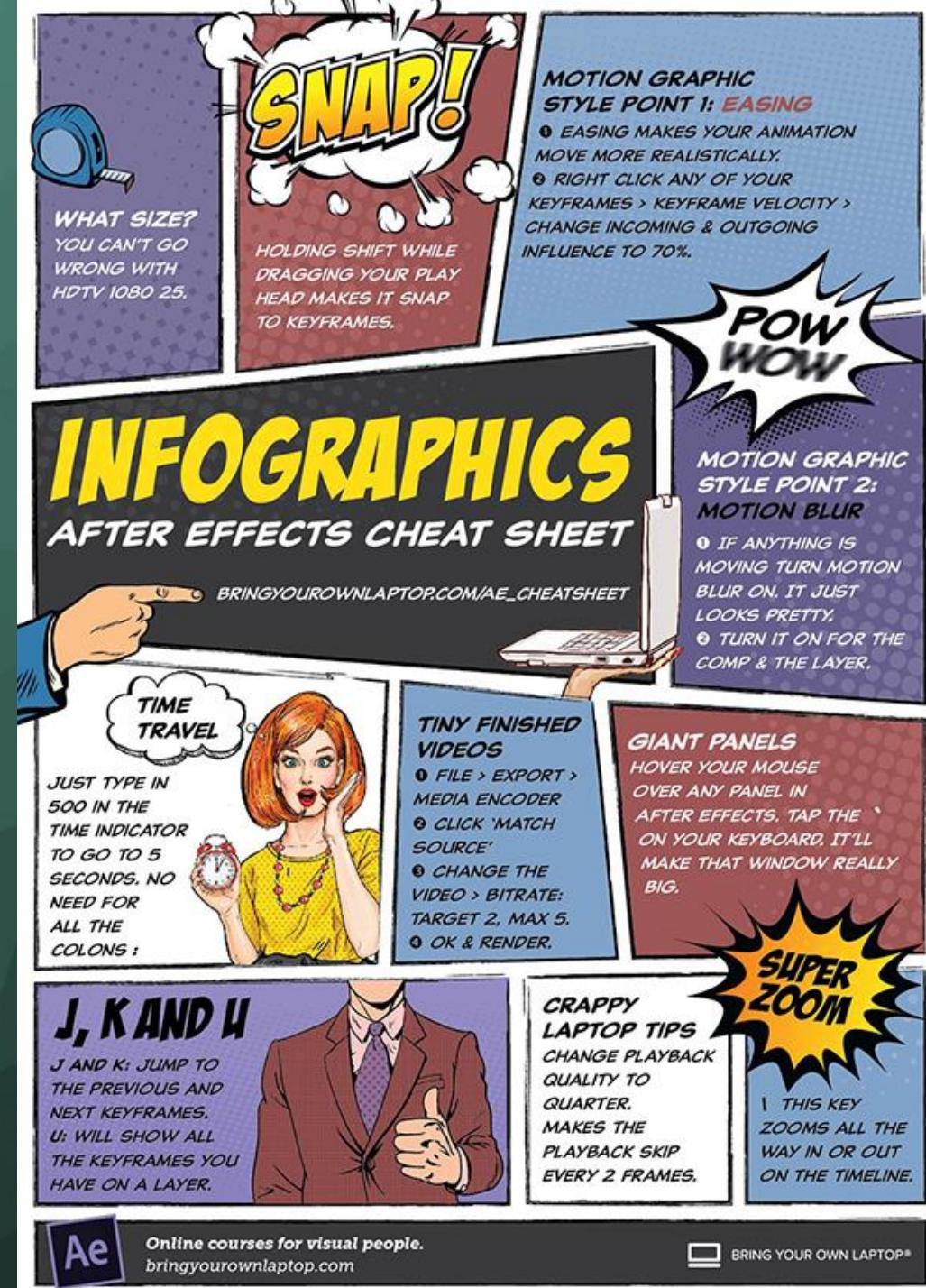
Creating digital paintings with raster
graphics, compositing illustrations,
and editing a single photo.

ILLUSTRATOR

Creating vector graphics, figure
editing, and composition.

KEY TECHNIQUES AND TOOLS

- Layers and Blending Modes
- Masks
- Stroke effects:
 - Trim paths
 - Wiggle paths
 - Roughen edges
- Visual effects
 - Fractal Noise/Displacement maps
- Expressions: JavaScript



EXAMPLES

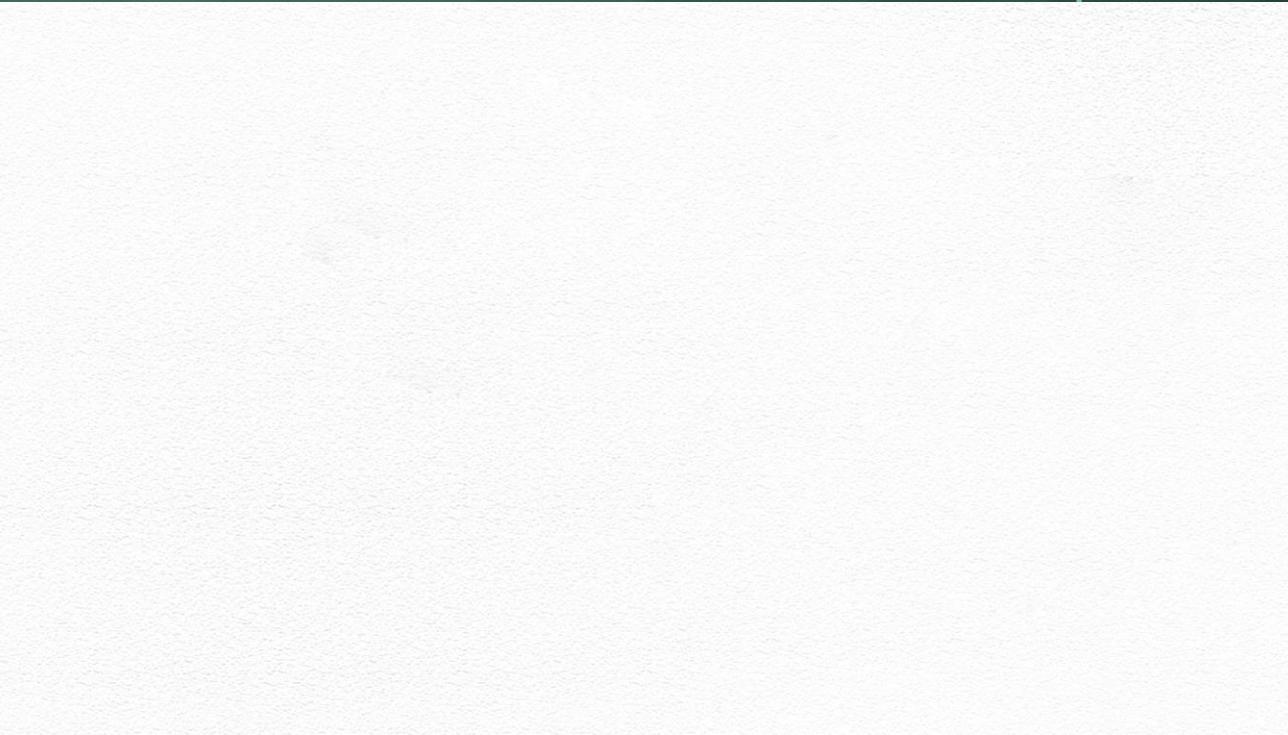
Can add labels, captions, and graphics to existing footage or 3D rendered animations.



these humpback whales fed.

3D tag model created in AutoDesk MAYA.

Can create your own line animations from scratch.



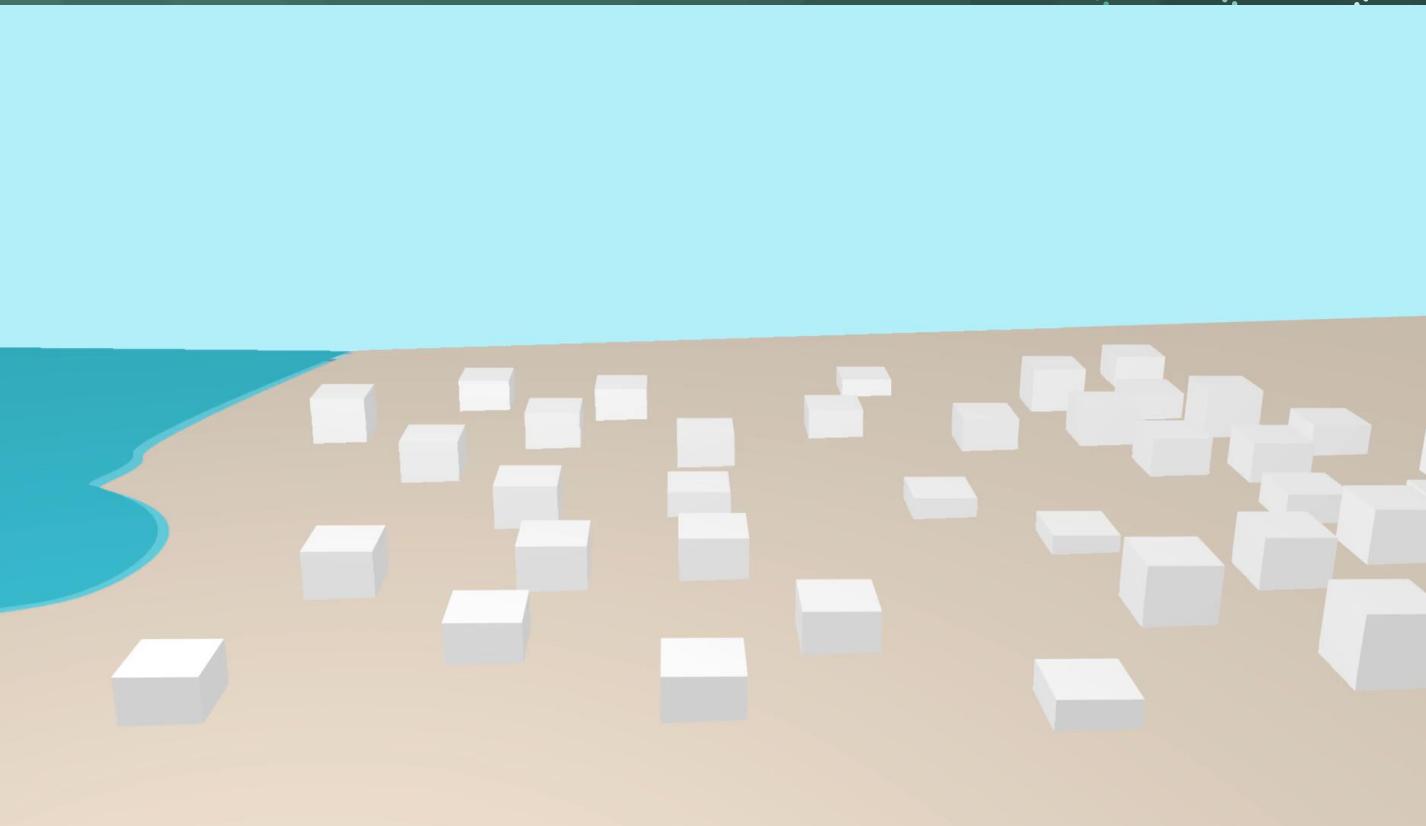
Background inside of theater created in Adobe Photoshop.

EXAMPLES

Can import Adobe Illustrator files and
animate them.



©Jessica Kendall-Bar



Can bring 2D objects into 3D to make
simple 3D animations.

EXAMPLES Kool & the Gang music video animated in After Effects



EXAMPLES Kool & the Gang music video animated in After Effects

BLOBBY DANCING

shape path
animated
with
keyframes

FACES MORPHING

path
animated
with
keyframe,
trim paths

LINEAR WIPE

same as
wipe
transition in
PowerPoint

BAND MEMBERS IN FRAMES: animated masks

STYLISTIC EFFECTS: background watercolor texture and blending modes,



Frame-by-frame drawings in Illustrator with the blob brush- doh! ☹

Imported into Adobe Animate then After Effects.
Would suggest different workflow..... ☺

You can apply textures to your paper, lines, and fills in After Effects.

To achieve a hand-drawn/watercolor look:



Window > Workspace > Animation

Adobe After Effects 2020 - C:\Users\Jessie\Downloads\logo_animation.aep

File Edit Composition Layer Effect Animation View Window Help

Project Water Comp 6
1280 x 720 (1.00)
Δ 0:00:30.00, 40.00 fps

Composition Water Comp 5
Footage (none)

Water Comp 5 Water Comp 3

Active Camera

Render: Classic 3D

Info
Preview
Effects & Presets
Preset
Animation Presets
3D Channel
Audio
Blur & Sharpen
Boris FX Mocha
Channel
CINEMA 4D
Color Correction
Distort
Expression Controls
Generate
Immersive Video
Keying
Matte
Noise & Grain
Obsolete
Perspective
Simulation
Stylize
Text
Time
Transition
Utility

Search Help

Name Type Size Frame
watermark.png PNG file 195 KB
Water Comp 6 Composition 40
Water Comp 5 Composition 40
Water Comp 3 Composition 10
Solids
Water Solid
Black Solid 3 Solid
Adjustm...yer 4 Solid
Adjustm...ayer 3 Solid
Adjustm...ayer 2 Solid
Comp 1 Composition 24
black watermark.psd Photoshop
bkgrd_w...gle_fiji.jpg Importe...G
bkgrd_a...ouds.jpg Importe...G 499 KB

8 bpc 58.3% 0:00:05:23 (Full) Active Camera 1 View +0.0

Water Comp 3 Water Comp 5 Comp 1 Water Comp 6

0:00:05:23 00225 (40.00 fps)

Layer Name Mode TrkMat Parent & Link

- 8 [Adjust... Layer 3] Normal None None
- 9 [Adjust... Layer 2] Normal None None
- 10 Camera 1
- 11 Shape Layer 2 Normal None
- 12 T jessie kendall-bar 2 Normal None None
- 13 [watermark.png] Normal None None
- 14 [Adjust... Layer 4] Normal None None
- 15 [bkgrd...ds.jpg] Normal None None
- 16 [bkgrd...ds.jpg] Normal LInv None None

Transform
Anchor Point 1949.5, 575.0
Position 640.0, 713.0
Scale 35.0, -72.0 %

Toggle Switches / Modes

The screenshot shows a logo animation project in Adobe After Effects. The composition 'Water Comp 5' displays a sunset over water with a logo and text. The timeline shows layers from 0:00:05:23 to 0:00:28. The properties panel shows layer settings like opacity and transform values.

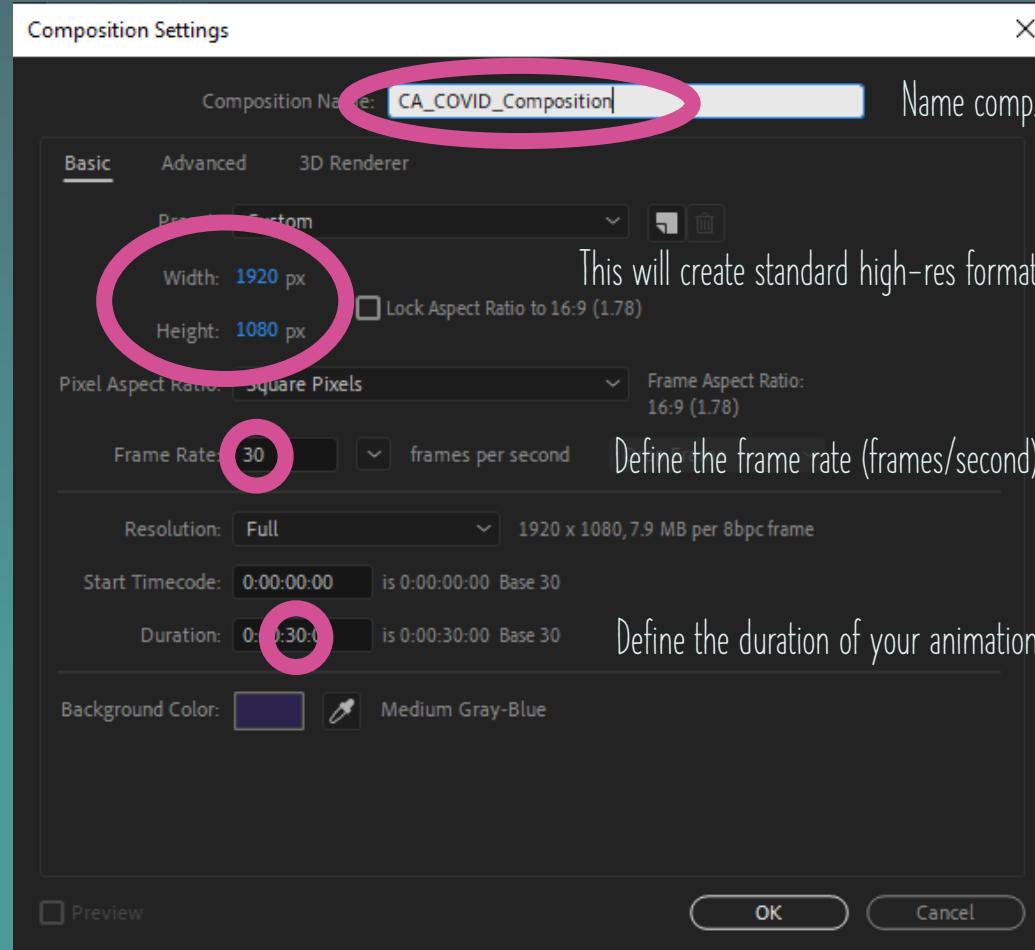
Tutorial

Linking CSV Data to your Animation

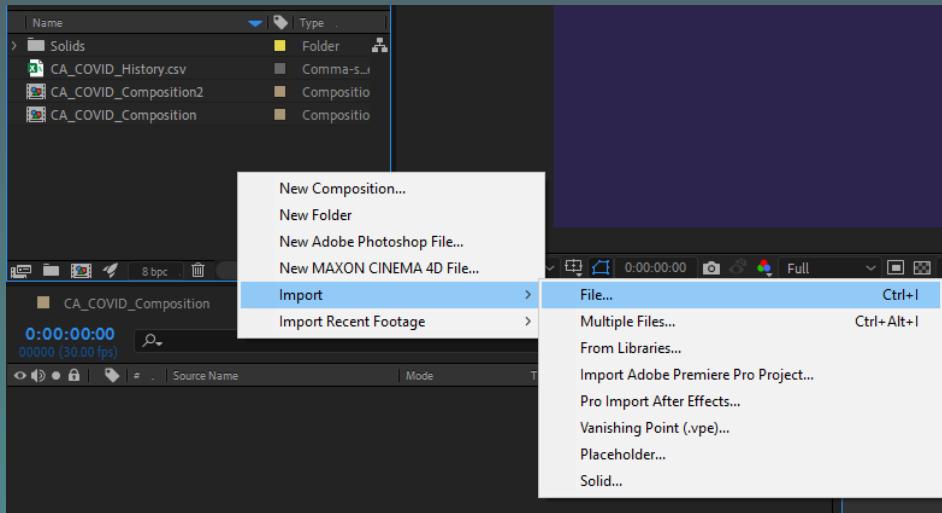
Using COVID-19 Case data downloaded from the COVID Tracking Project at
<https://covidtracking.com/data/download>



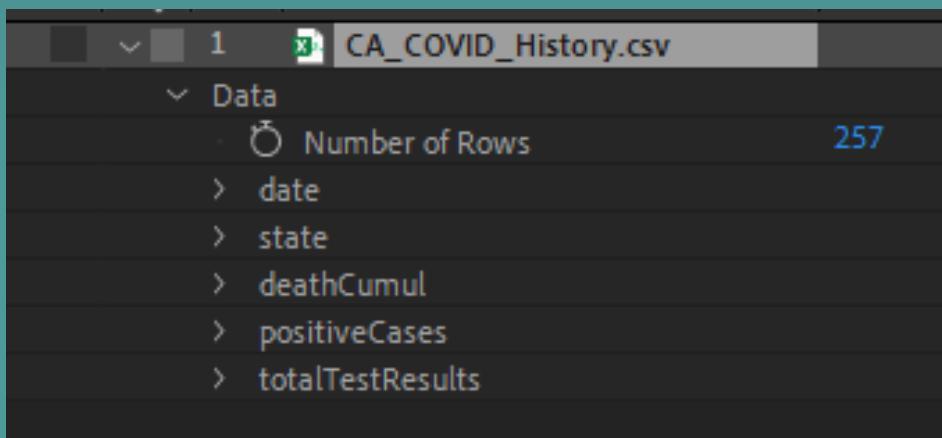
1. CREATE NEW PROJECT & COMPOSITION



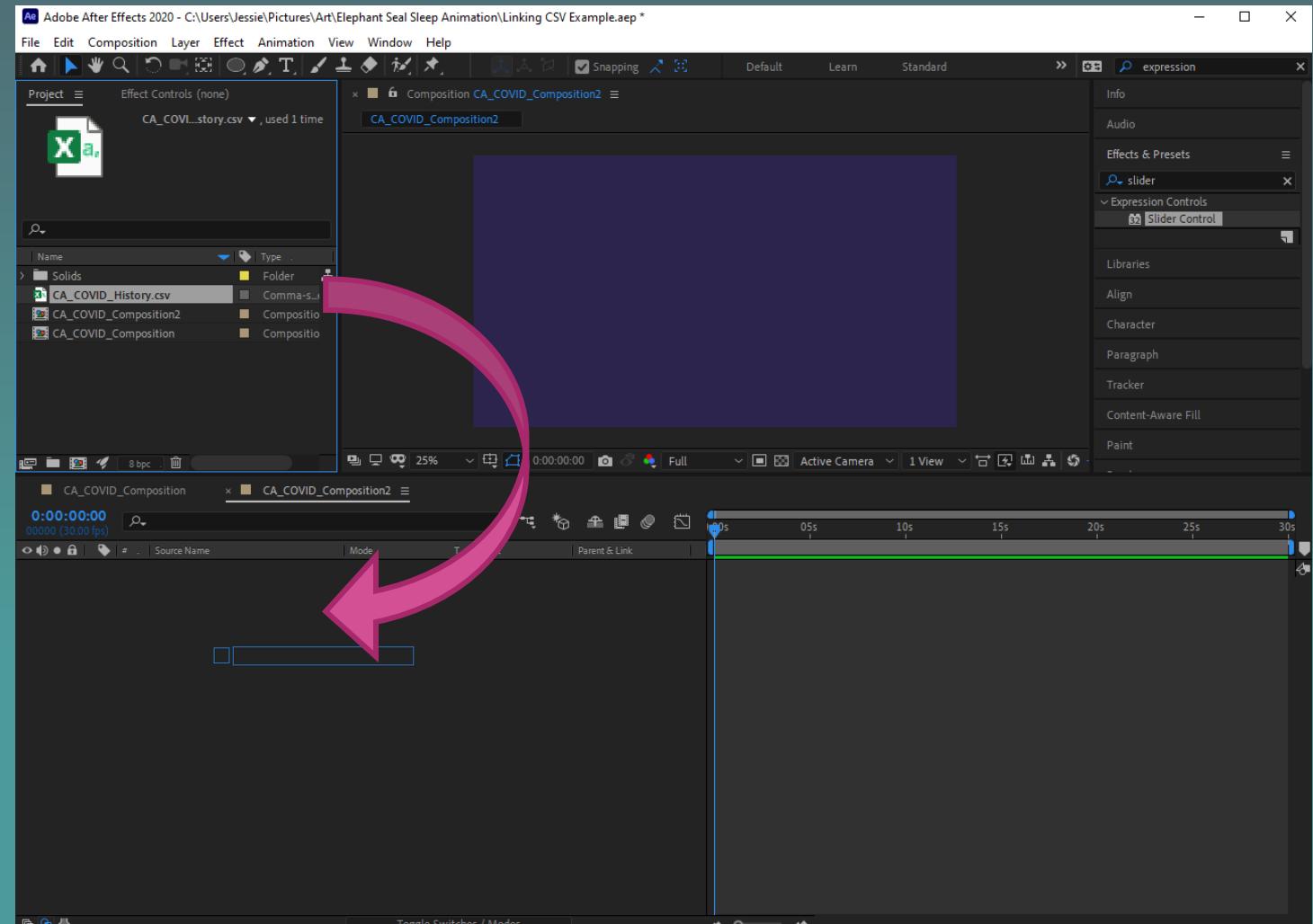
2. IMPORT YOUR CSV



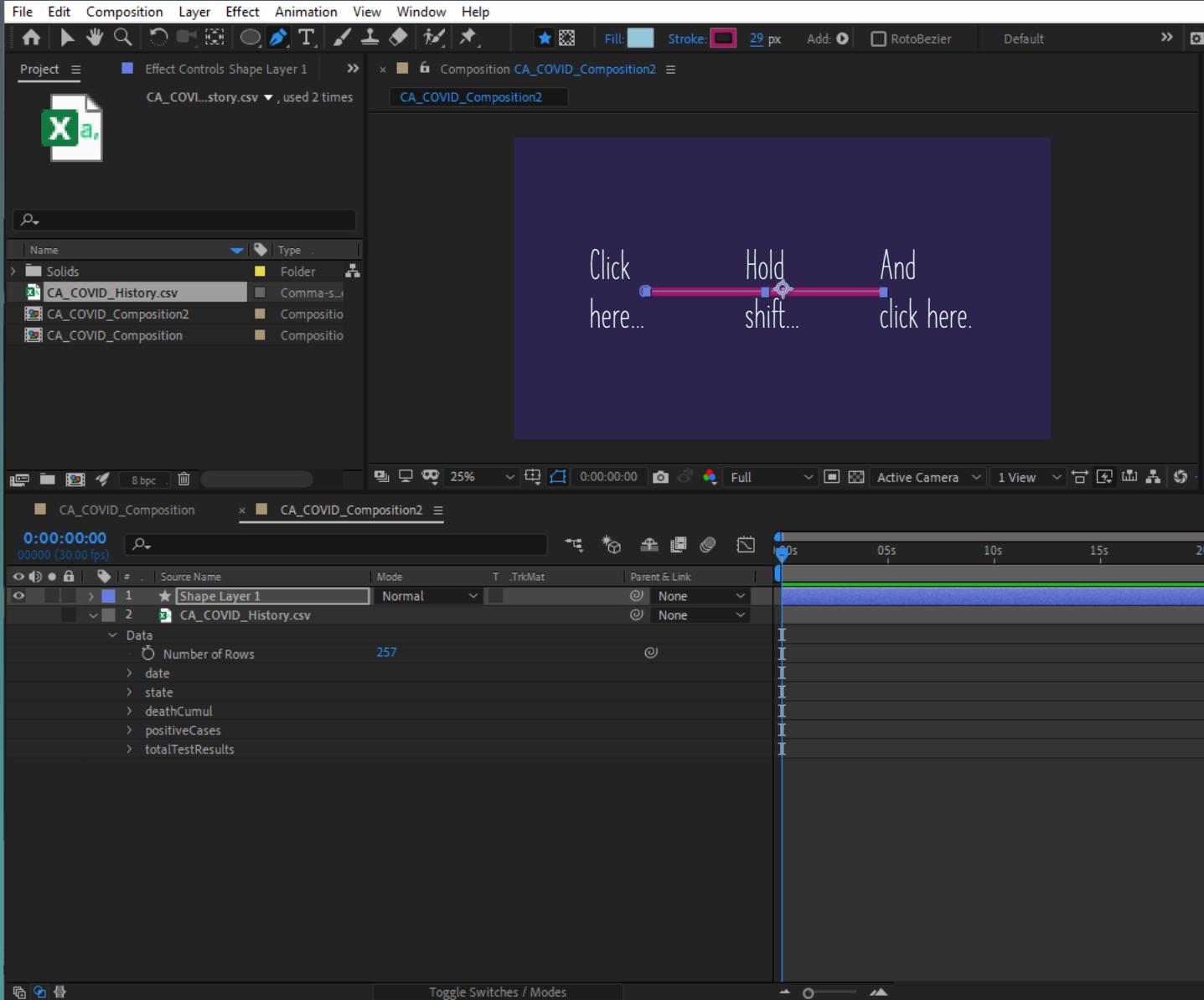
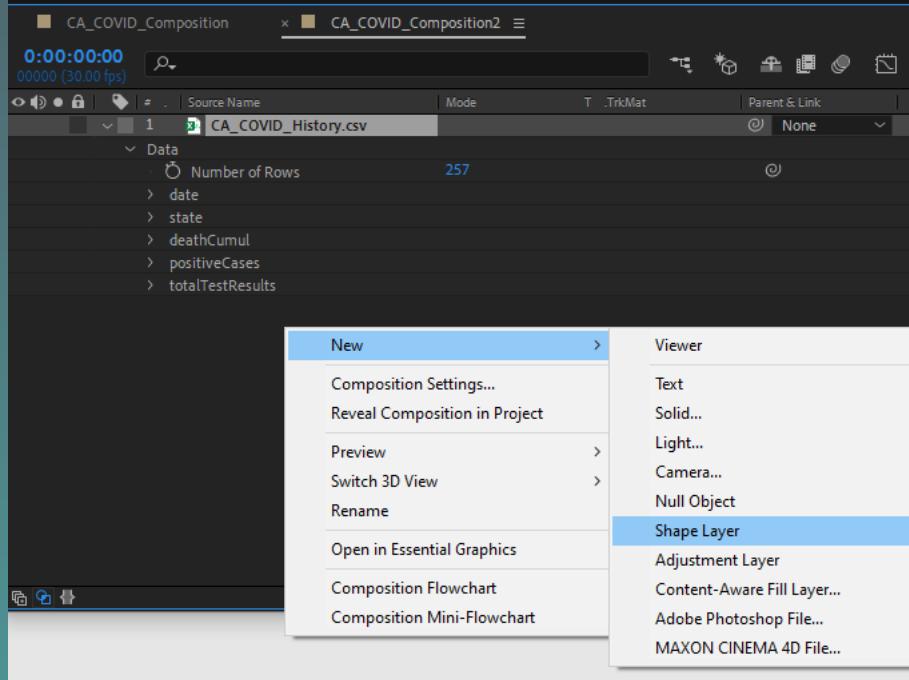
4. EXPLORE YOUR FILE



3. DRAG INTO COMPOSITION

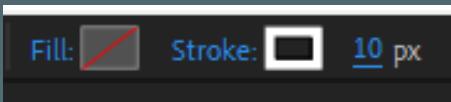


5. ADD NEW SHAPE LAYER

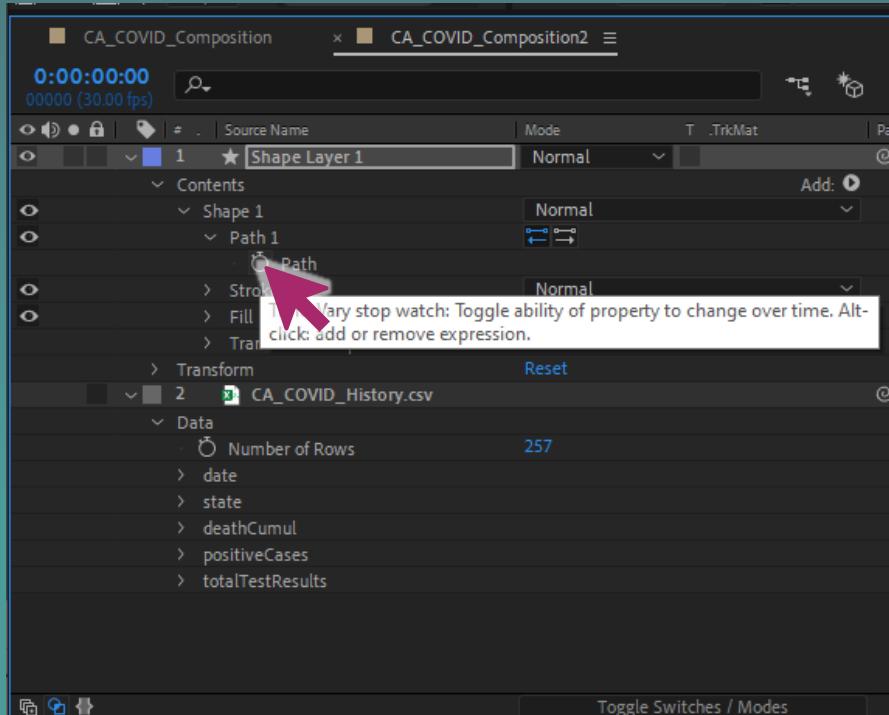


6. CREATE PATH WITH PEN TOOL

7. FORMAT SHAPE



8. OPEN EXPRESSIONS



Alt- or Option- click on the stopwatch to add and edit an expression

9. ADD THIS EXPRESSION

This code is in Javascript. To create new variables, type "var variable name = whatever you'd like the variable to be;"

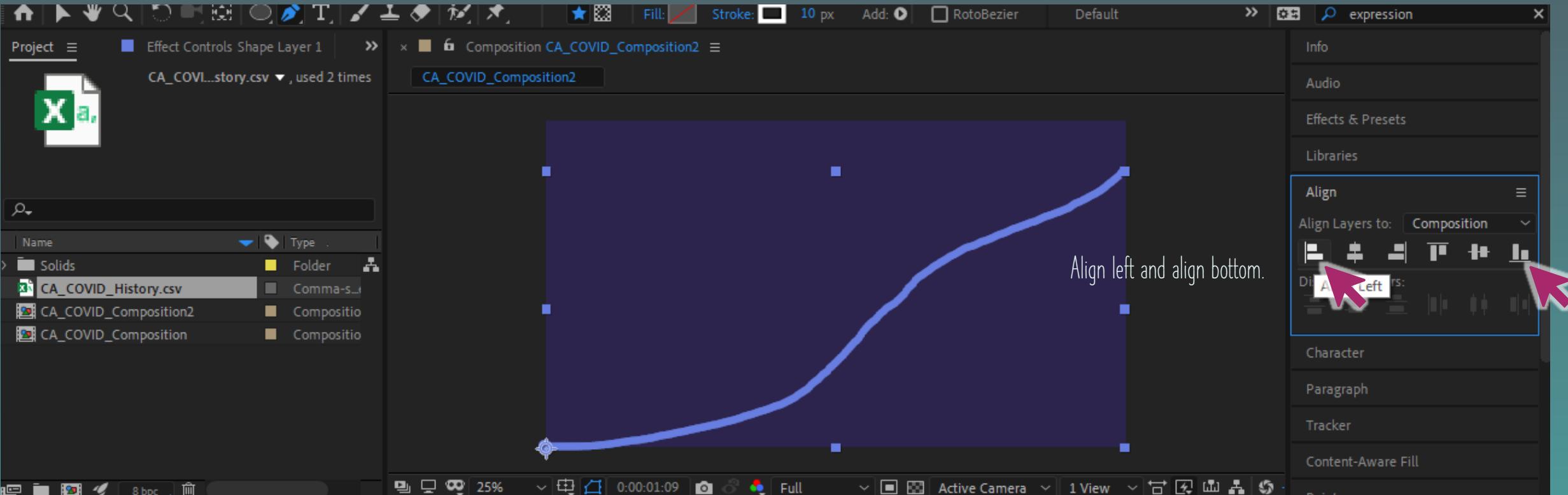
```
var numberOfPoints =
thisComp.layer("CA_COVID_History.csv")("Data")("Number of Rows");
//Setting # of Point variable equal to the number of rows of data in CSV
var spacingForPoints = thisComp.width / numberOfPoints; //Spacing points
var startingPointX = 0; //Setting the first X value position
var thePath = content("Shape 1").content("Path 1").path; //Renaming path
var maximumYValue = 1200000; //Maximum Y value
var lineHeight = 0; //Initializing lineHeight variable
var arrayOfPoints = []; //Creating an empty array called arrayOfPoints

for(var i = 0; i < numberOfPoints; i++) {
//Writing a for loop that loops through each row of data
    var data = thisComp.layer("CA_COVID_History.csv");
    var dailyCases = data.footage("CA_COVID_History.csv").dataValue([3,i])
    lineHeight = linear(dailyCases, 0, maximumYValue, content("Shape
1").content("Stroke 1").strokeWidth/2, thisComp.height)*-1;
//Function remaps data from the bottom of the composition to the top.
    arrayOfPoints[i] = [startingPointX, lineHeight];
//Store new x and y data into the array arrayOfPoints
    startingPointX += spacingForPoints;
//Update x value by adding the spacing between points
}

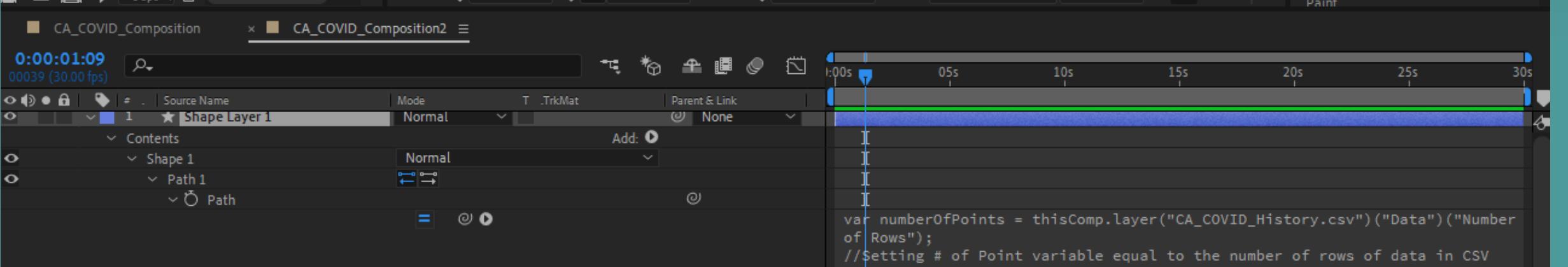
thePath.createPath(points=arrayOfPoints, inTangents=[], outTangents=[],
is_closed=false);
//Create a path with the array of points and keep it an open path
```

