

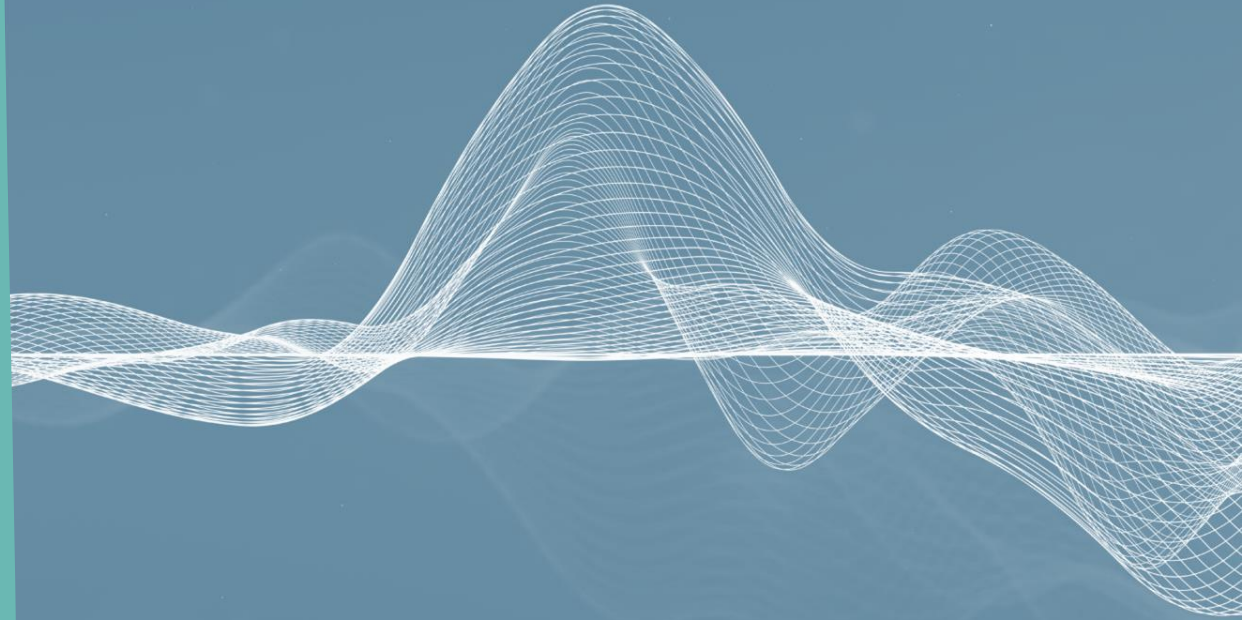
Data-Driven Animation

for Science
Communication

Jessica Kendall-Bar

July 18-29

CSUMB Summer of Science Illustration



OUTLINE

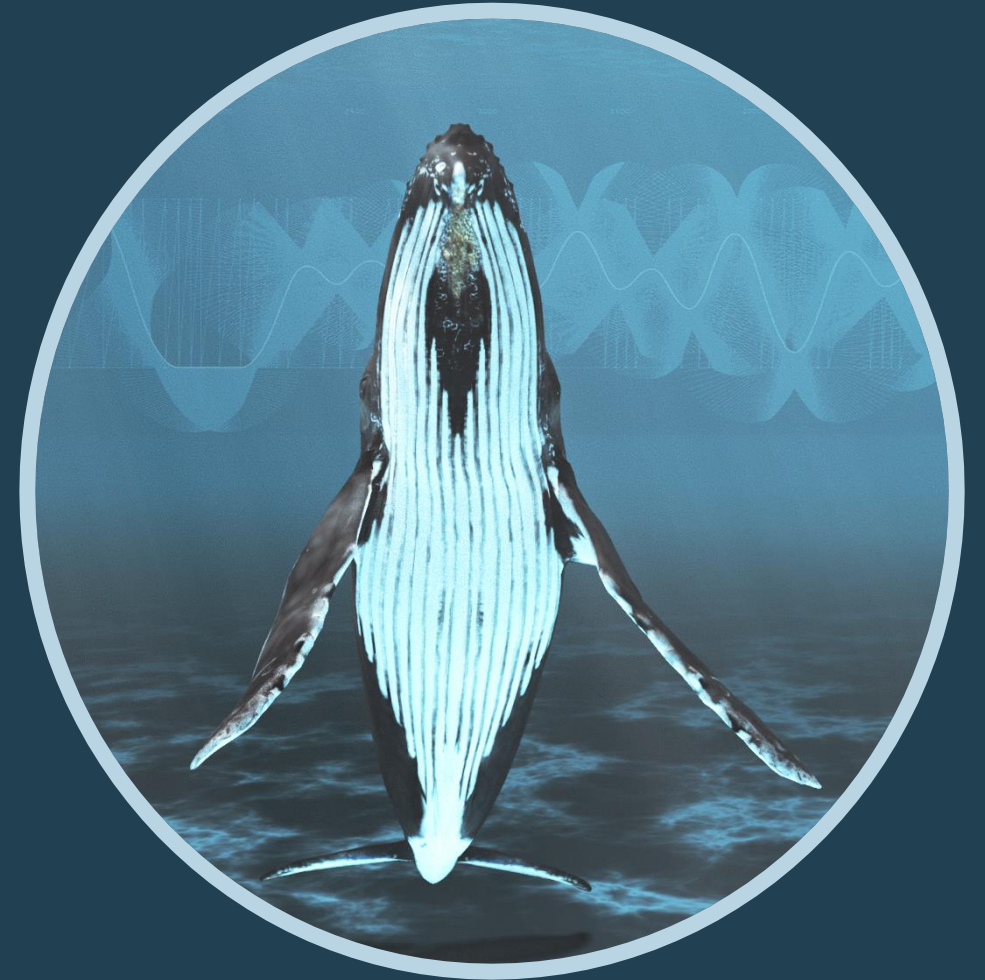
Course structure

	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	<i>Introductions & Collaboration</i>	<i>Conceptualization</i>	<i>Digital Art and Design</i>	<i>Data Visualization</i>	<i>Animation & Motion Graphics</i>	<i>Animating 2D Data</i>	<i>Intro to 3D Animation</i>	<i>Animating 3D Data</i>	<i>Editing & Compositing</i>	<i>Final Critique & Communication Strategy</i>
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	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 3

Digital Art & Design

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: Animatic Critique** - Watch animatics and discuss key assets (20 min)
- 2:20 - 2:50: Animatic Reflection** - Small group discussions & troubleshooting (30 min)
- 2:50 - 3:00: Break / Reflection** (10 min)
- 3:00 - 3:30: Lecture & Demo: Introduction to Digital Art / Vector Graphics** (30 min)
- 3:30 - 4:00: Work time - Vector Graphics** (30 min)
- 4:00 - 4:10: Break** (10 min)
- 4:10 - 4:40: Demo - Raster Graphics** (30 min)
- 4:40 - 5:20: Work time - Raster Graphics** (40 min)
- 5:20 - 5:30: Break** (10 min)
- 5:30 - 6:30: Guest speaker** - Alex Boersma - Science illustration and animation

