Data-Driven Animation

for Science Communication

Jessica Kendall-Bar

July 18-29

CSUMB Summer of Science Illustration

OUTLINE

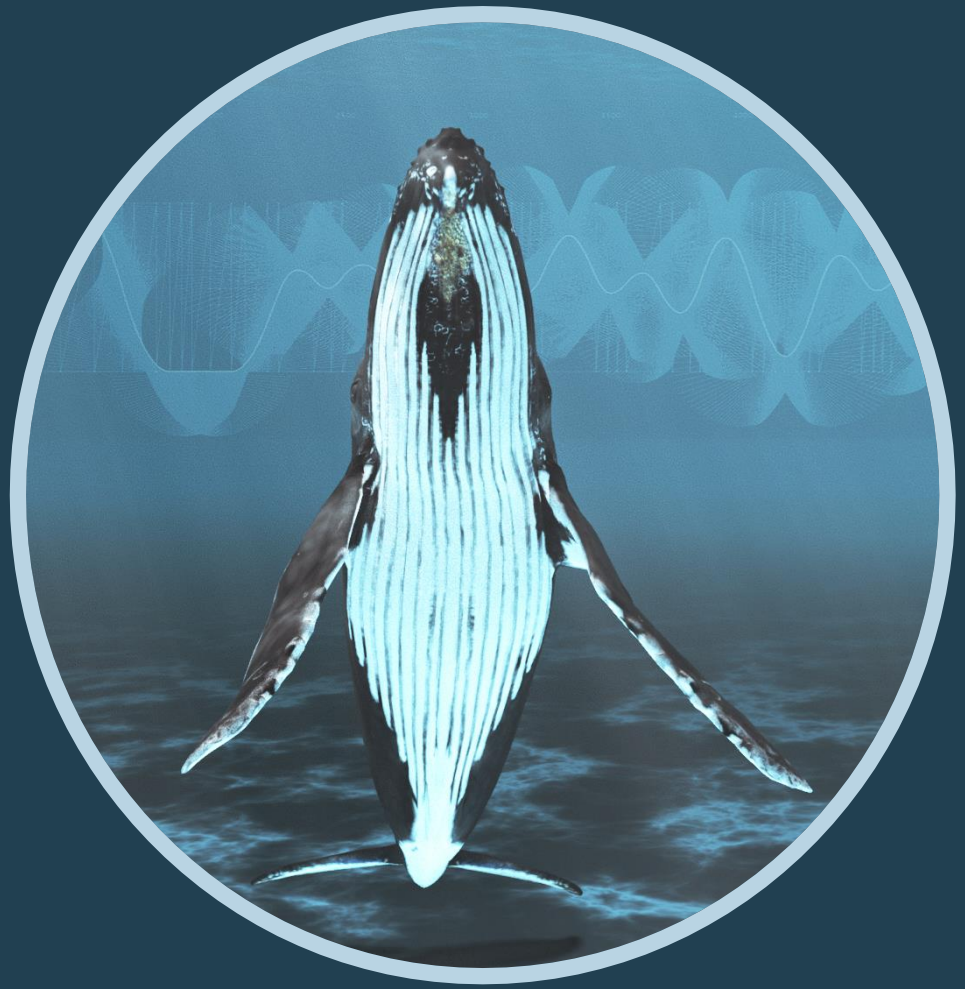
Course structure

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
	Jul 18	**Jul 19**	**Jul 20**	**Jul 21**	**Jul 22**	**Jul 25**	**Jul 26**	**Jul 27**	**Jul 28**	**Jul 29**
Topic	***Introductions & Collaboration***	***Conceptualization***	***Digital Art and Design***	***Data Visualization***	***Animation & Motion Graphics***	***Animating 2D Data***	***Intro to 3D Animation***	***Animating 3D Data***	***Editing & Compositing***	***Final Critique & Communication Strategy***
Program	Adobe Premiere Pro	Adobe Premiere Pro	Adobe Photoshop & Illustrator	Adobe Illustrator & R	After Effects	After Effects	Autodesk Maya	Autodesk Maya	Adobe After Effects/Premiere Pro	Social Media
Starting products	Draft scientific paper with key figures and points, any existing assets (videos, illustrations, or 3D models).	Style Guide & Script	Reference images and list of key assets and animatic	One key figure	Animatic	Made-over key figure	3D asset	Animated 3D scene	Rendered image sequences	Final composition
Main output	Style Guide, Budget, Contract, & Script	Storyboard & Animatic	Custom 2D raster & vector graphics	Made-over key figure	Scene with motion graphics	Animated key figure	Animated 3D scene	Data-driven 3D scene	Final composition (mp4 with narration, annotations, custom musical score)	Science Communication Strategy document
Interview with industry Expert - Guest lecture	**Sara El Shafie** - Distilling Complexity; Science through Story	**Ilgavak (Peter Williams)** - Storytelling and place-based learning	**Alex Boersma** - Scientific illustrations and animations for high-impact science	**Allison Horst** - Art to build agency for budding data scientists	**Bailee Desrocher** - Animations for science storytelling: NASA & beyond	**Katherine Vlamis** – CrossTown LA COVID data visualizations for large cities amidst a global pandemic	**Johnson Martin** - Digital Life 3D: Realistic animal models for science and education	**Geraldine Fauville;** VR for environmental education	**Connor Vance** - Musical Compositions for Data Storytelling	**Sal Alper** - Science communication and outreach through the SF Exploratorium

DAY 6

Animating 2D Data

Data-Driven Animation
for Science Communication



PART 1

WELCOME

Agenda & Goals

Review today's agenda & goals – 20 min

AGENDA

Today's agenda

2:00 - 2:20: 2D Data Brainstorming – Sketch frames with 2D data (20 min)

2:20 - 2:50: Discussion – List ideas and recall animation techniques (30 min)

2:50 - 3:00: Break / Reflection (10 min)

3:00 - 3:30: Lecture: 2D Data-Driven Animation - Examples & software (30 min)

3:30 - 4:00: Demo/Tutorial - Animating CSV Data Example (30 min)

4:00 - 4:10: Break (10 min)

4:10 - 4:40: Demo: Overview of other 2D animation methods (30 min)

4:40 - 5:20: Work time – Animating your 2D data (40 min)

5:20 - 5:30: Break (10 min)

5:30 - 6:30: Guest speaker – Katherine Vlamis: CrossTown LA - COVID data visualizations for large cities amidst a global pandemic