Variable names
Functions()
//Comments
Values
Pick up with PickWhip

10. ALIGN PATH



11. RENAME SHAPE LAYER



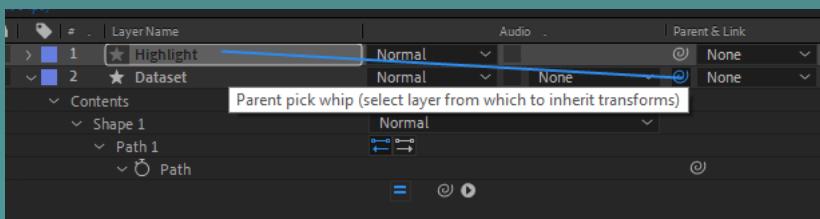
12. DUPLICATE LAYER

Ctrl + D / Command + D to duplicate layer

13. RENAME DUPLICATE



14. LINK LAYER TO PARENT



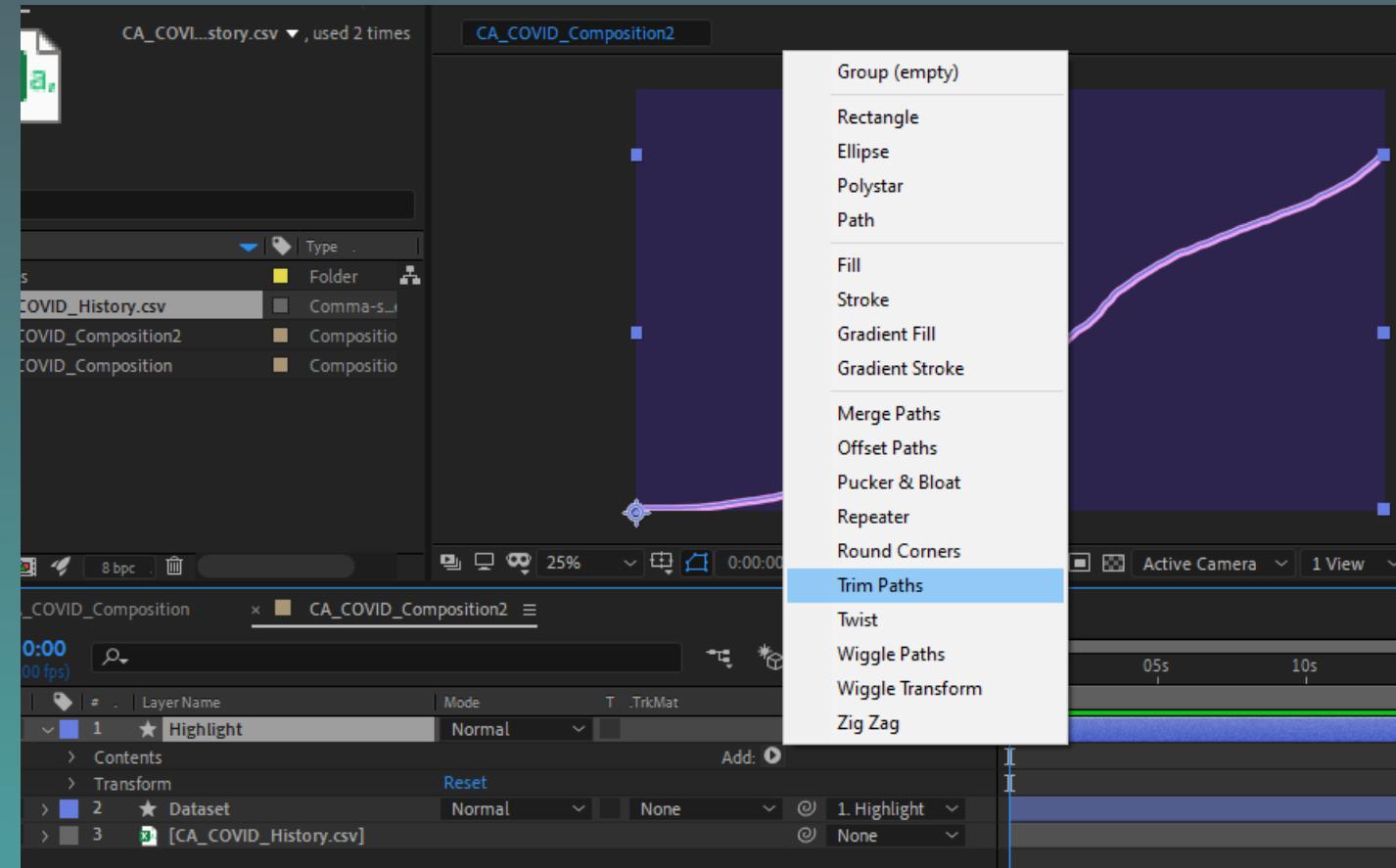
This causes any transforms to layer "Highlight" to also apply to "Dataset"

15. CHANGE FILL & STROKE

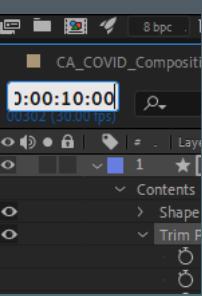
Change color
& width for
"Highlight"



16. ADD TRIM PATH TO SHAPE



This will allow us to animate along the path to reveal the stroke.

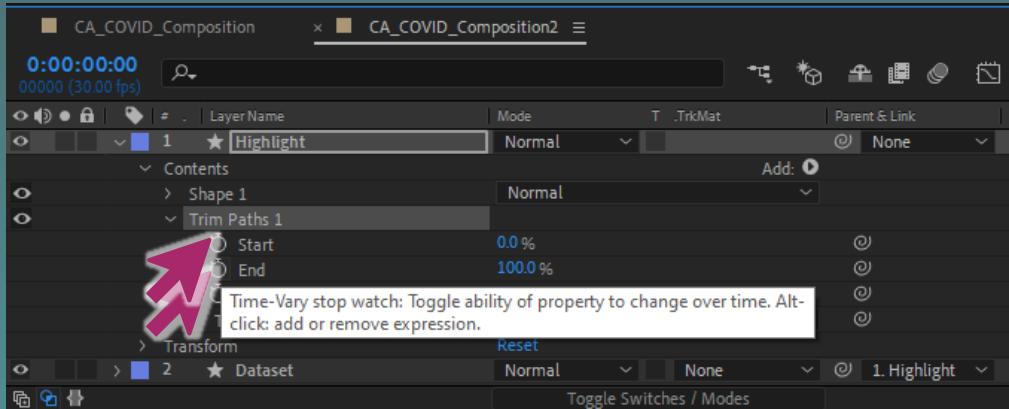


17. SET END OF DATA ANIMATION

Place playhead where you would like your animation to stop.

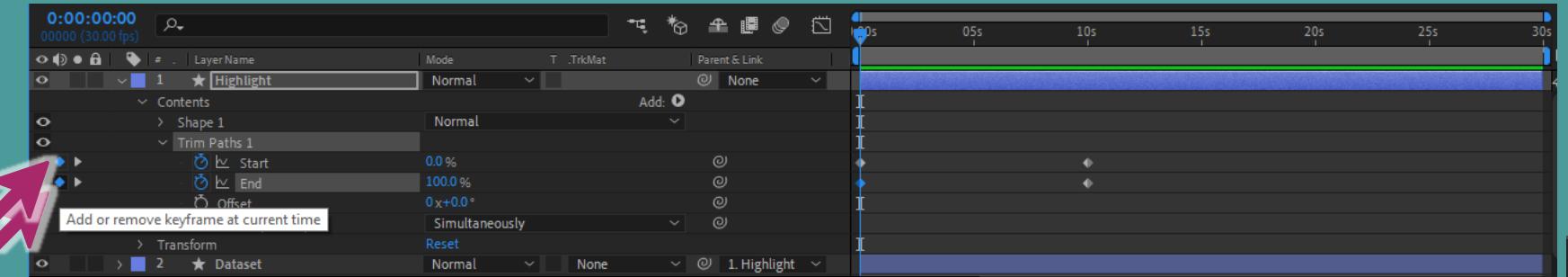
18. ADD KEYFRAMES

Keyframes fix the value of a certain property at the playhead.



20. ADD KEYFRAMES

Between keyframes, the values shift between the previous and subsequent keyframes.



19. NAVIGATE TO BEGINNING

Either press "J" and "K" to navigate between keyframes or drag the playhead and hold down Shift to snap between keyframes and other landmarks.

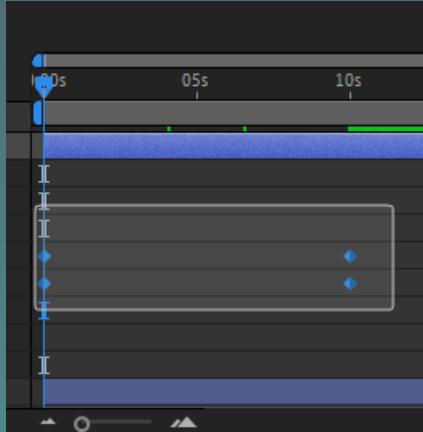
21. CHANGE VALUE

Change "End" value to 0% at 0 seconds



22. PREVIEW ANIMATION

Scrub forward with the playhead to preview the effect you've just added.

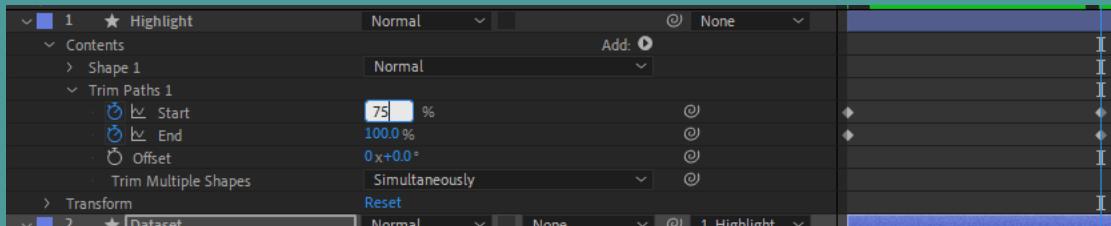


23. SELECT KEYFRAMES

Drag and drop to select the four keyframes.

25. ADJUST TRIM PATH

Change "Start" value to 75% at 10 seconds.



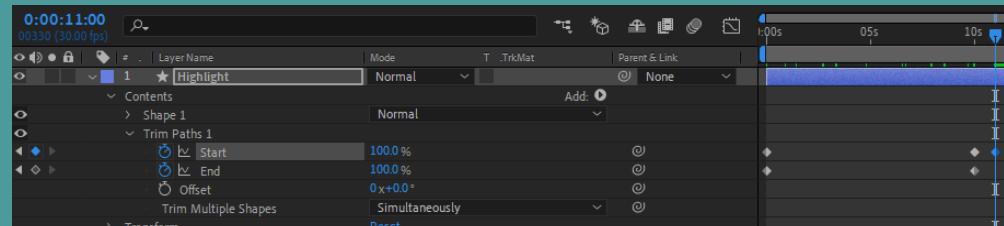
24. COPY/PASTE KEYFRAMES

Copy keyframes (Ctrl+C), navigate to layer you would like to place them on (onto layer "Dataset"), and paste keyframes (Ctrl+V)

The first pasted keyframe will be aligned with the playhead.

26. LET HIGHLIGHT EXIT

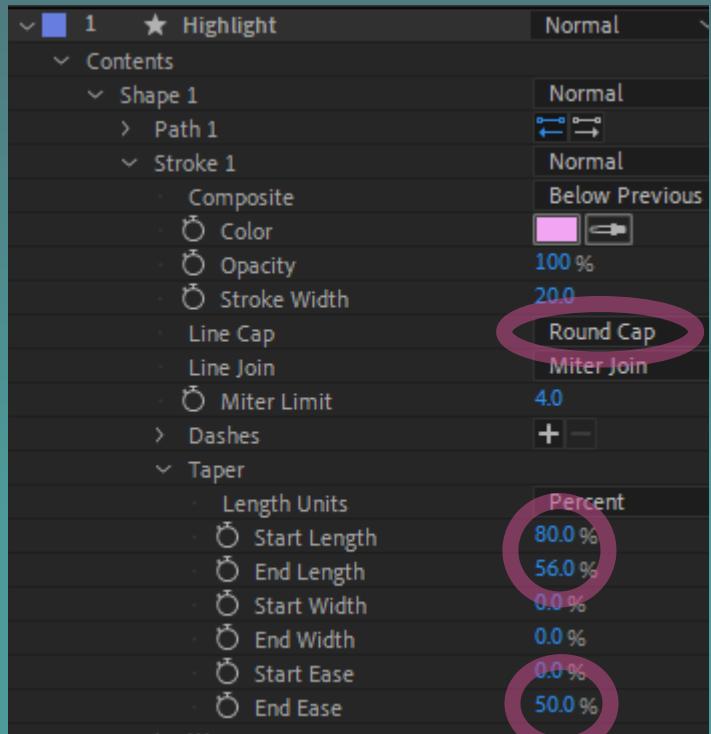
Change "Start" value to 100% at 11 seconds.



27. ADD SOME STYLE

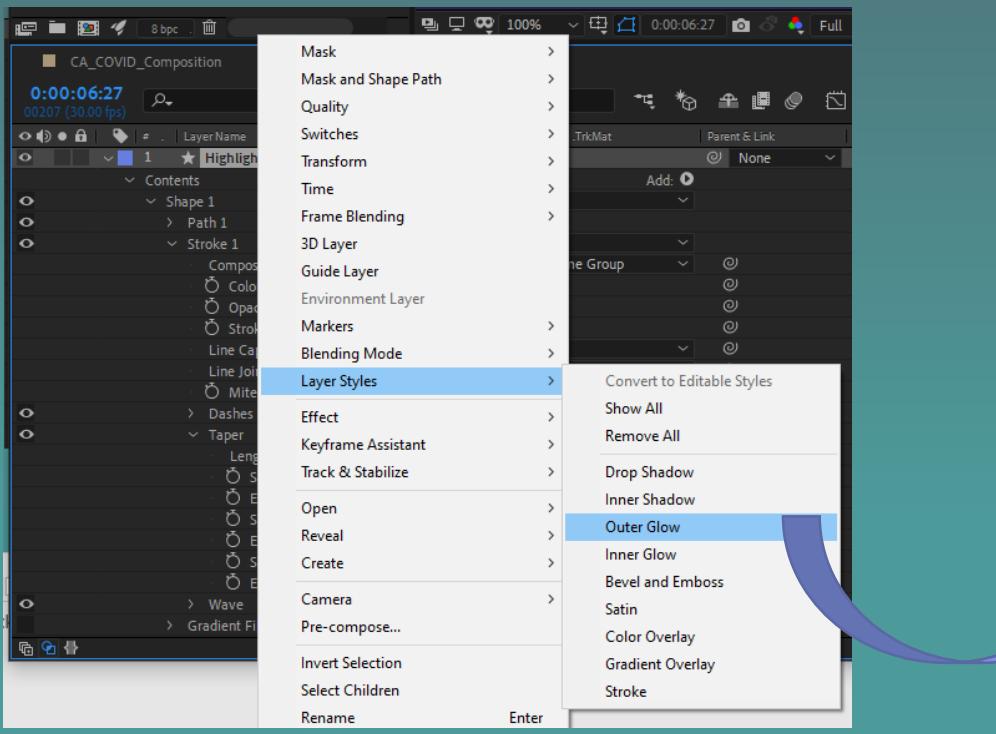
Add TAPER:

Contents > Shape > Stroke > Taper



Add GLOW:

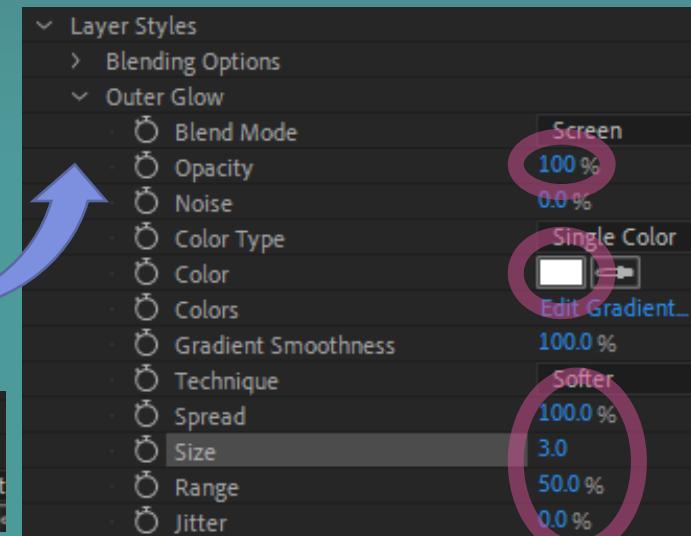
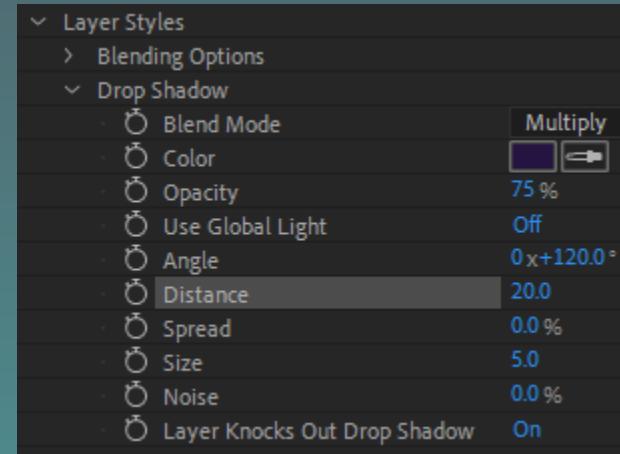
Right Click > Layer Styles > Outer Glow



Can select Drop Shadow effect and copy/paste it onto another layer, like "Dataset".

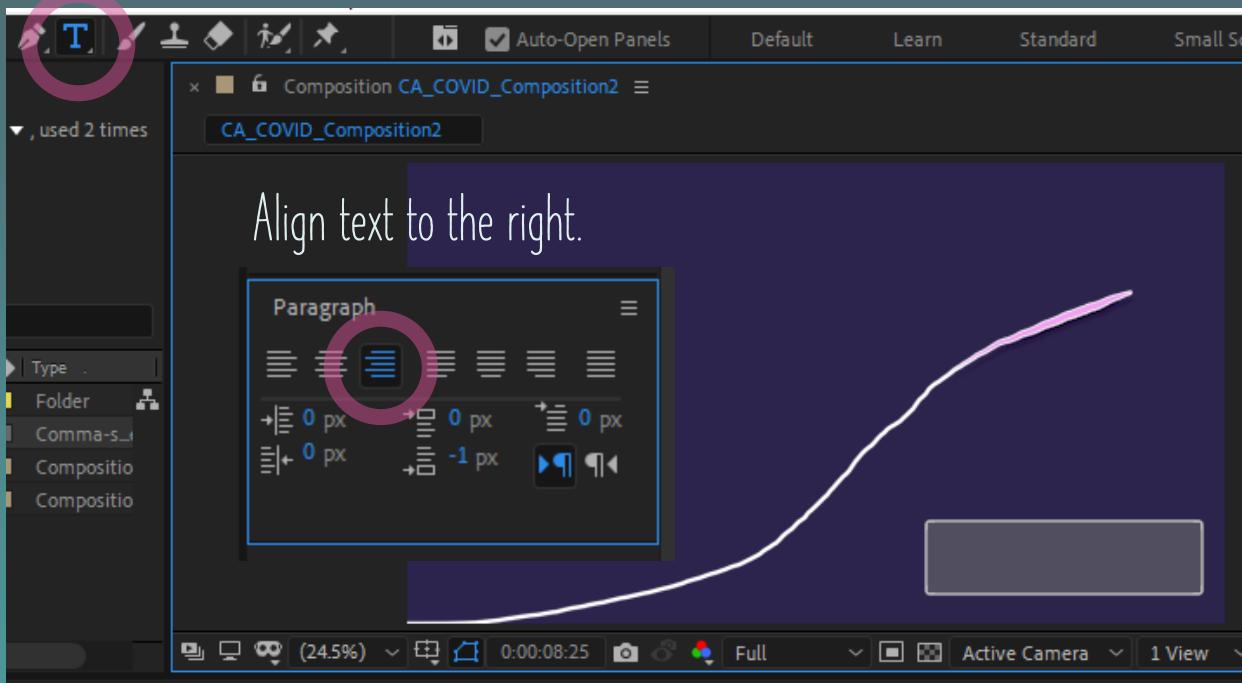
Add SHADOW:

Right Click > Layer Styles > Drop Shadow



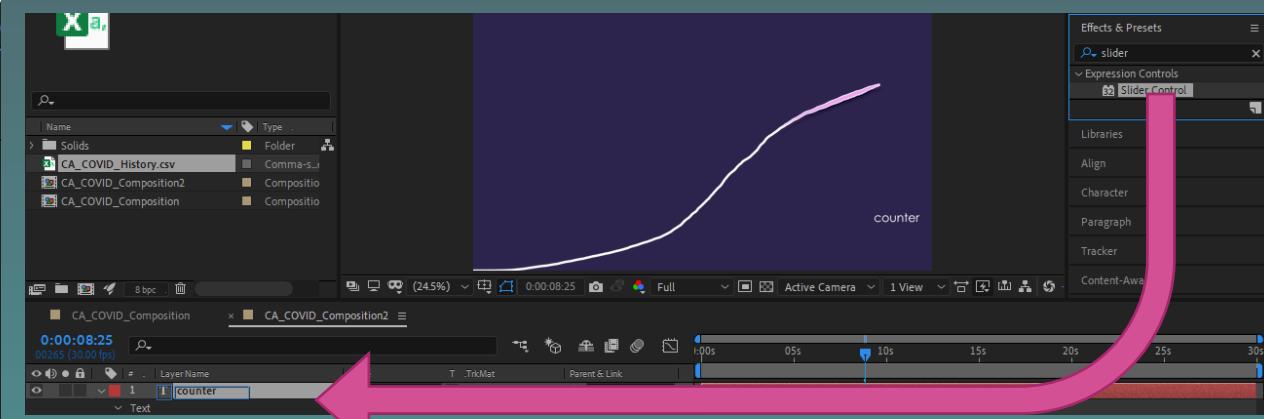
28. ADD TEXT COUNTER

Select text tool, click and drag to create text box, and scale text so that it is visible.



29. ADD A SLIDER CONTROL

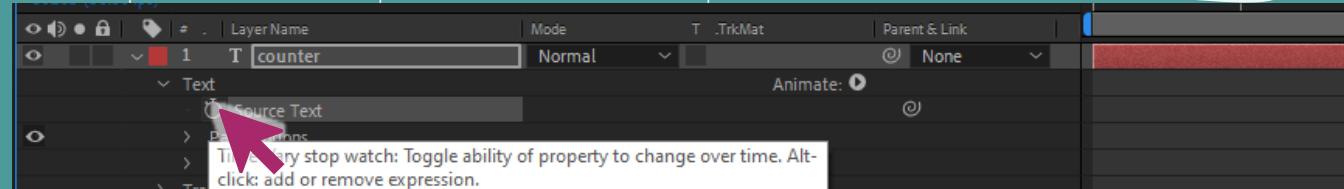
Search the Effects menu and drag & drop the Slider Control onto the Text layer.



Rename Slider control "Current Data Row"

30. ADD AN EXPRESSION

Alt- or Option- click on the stopwatch to add and edit an expression



```
var current = Math.floor(effect("Current Data Row")("Slider"))

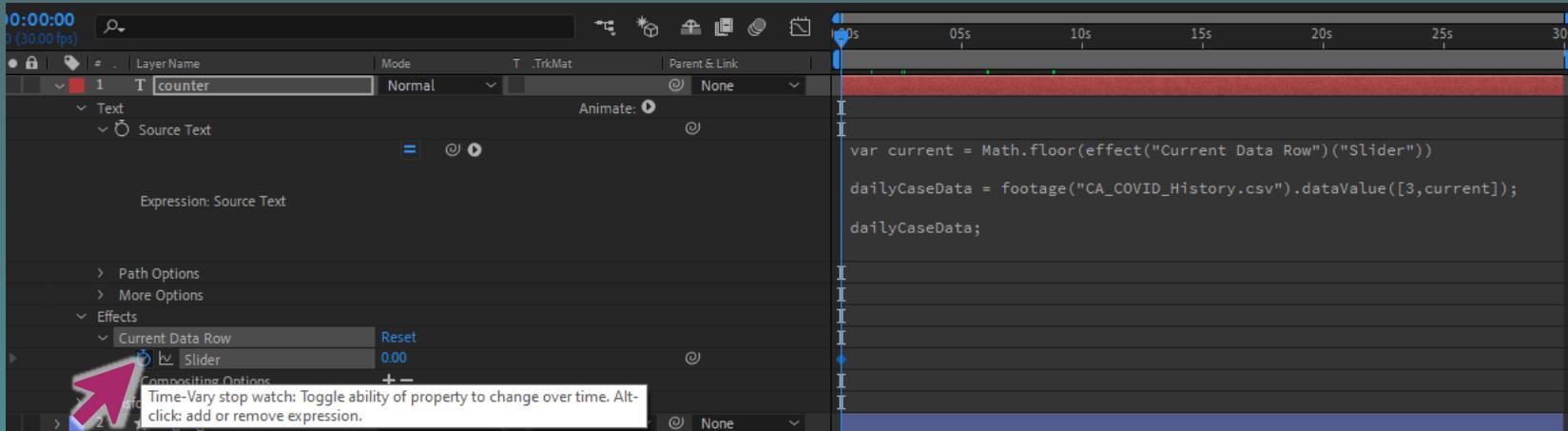
var dailyCaseData = footage("CA_COVID_History.csv").dataValue([3,current]);

dailyCaseData;
```

The expression above will show the current case data for each row based on the slider value.

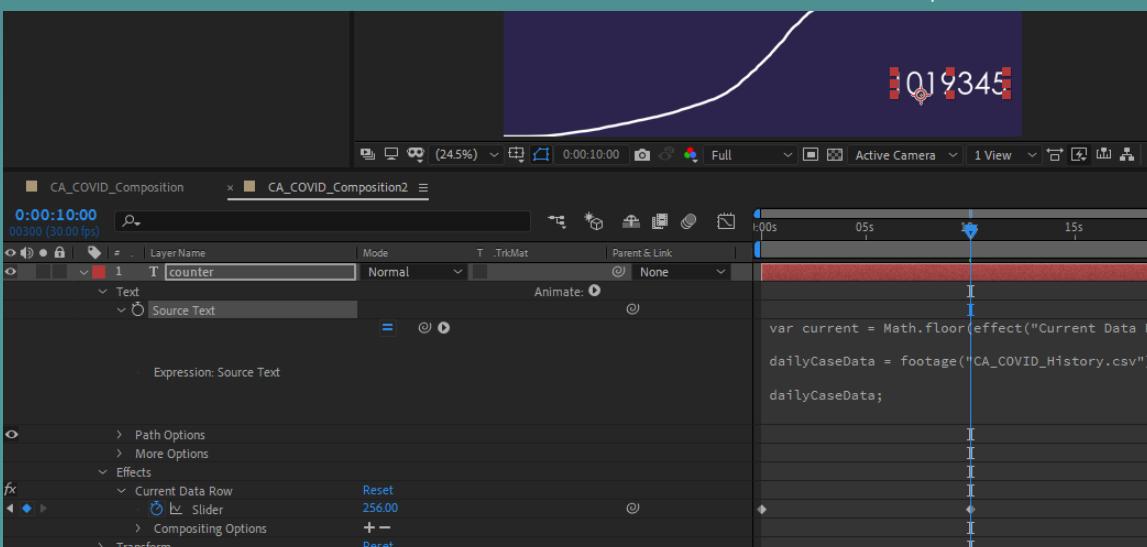
31. ADD SLIDER KEYFRAMES

Go to the beginning of the animation and create a keyframe with the "Current Data Row" slider = 0 (1st row)



Since JavaScript indexing starts at 0, 1, 2, etc.

Go to the END of the animation (10 seconds) and create a keyframe with the "Current Data Row" slider = 256 (last row)



The text box
should display the
according to the
row indicated by
the slider.

32. DUPLICATE COUNTER LAYER

Change text in expression to be associated with column 0 to get date counter.

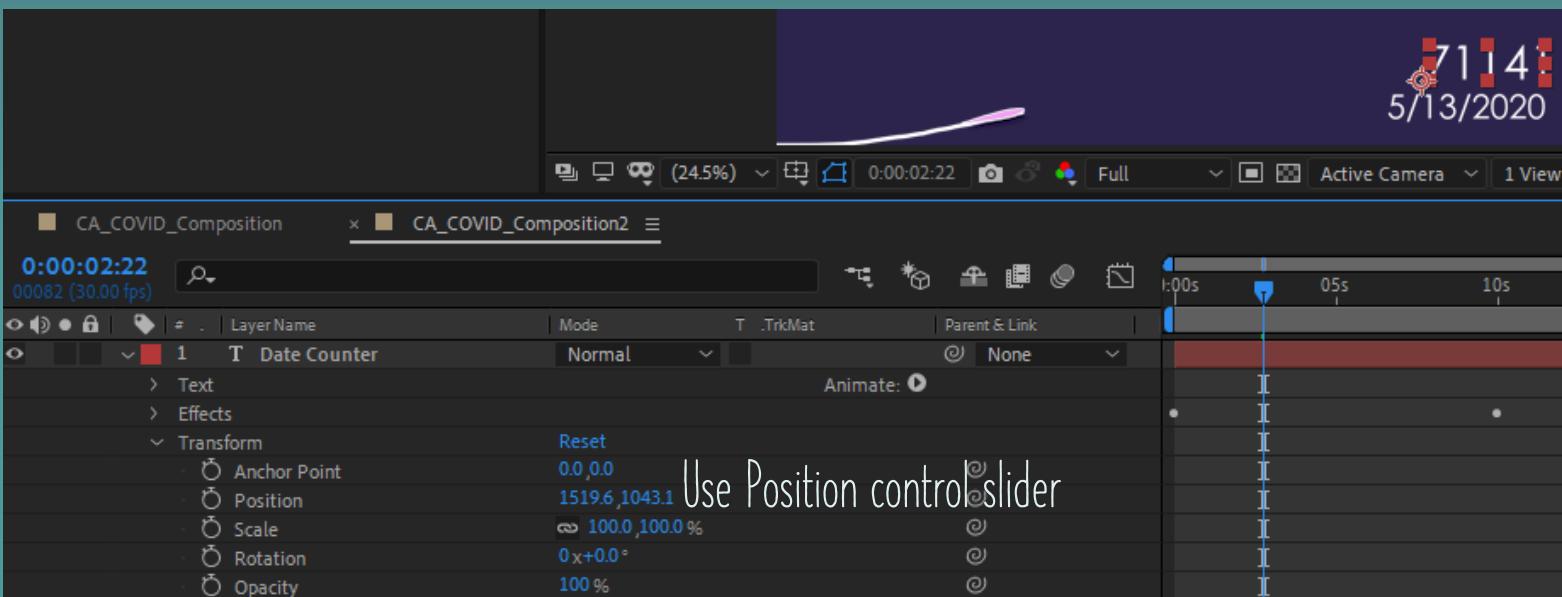
```
var current = Math.floor(effect("Current Data Row")("Slider"))

var dateCounter = footage("CA_COVID_History.csv").dataValue([0, current]);

dateCounter;
```

33. RENAME & MOVE LAYERS

Can also align layers

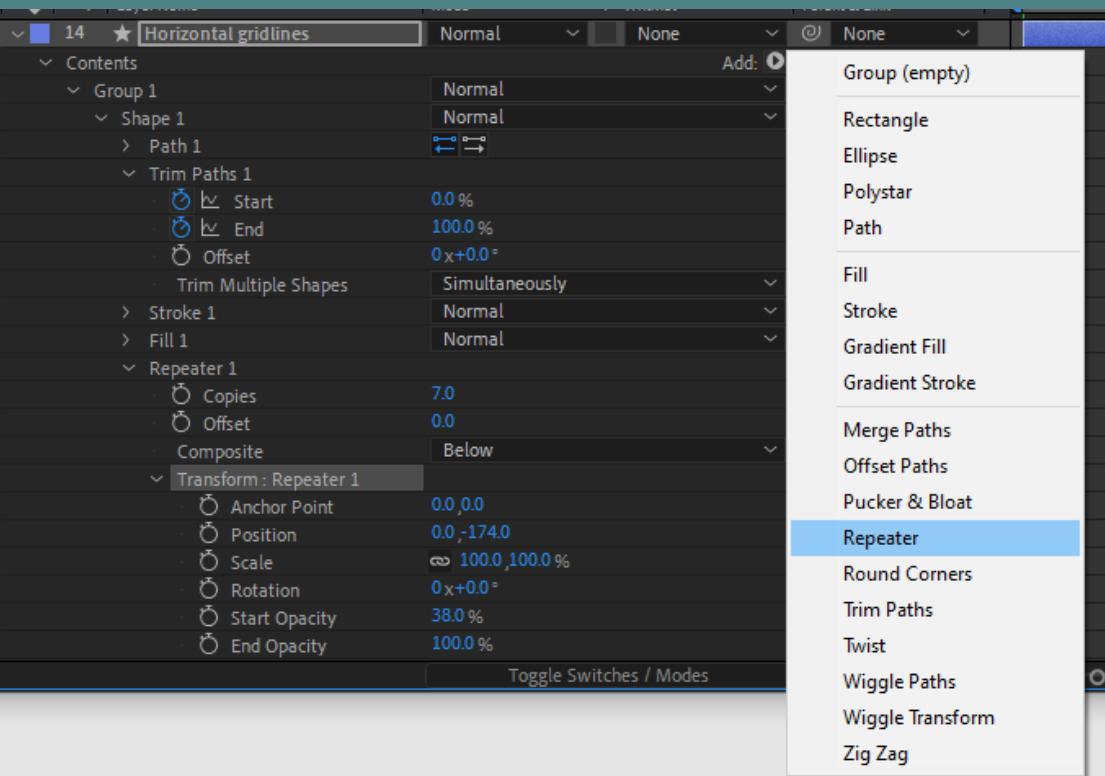


34. FINISHING TOUCHES!

Create horizontal gridlines, y-axis labels, and any other titles, styles, or effects.