DAY 3

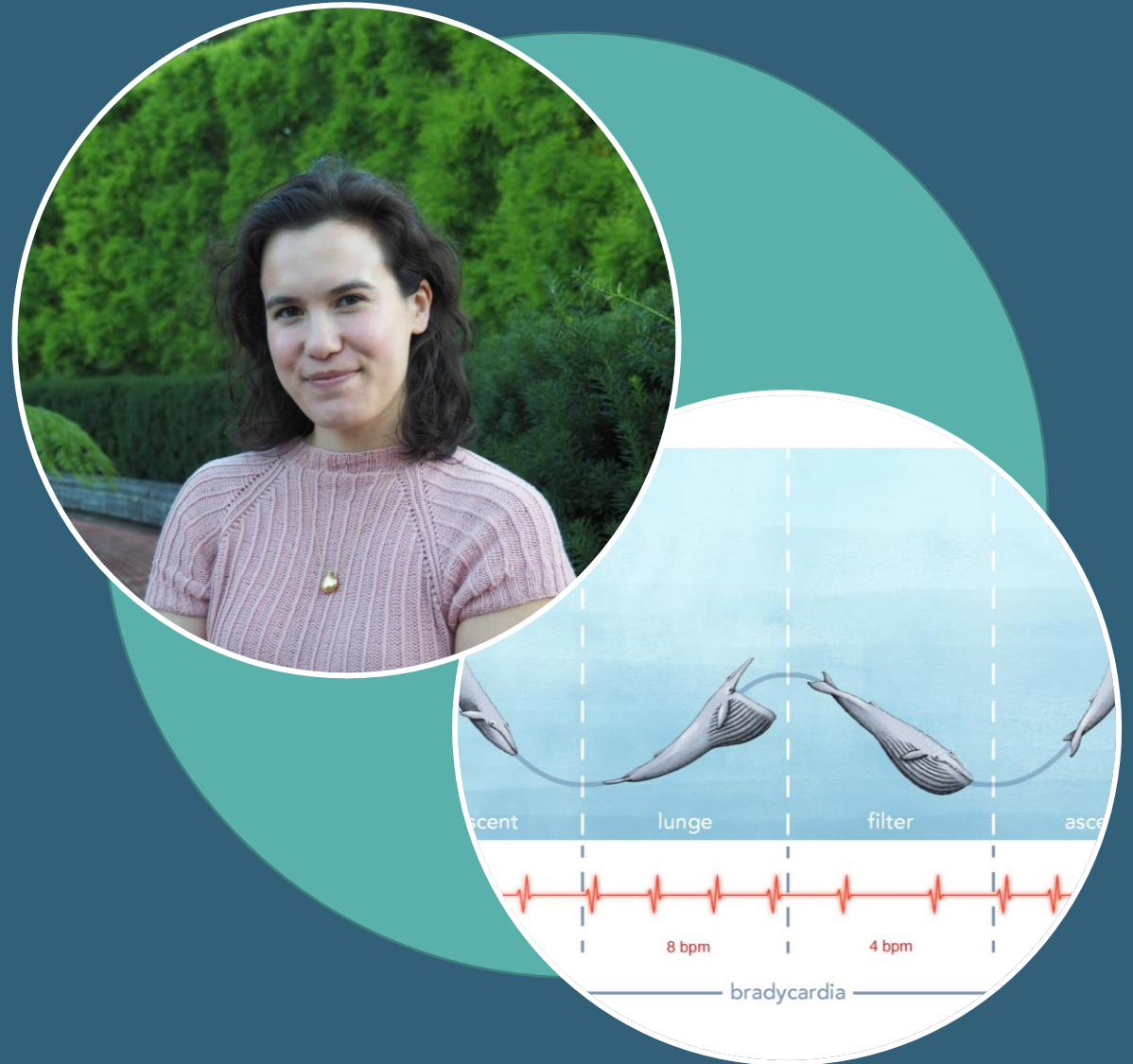
GUEST SPEAKER

Scientific illustration for high-impact science

Alex Boersma

Freelance Scientific Illustrator;
Alex Boersma Illustration

Contact: alexboersmaart@gmail.com



GOALS

Today's goals

- Review & revise animatic
- Refine list of key assets
- Assemble/create key assets (with Illustrator & Photoshop)

PART 2

OPENING ACTIVITY

Animatic Critique & Reflection

Watch, reflect, and discuss- 40 min



OPENING ACTIVITY

Animatic Reflection

- Review the rubric as you watch each other's animatics. We will compile a list of things that were successful. What were some things that you struggled with while making your animatic? How did you decide to prioritize what key assets you will need?
- While you watch the animatics:
 - What were some things that you enjoyed in the animatics?
 - What were some things that you think could be improved?