DAY 6

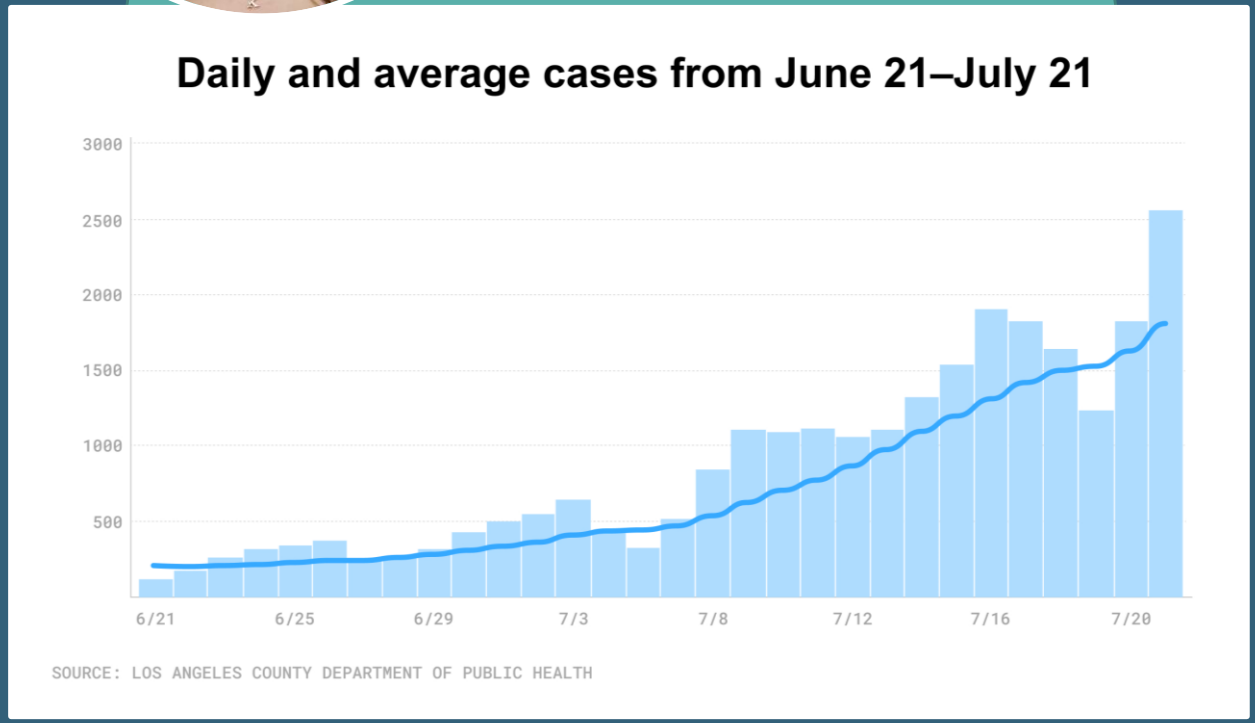
GUEST SPEAKER

COVID Data Visualizations amidst a global pandemic

Katherine Vlamis

Marketing and Social Media Editor,
Crosstown LA

Contact: vlamis@usc.edu



GOALS

Today's goals

- Create animation with 2D data

PART 2

OPENING ACTIVITY

2D Data Brainstorming

Sketch, brainstorm, discuss, reflect - 50 min

Opening Activity

2D Data Brainstorming

- Sketch frames with 2D data

Opening Activity

Discussion

- List ideas and recall animation techniques

B R E A K

10 min – Return at 3:00 PM

PART 3

LECTURE

2D Data-Driven Animation

Examples and software - 30 min

PART 4

DEMO/TUTORIAL

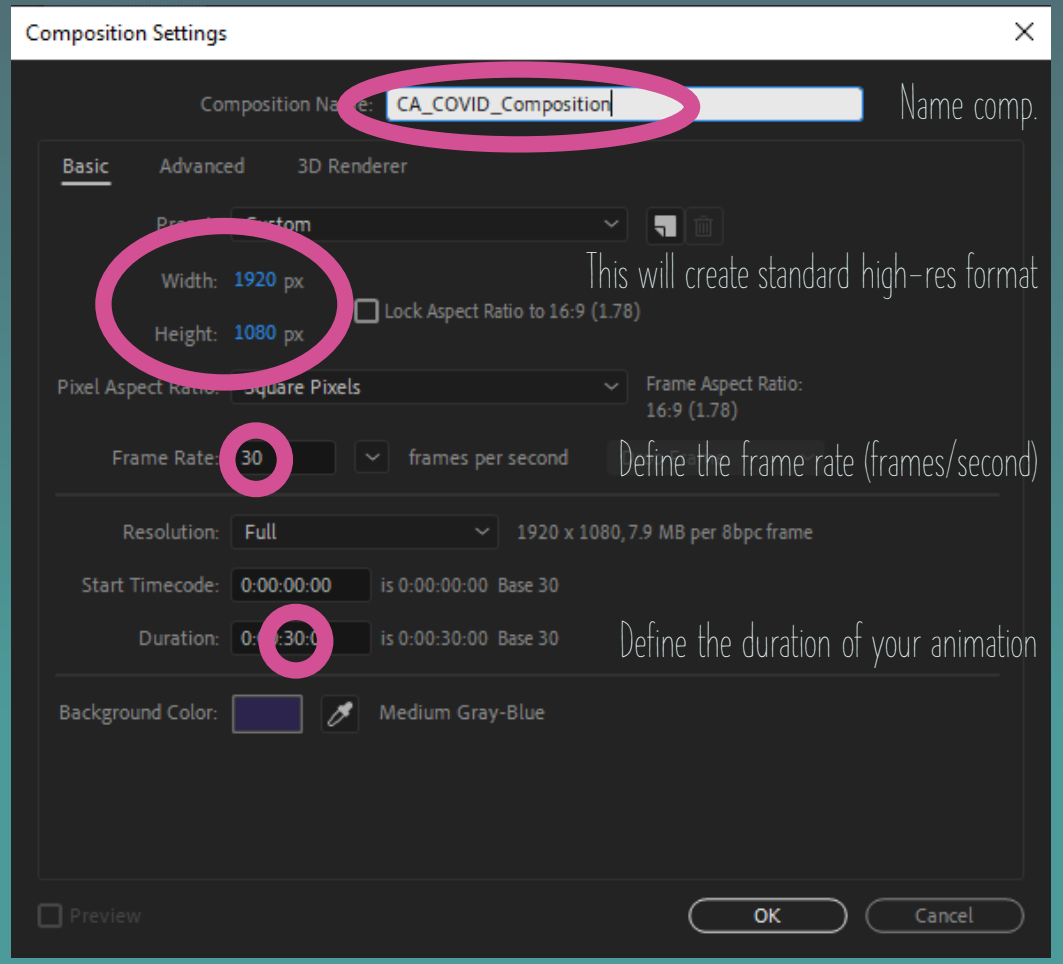
30 min – Stop & break at 4:00 PM

Tutorial

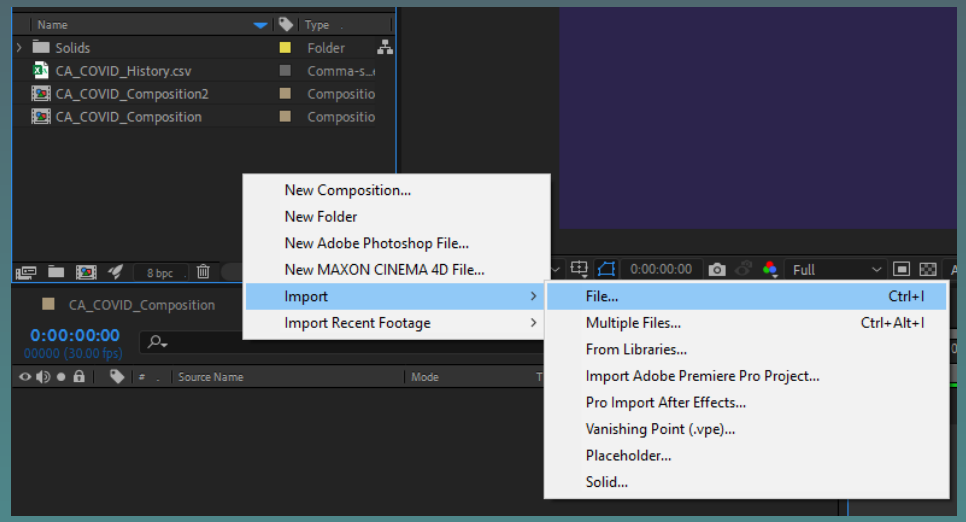