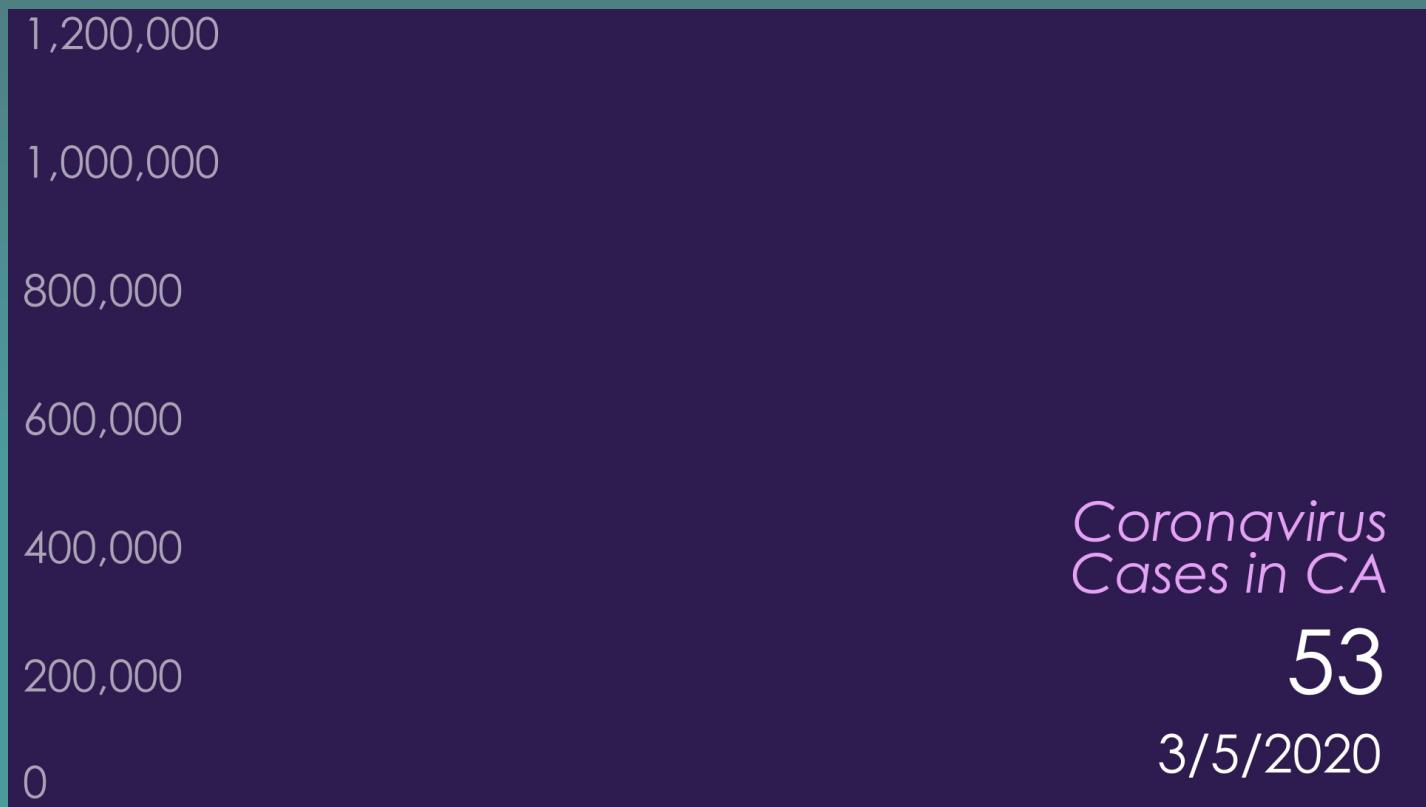
Horizontal Gridlines:

- Create horizontal path (by holding Shift)
- Add Repeater with n copies
- Transform each instance of the repeater by adjusting the Y-value for Transform : Repeater 1

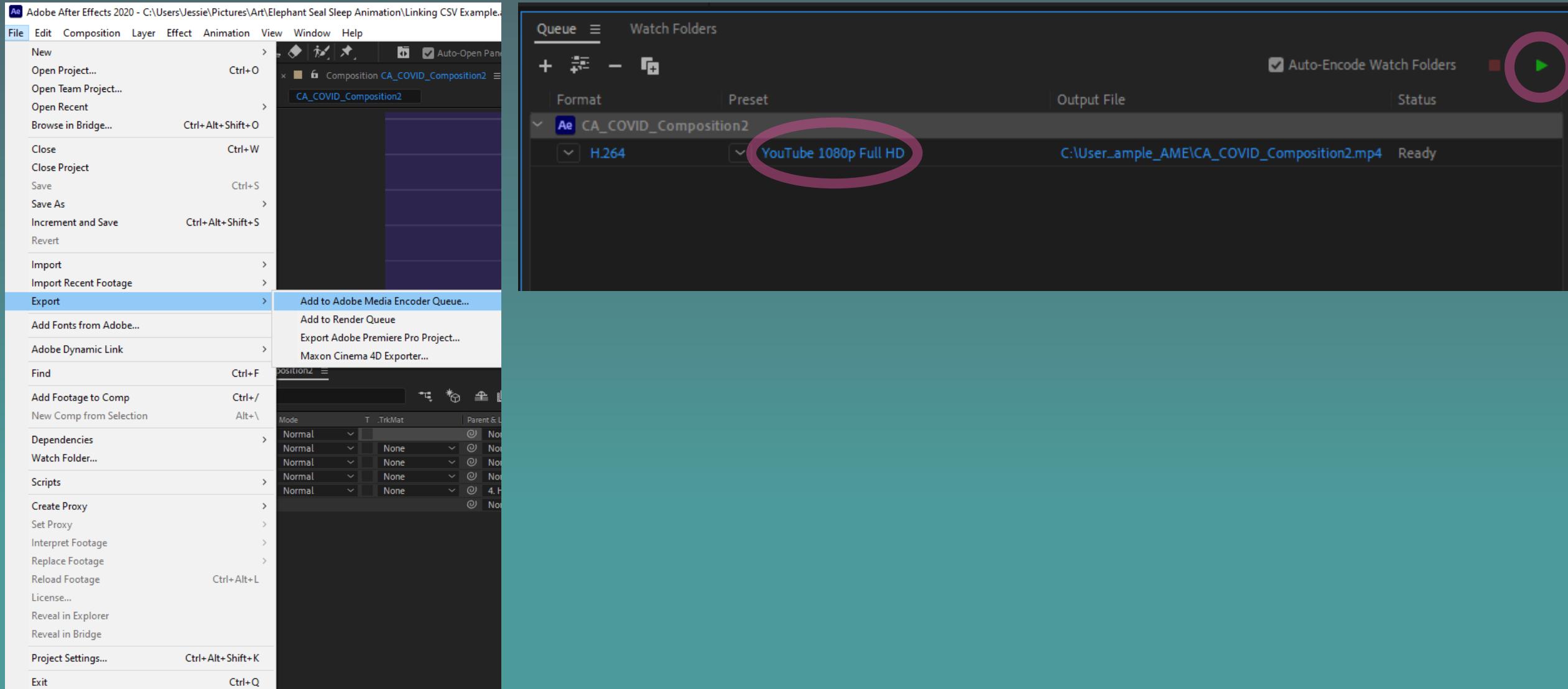


Y-axis labels:

- Create text box "0" and left align paragraph text
- Ctrl + D to create a label for each gridline
- Change text for each layer



35. EXPORTING AN .MP4



Practice

Syncing timeseries data to a video

Using your own data or the toadfish data generously provided in the workshop folder by Jacey Van Wert & Loranzie Rogers from Mensinger et al. 2019

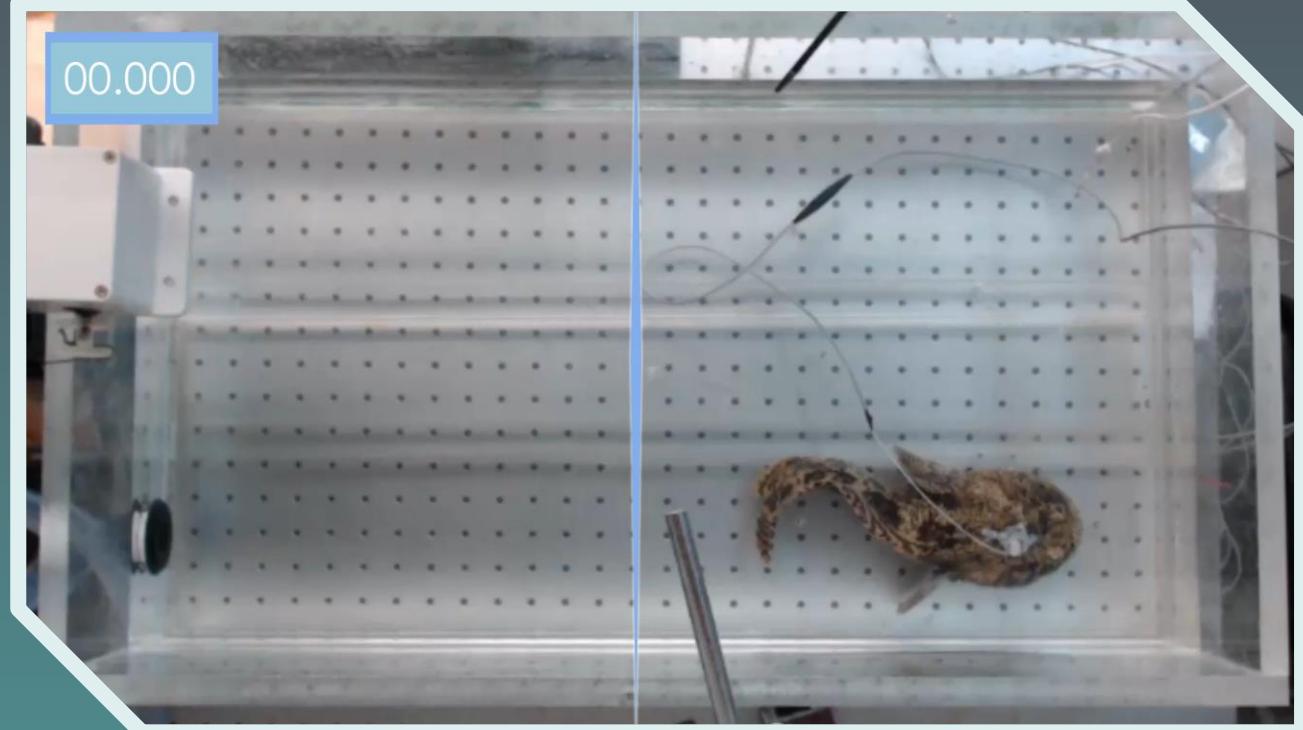
DOWNLOAD SAMPLE DATA

Go to jessiekb.com/resources password ucsc

Download sample data. These data are provided for educational use and are not intended for distribution or reproduction– thank you!

Data demonstrating increased anterior lateral line afferent neuronal activity during self-generated swimming.

Toadfish video and data provided by LJ Rogers & Jacey Van Wert from Mensinger et al. 2019.



PREPPING YOUR OWN DATA

- 1) A figure– vector graphic format with transparent background or with your data in a separate layer in illustrator/PDF .ai or .pdf (with layers) file formats are ideal, but .eps or .svg can work.
- 2) .CSV file with the data you used to create your figure. Keep it simple with 2 columns, one for time and one for your data.
- 3) A video file that you'd like to sync or pair with the data.

- 1) **FIGURE:** vector graphic format with transparent background or with your data in a separate layer in Illustrator/PDF .ai or .pdf (with layers) file formats are ideal, but .eps or .svg can work.



I copy/pasted an Excel graph of the data from a CSV into Illustrator, selected the path with the data, copy/pasted the line with the data into a new layer ("Layer 2" above), saved the file as type ".ai" (Illustrator file).

- 2) **DATA:** .CSV file with the data you used to create your figure. Keep it simple with 2 columns, one for time and one for your data.
- 3) **VIDEO:** A video file that you'd like to sync or pair with the data.

I trimmed the video to the exact length that I had data for.

1) CREATE PROJECT & COMPOSITIONS

A) If you are bringing in your data as an illustrator file, just make 1 composition. Name it "Data Synced with Video" and scale it to 1920 x 1080, 30 fps.
B) If you are bringing in your data as an .eps file or .png, make 2 compositions. The first will be your "Data" composition and your second will be your "Data Synced with Video" composition. Scale your final version, the "Data Synced with Video" composition to 1920 x 1080, but scale up your "Data" composition horizontally depending on how fast you want your data to move across the screen. For me, I chose to zoom in by a factor of ~4.2: 8090 x 1080. When you bring in your figure, scale it up so that it fills the composition.

2) IMPORT FILES: your figure, video, and CSV file.

Import your files by dragging & dropping OR by right clicking in the Project Panel > Import > File. If you are importing an illustrator file, make sure to import it as a Composition instead of as footage, so that each Illustrator layer becomes a separate After Effects Layer. This way you can just hide the layer with the rest of your graph and only display the timeseries data.

3) SYNC DATA TO VIDEO!

Drag your "Data" or Illustrator composition into your "Data Synced with Video" composition. Drag your video into that composition as well. Navigate to the beginning of the video and add a Position keyframe to the data layer to align the beginning of the datastream where you would like it to appear. Navigate to the end of the video and add a Position keyframe to the data layer where you would like it to stop. After the video is synced, you can use the same methods in our previous tutorial to create time counters and stylize your animation.

1) SOME NEW THINGS

A) Creating time counter:

Just like the expressions we used in the last example to create numerical counters, we can add a counter to keep track of time elapsed.

```
var slider = effect("Custom Start Time")("Slider");
var rate = 1;
var clockStart = slider;

function padZero(n) {
    return (n < 10 ? "0" : "") + n;
}

clockTime = clockStart + rate*(time - inPoint);

if (clockTime < 0) {
    sign = "-";
    clockTime = -clockTime;
} else{
    sign = "";
}

t = Math.floor(clockTime);
hr = Math.floor(t/3600);
min = Math.floor((t%3600)/60);
sec = Math.floor(t%60);
ms = clockTime.toFixed(3).substr(-3);
sign + padZero(hr) + ":" + padZero(min) + ":" + padZero(sec) + "." + ms
```

BUT! What if we don't want the whole timestamp?

Either alter the code OR if you think you might want it later, you can just add a mask to hide the HH:MM and reveal the seconds.

Select the layer you want to mask and then draw a rectangle over what you want to hide. Make sure the mask is set to "Subtract".

3D Animation

Basics of editing figures & compositing

ADDITIONAL RESOURCES

Website:

<https://jessiekb.com/resources> passcode ucsc

RESOURCES
for learning science communication with art

1: PowerPoint 2: After Effects 3: Autodesk Maya

4: Inkscape/Illustrator Example Animations

Workshop requests? Contact me!

Hello students, educators, and scientists!

As I explore the world of digital art, I have come across many helpful tools and techniques to visually communicate science. This page is designed to share what I've learned along the way and to help students, educators, and scientists navigate the world of digital art for science communication. Please feel free to view and download these resources to begin your science communication journey!

~ Terms of Use ~



These resources may contain unpublished data and are intended for educational purposes, not for reproduction or redistribution. Please contact me at jkb@ucsc.edu regarding copyright and use permissions or if you would be interested in featuring a workshop at your institution.

Upcoming Workshops:
Questions? Email me! jkb@ucsc.edu



Instagram:
@artforscicomm

artforscicomm

6 posts 80 followers 35 following

Jessie KB Art
A compilation of data-driven digital design tips for science communication! See more of my art at @jessiekb_art jessiekb.com

Followed by jaceyww, sylviakt, bibonkers +18 more

POSTS TAGGED

DAY 4 DIGITAL DESIGN CUSTOM CHART TEMPLATES

DAY 3 DIGITAL DESIGN DISTRIBUTE

DAY 2 DIGITAL DESIGN ALIGN

DAY 1 DIGITAL DESIGN DUPLICATE

Welcome!

Twitter:
@jm kendallbar

Jessica Kendall-Bar

206 Tweets

Followed by jaceyww, sylviakt, bibonkers +18 more

Jessica Kendall-Bar
@jm kendallbar

PhD student at UC Santa Cruz inspired by art and science and together to vividly depict the underwater world. Berkeley '16

jessiekb.com Joined March 2015

521 Following 156 Followers

Tweets Tweets & replies Media

Jessica Kendall-Bar @jm kendallbar · Dec 2 Have you wasted too much time making #PowerPoint conference talks? No more! I'm delivering #tips every your #DailyDoseOfDigitalDesign with helpful tricks th Let me know if you have requests! #scicomm #scienc

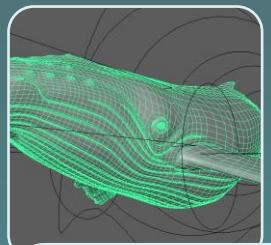
1 1 5 1

Show this thread

Jessica Kendall-Bar @jm kendallbar · Dec 3 Replying to @jm kendallbar Tip #3 for #December's #DailyDoseOfDigitalDesign is tool in #PowerPoint to quickly and evenly distribute y tick marks) which is within the ALIGN tool in the Shape Home tab under 'Arrange'. #scicomm

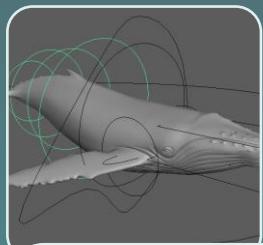
DAY 1

3D ANIMATION WORKFLOW



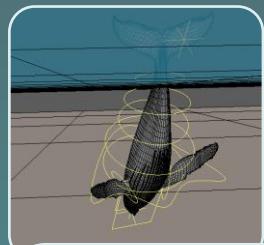
MODEL

Create 3 dimensional models using polygon primitives



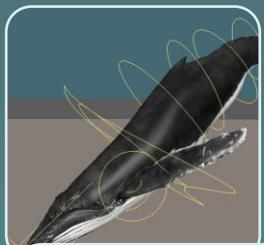
RIG

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



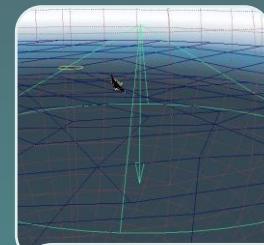
ANIMATE

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



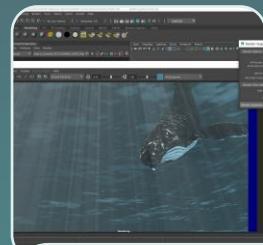
TEXTURE

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!



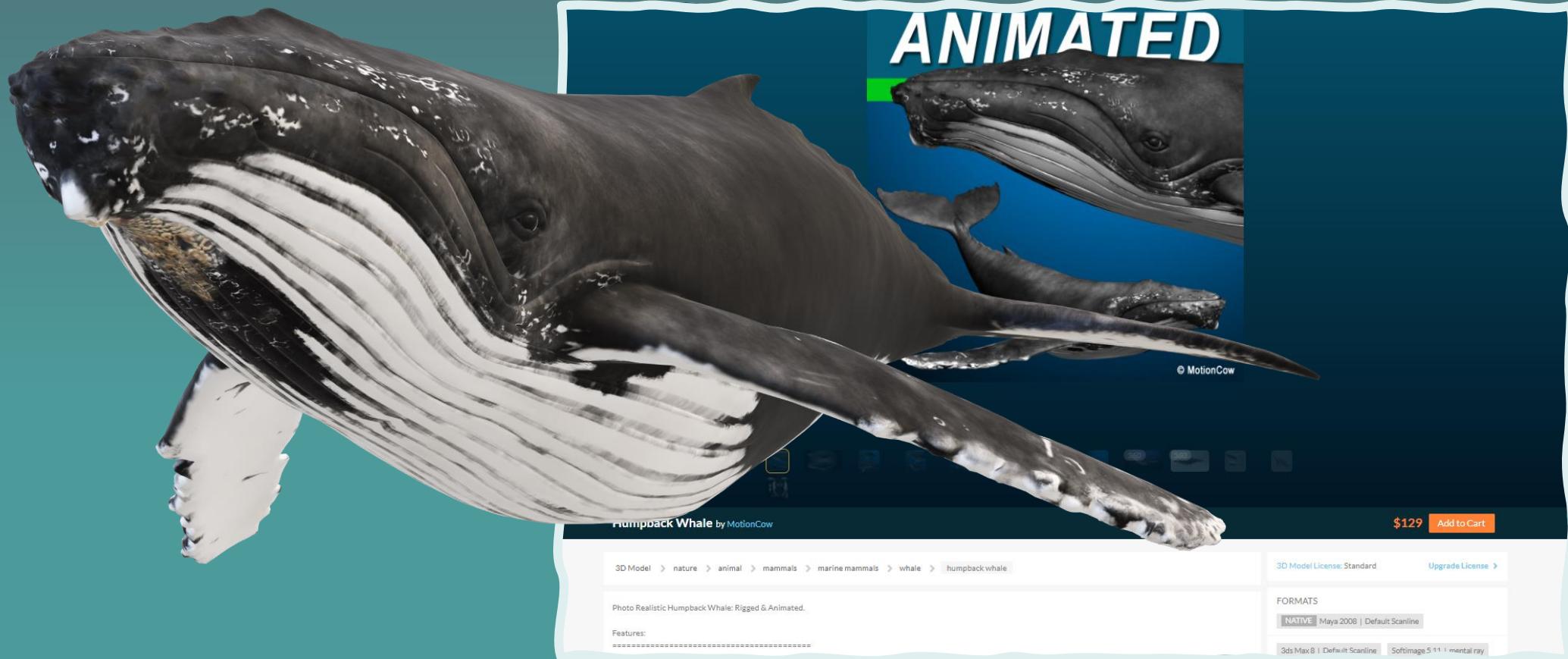
A 3D model I purchased from:
<https://www.turbosquid.com/3d-models/3d-humpback-whale-hump/597221>

A screenshot of the Turbosquid product page for the "Humpback Whale" 3D model by MotionCow. The main image shows a large humpback whale swimming, with a smaller inset showing two whales. A large blue banner across the top says "ANIMATED". Below the images, there's a row of smaller thumbnail previews. At the bottom, there's navigation for 3D Model, nature, animal, mammals, marine mammals, whale, and humpback whale. The product title is "Humpback Whale" by MotionCow. It shows a price of \$129 and an "Add to Cart" button. The page also includes sections for "FORMATS" (listing NATIVE Maya 2008 | Default Scanline, 3ds Max 8 | Default Scanline, Softimage 5.11 | mental ray) and "UPGRADE LICENSE" options.

OPTION 1) PURCHASE A 3D MODEL

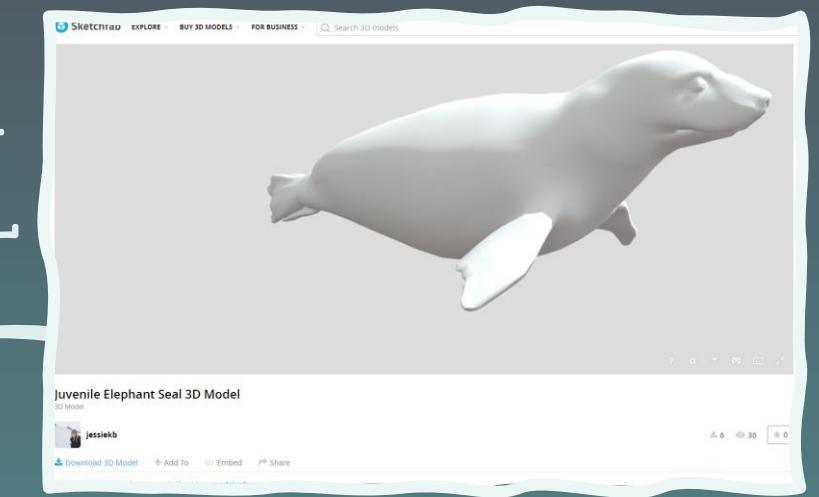
Websites: Turbosquid, Sketchfab, CGTrader, etc!

A 3D model I purchased from:
<https://www.turbosquid.com/3d-models/3d-humpback-whale-hump/597221>



OPTION 2) DOWNLOAD A FREE 3D MODEL

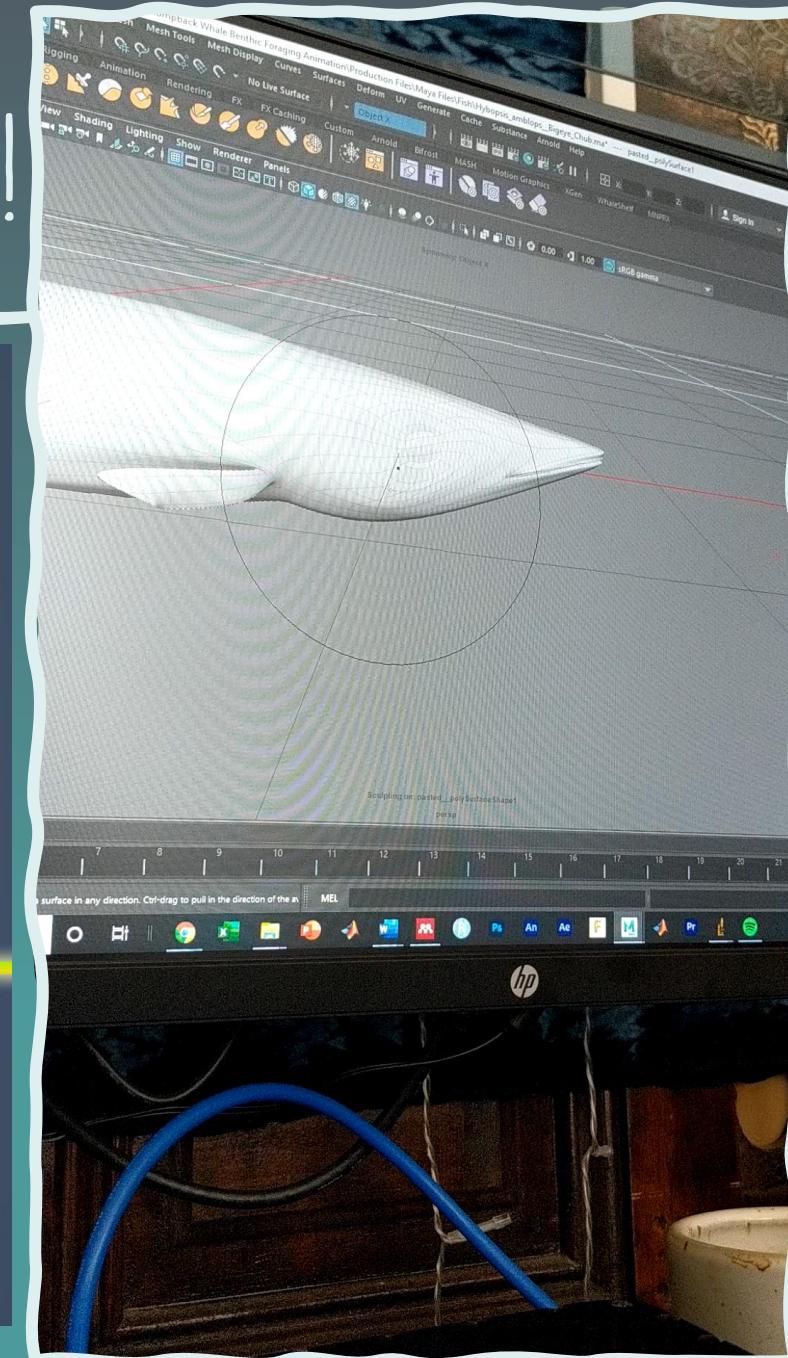
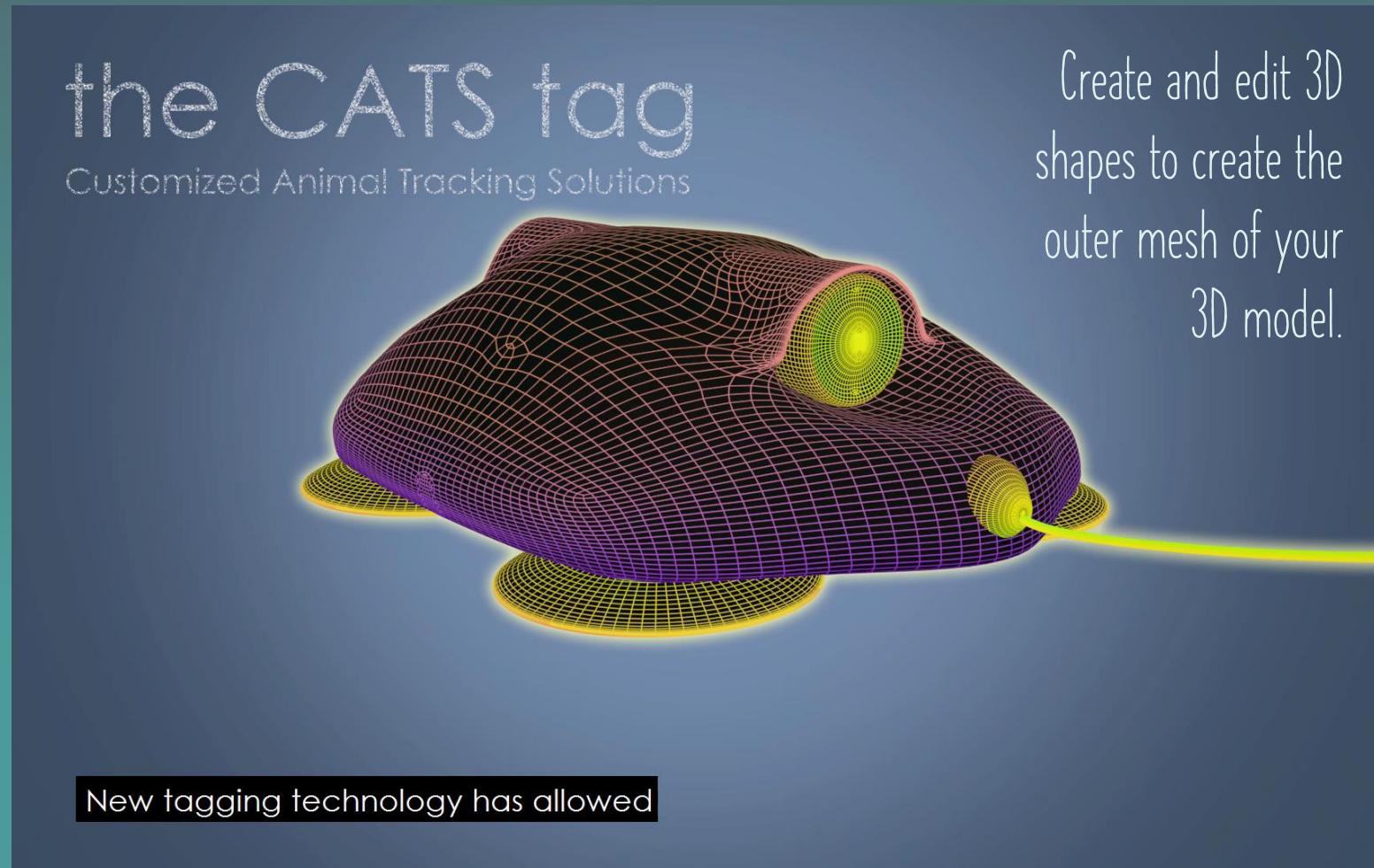
Websites: Turbosquid, Sketchfab, CGTrader, etc!



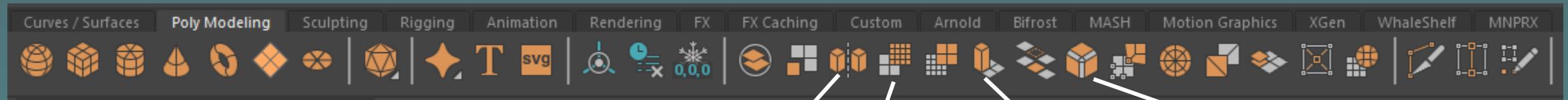
Free model I made:
<https://skfb.ly/6WSIz>

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!

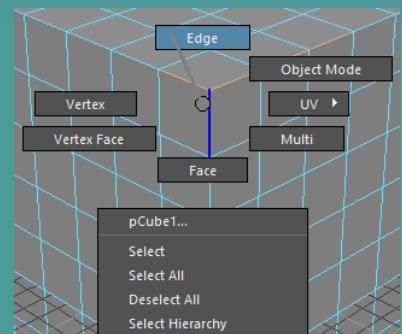


OPTION 3) MAKE YOUR OWN FROM SCRATCH!



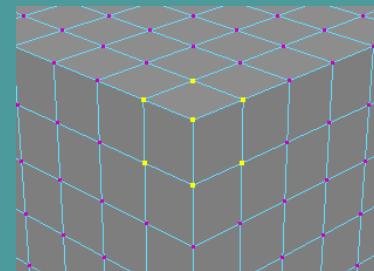
Make spheres, cubes,
cylinders, cones, donuts,
planes or discs.

Mirror Smooth Extrude Bevel

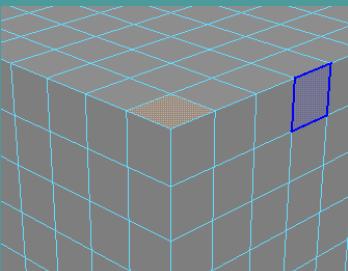


Change selection mode by
right clicking, holding, and
toggling selection modes:

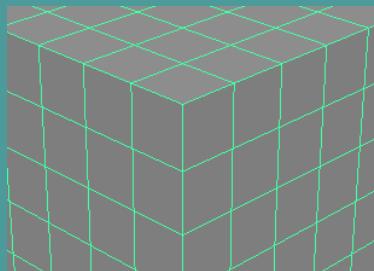
Vertex mode



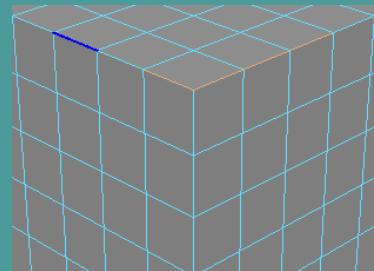
Face mode



Object mode

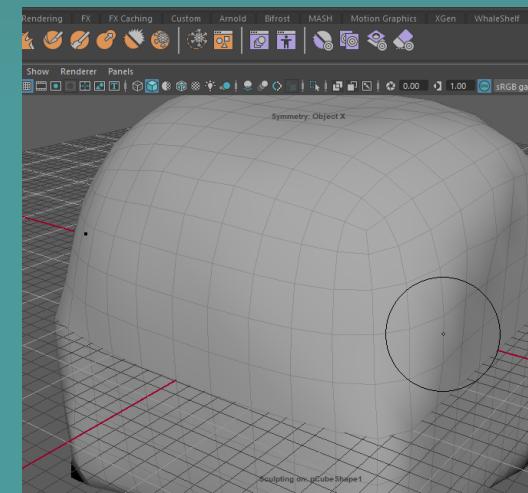
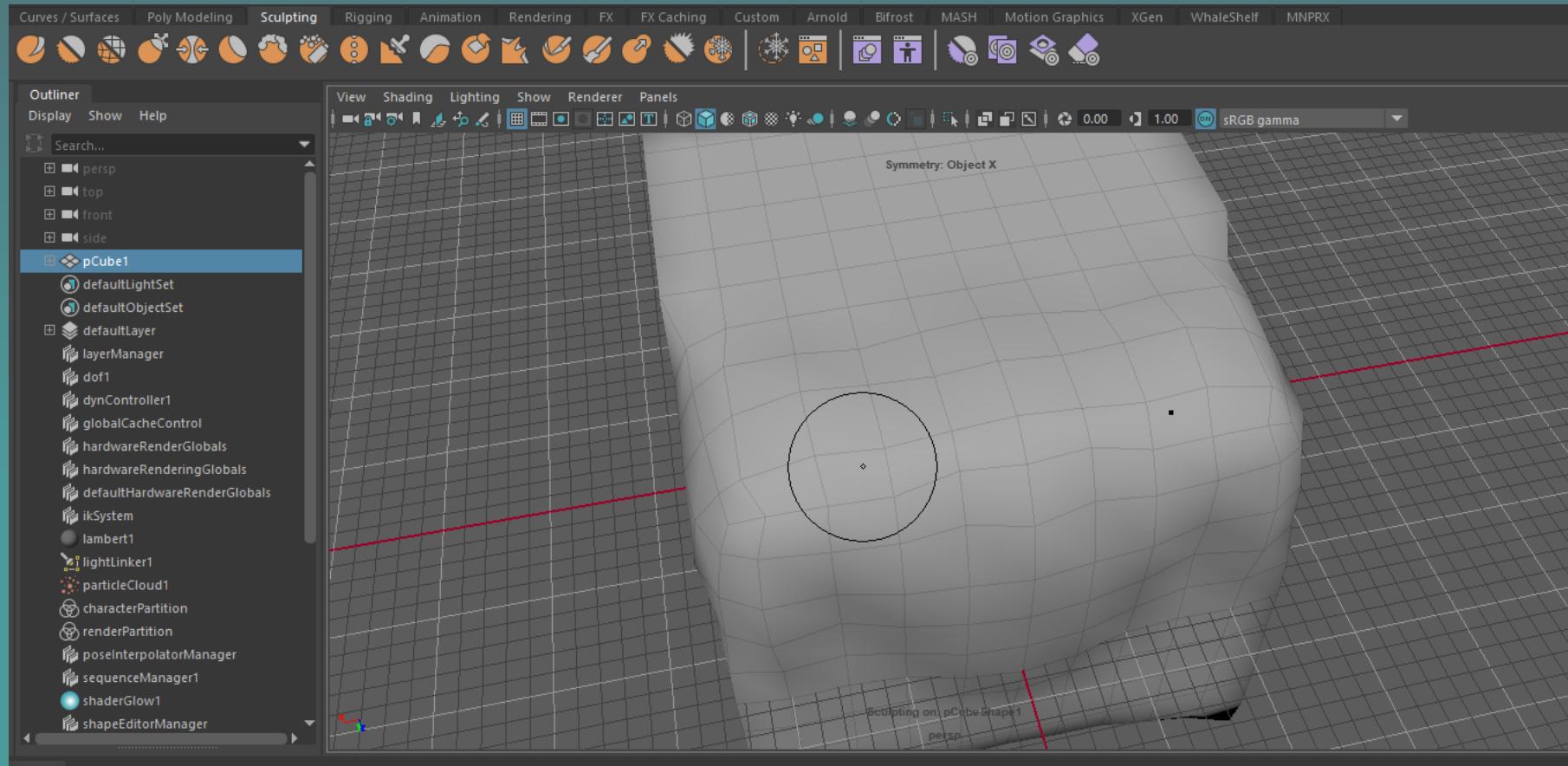


Edge mode



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!