OPENING ACTIVITY

Animatic Discussion & Revision

- Small group discussions & troubleshooting
- Review:
 - What were some things that you enjoyed in the animatics?
 - What were some things that you think could be improved?
- Revise & edit:
 - Which of your key assets will you absolutely need (high priority)?
 - Are there assets on your list that would help the story, but are not critical (low priority)?
 - Are there assets that are missing but would help (or be critical to) the story?

B R E A K

10 min - Return at 3:00 PM



PART 3

LECTURE & DEMO

Illustrator - Vector Graphics

Create an outline of your study
organism - 20 min



“Rasterizing”

VECTOR v. RASTER ARTWORK

RASTER GRAPHIC

- Composed of pixels.
- Draw curves only by pixel approximation.
- Enlarging causes loss of resolution.
- Can “paint” gradients and smooth blending.

Programs: Adobe Photoshop (expensive), Procreate (\$10, Apple only), GIMP (free)

File types: .jpg, .tif, .png*

.png's are ideal for Powerpoint because they can be compressed for web and they can have a transparent background

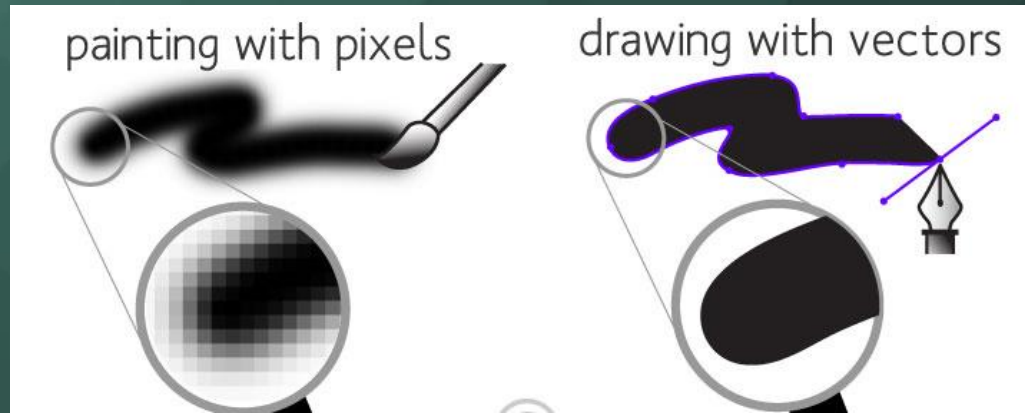
VECTOR GRAPHIC

- Composed of mathematical paths.
- Continuous and smooth lines.
- Enlarging **does not** cause loss of resolution.
- Usually have sharp, graphic look with crisp lines.

Programs: Adobe Illustrator (expensive), Inkscape (free)

File types: .svg*, .emf*, .pdf*, .eps

“Image Trace”