Linking CSV Data to your Animation

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

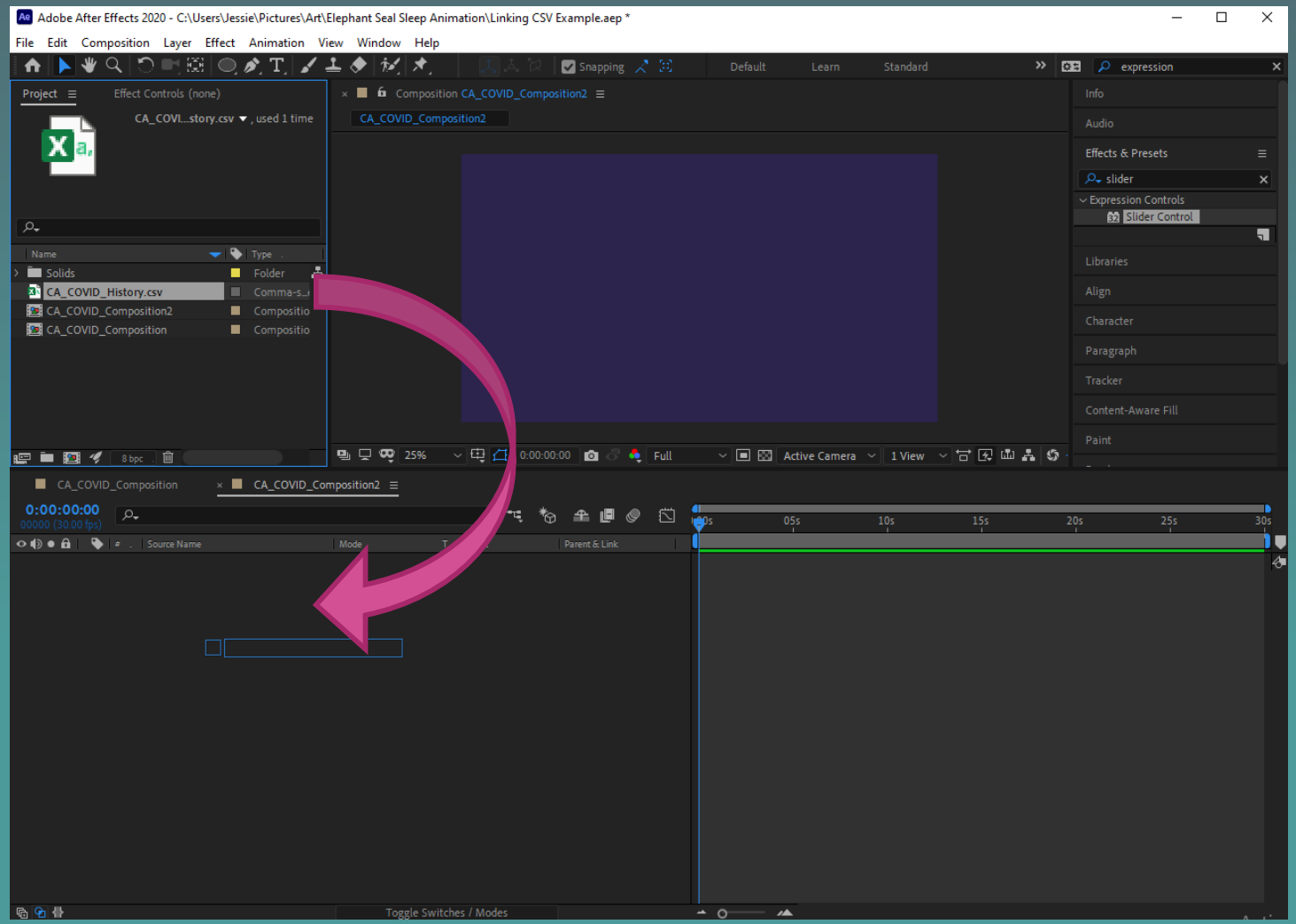
1. CREATE NEW PROJECT & COMPOSITION



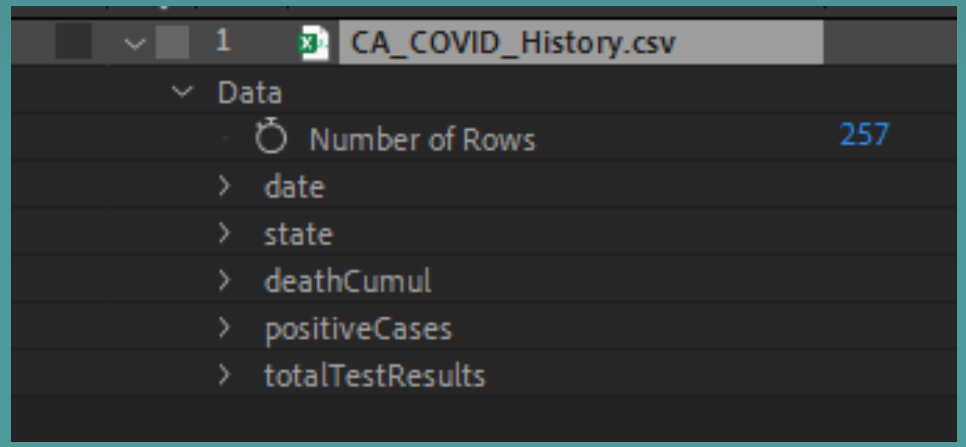
2. IMPORT YOUR CSV



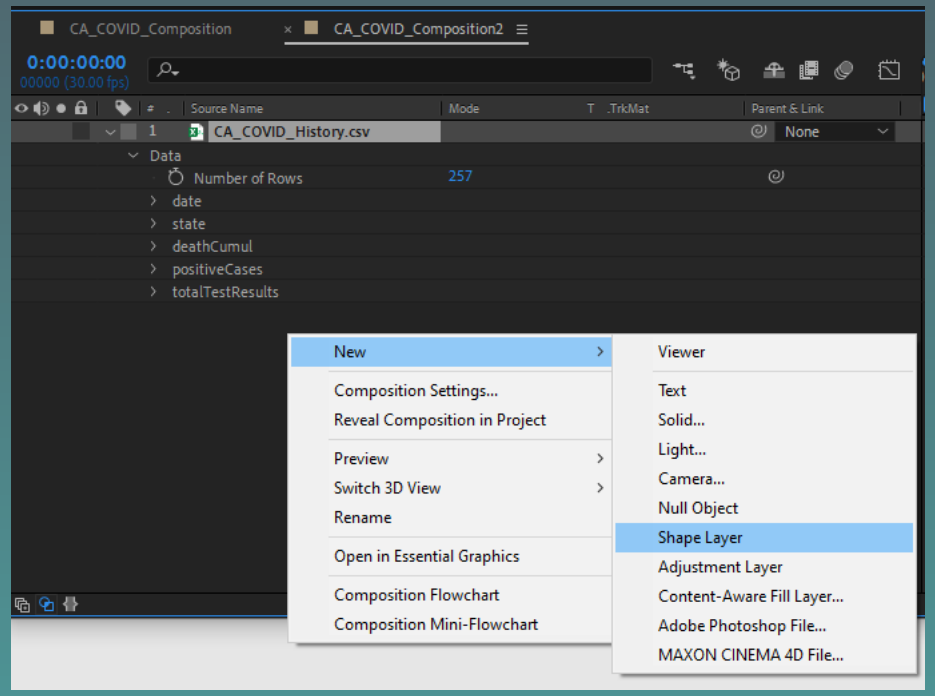
3. DRAG INTO COMPOSITION

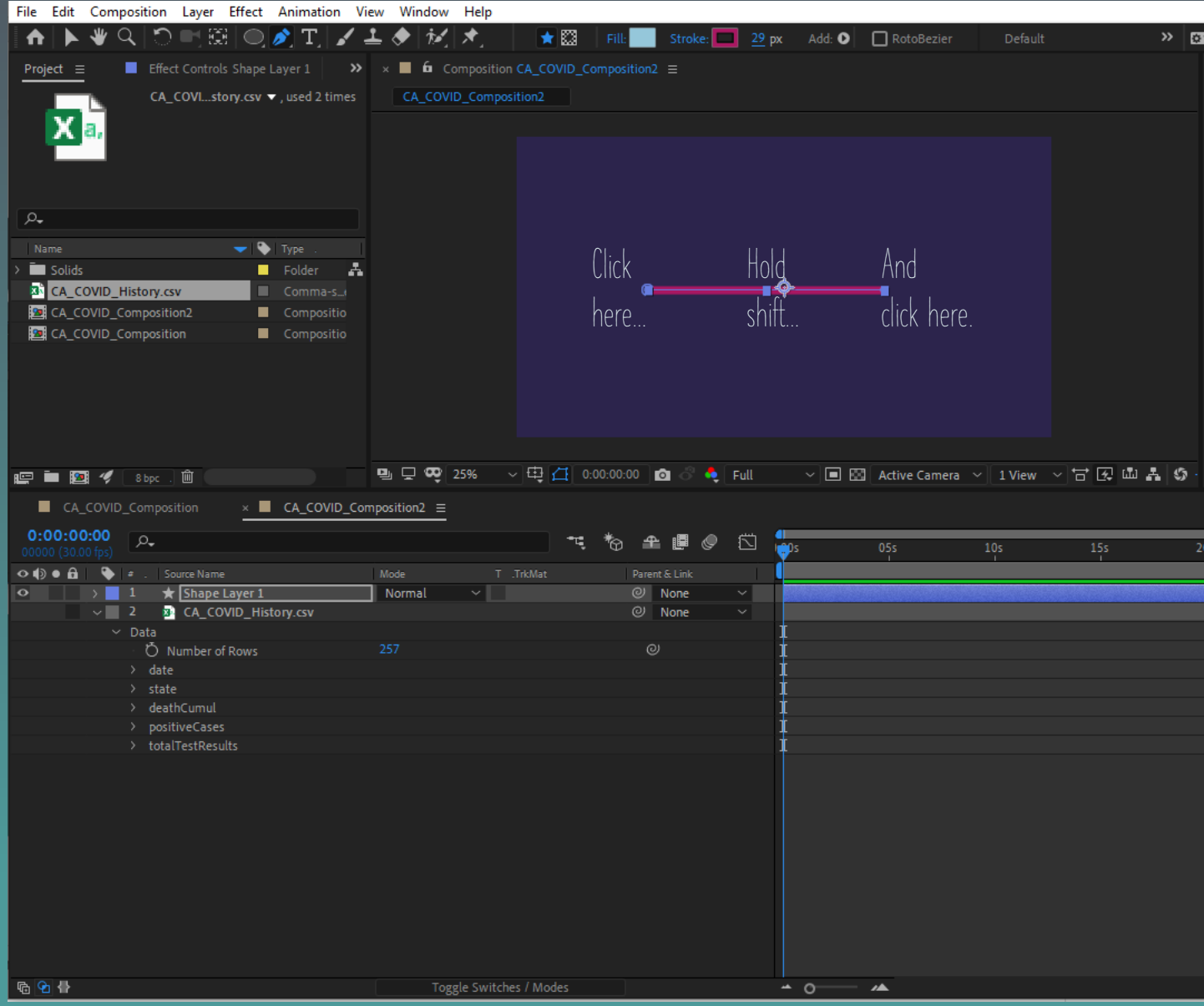


4. EXPLORE YOUR FILE



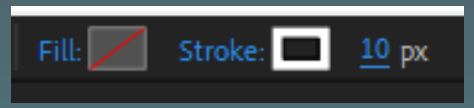
5. ADD NEW SHAPE LAYER



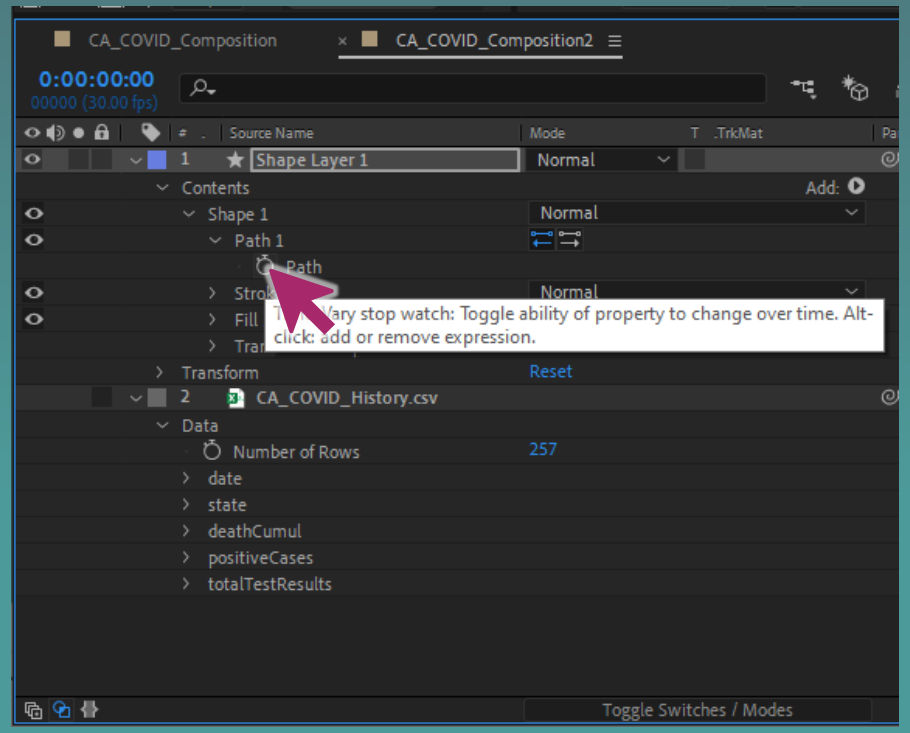


6. CREATE PATH WITH PEN TOOL

7. FORMAT SHAPE



8. OPEN EXPRESSIONS



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

9. ADD THIS EXPRESSION

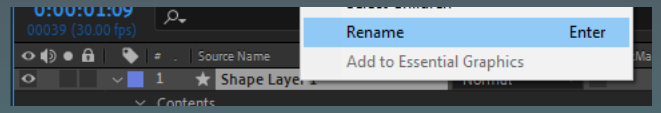
```
Variable names
Functions()
//Comments
Values
Pick up with PickWhip
```