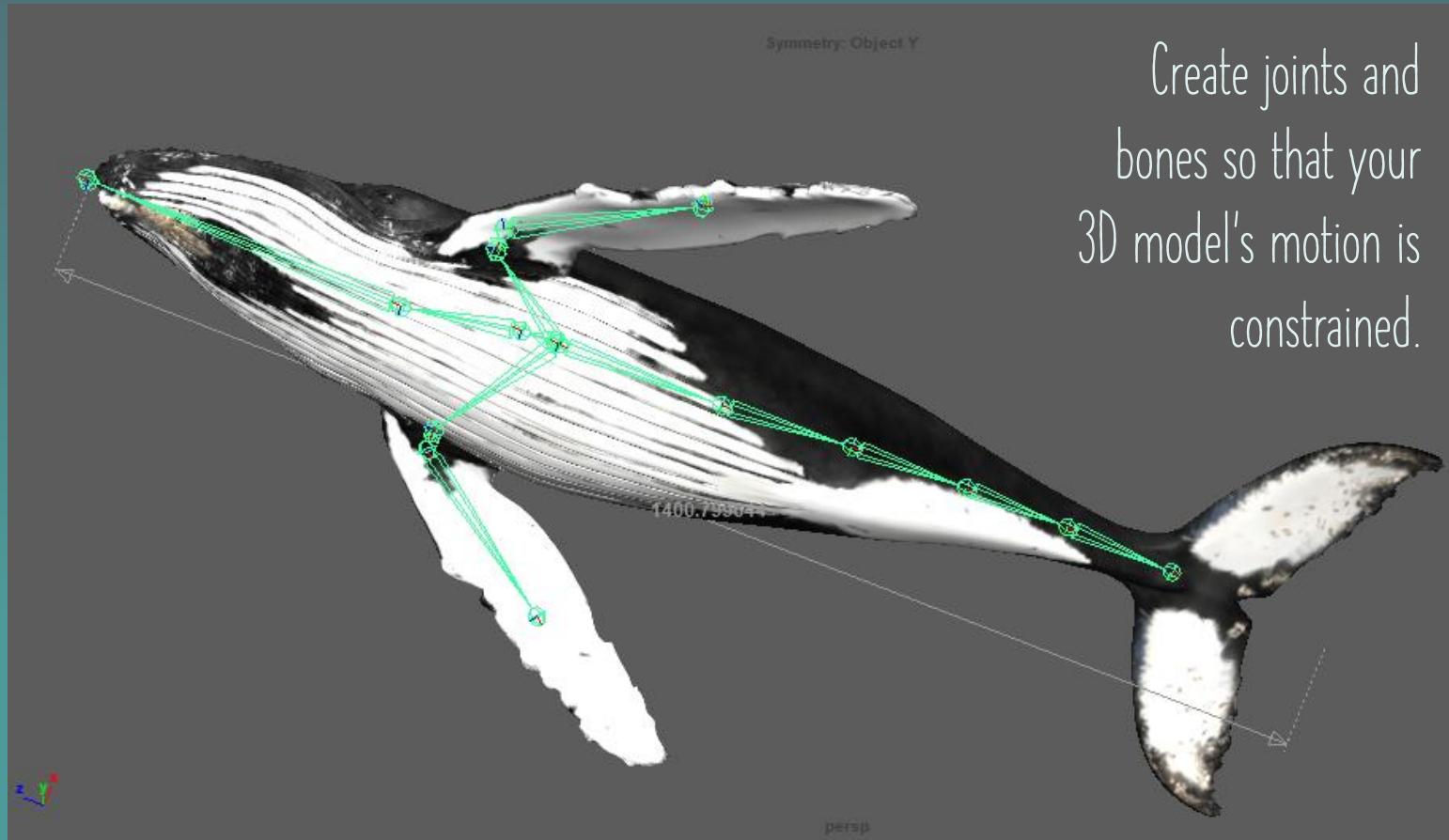
<https://youtu.be/qmuwXr3bNBY>



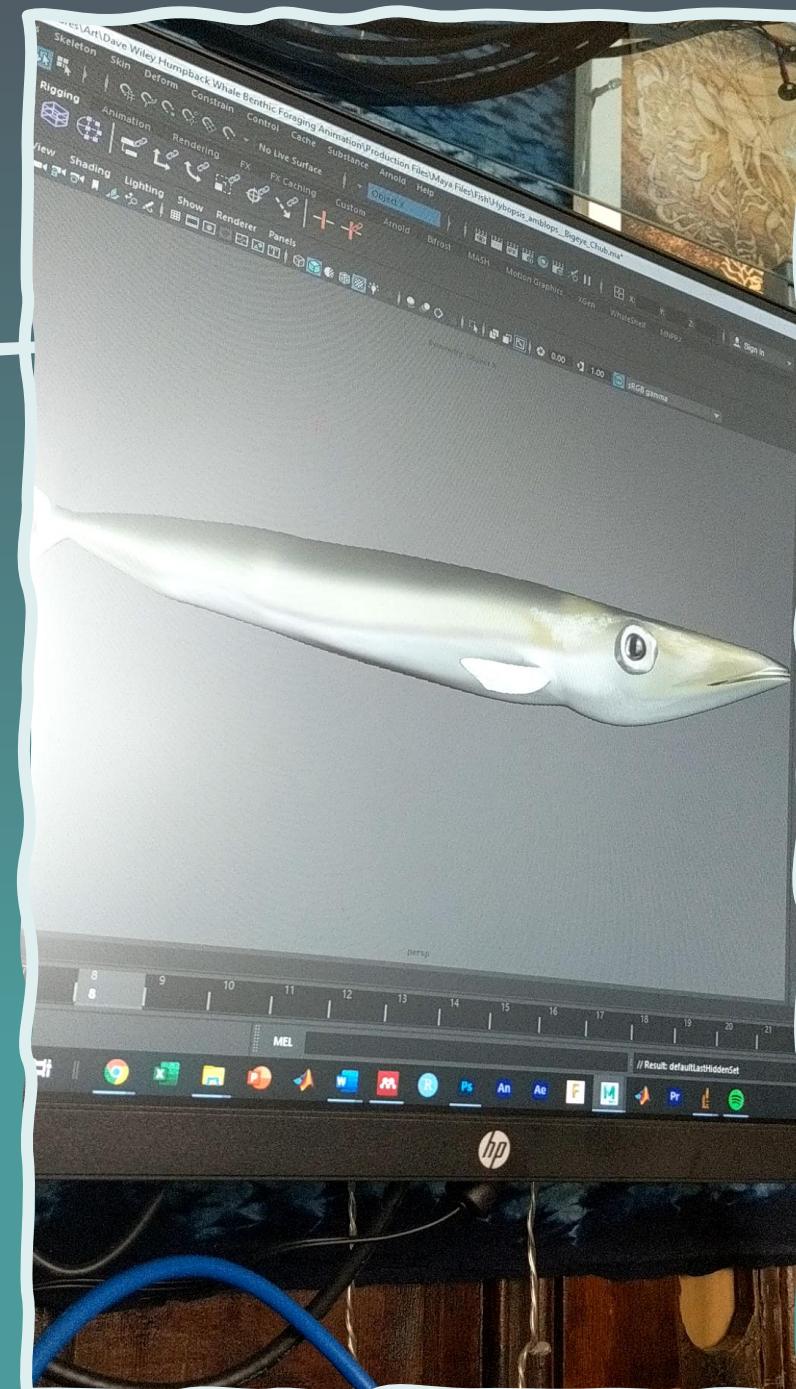
Rigging

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

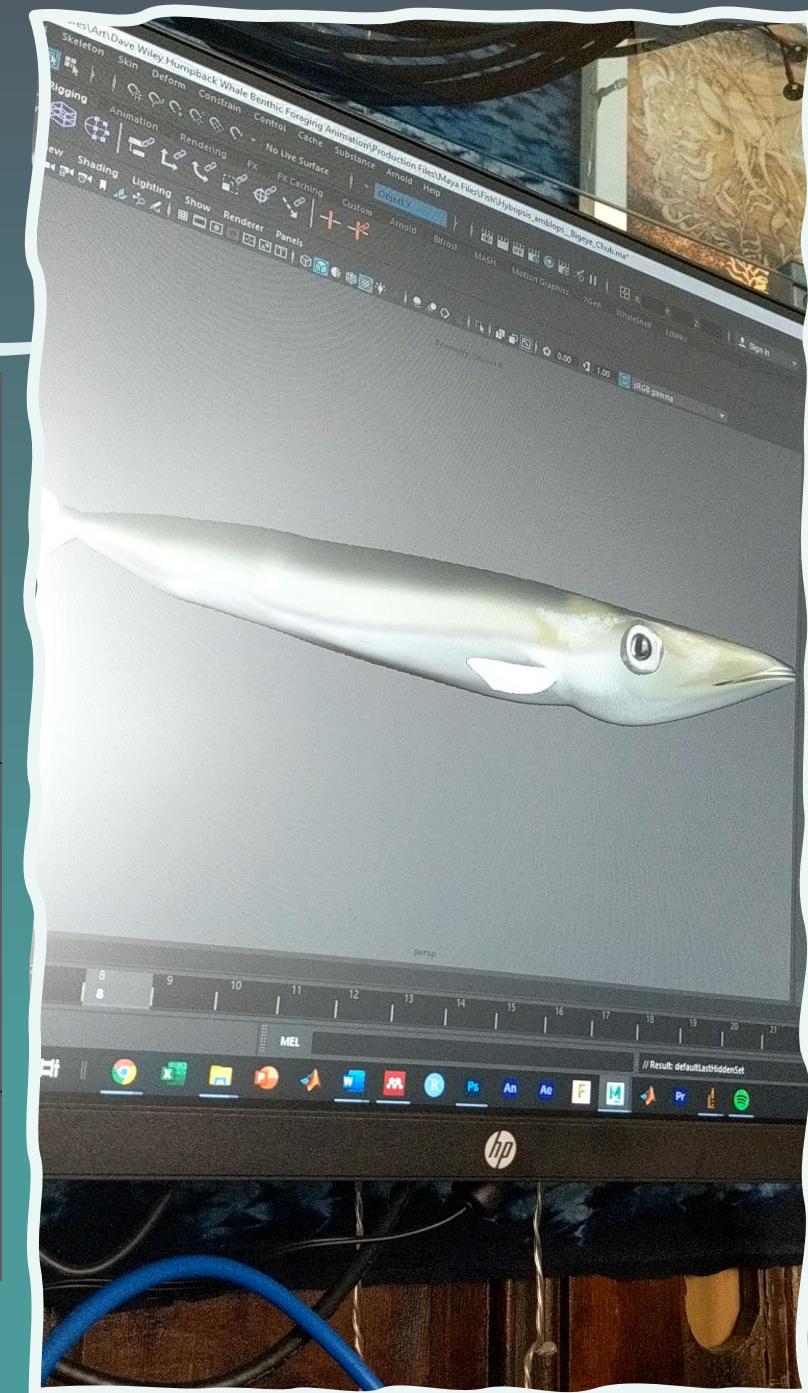
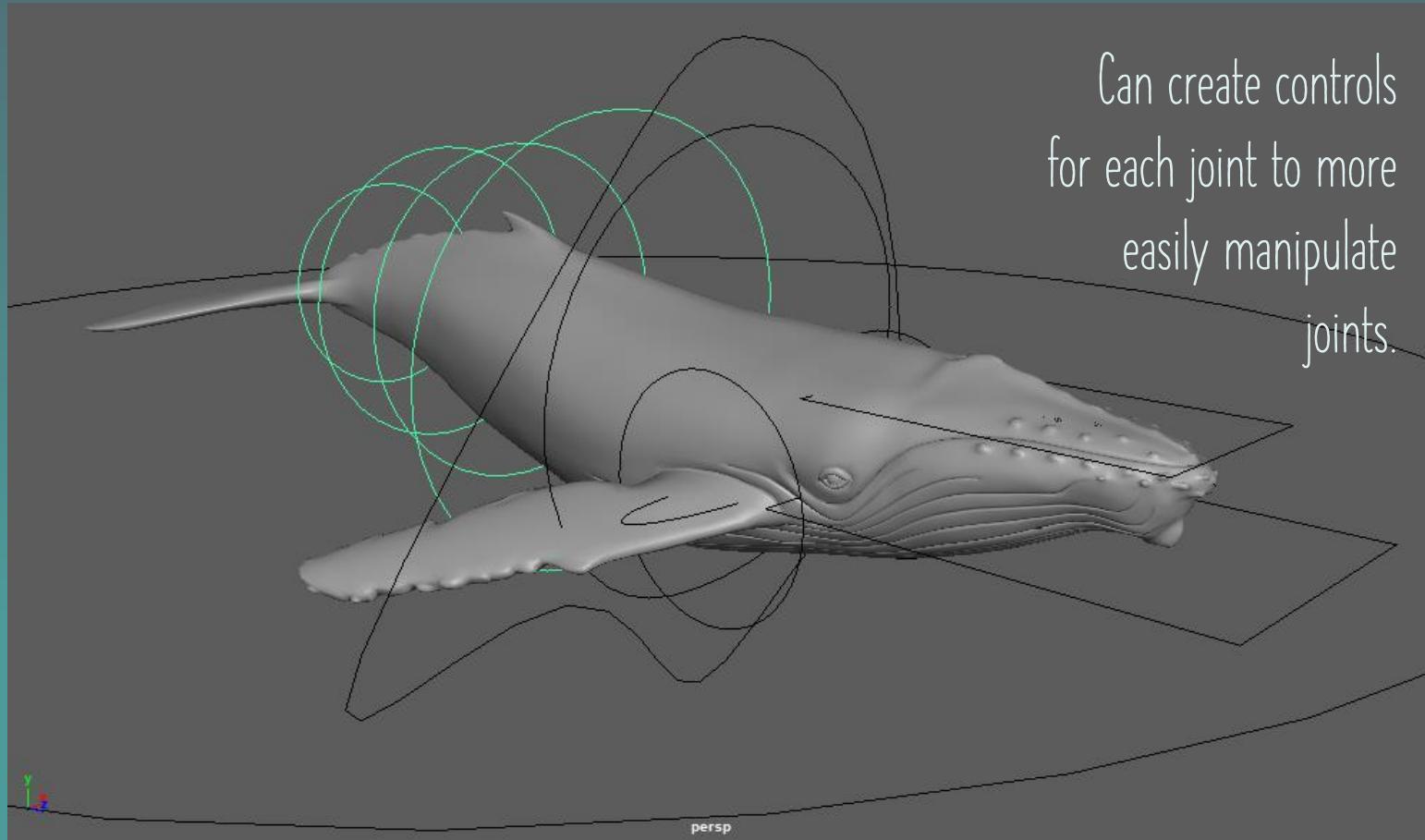
RIGGING



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



RIGGING

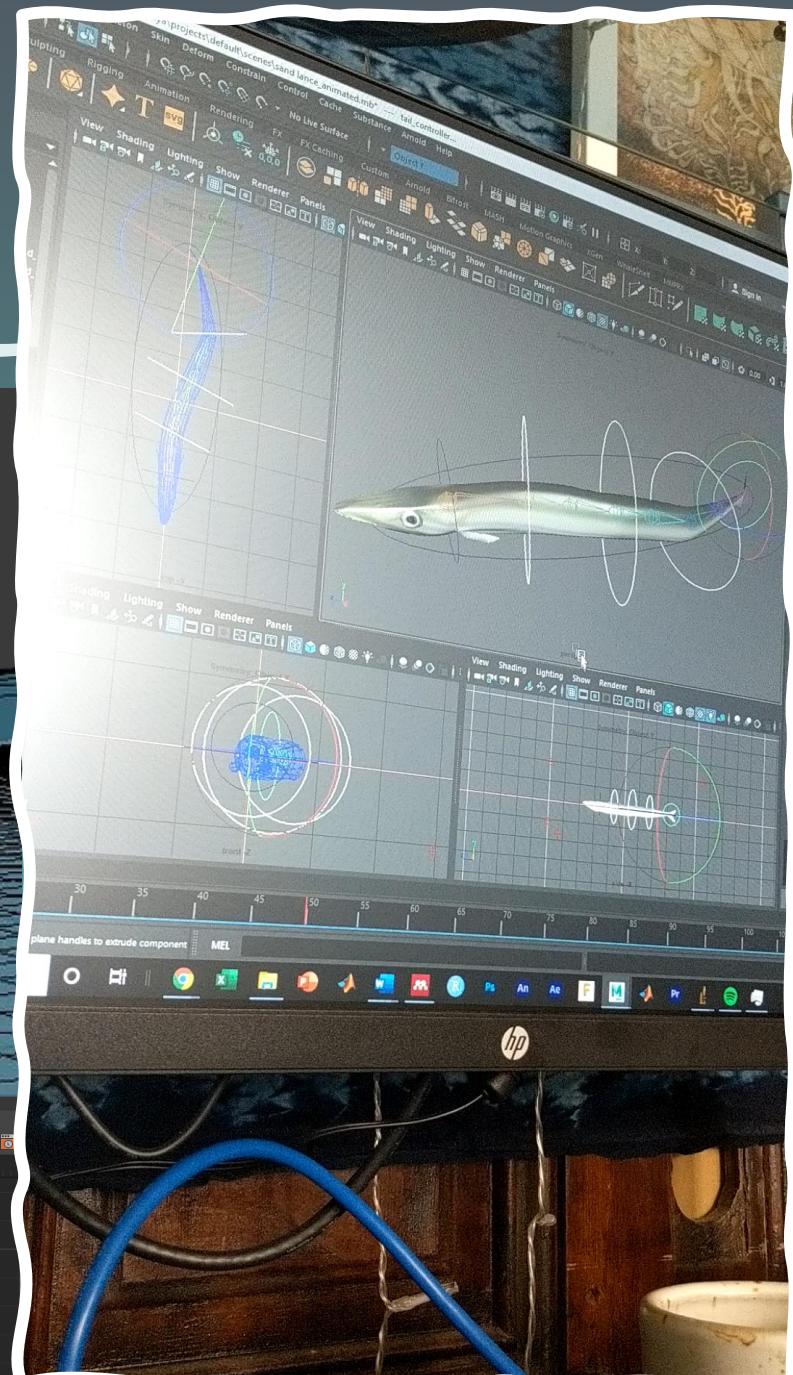
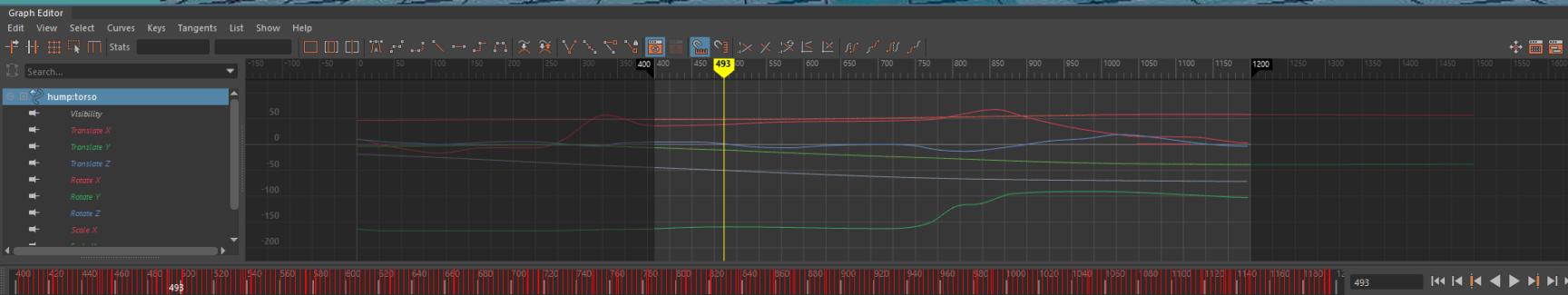
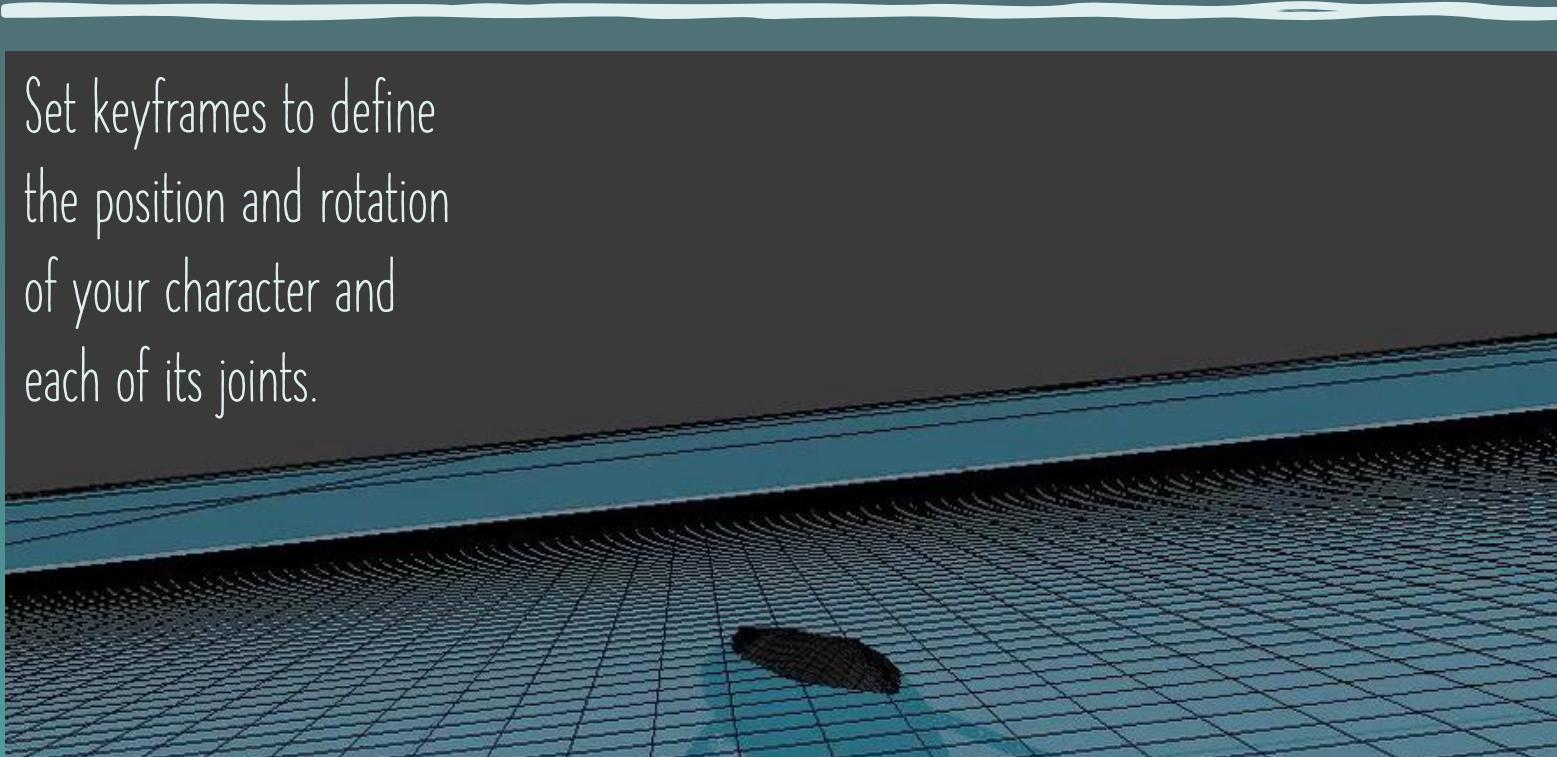


Animation

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

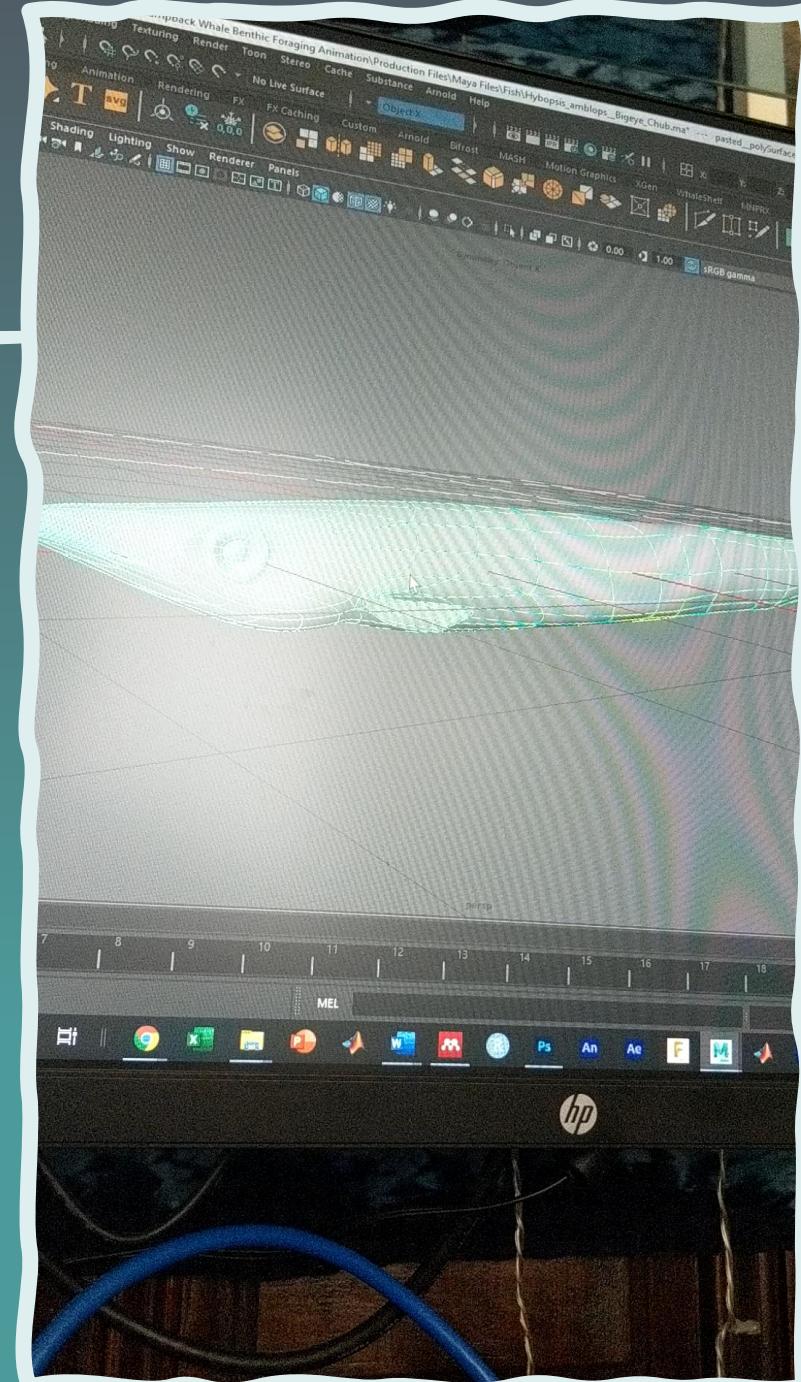
ANIMATION

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



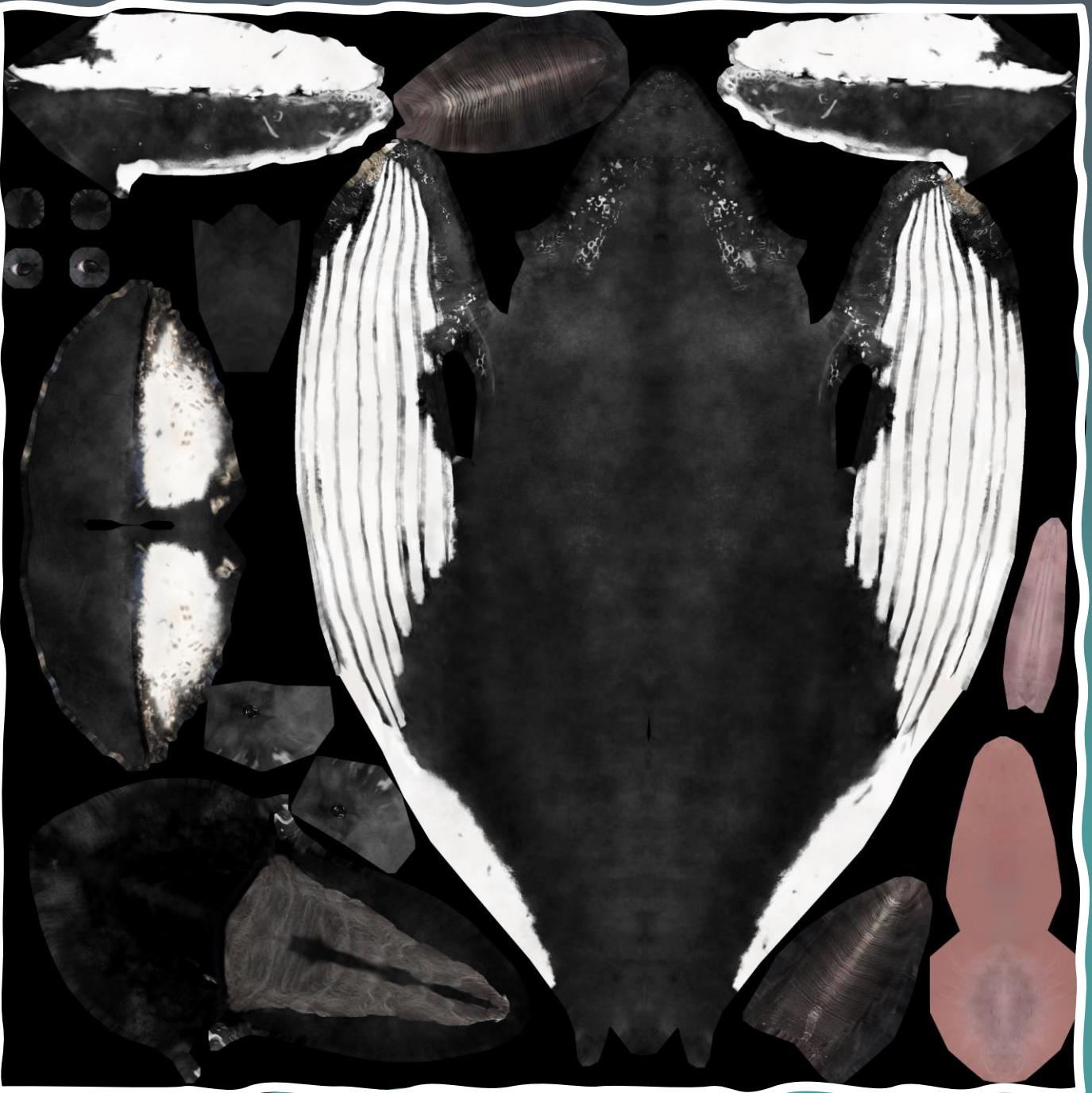
TEXTURE

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

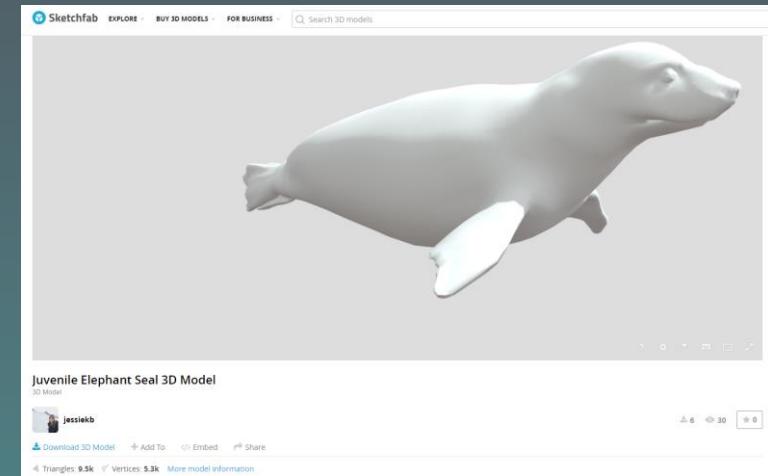
Using sample dataset that can be found under Autodesk Maya Tutorial Resources at jessiekb.com/resources passcode ucsc

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/6WSIz>



FILE ORGANIZATION IN MAYA

Put your seal .obj and .mtl files here

Documents > maya > projects > default > assets

Folder created by default

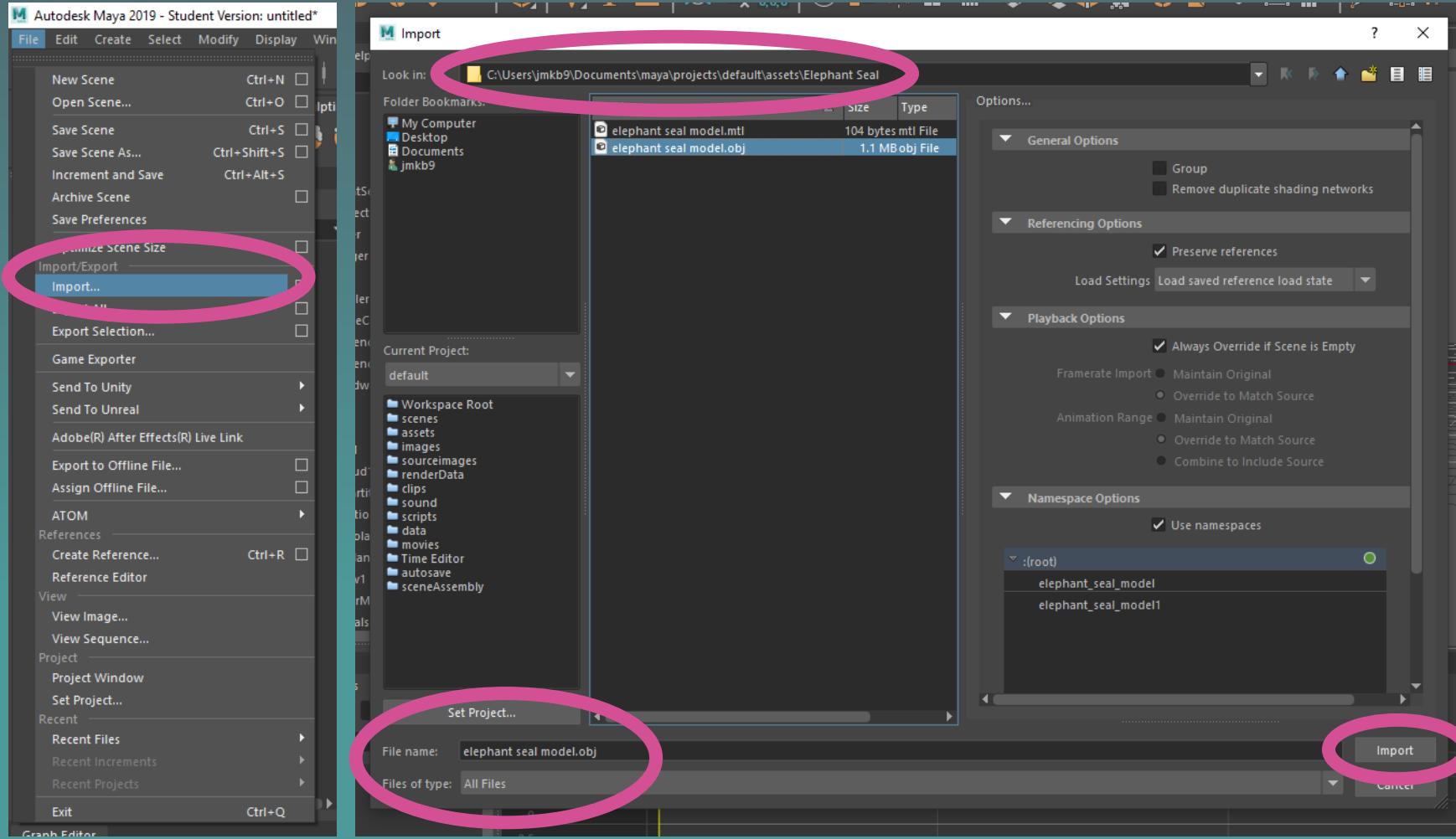


We will use default
Where you store different projects

A screenshot of a Windows File Explorer window. The path "Documents > maya > projects > default" is selected. The table below lists the contents of the "assets" folder.