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
```

Inspiration and guidance from a brilliant tutorial: https://www.youtube.com/watch?v=oqWEoalFKs0

10. ALIGN PATH 11. RENAME SHAPE LAYER



Align left and align bottom.

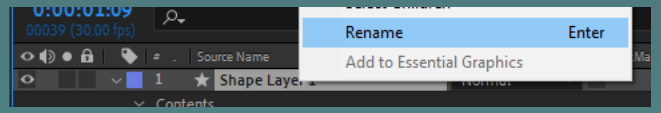
```
var numberOfPoints = thisComp.layer("CA_COVID_History.csv")("Data")("Number
of Rows");
//Setting # of Point variable equal to the number of rows of data in CSV
```

12. DUPLICATE LAYER

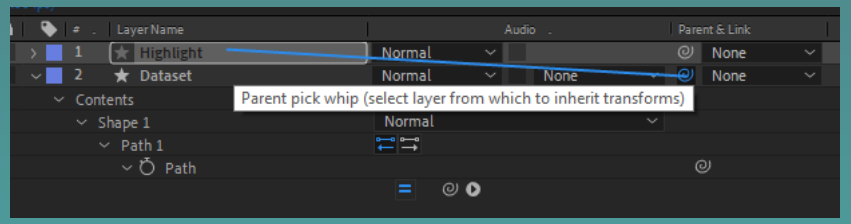
Ctrl + D / Command + D to duplicate layer

13. RENAME DUPLICATE

Change name to "Highlight"



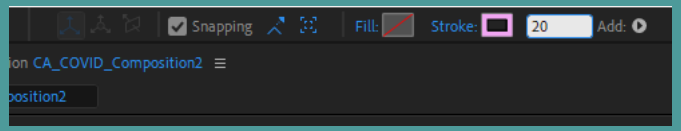
14. LINK LAYER TO PARENT



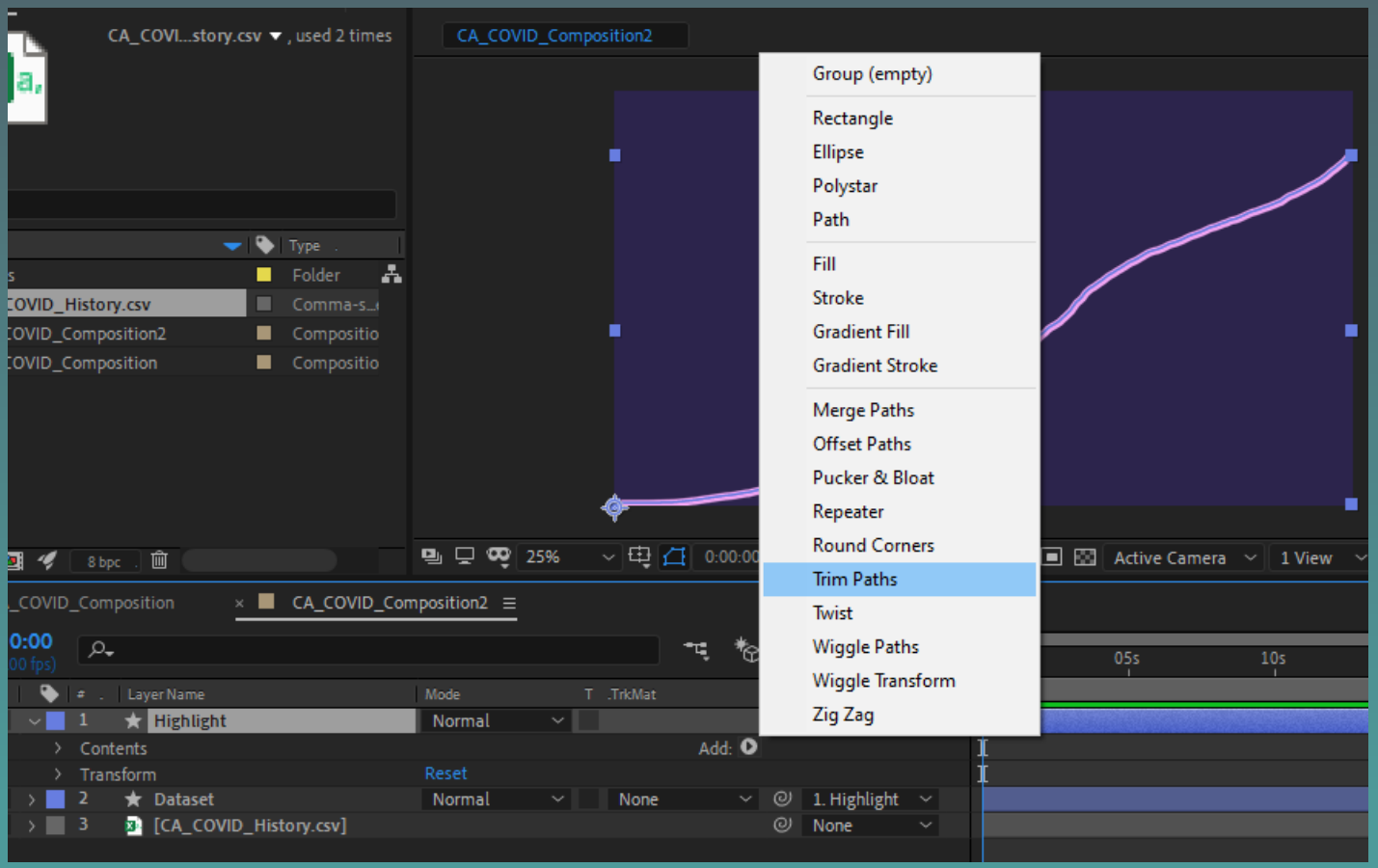
This causes any transforms to layer "Highlight" to also apply to "Dataset"

15. CHANGE FILL & STROKE

Change color & width for "Highlight"



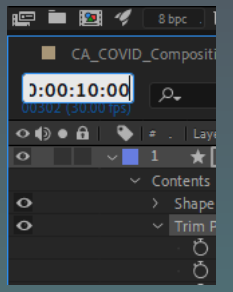
16. ADD TRIM PATH TO SHAPE



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

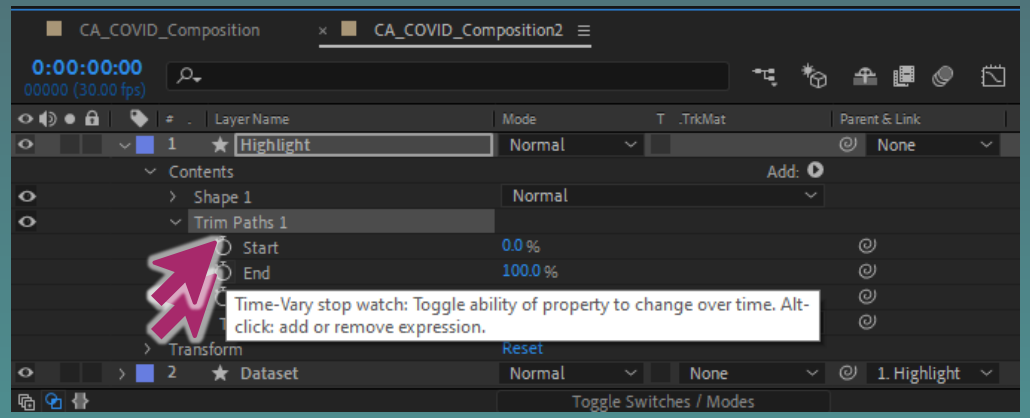
17. SET END OF DATA ANIMATION

Place playhead where you would like your animation to stop.



18. ADD KEYFRAMES

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

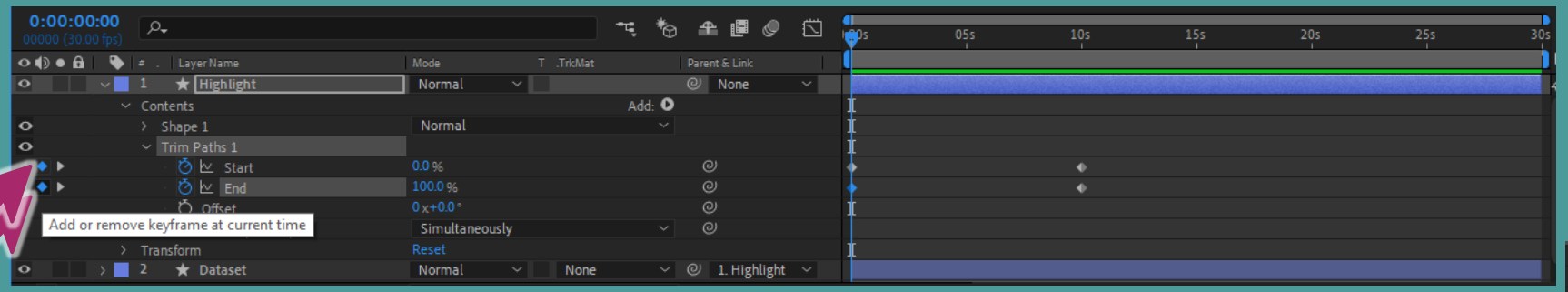


19. NAVIGATE TO BEGINNING

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

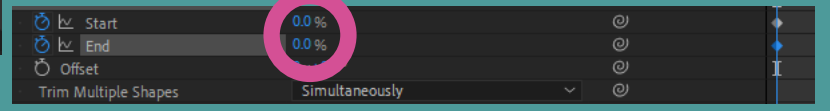
20. ADD KEYFRAMES

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



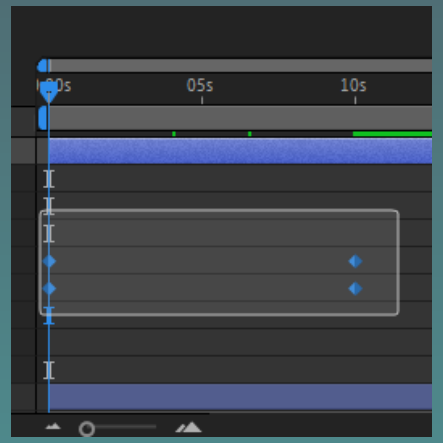
21. CHANGE VALUE

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.

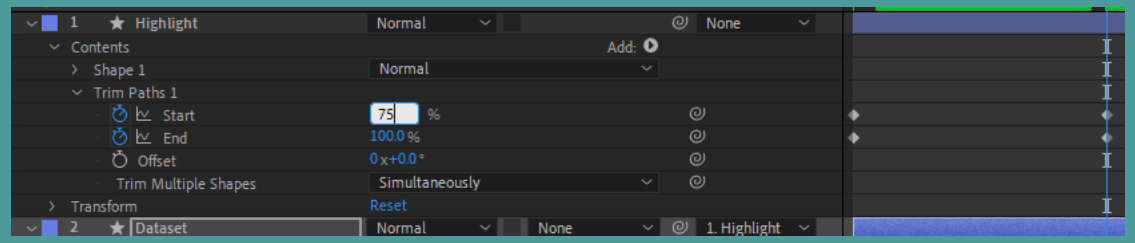
24. COPY/PASTE KEYFRAMES

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.

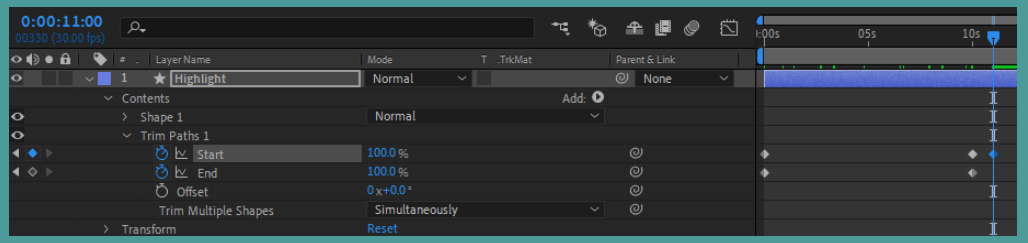
25. ADJUST TRIM PATH

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

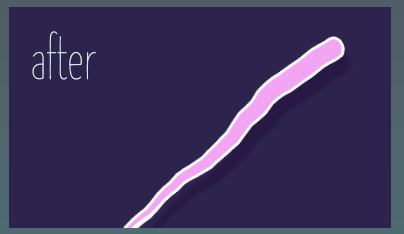


26. LET HIGHLIGHT EXIT