Name	Date modified	Type	Size
assets	6/21/2020 2:34 PM	File folder	
autosave	11/29/2019 4:25 PM	File folder	
cache	11/29/2019 4:25 PM	File folder	
clips	11/29/2019 4:25 PM	File folder	
data	11/29/2019 4:25 PM	File folder	
images	7/15/2020 1:58 PM	File folder	
movies	11/29/2019 4:25 PM	File folder	
renderData	11/29/2019 4:25 PM	File folder	
sceneAssembly	11/29/2019 4:25 PM	File folder	
scenes	10/4/2020 4:01 PM	File folder	
scripts	11/29/2019 4:25 PM	File folder	
sound	11/29/2019 4:25 PM	File folder	
sourceimages	11/29/2019 4:25 PM	File folder	
Time Editor	11/29/2019 4:25 PM	File folder	
MEL workspace.mel	11/29/2019 4:25 PM	Maya Script File	2 KB

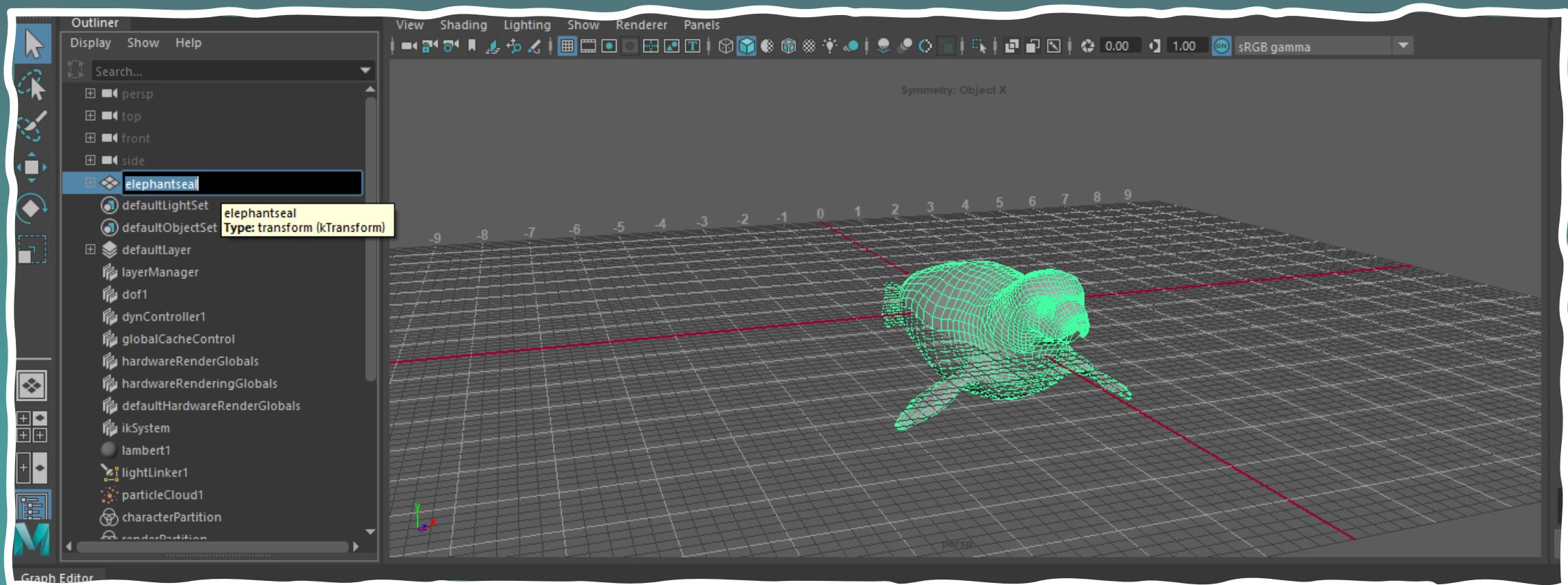
2. IMPORT 3D MODEL



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.

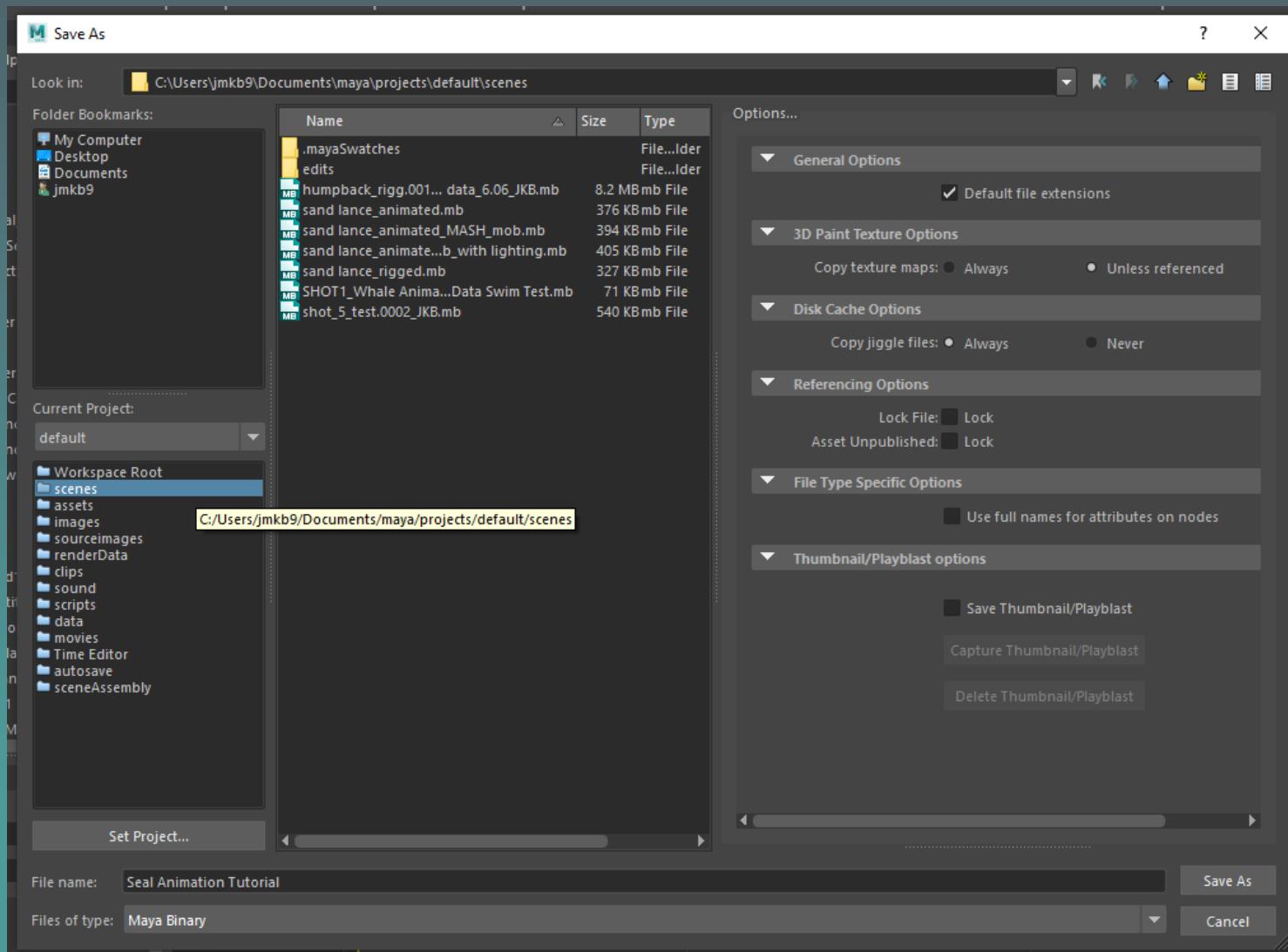


4. SAVE YOUR SCENE

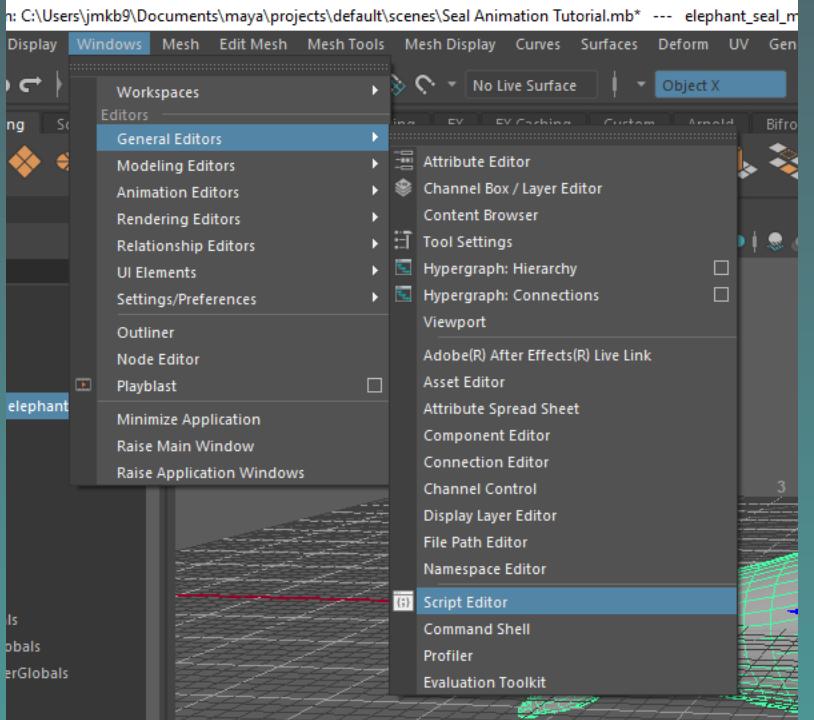
FILE ORGANIZATION IN MAYA

Put your scenes here:

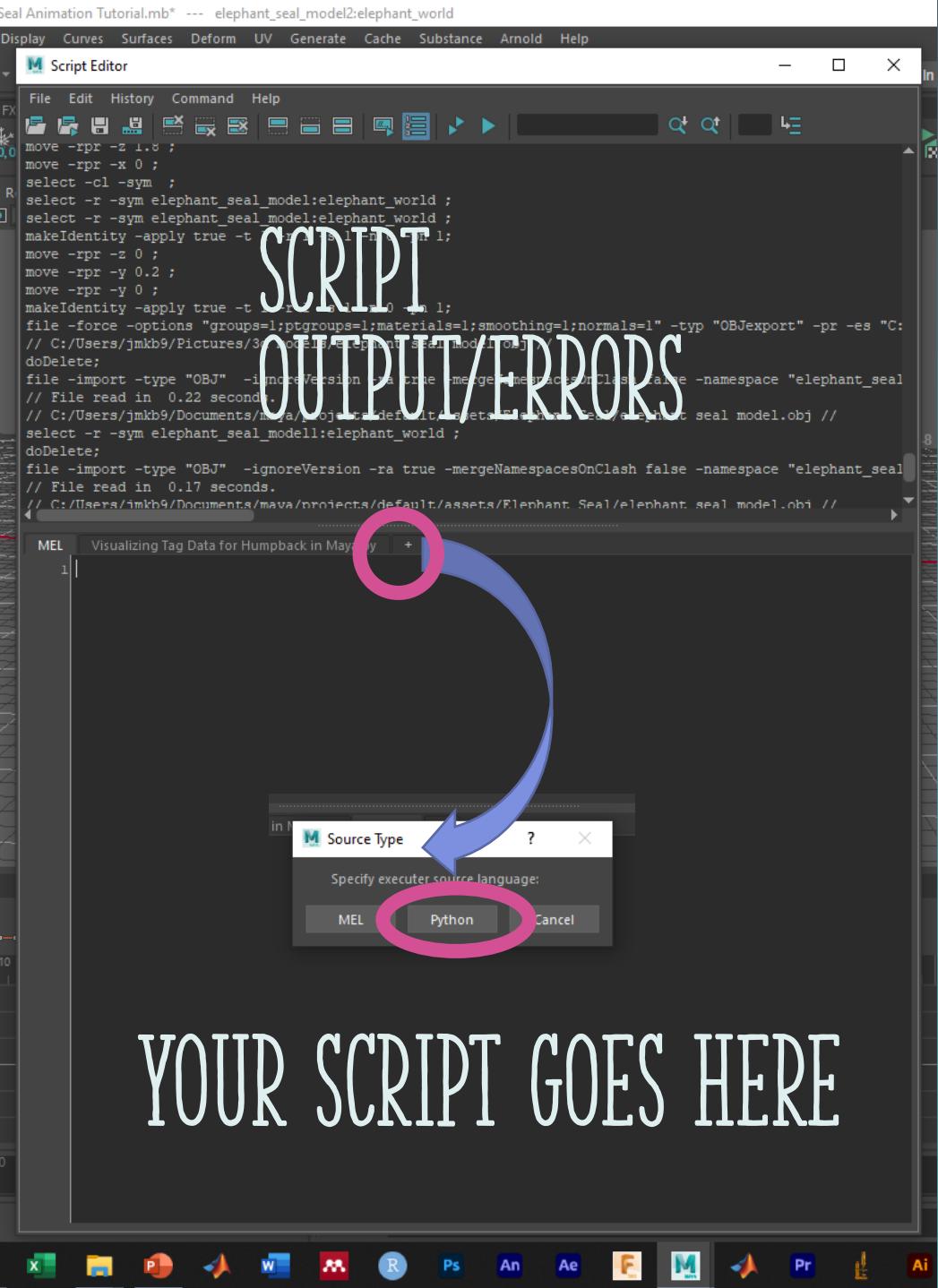
Documents > maya > projects > default > scenes



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.



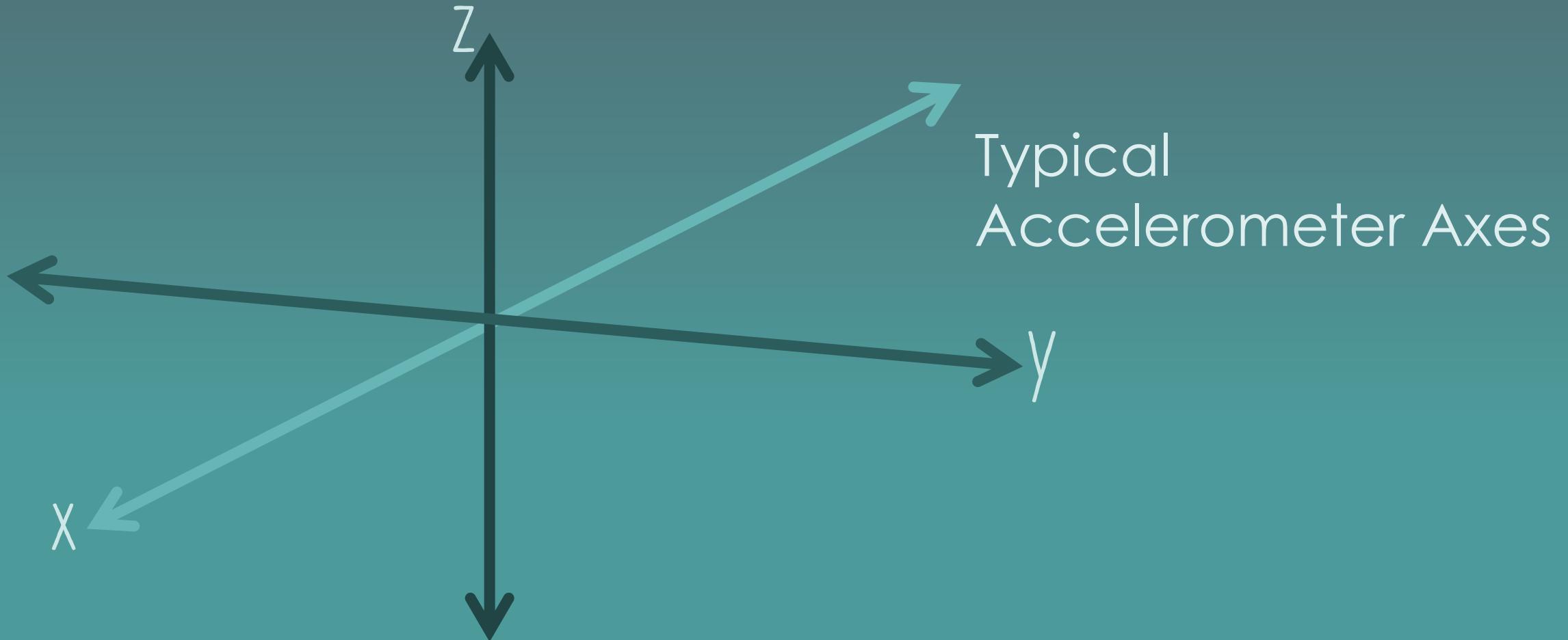
Save your script!

File > Save Script...

Save in:
default > scripts

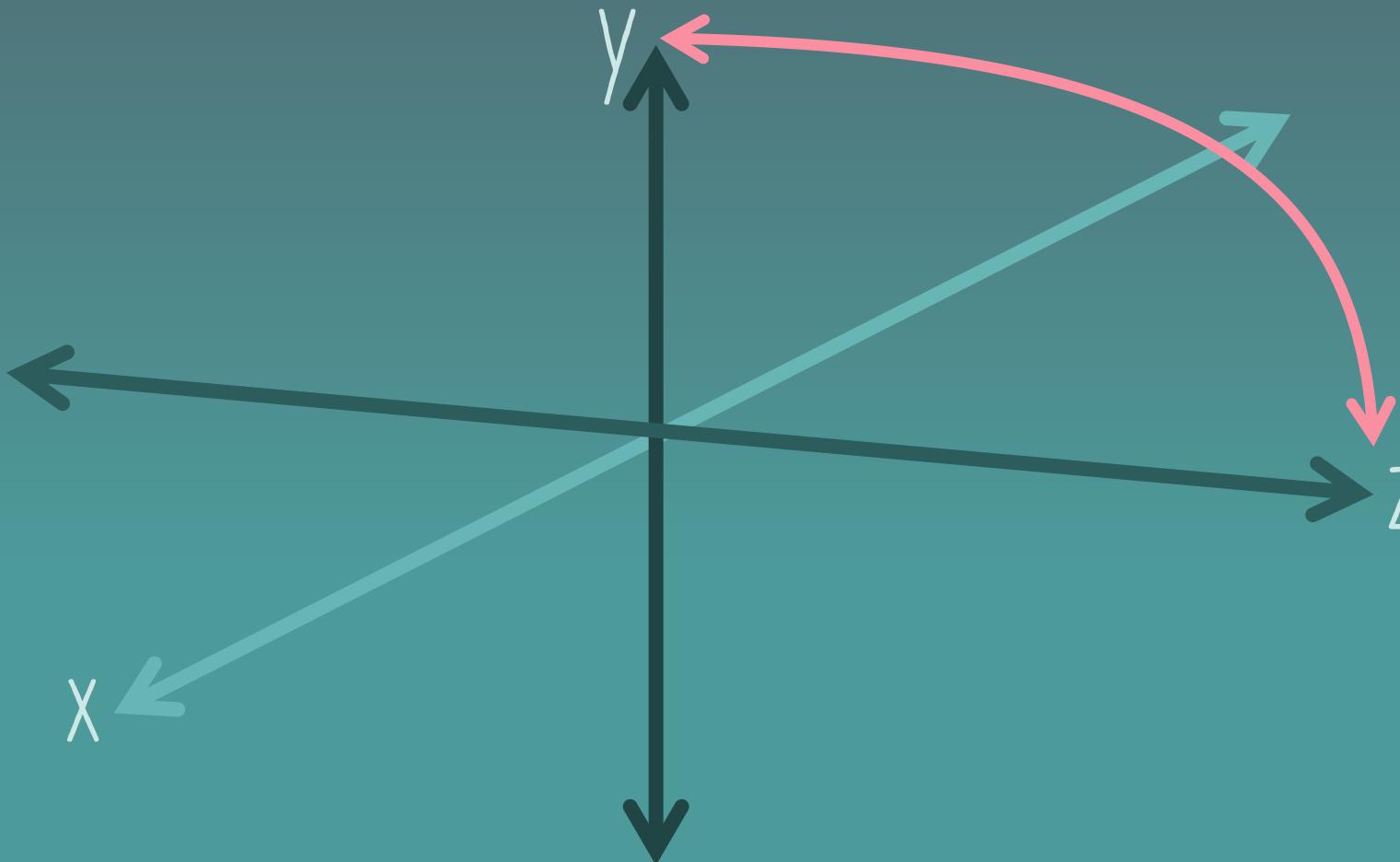
6. UNDERSTANDING 3D DATA

Seconds	pitch_deg	roll_deg	head_deg	x_position	z_position	Depth (y_pos)



6. UNDERSTANDING 3D DATA

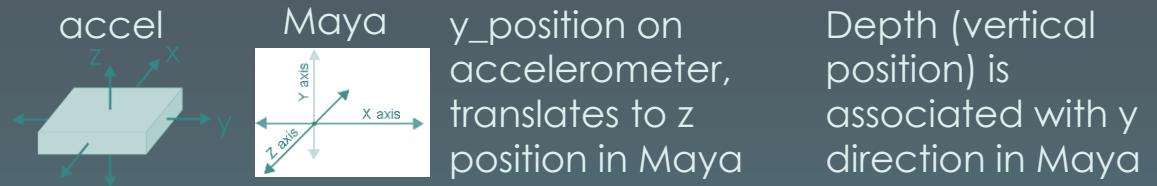
Seconds	pitch_deg	roll_deg	head_deg	x_position	z_position	Depth (y_pos)



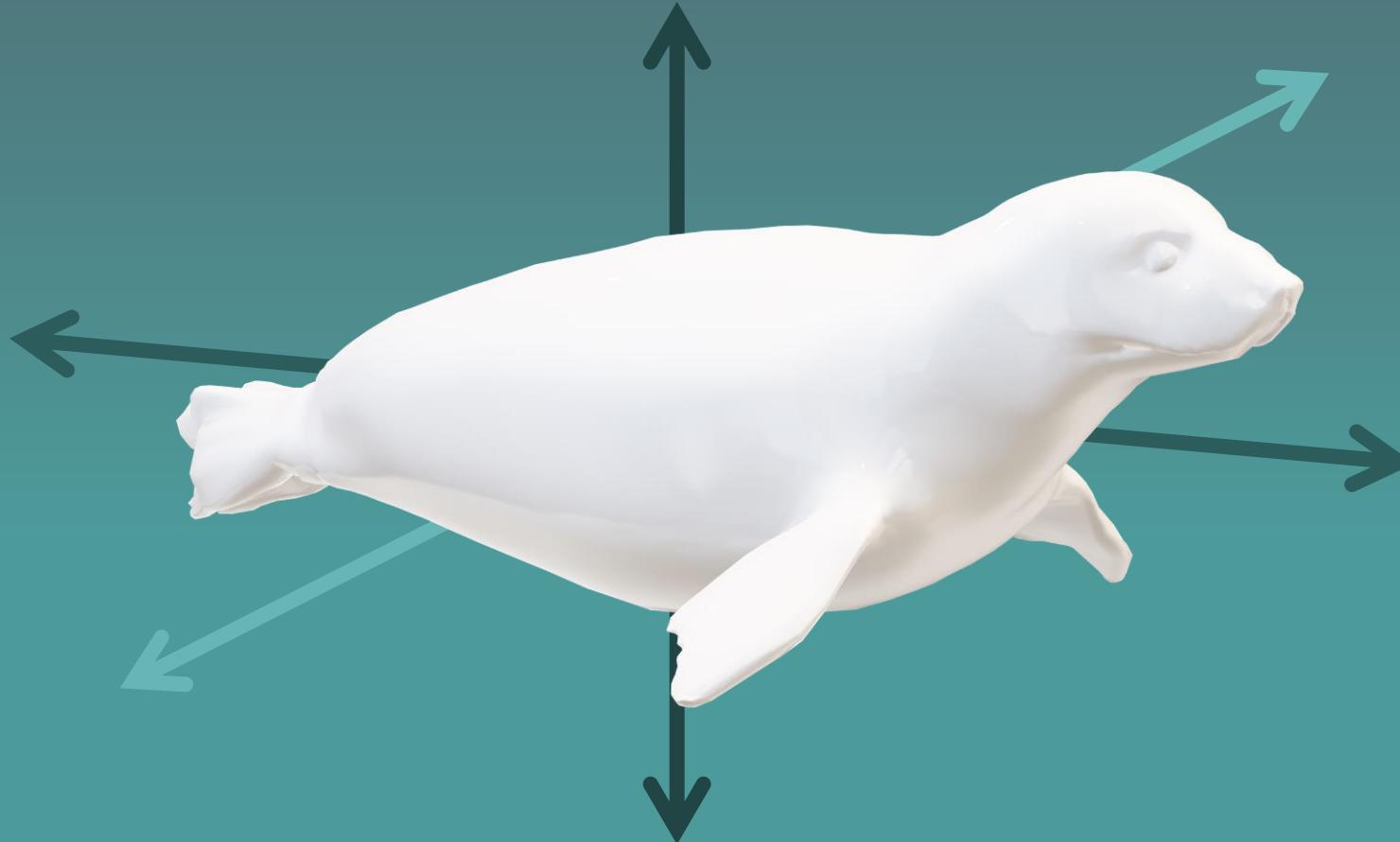
Default
Maya Axes

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

6. UNDERSTANDING 3D DATA

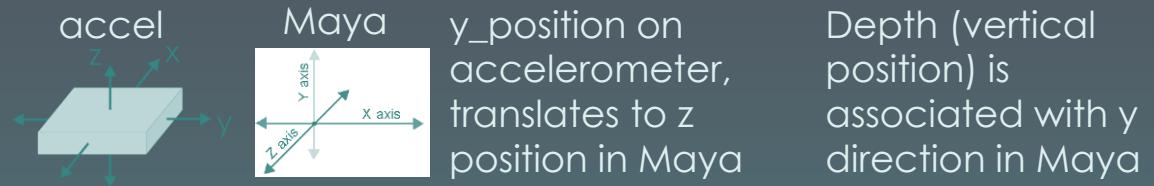


Seconds	pitch_deg	roll_deg	head_deg	x_position	z_position	Depth (y_pos)

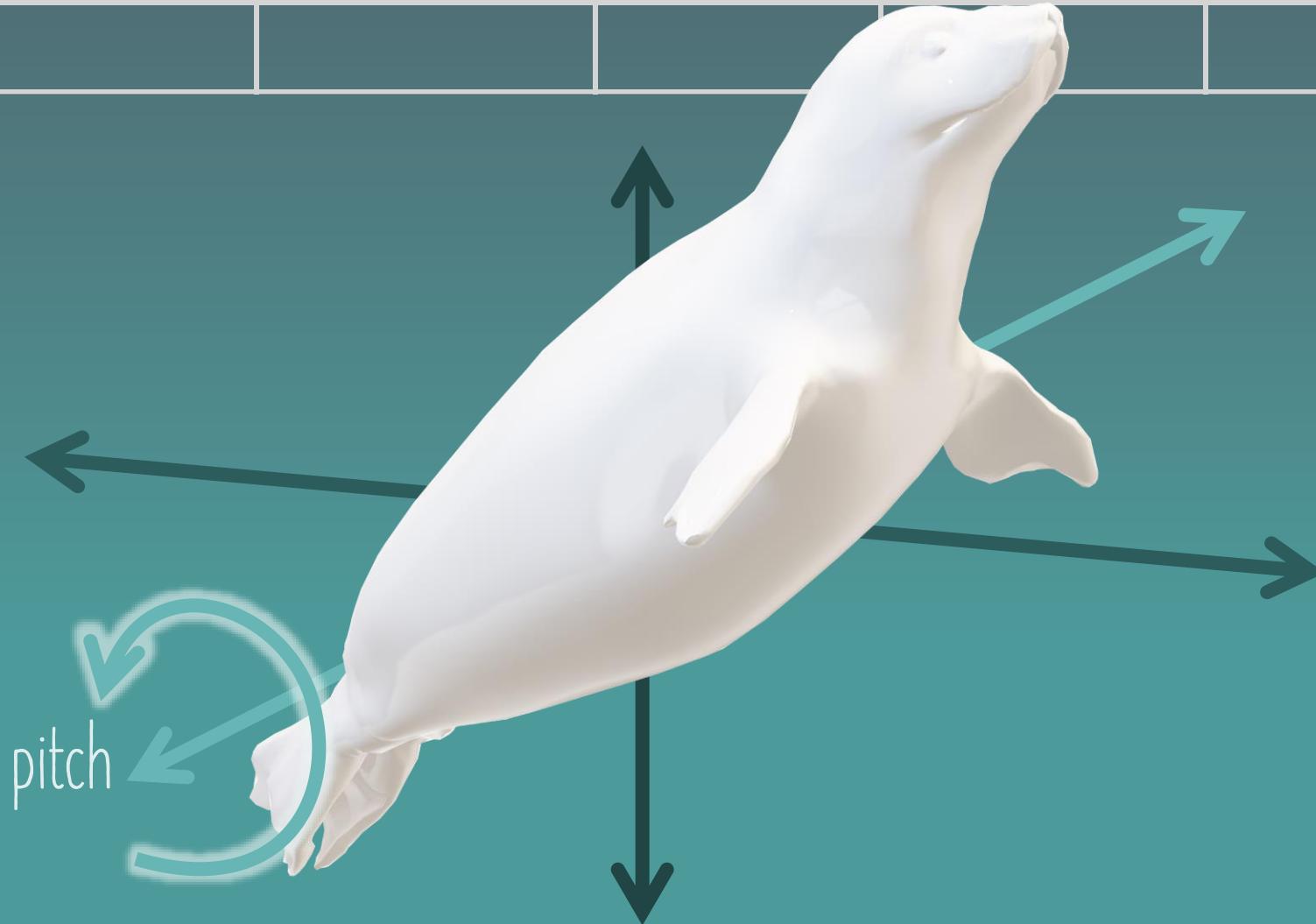


Pitch = 0°
Roll = 0°
Heading = 0°

6. UNDERSTANDING 3D DATA



Seconds	pitch_deg	roll_deg	head_deg	x_position	z_position	Depth (y_pos)

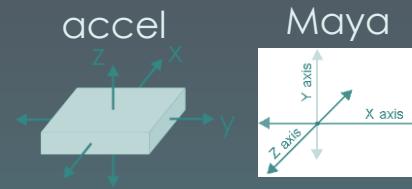


Pitch = **45°**

Roll = **0°**

Heading = **0°**

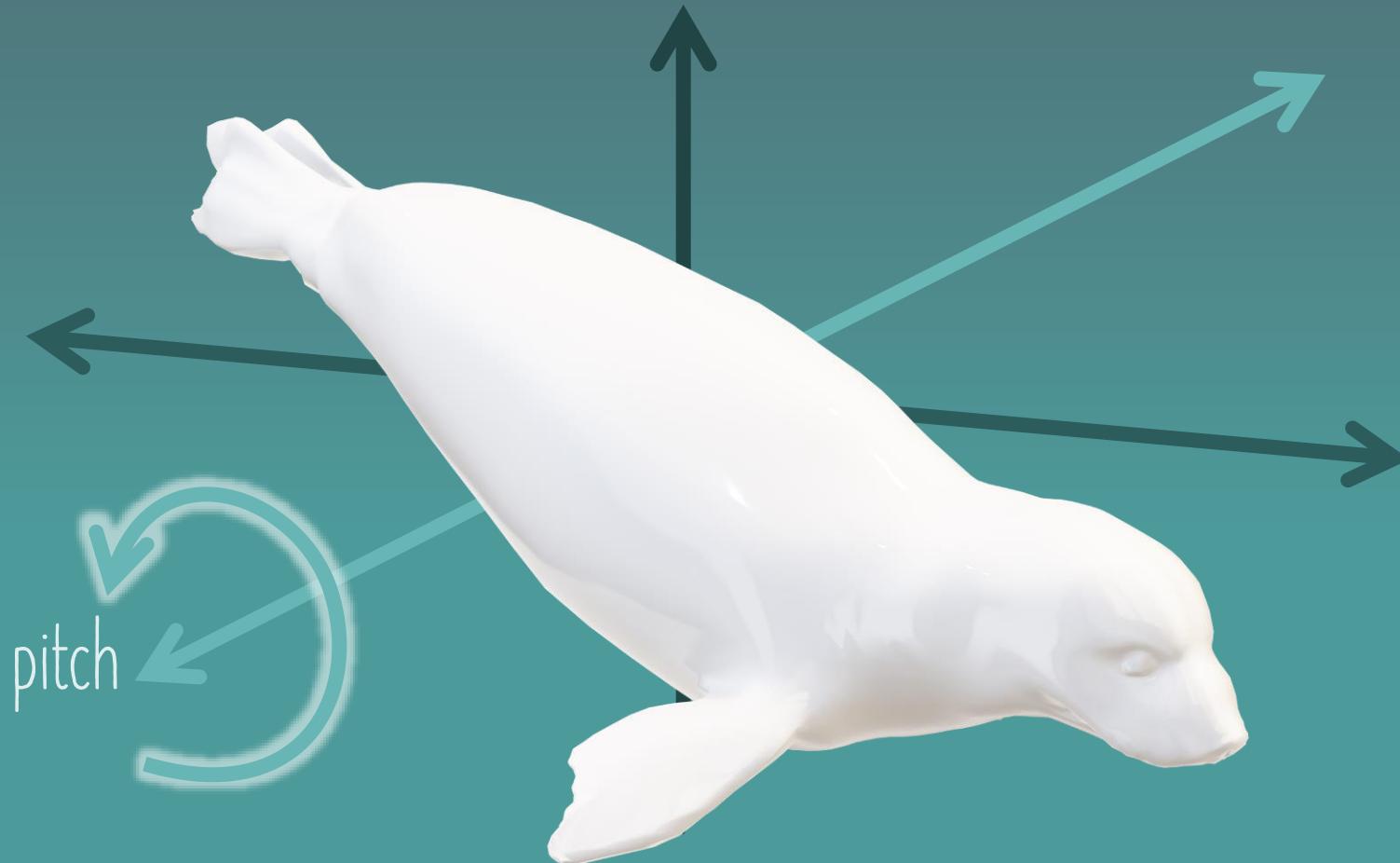
6. UNDERSTANDING 3D DATA



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)

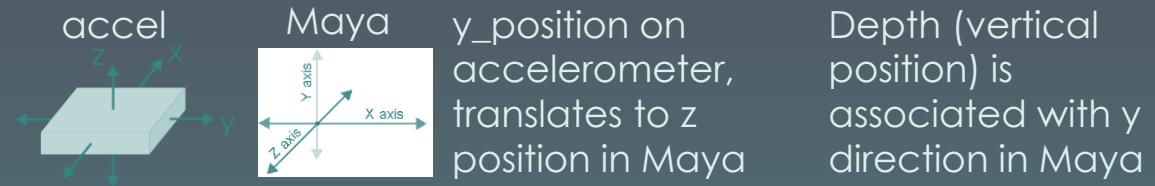


Pitch = -45°

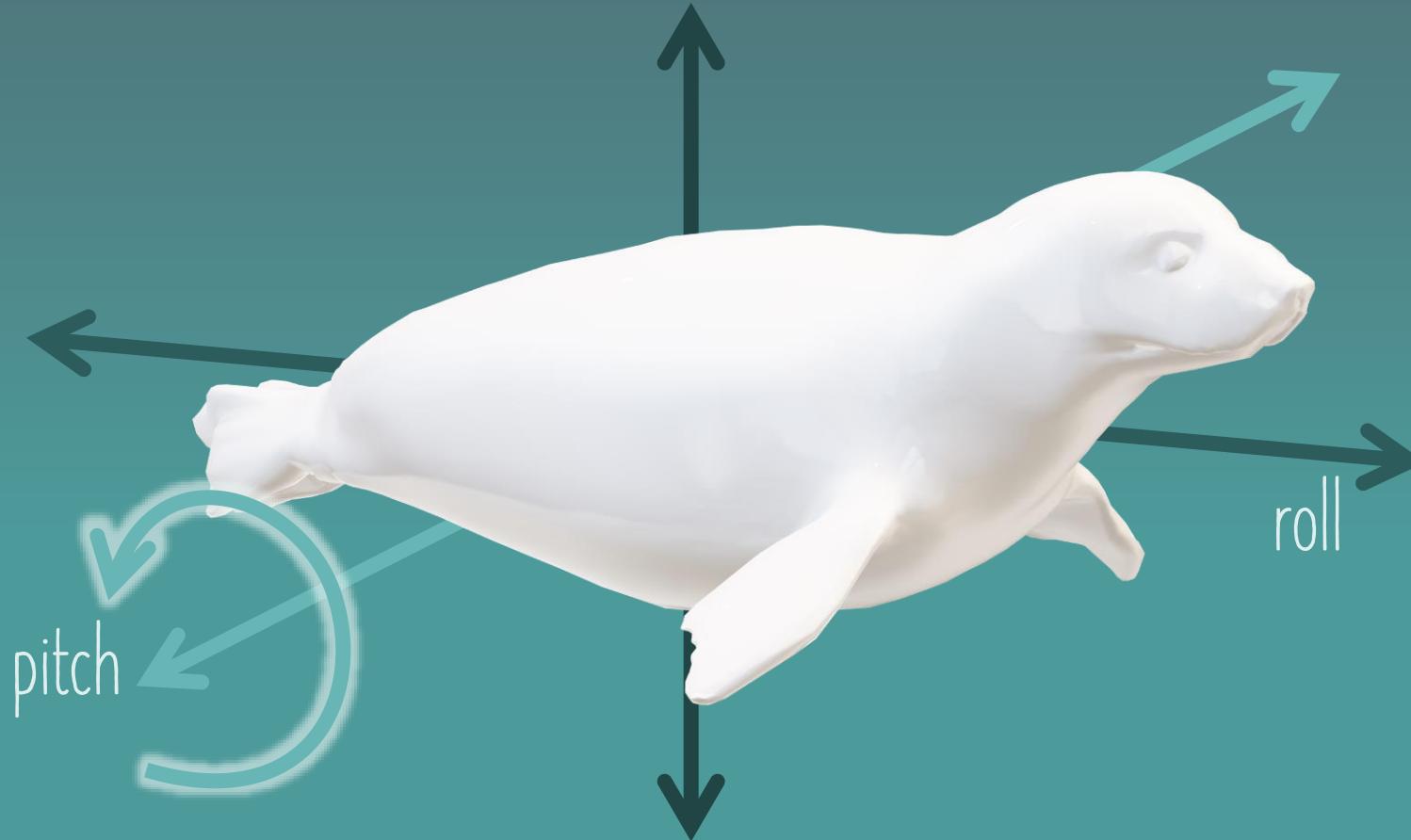
Roll = 0°

Heading = 0°

6. UNDERSTANDING 3D DATA



Seconds	pitch_deg	roll_deg	head_deg	x_position	z_position	Depth (y_pos)

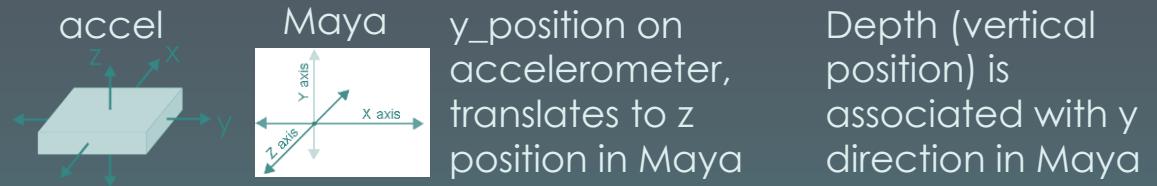


Pitch = 0°

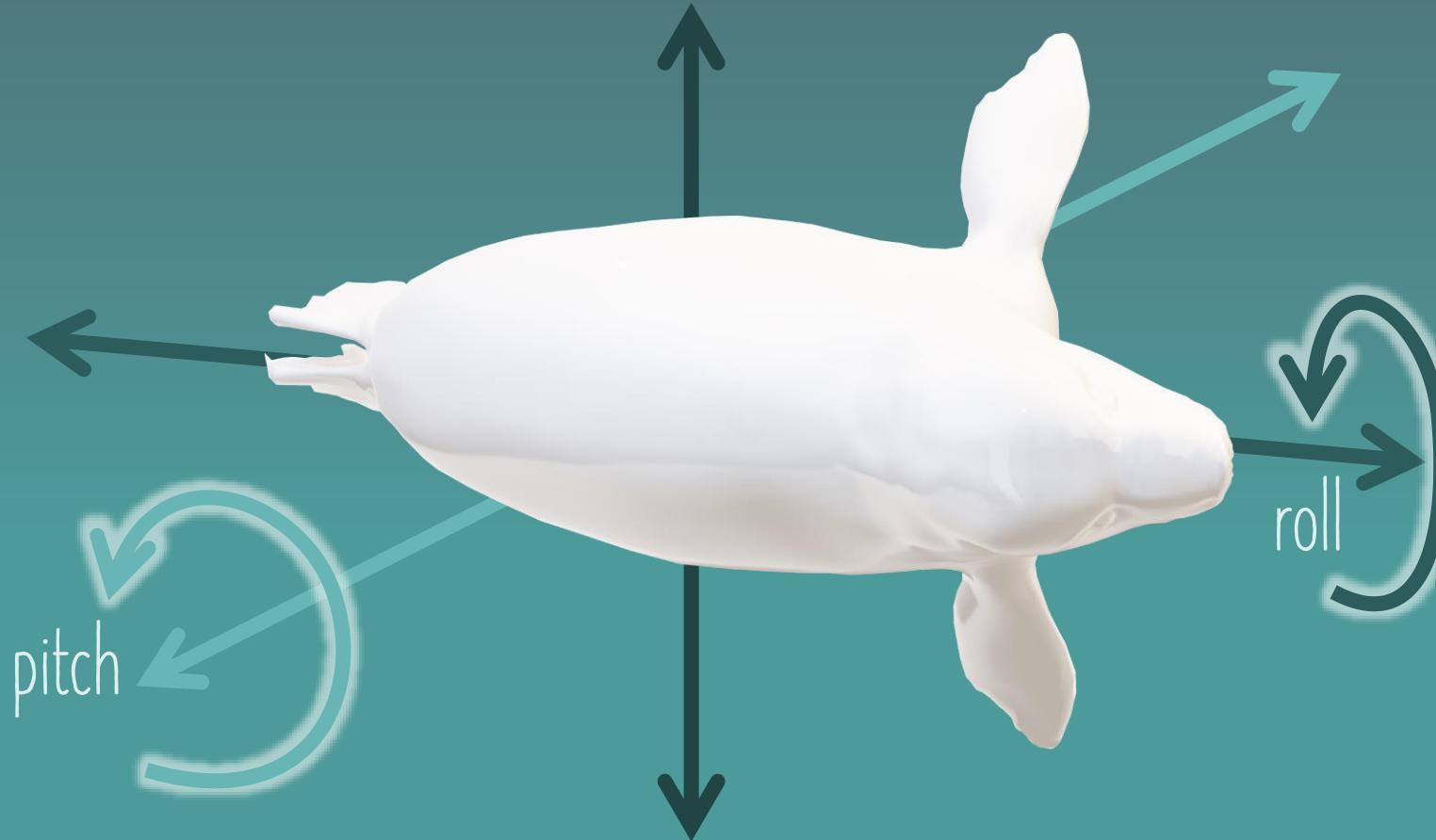
Roll = 0°

Heading = 0°

6. UNDERSTANDING 3D DATA

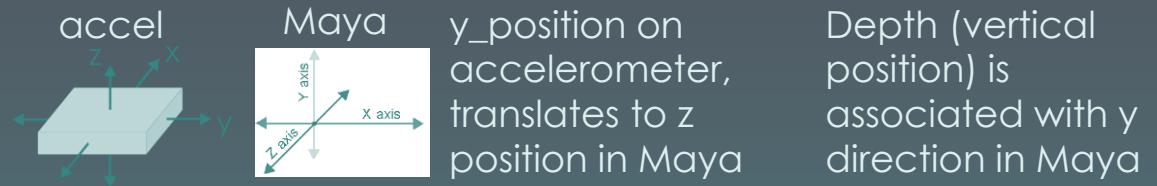


Seconds	pitch_deg	roll_deg	head_deg	x_position	z_position	Depth (y_pos)

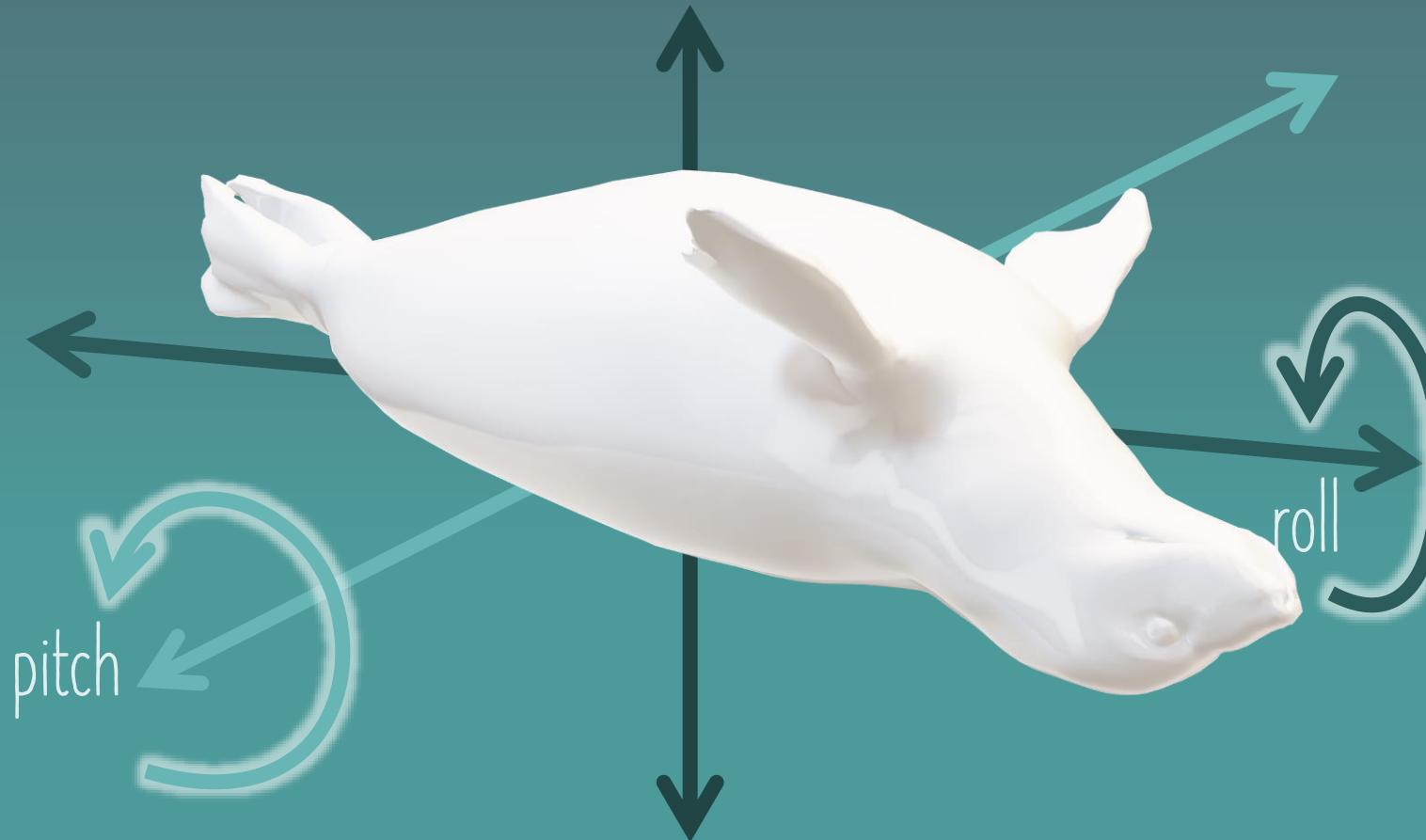


Pitch = 0°
Roll = 90°
Heading = 0°

6. UNDERSTANDING 3D DATA



Seconds	pitch_deg	roll_deg	head_deg	x_position	z_position	Depth (y_pos)



Pitch = 0°

Roll = 180°

Heading = 0°

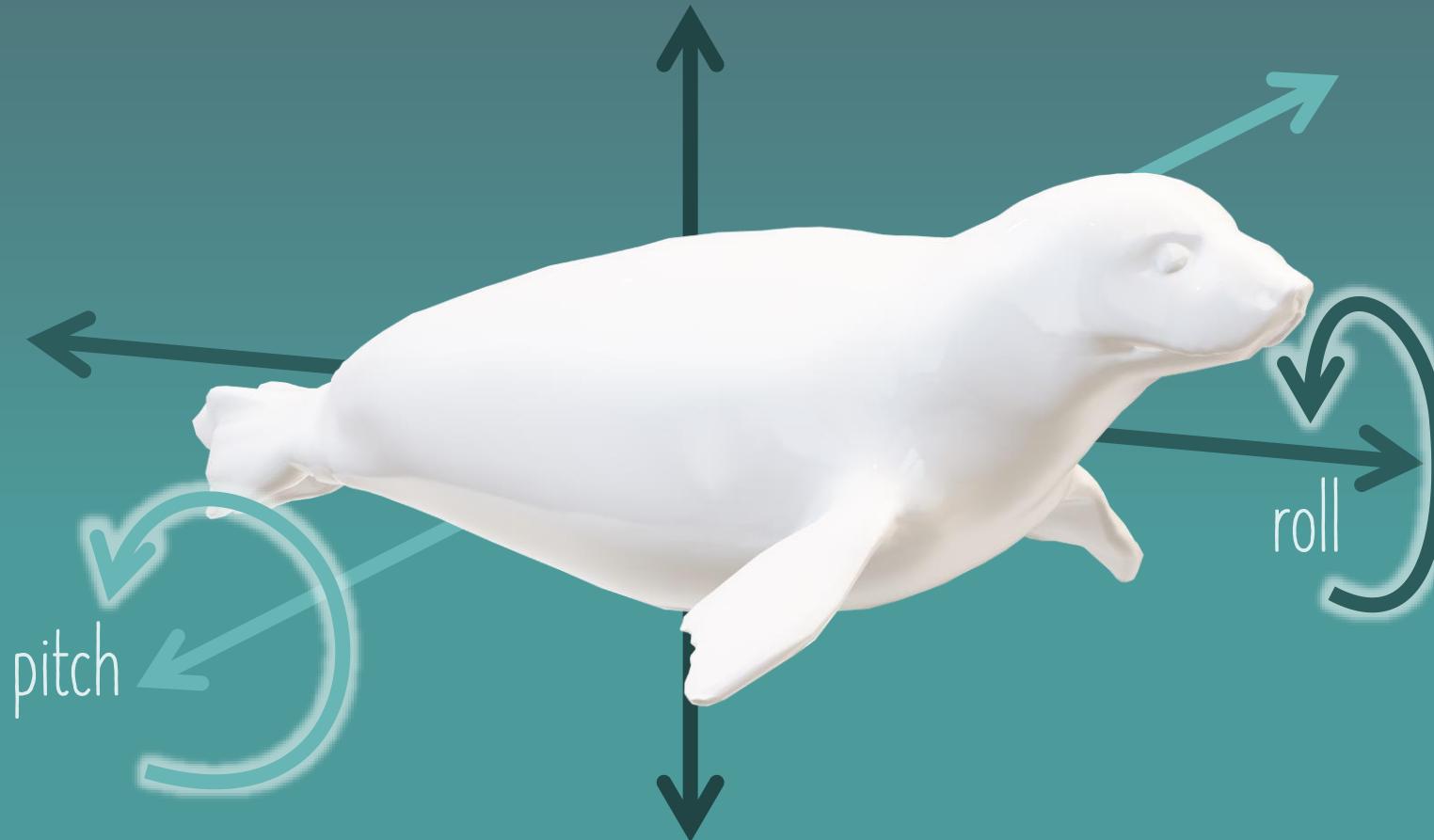
6. UNDERSTANDING 3D DATA



y_position on
accelerometer,
translates to z
position in Maya

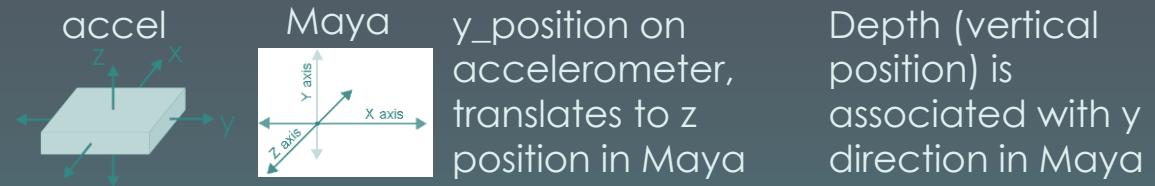
Depth (vertical
position) is
associated with y
direction in Maya

Seconds	pitch_deg	roll_deg	head_deg	x_position	z_position	Depth (y_pos)



Pitch = 0°
Roll = 0°
Heading = 0°

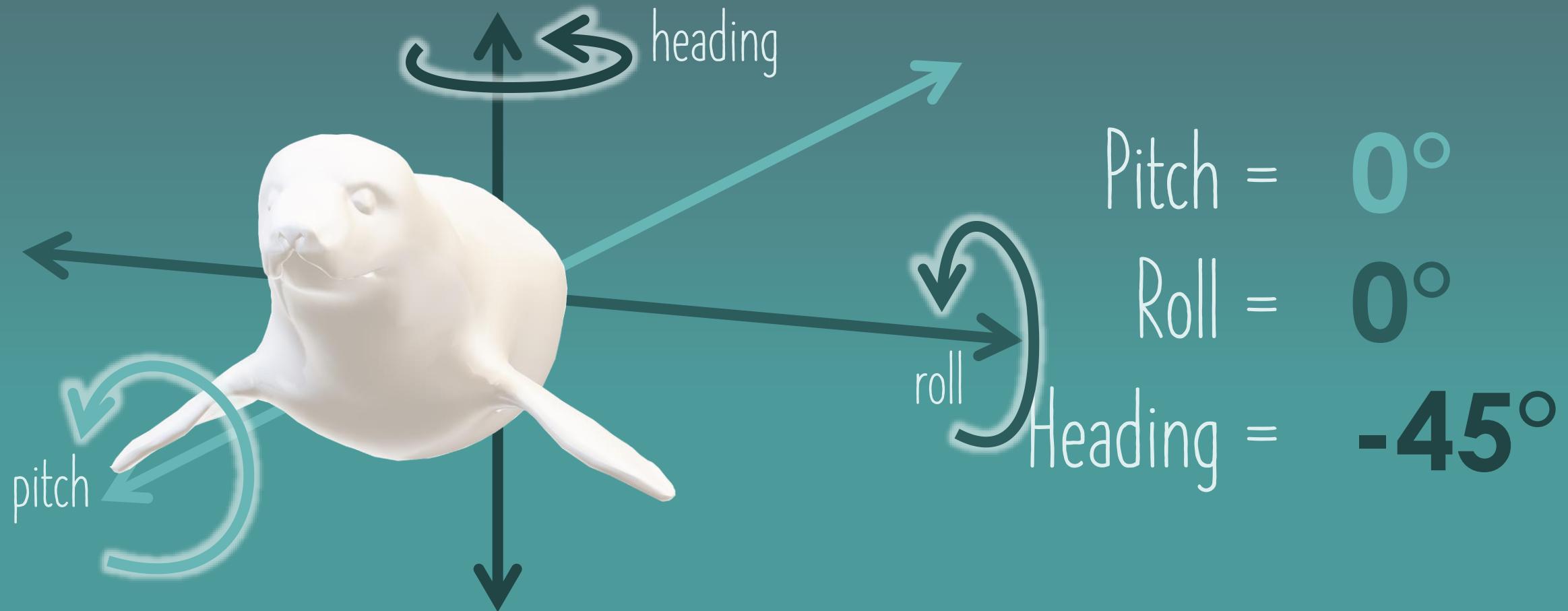
6. UNDERSTANDING 3D DATA



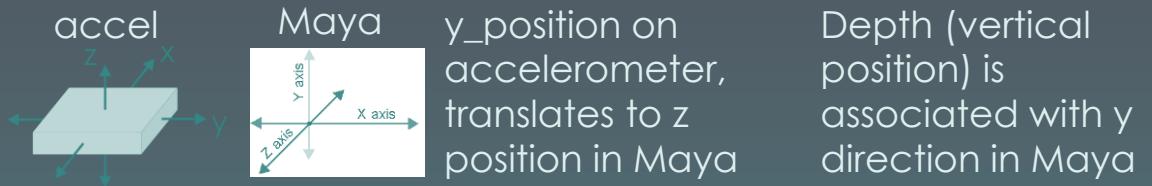
y_position on
accelerometer,
translates to z
position in Maya

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

Seconds	pitch_deg	roll_deg	head_deg	x_position	z_position	Depth (y_pos)



6. UNDERSTANDING 3D DATA



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

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)