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

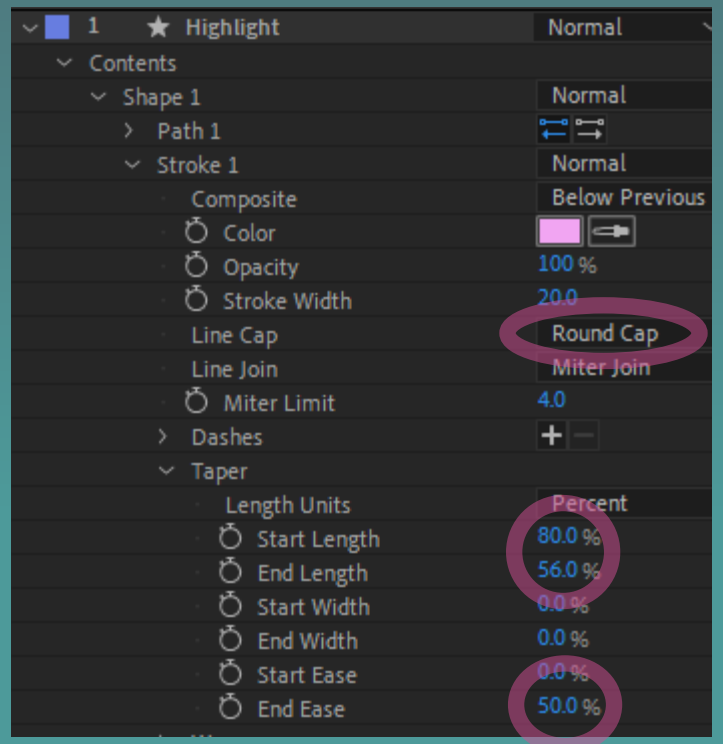


27. ADD SOME STYLE



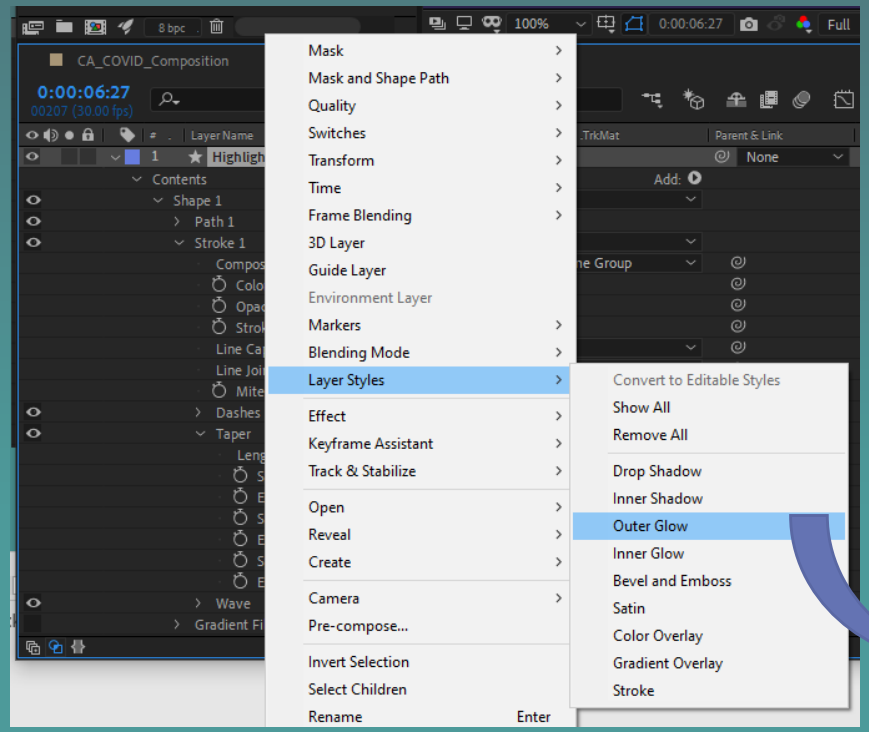
Add TAPER:

Contents > Shape > Stroke > Taper



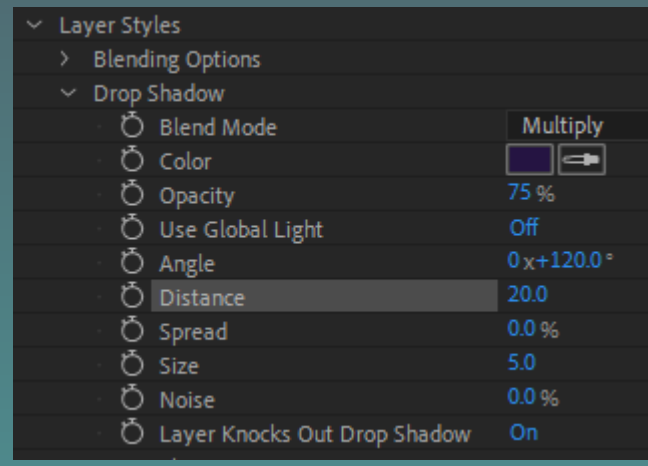
Add GLOW:

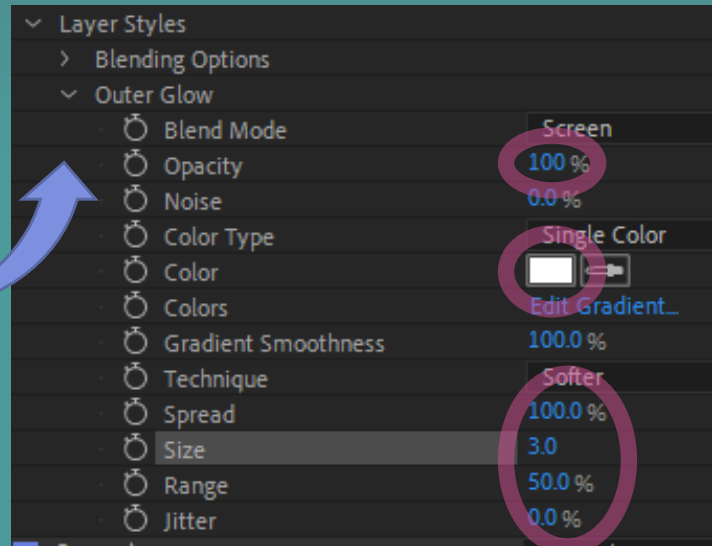
Right Click > Layer Styles > Outer Glow

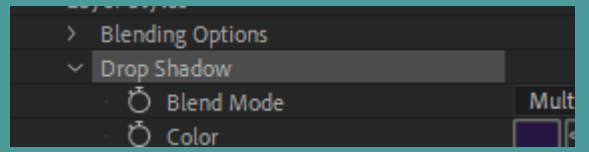


Add SHADOW:

Right Click > Layer Styles > Drop Shadow



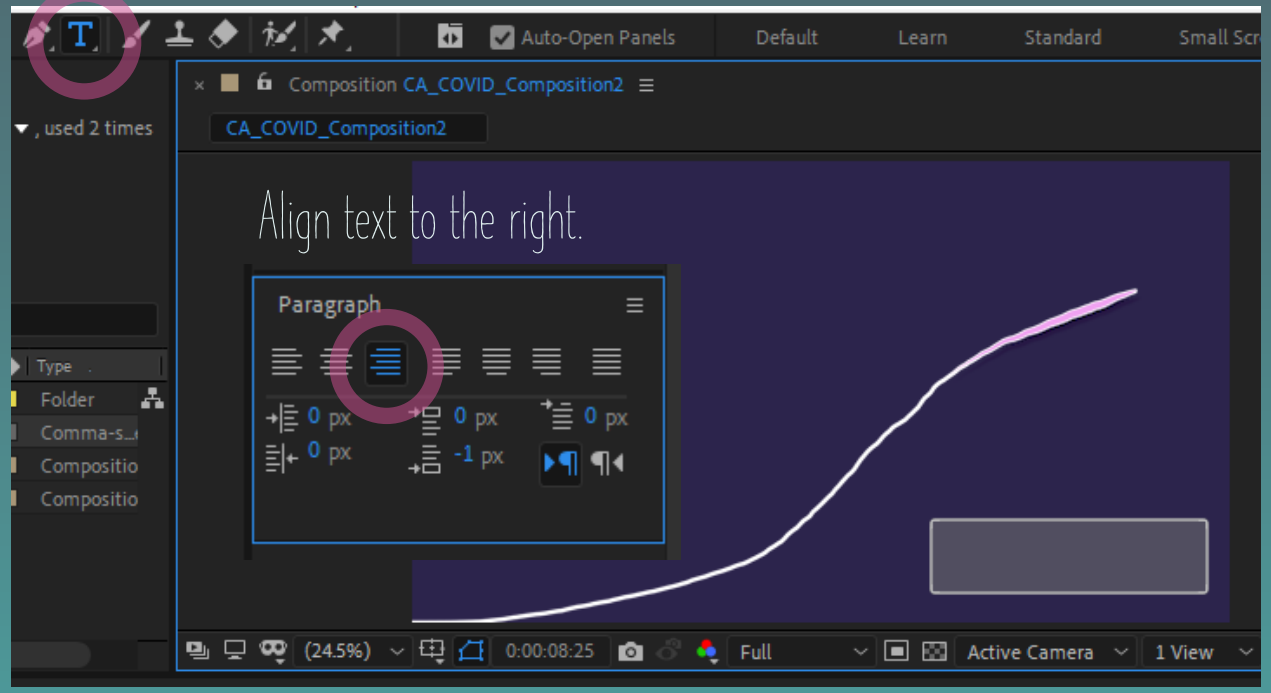




Can select Drop Shadow effect and copy/paste it onto another layer, like "Dataset".

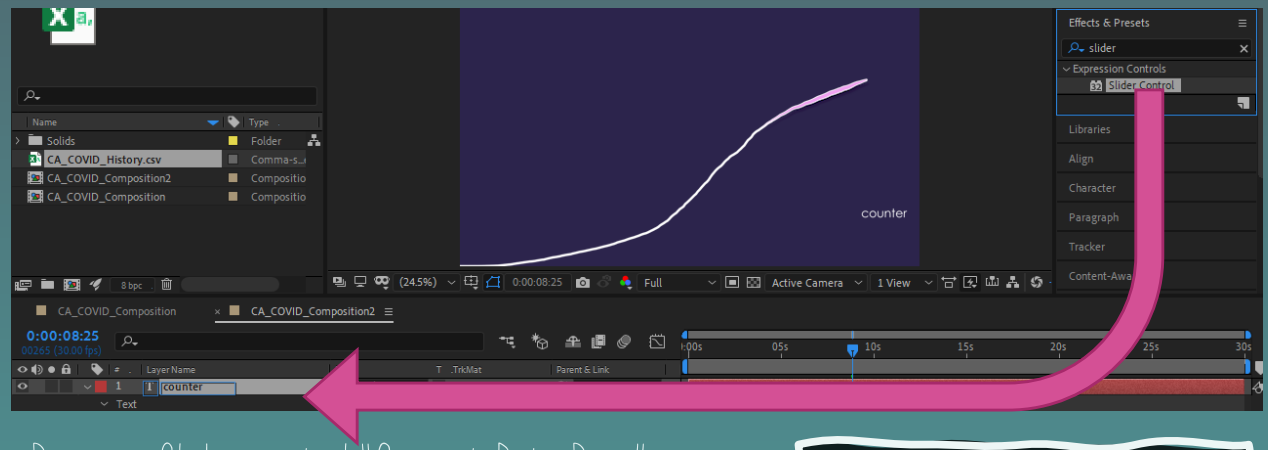
28. ADD TEXT COUNTER

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.

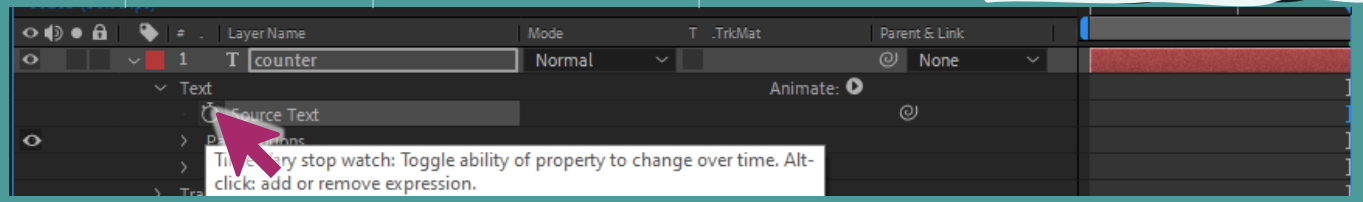


Rename Slider control "Current Data Row"

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

30. ADD AN EXPRESSION

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

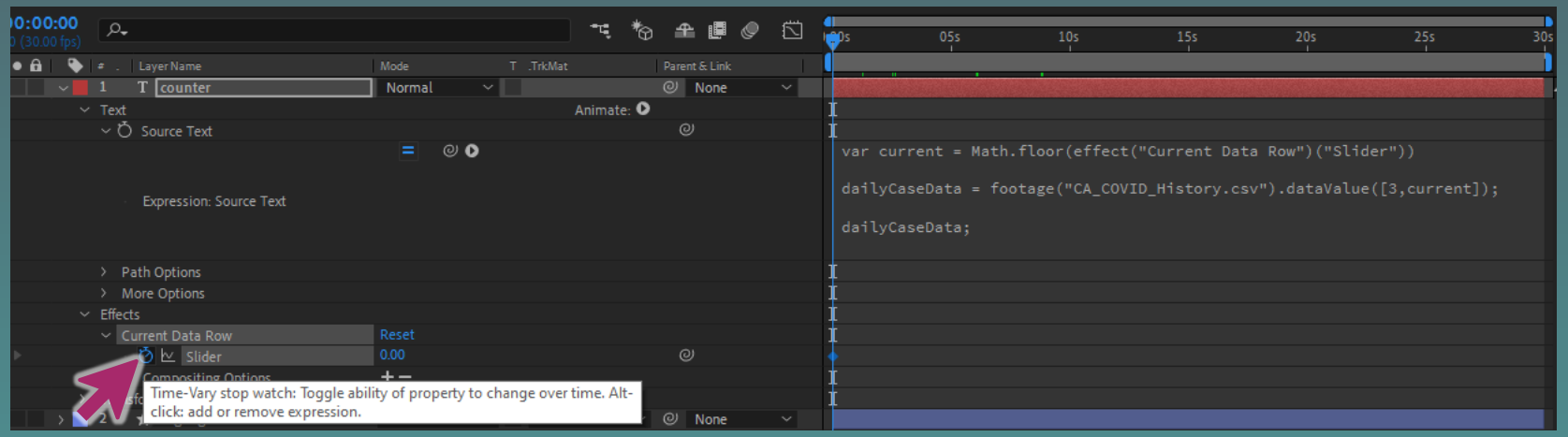