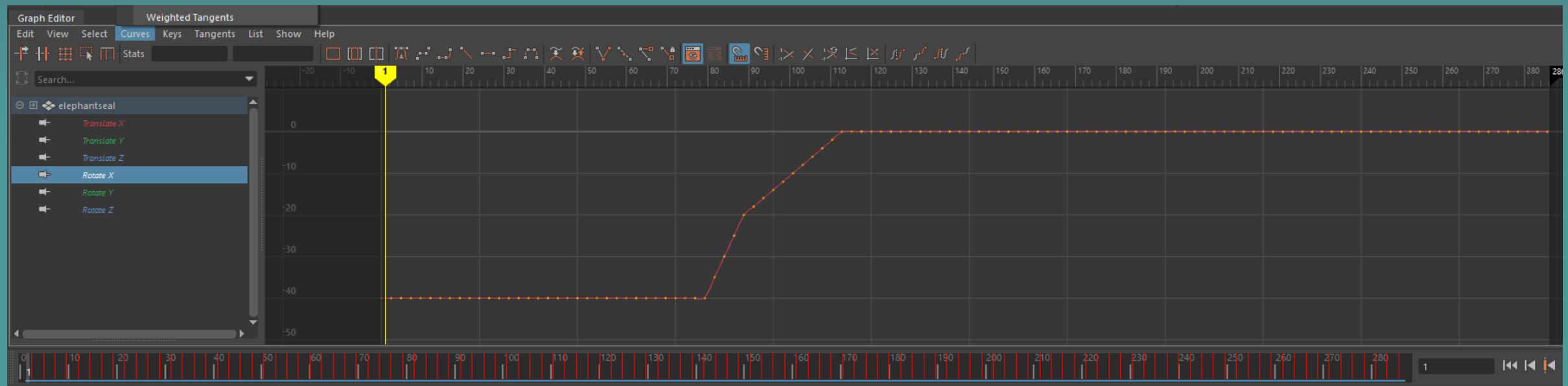
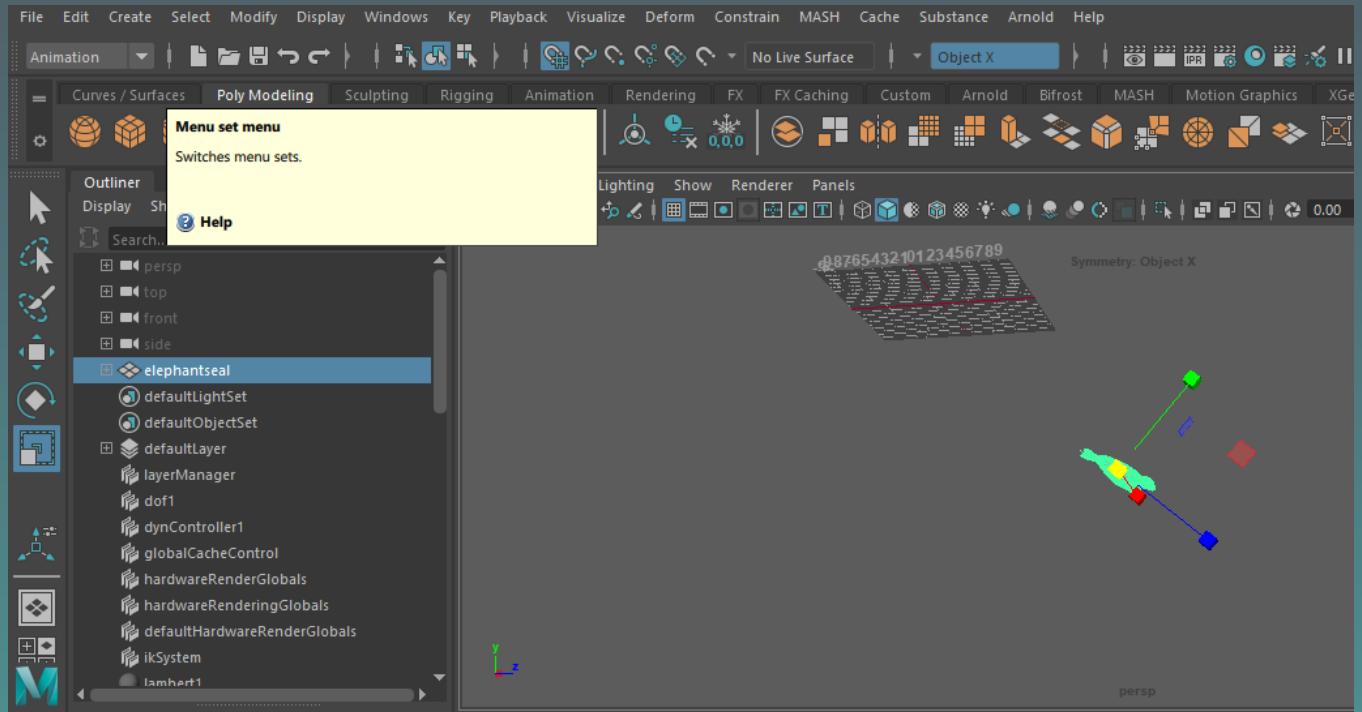
            print 'setting y= %s msw, x= %s, z= %s, rotX= %s, rotY= %s, rotZ = %s for time= %s frames' %
(depth_value , translateX_value , translateZ_value , pitch_value , head_value , roll_value , time)
```

8. PREVIEW ANIMATION

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

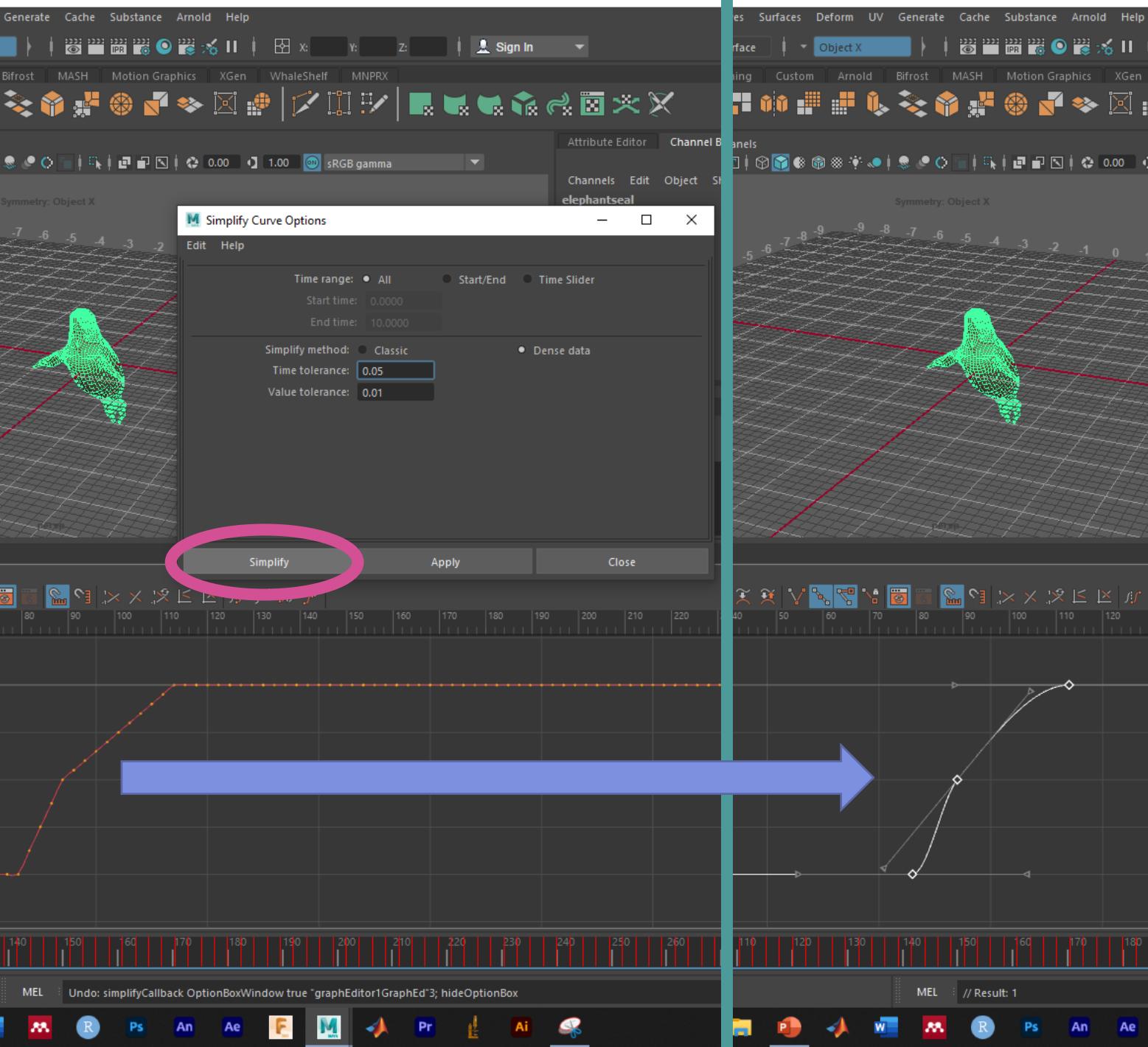
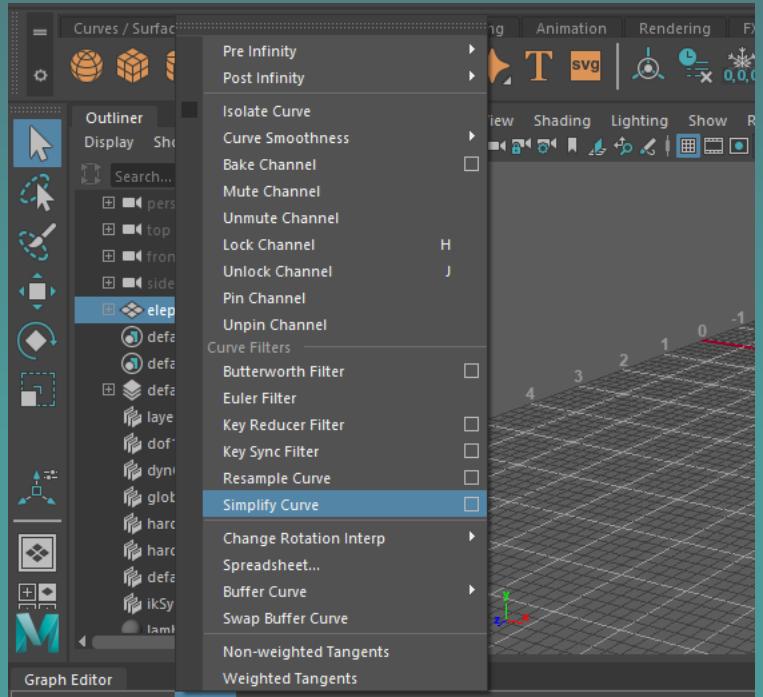
The code will have added many (120 in our case) red keyframes into the timeline, evenly spaced over 12 seconds (286 frames).

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



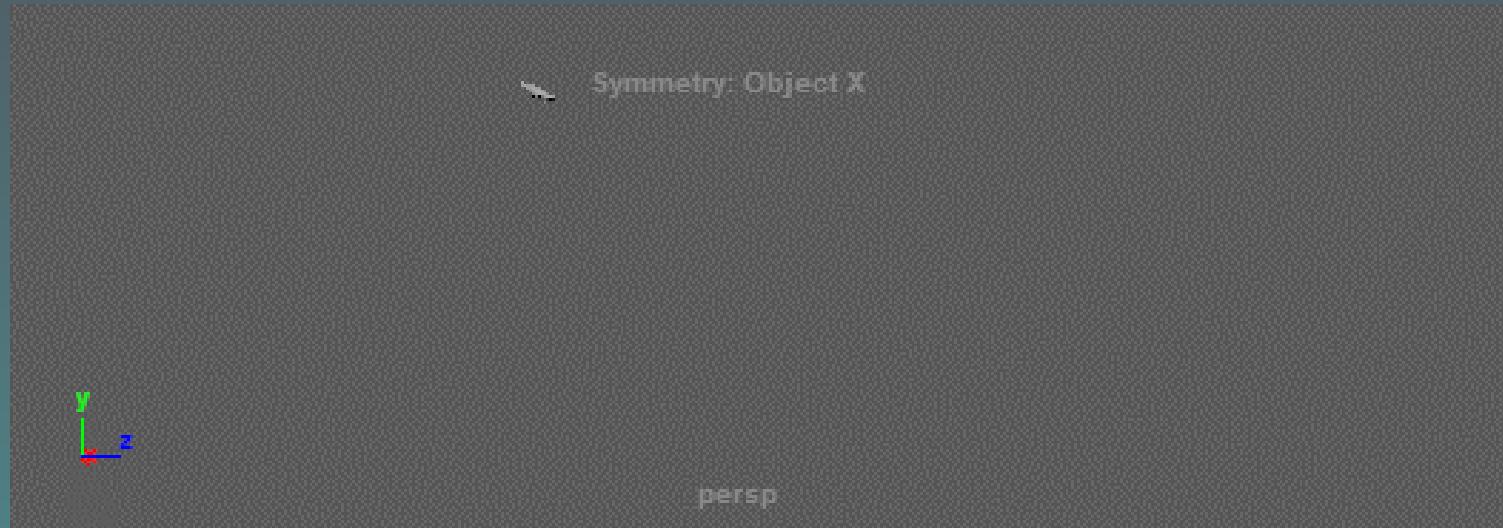
9. SMOOTH ANIMATION

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.



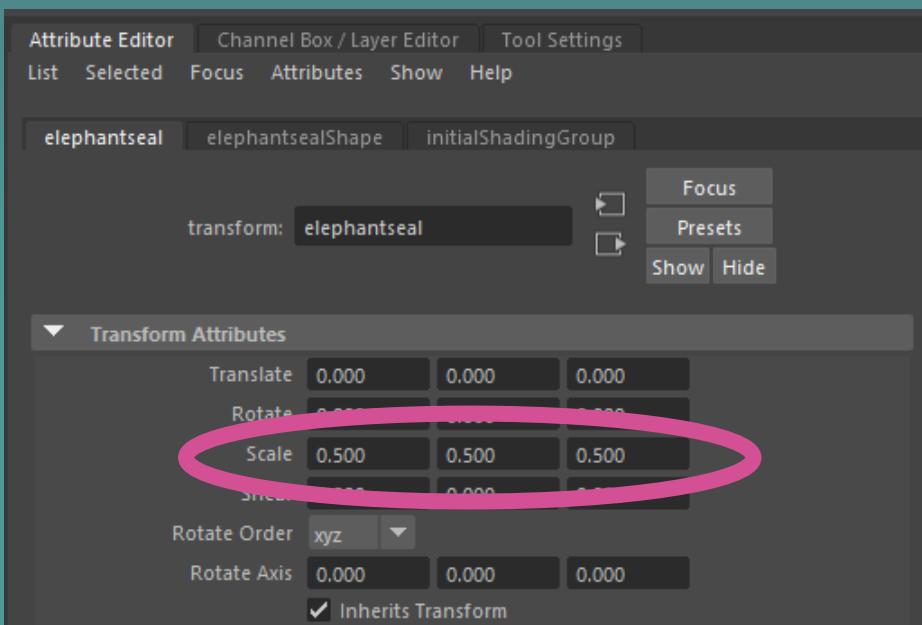
10. PLAYBLAST

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



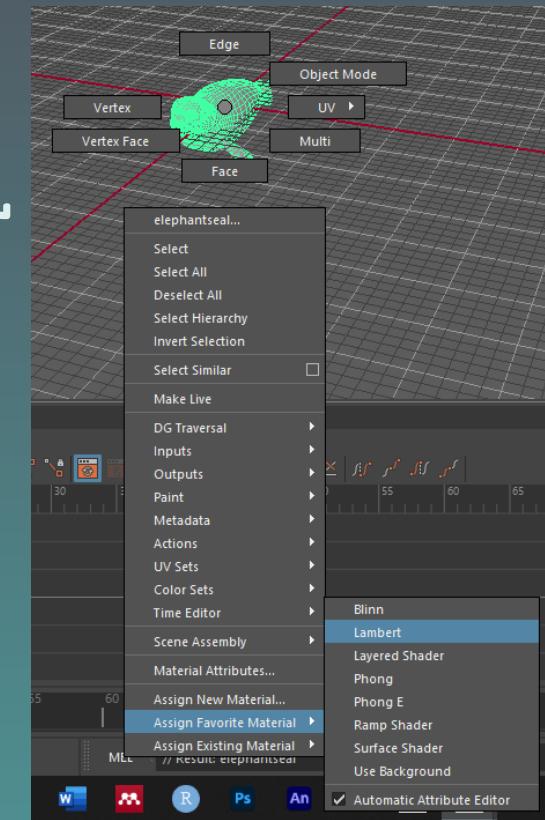
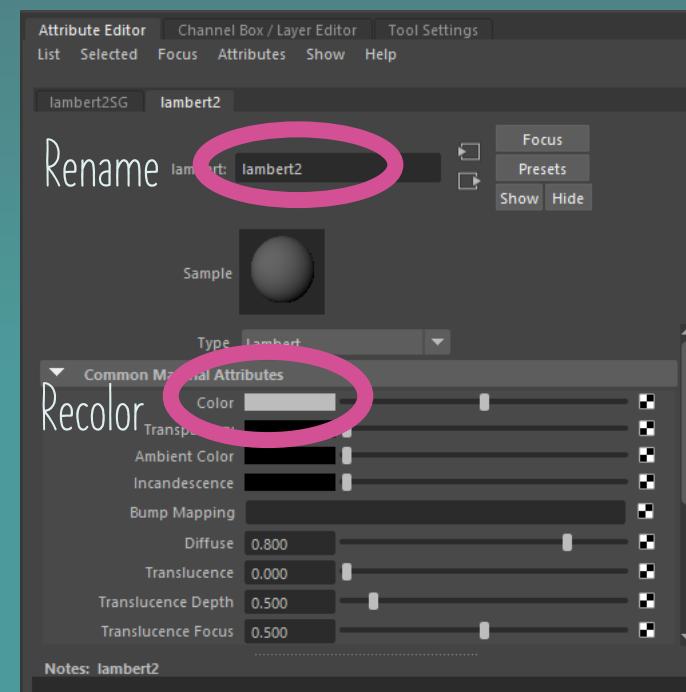
11. SCALE YOUR SCENE

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.



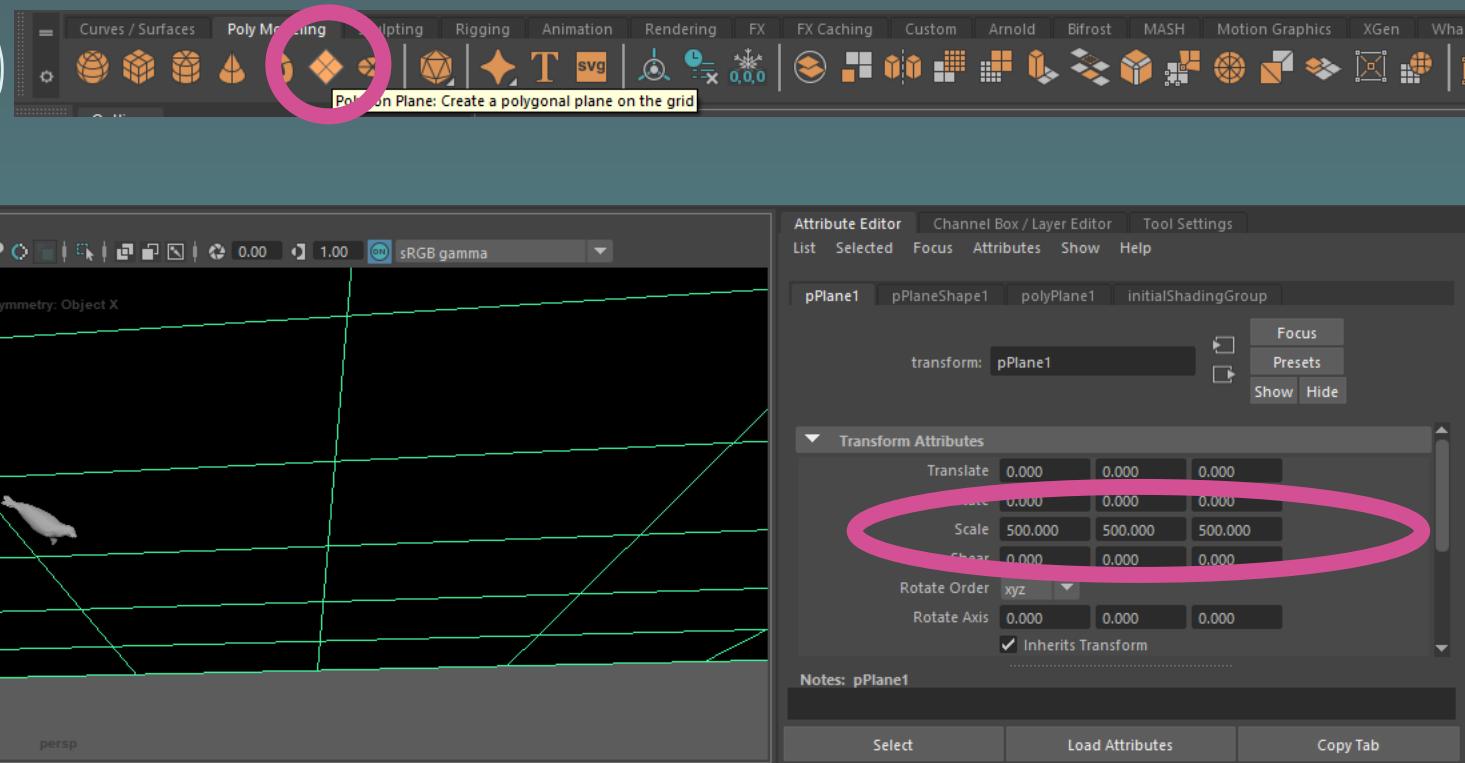
12. TEXTURE YOUR SEAL

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.

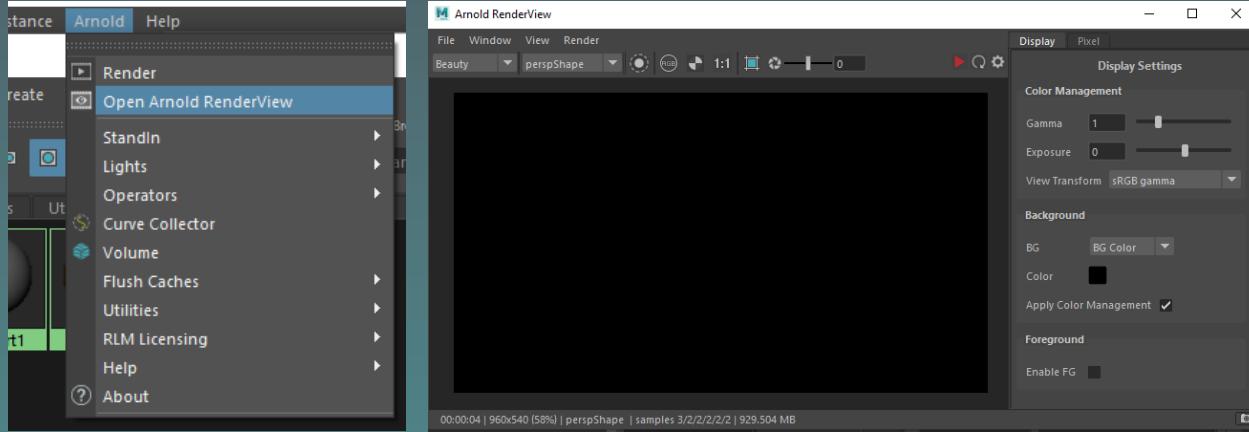


13. ADD SOME WATER

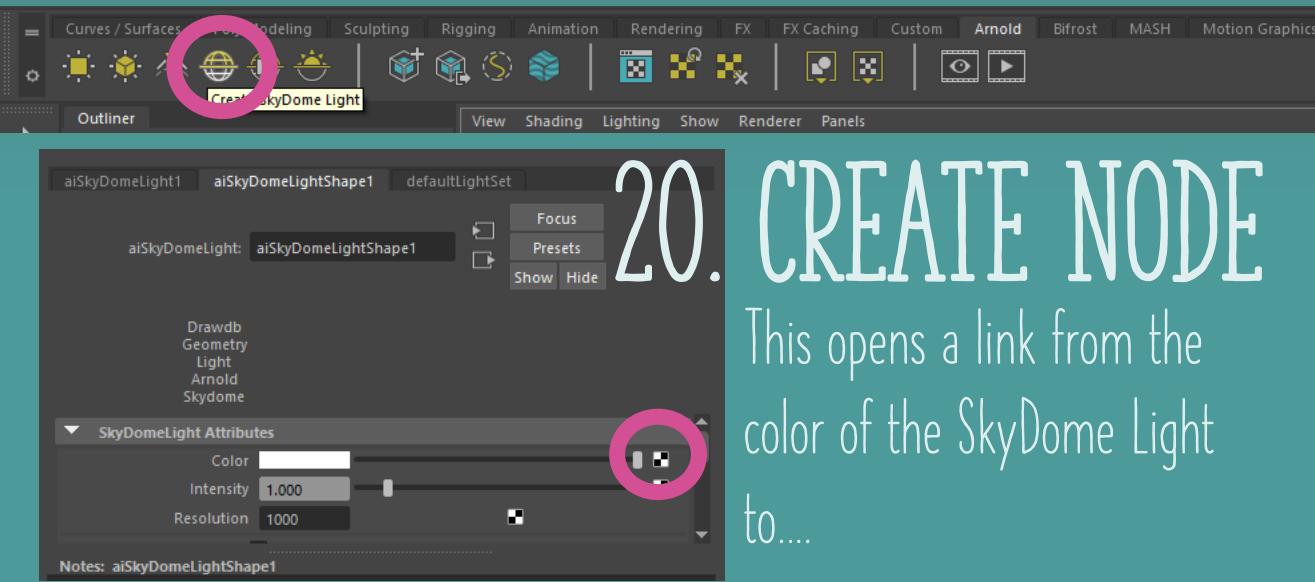
Create a plane and scale it up to 500 x 500 x 500
(don't ask me why there is a y [vertical] dimension to a plane!)



17. OPEN UP A RENDER PREVIEW



18. CREATE A LIGHT

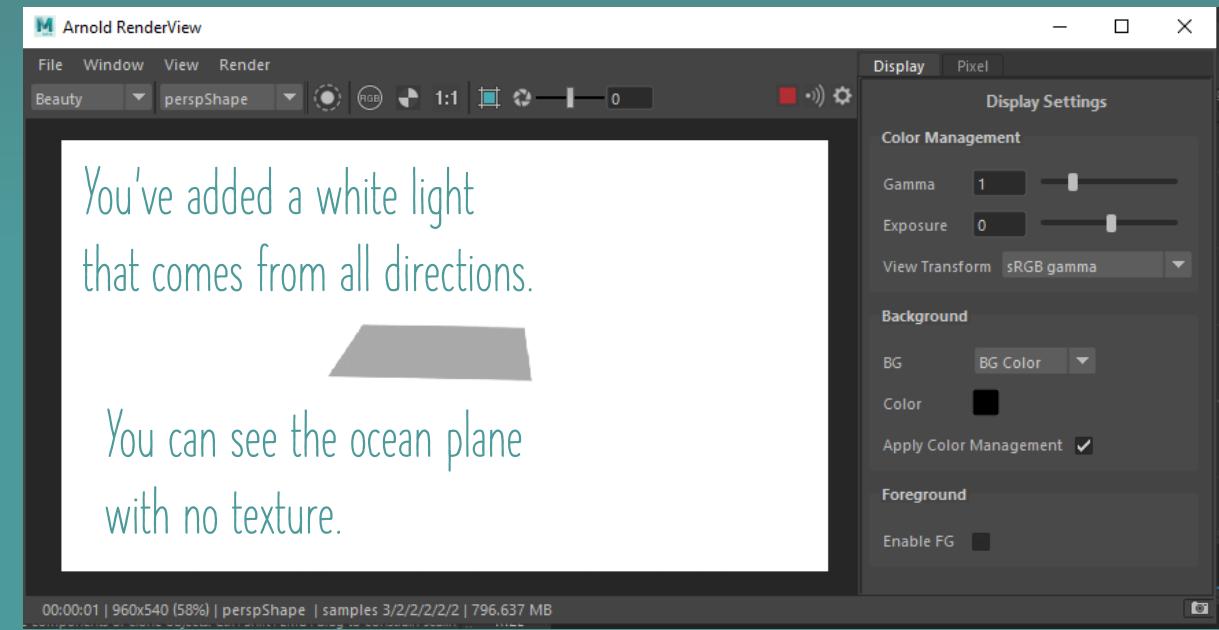


20. CREATE NODE

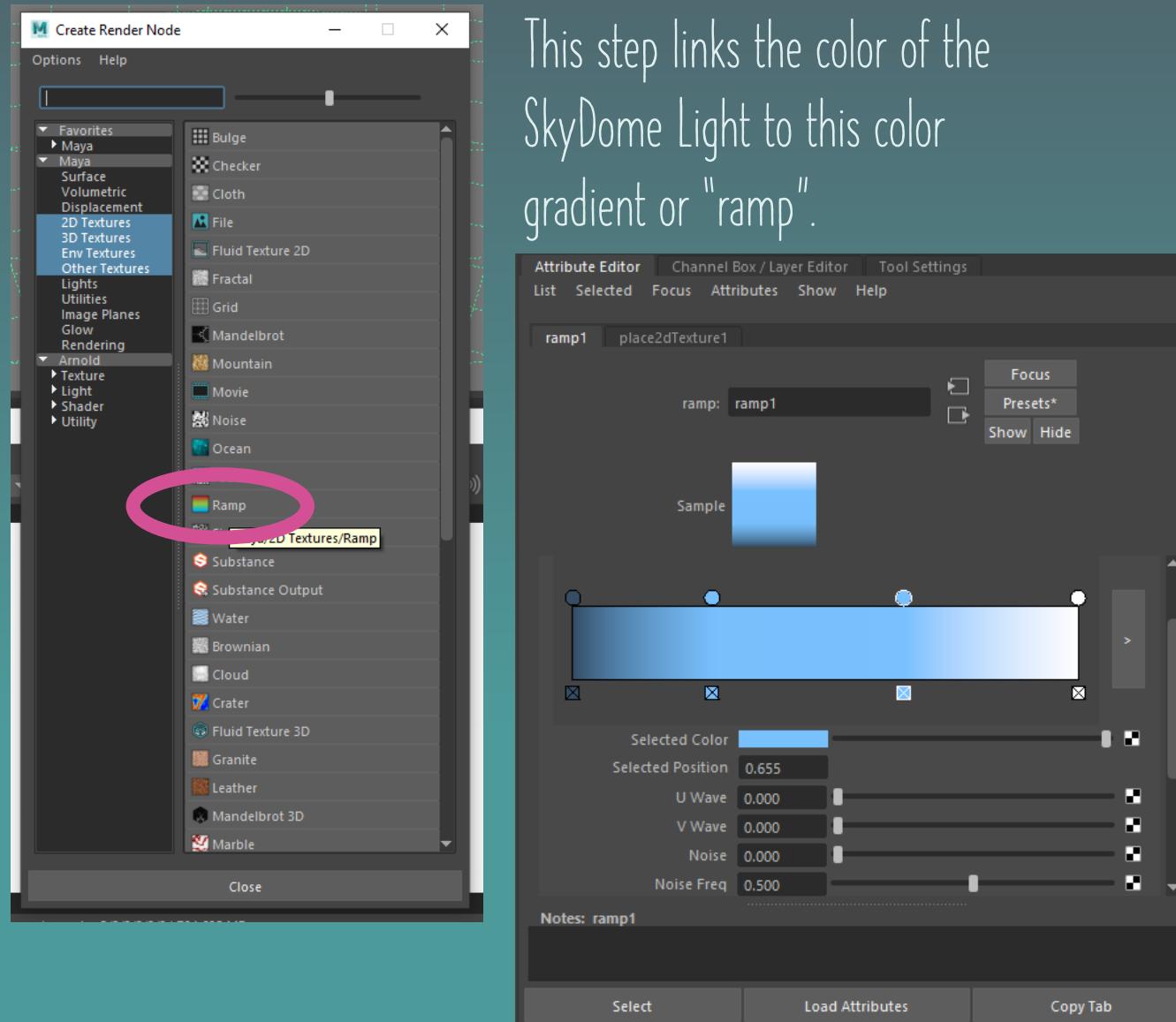
This opens a link from the color of the SkyDome Light to...

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!

19. PRESS PLAY NOW



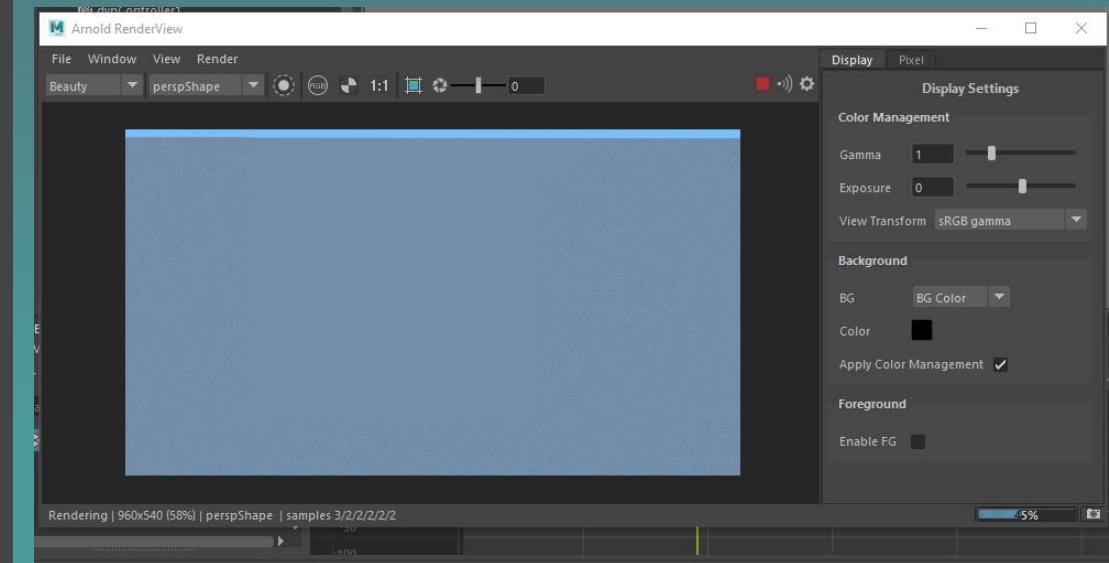
21. LINK RENDER NODE TO COLOR RAMP



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

22. PRESS PLAY AGAIN

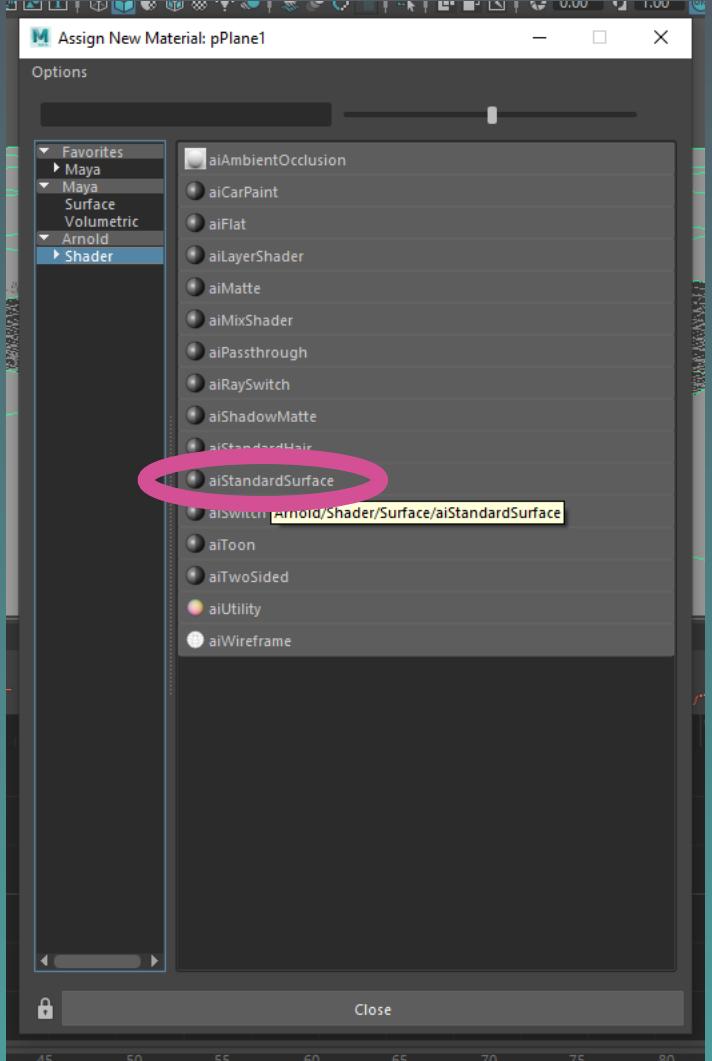
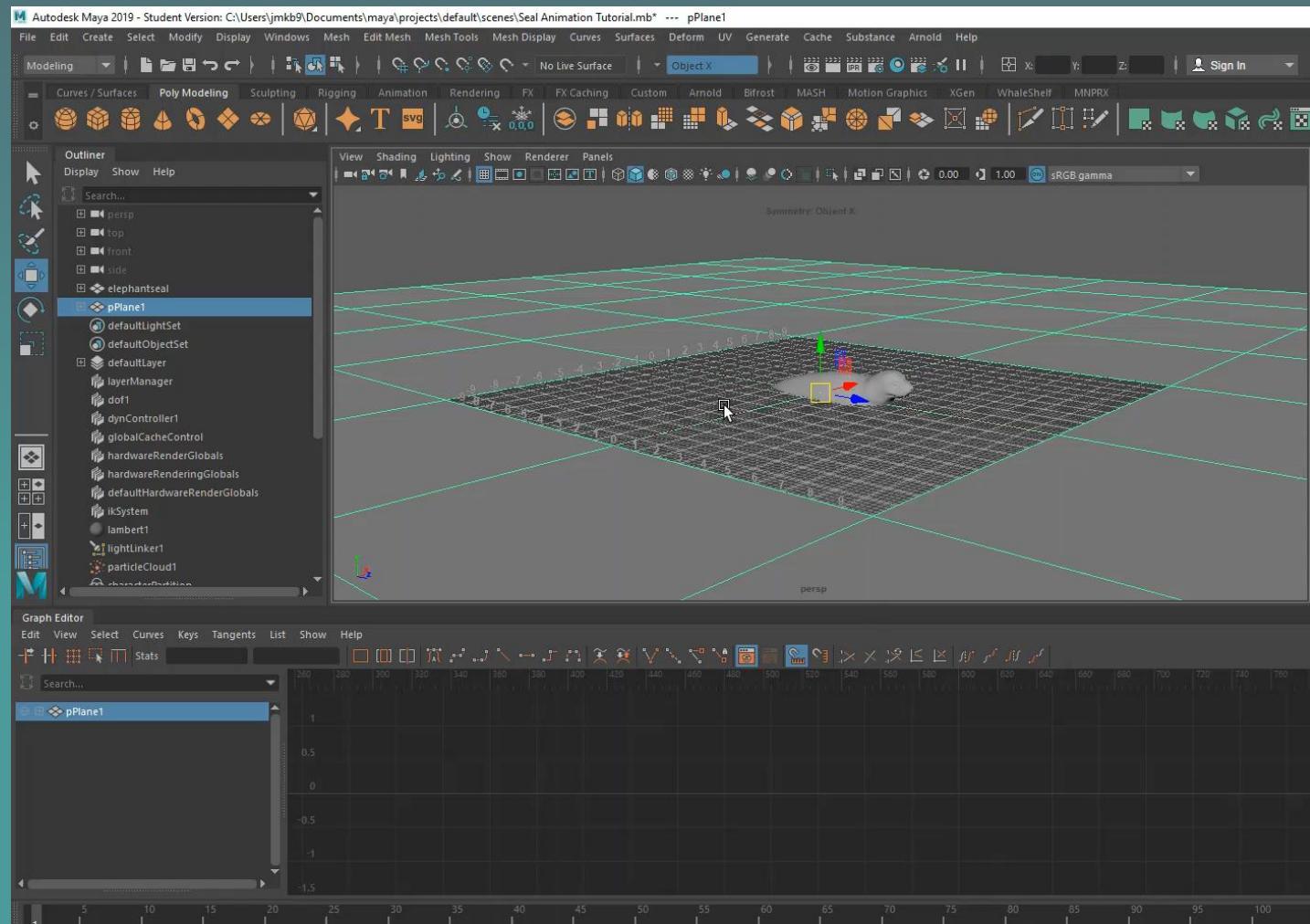
Now you have a blue sky around your scene. Next, we need to make the ocean look good!



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)

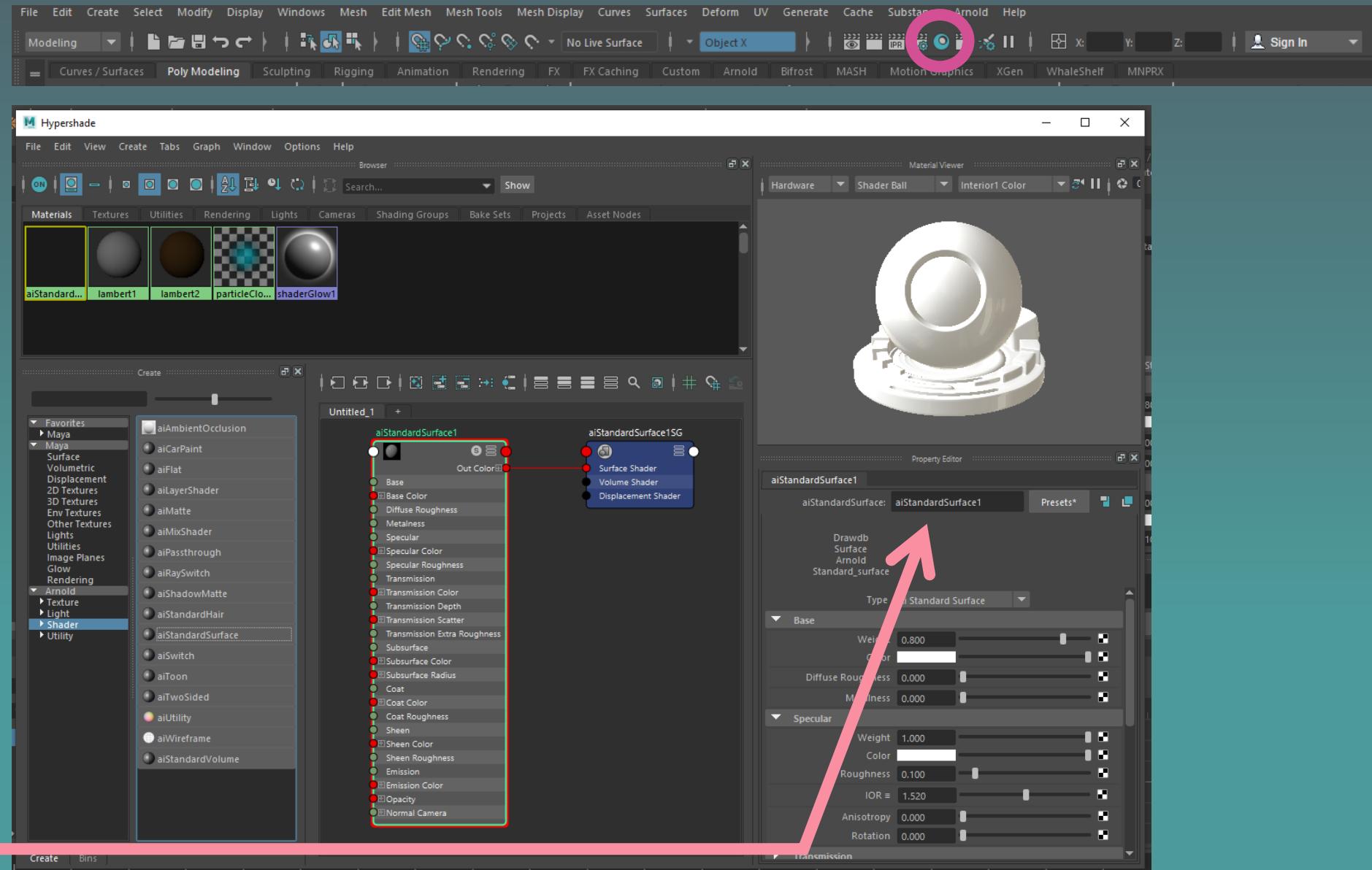


24. ANOTHER METHOD

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.

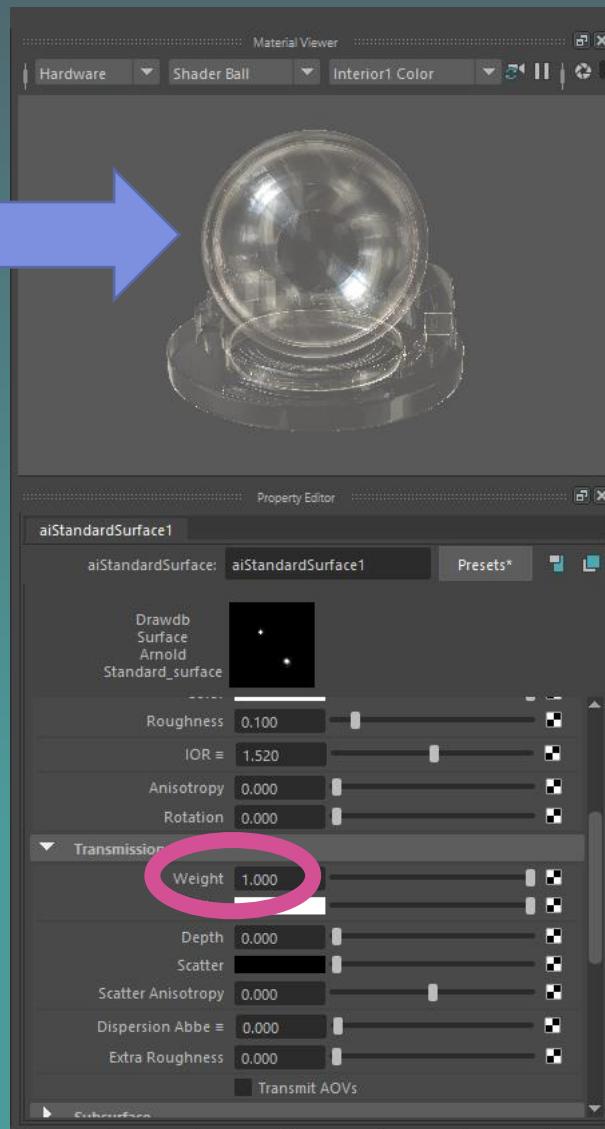
Rename this texture to "Ocean Surface"



25. CUSTOMIZE OCEAN SURFACE TEXTURE



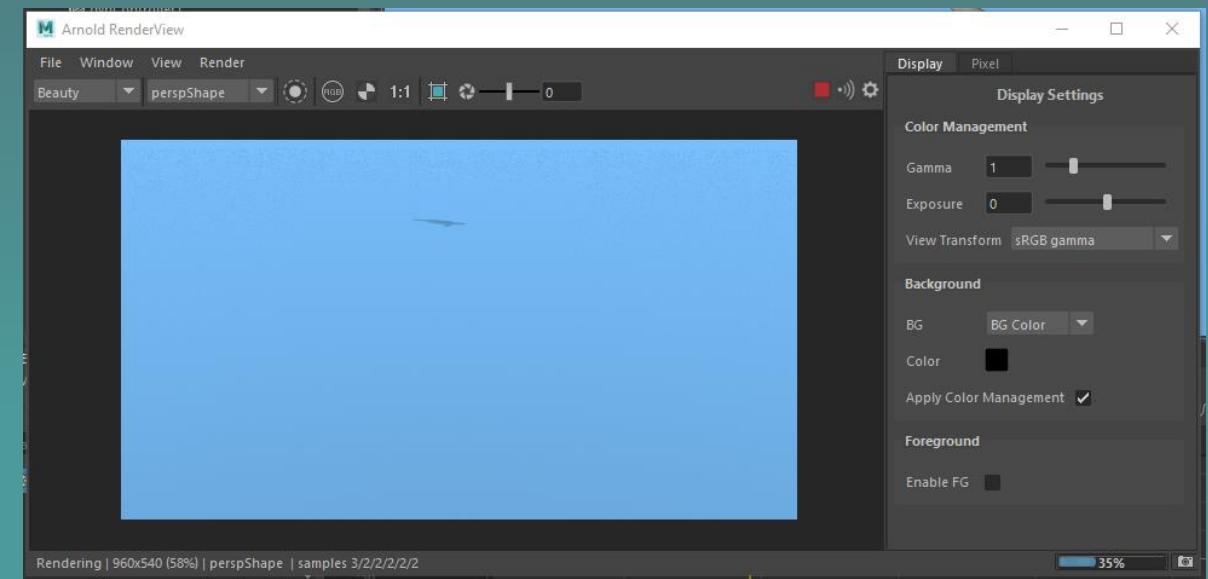
Make the ocean transparent, but reflective, by increasing Transmission Weight to 1 and keeping Specular Weight as is.



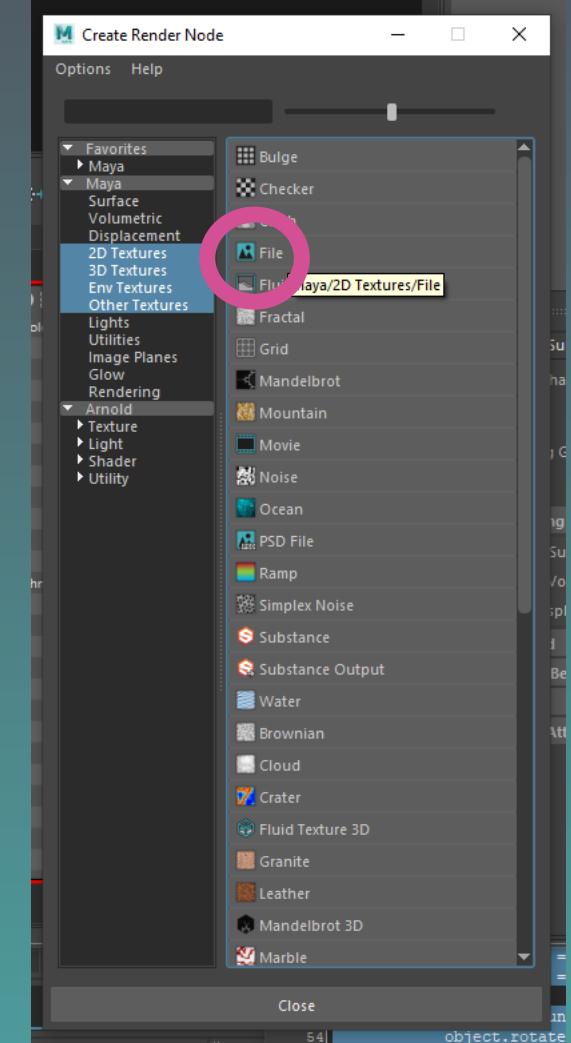
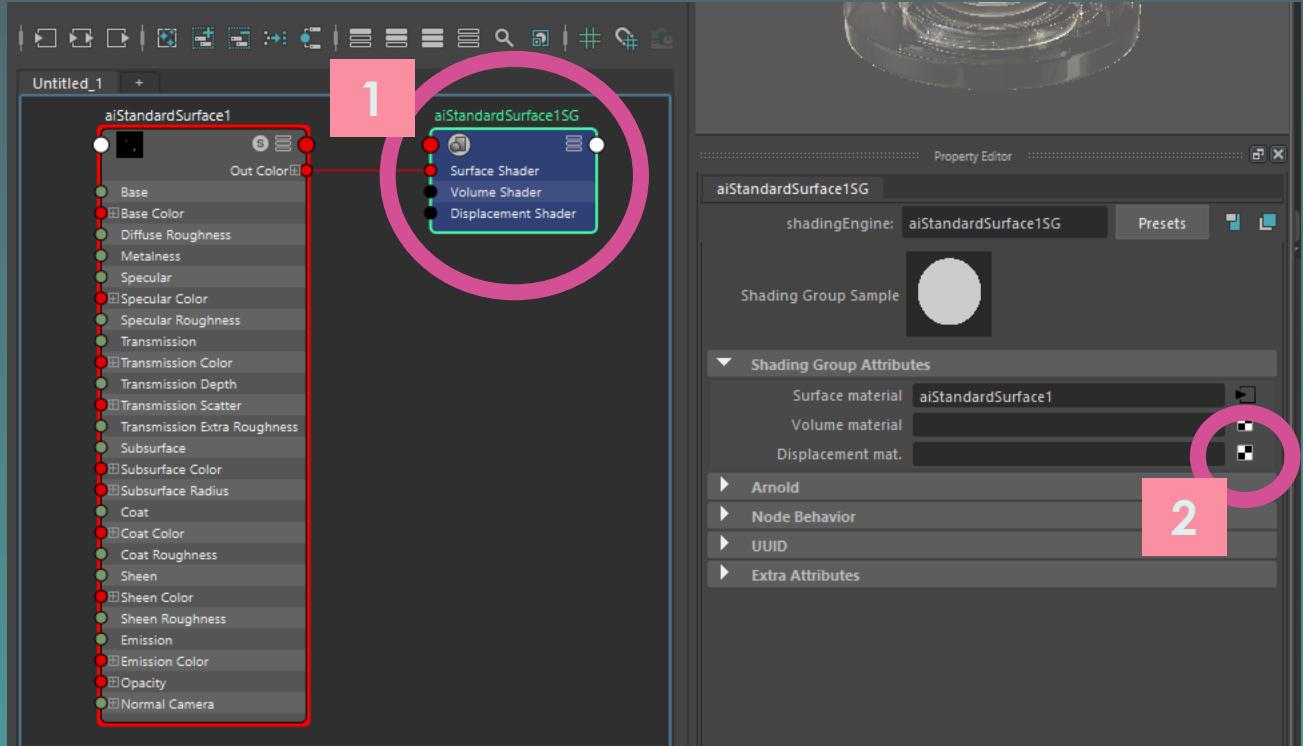
26. PRESS PLAY AGAIN

Now your ocean is transparent!

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

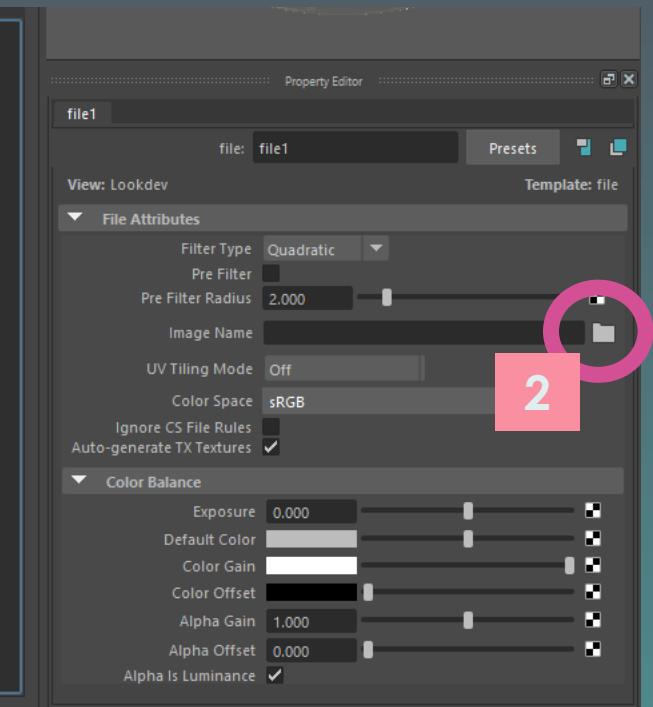
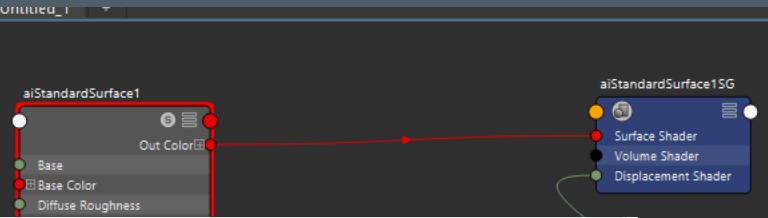
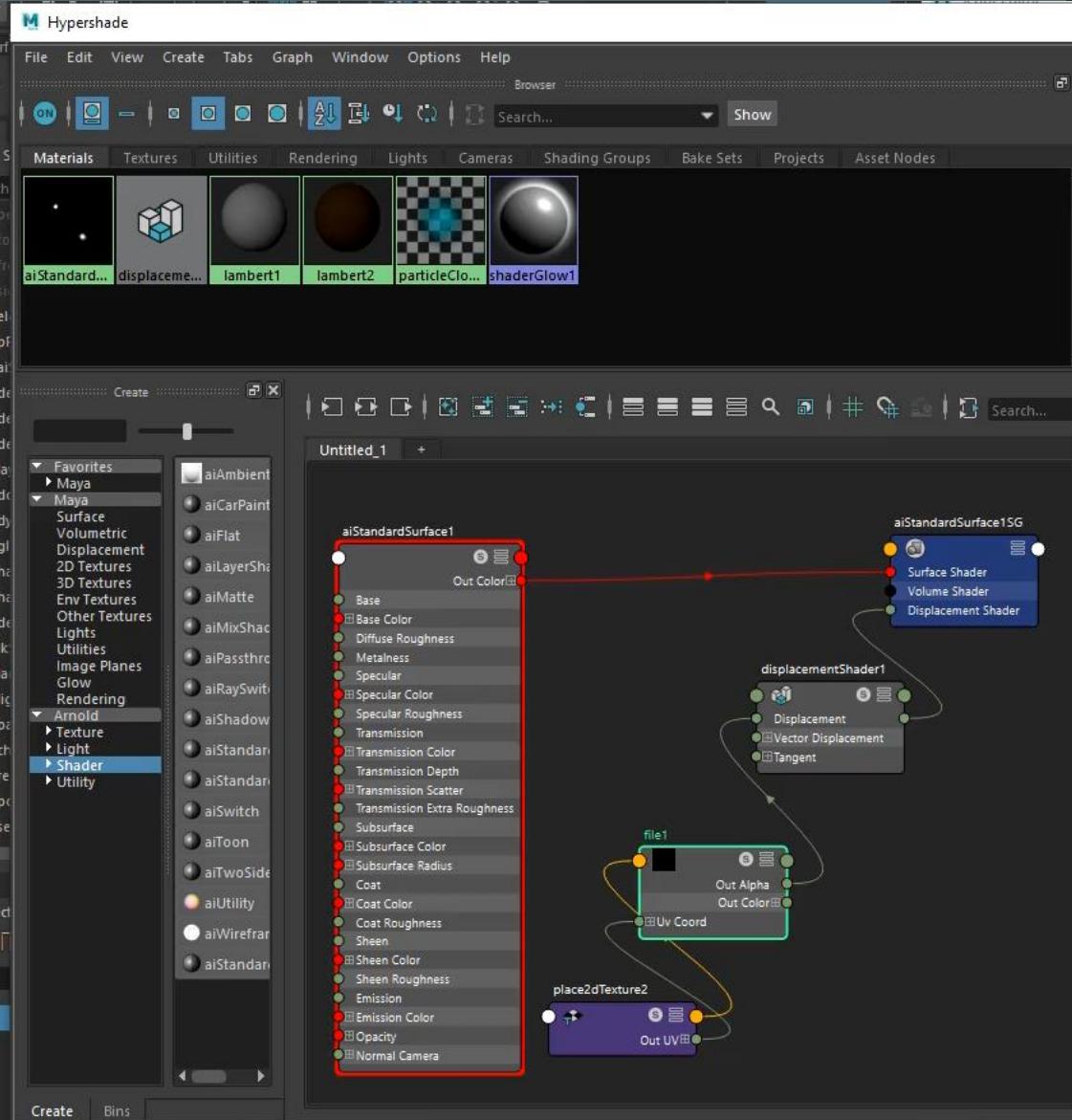


27. CUSTOMIZE OCEAN SURFACE TEXTURE



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

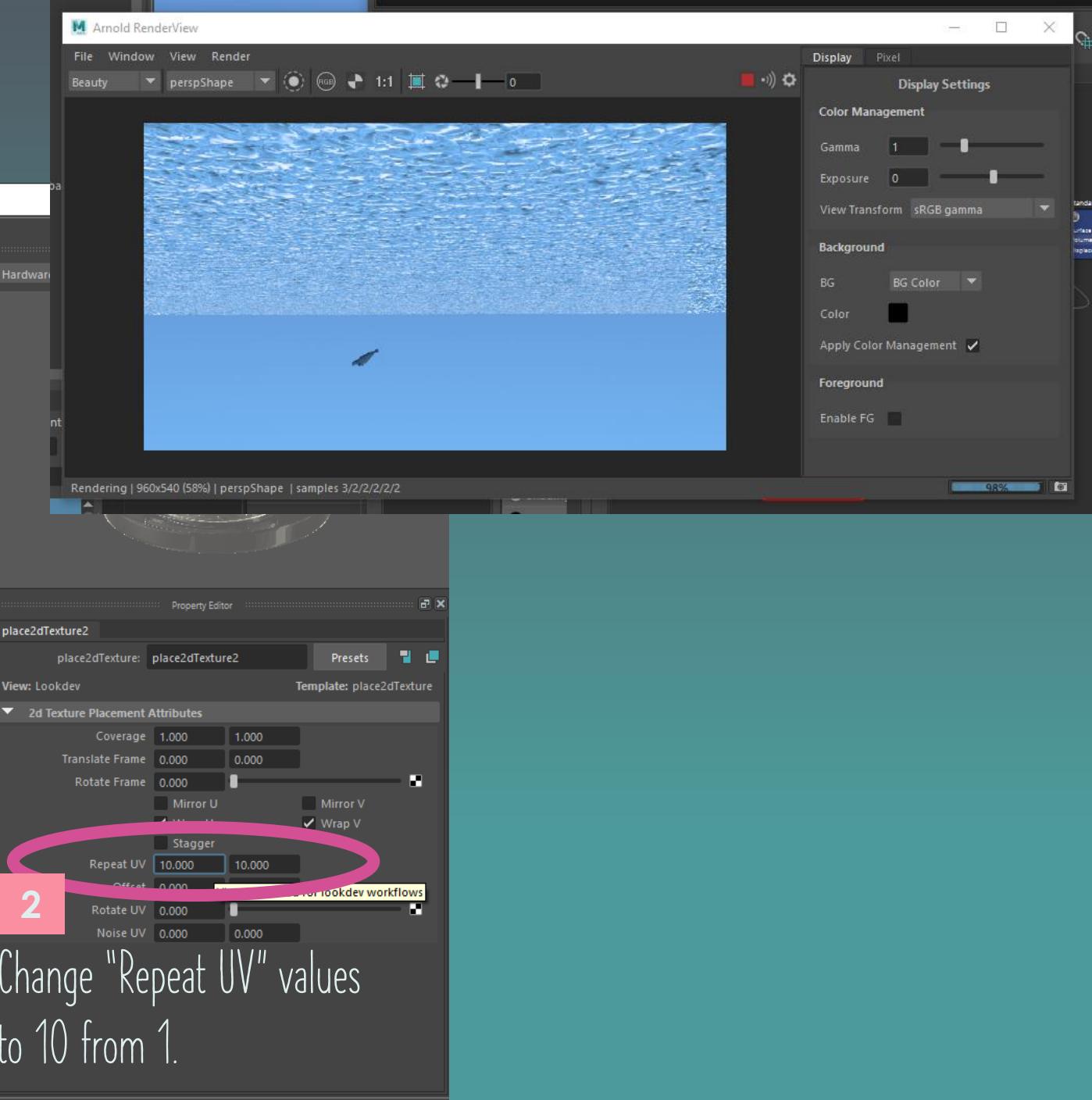
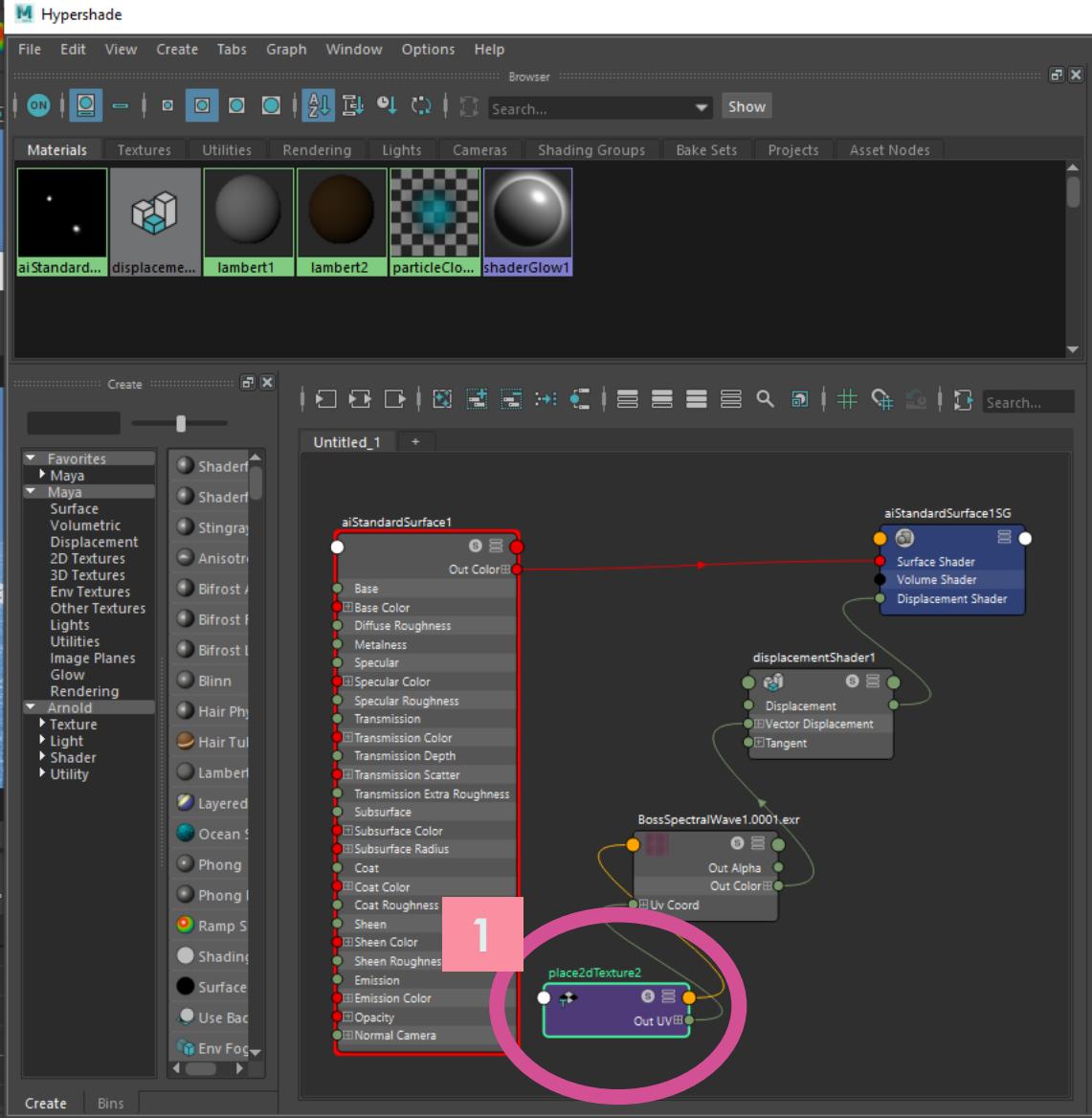
28. OPEN THE FILE NODE



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



30. LOOP DISPLACEMENT MAP TEXTURES

Autodesk Maya 2019 - Student Version: untitled* --- file1

File Edit Create Select Modify Display Windows Key Playback Visualize Deform Constrain MASH Cache Substance Arnold Help