```
var current = Math.floor(effect("Current Data Row")("Slider"))

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.

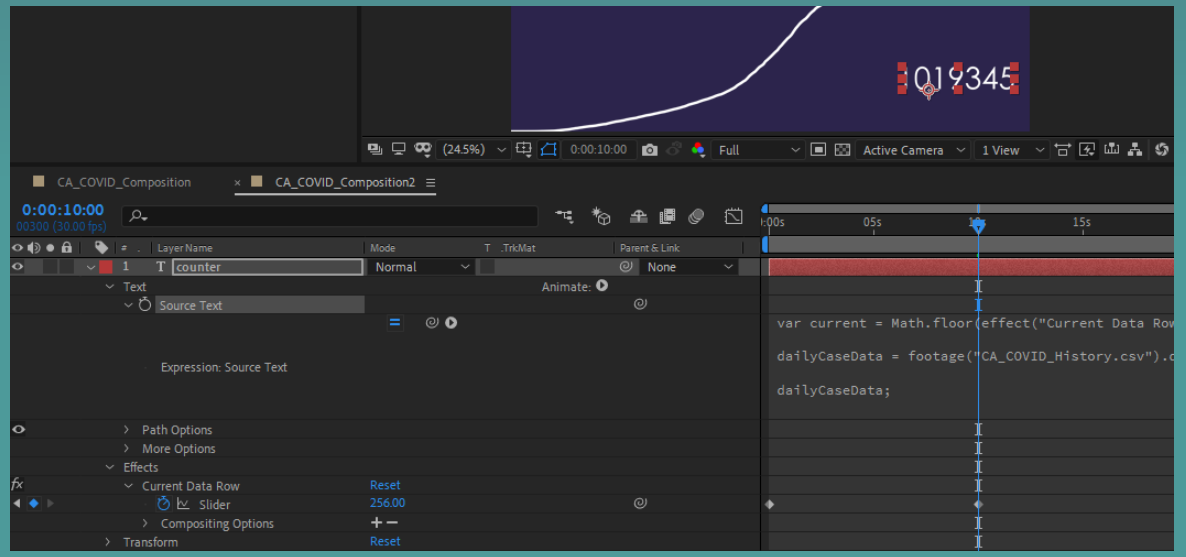
31. ADD SLIDER KEYFRAMES

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.

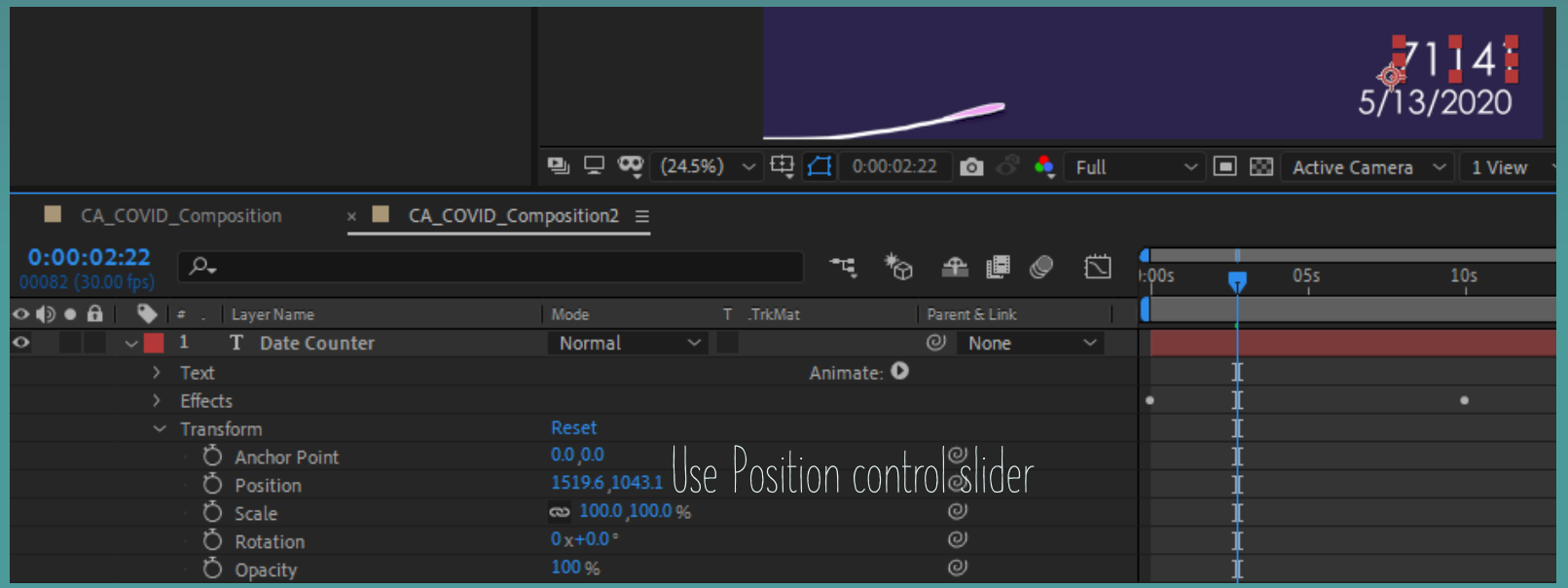
32. DUPLICATE COUNTER LAYER

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:

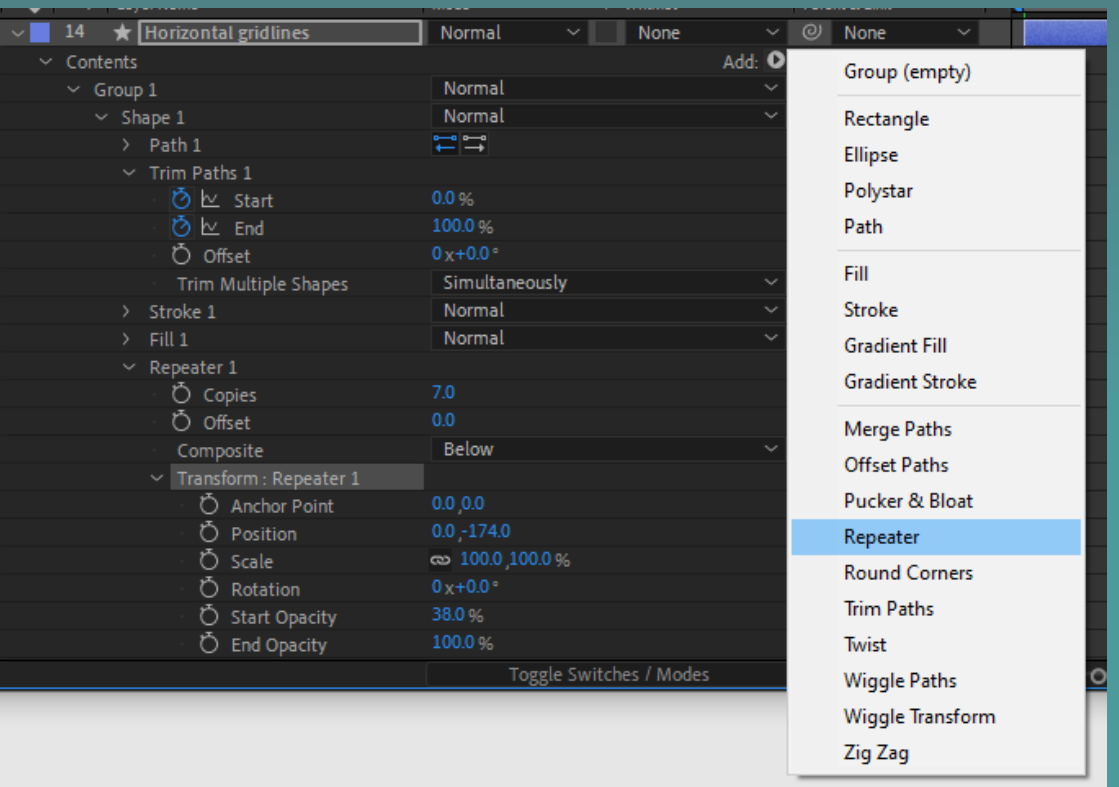
- Create horizontal path (by holding Shift)
- Add Repeater with n copies
- Transform each instance of the repeater by adjusting the Y-value for Transform : Repeater 1

Y-axis labels:

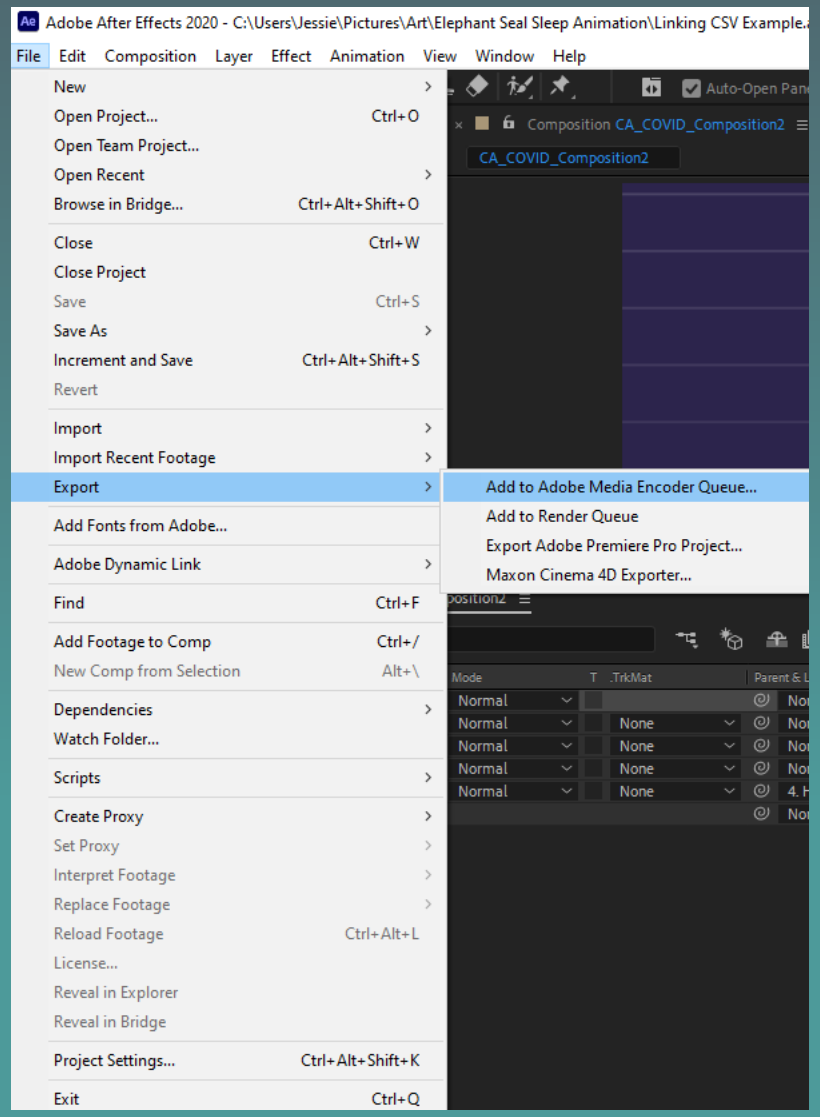
- Create text box "0" and left align paragraph text
- Ctrl + D to create a label for each gridline
- Change text for each layer

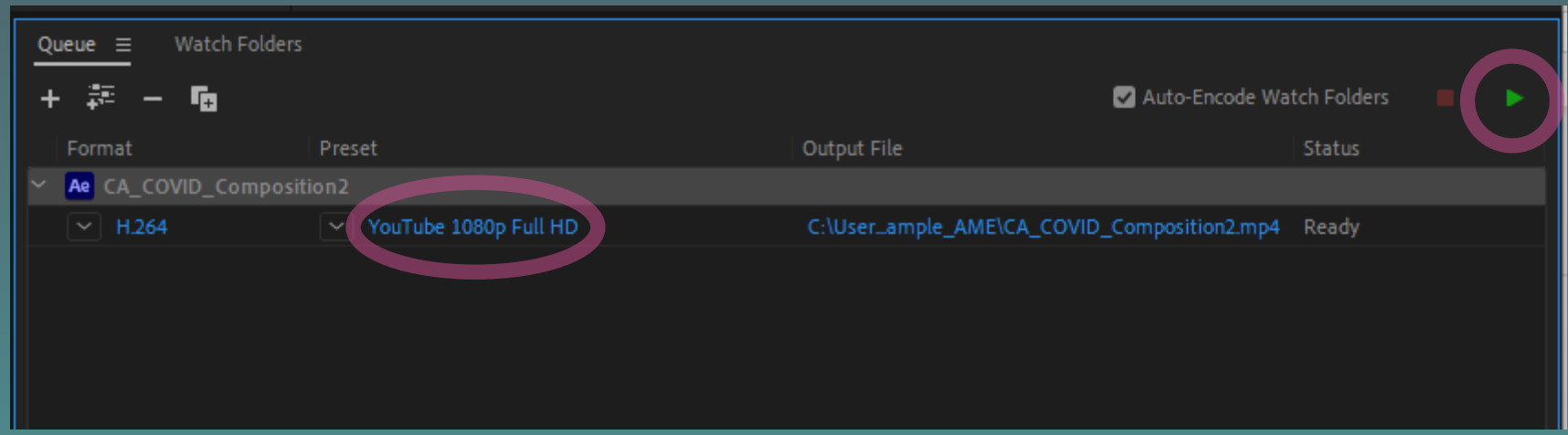
Changing position and scale

- You can also change the position and x-scale of the graph, so that you can zoom into the data as it changes over time.
- Be Creative! ☺



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".

Inspiration and guidance from a helfpul tutorial: https://www.youtube.com/watch?v=14N1JQr5RrU&t=49s

B R E A K

10 min – Return at 3:00 PM

PART 5

DEMO

Overview of 2D Animation Methods

Different ways to animate 2D data - 30 min

OVERVIEW

2D Data Animation Methods

- Geospatial data – ArcGIS animation : https://pro.arcgis.com/en/pro-app/2.8/help/mapping/animation/animation-how-to-videos.htm
- gganimate : https://www.datanovia.com/en/blog/gganimate-how-to-create-plots-with-beautiful-animation-in-r/

PART 6

WORK TIME

40 min – Stop & break at 5:20 PM

B R E A K

10 min – Return at 5:30 PM

HOMEWORK

Deliverables for Tomorrow

- Upload your 2D data scene to the shared Google Drive & Canvas and name it:

06_2D-Data_FirstName_LastName_SceneName.mp4

- 2D DATA ANIMATION RUBRIC:

Data Exploration	Data description (0.67)	Describe the columns in your dataset, what units they are in, and what type of data (categorical, continuous, etc.)
	Data animation priorities (0.67)	Prioritize which columns you want to include in your animation and in what form (line graph, text counter, etc)
	Pattern Finding (0.67)	Provide a screenshot of a conditionally-formatted data sheet in Excel to show the patterns in your data.
Data Animation	Completeness (3)	Applied techniques from tutorial to create an animated line chart and text counter with your data.
***Extra Credit**	*Try/make something new (1)	If you'd like to animate 2D data in another software (R, ArcGIS, etc), you can do this. Please provide a detailed step-by-step list of instructions for someone to follow in your footsteps.
***Extra Credit**	*Originality (1)	If your code or tool is brand new (you didn't follow a detailed step-by-step online tutorial), you get a bonus point!

DAY 6

GUEST SPEAKER

COVID Data Visualizations amidst a global pandemic

Katherine Vlamis

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