Animation Curves / Surfaces Poly... Hypershade

Materials Textures Utilities Rendering Lights Camera Shading Groups Projects Asset Nodes

Outliner Display Show Help

Search...
aiStandard... dispacement... lambert1 lambert2 particleClo... shaderGlow1

Curves / Surfaces Poly... Hypershade

File Edit View Create Tabs Graph Window Options Help

Browser

Material Viewer

Hardware Shader Ball Interior1 Color

Workspace Modeling

No Live Surface Object X

Sign In

2

3

4 (right click)

5

6 Enter this expression:
File2.frameExtensions= ((frame%120)+1);

Attribute Editor Channel Box / Layer Editor Tool Settings

List Selected Focus Attributes Show Help

file1 place2dTexture2 expression1

Focus Presets Show Hide

Sample

File Attributes

Filter Type Quadratic Pre Filter

Pre Filter Radius 2.000

Image Name Maya\Ocean Texture Images\BossSpectralWave1.<f>.exr

Reload Edit View

UV Tiling Mode Off

Image Number 46

Edit Expression... Delete Expression Lock Attribute

Notes: file1

Select Load Attributes Copy Tab

File Editor

View: Lookdev Template: file

File Attributes

Filter Type Quadratic Pre Filter

Pre Filter Radius 2.000

Image Name in Texture Images\BossSpectralWave1.0001.exr

UV Tiling Mode Off

Color Space Raw

Ignore CS File Rules Auto-generate TX Textures

Color Balance Exposure 0.000 Default Color Color Gain Color Offset Alpha Gain 1.000 Alpha Offset 0.000 Alpha Is Luminance

230 240 250 260 270 280 286 290 300 310

Load Attributes Copy Tab

MEL

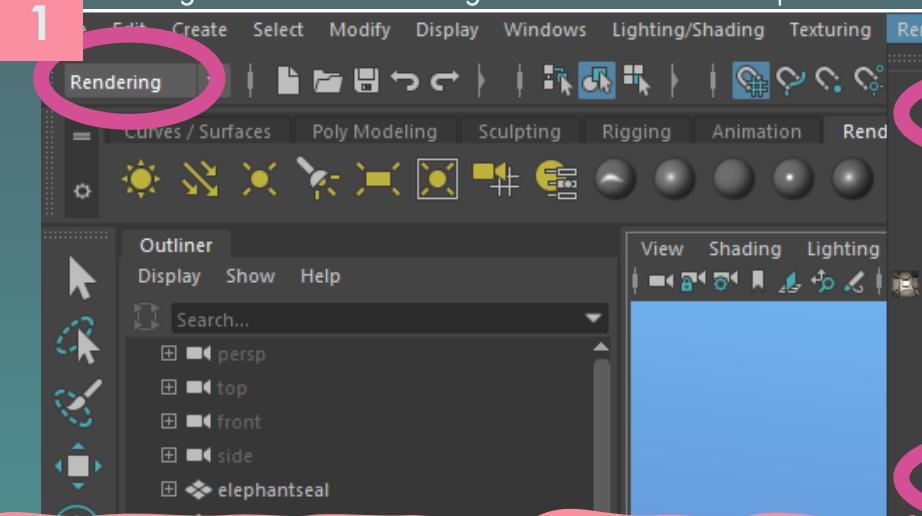
Search for anything

O C x E P W R Ps An Ae F M Pr L Ai

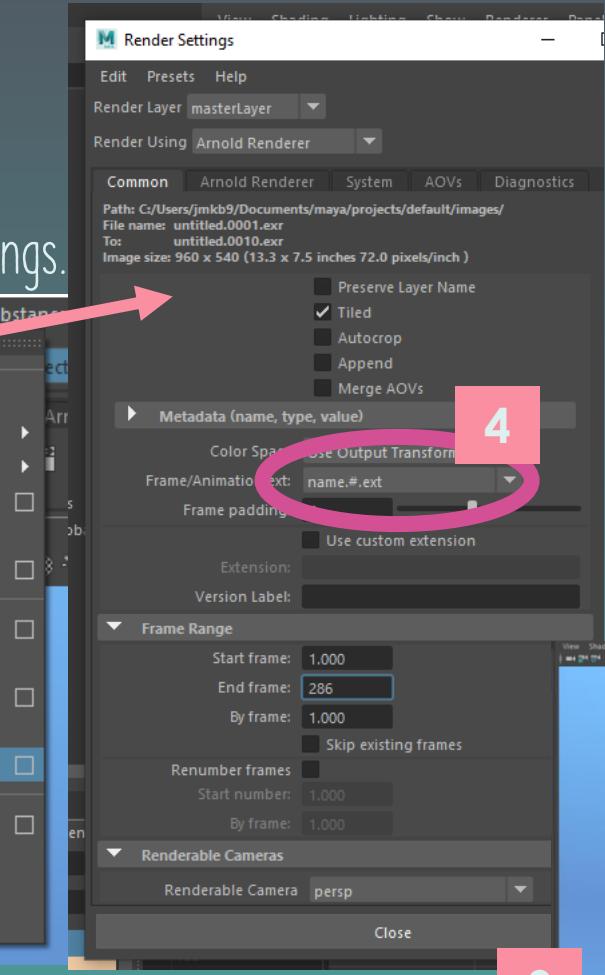
31. RENDER YOUR SCENE

Navigate to Rendering Menu Set and open Render Sequence settings.

1



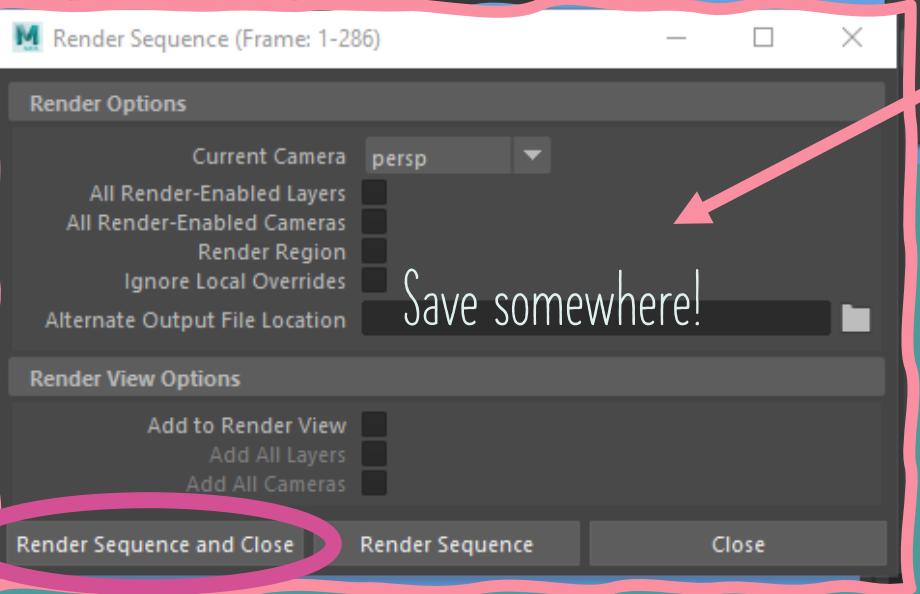
2



4

Important! Otherwise
will only render 1
frame.

5



3

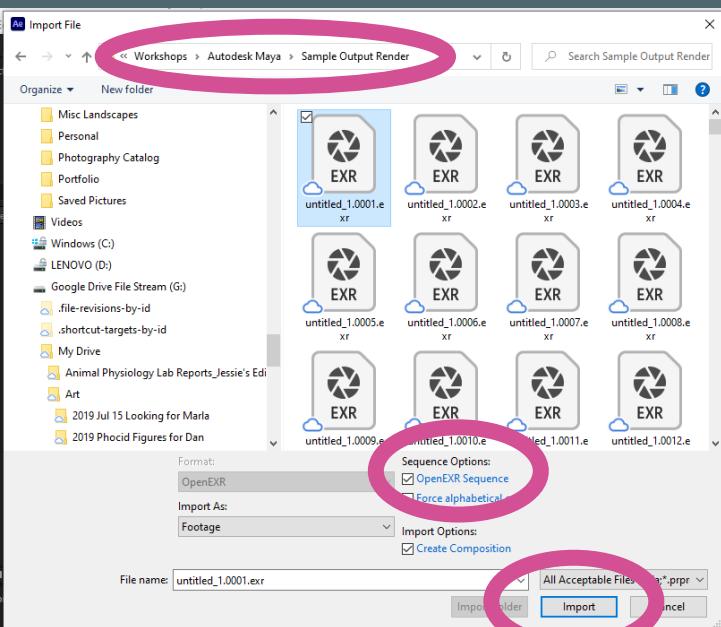
Arrange your perspective view so that the seal is in
view the whole time. You can also use an animated
camera but for our purposes this will be fine.

32. MAKE A VIDEO WITH YOUR SEQUENCE

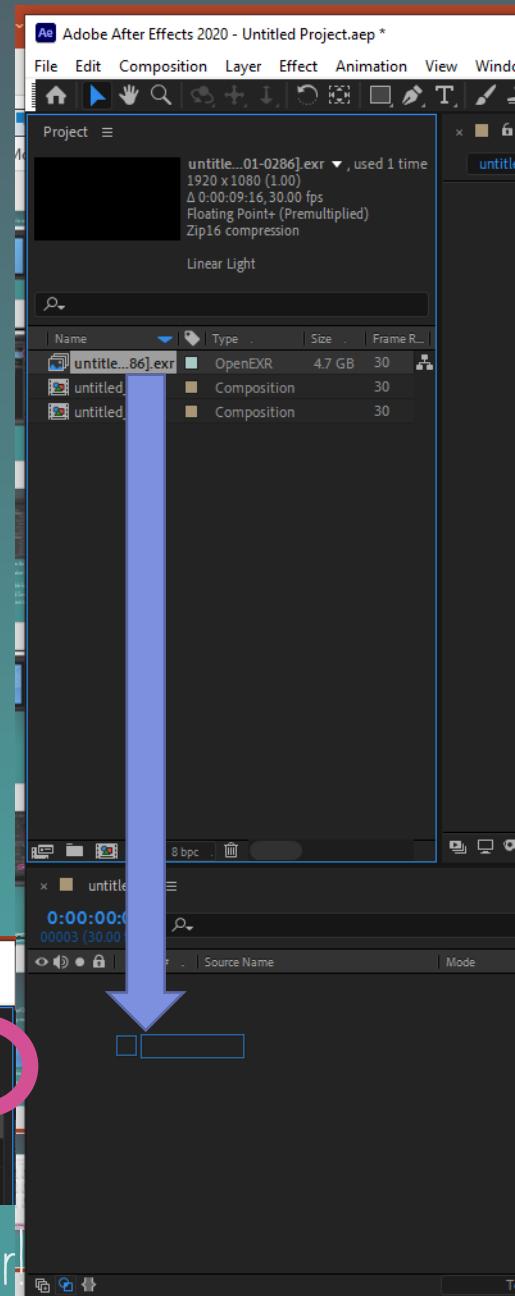
1 Open Adobe After Effects
(now free for UCSC students)

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

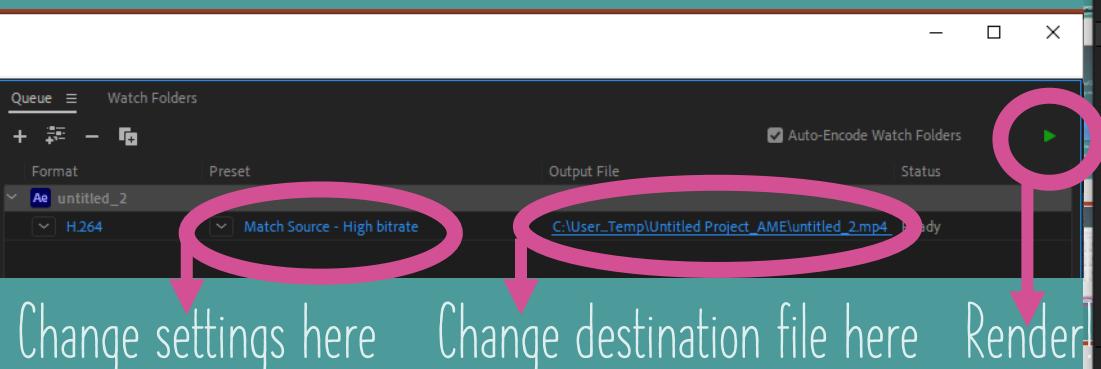
3 Navigate to where you've
saved your exported exr
image sequence and
import that image



4 Drag and drop footage into timeline.



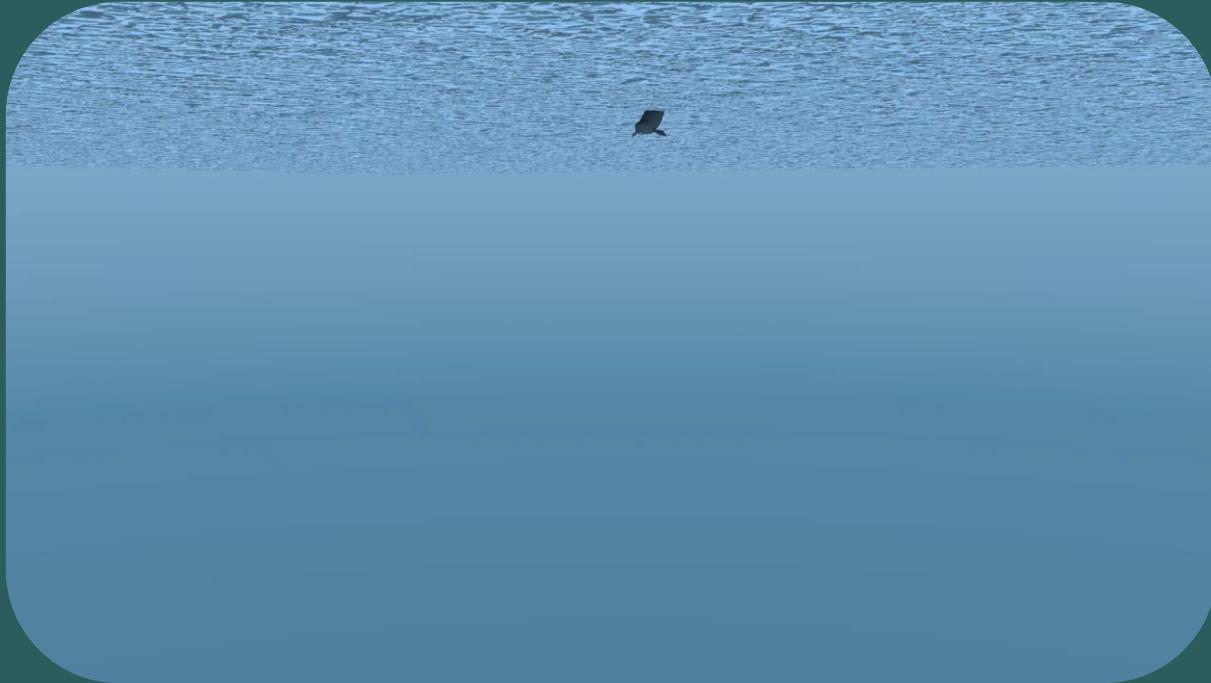
5 Export your video in File > Export >
Add to Adobe Media Encoder Queue..



Change settings here

Change destination file here

Render



33. ADMIRE YOUR OUTPUT

POST-MEETING TO DO'S

- Due next week: Animation

- Use your graphics and some raw CSV data to animate the science and tell a story.

The animation can be as involved or as simple as you would like, but must be submitted in .mp4 format and incorporate one of the techniques we discussed in our meeting this week.

- Explore LinkedIn Learning, R Graph Gallery, Python Graph Gallery to decide what language and packages you would like to use to code your publication-ready figure next week. Download software and packages that you might use, input and wrangle your data, and play with some graphing options!