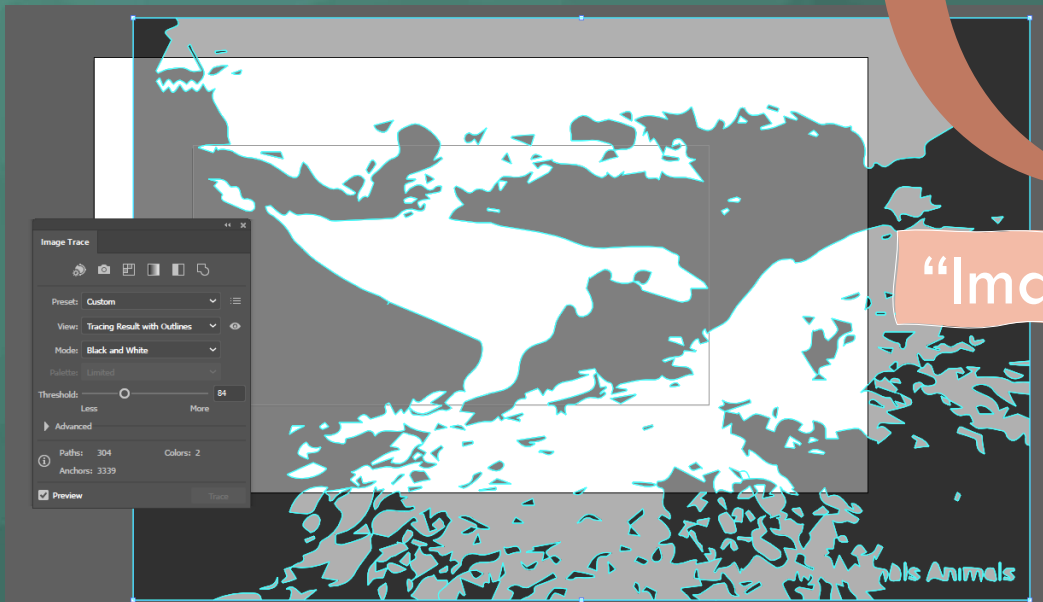


VECTOR v. RASTER ARTWORK

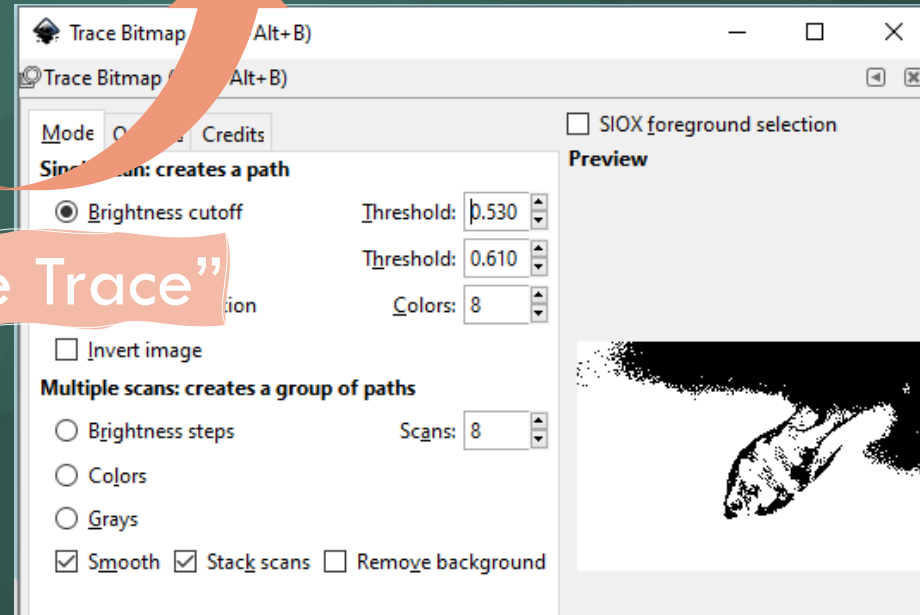
“Rasterizing”

RASTER GRAPHIC

VECTOR GRAPHIC



“Image Trace”



Illustrator: Object > Image Trace

Inkscape: Path > Trace Bitmap

DIGITAL ART

SHORTCUTS:

- ORGANIZATION IS KEY!
 - Create many versions (save often!) and layers with meaningful filenames.
- Make use of layers/Selection Pane to organize elements.
- Use guidelines, align, and distribute! Hold down shift to snap to regular positions.
- Duplicate objects to speed up the process of aligning (hold down Ctrl + Shift and drag your new object to its new location)

	ILLUSTRATOR	INKSCAPE	POWERPOINT
Paste in place	Ctrl + F	Ctrl + alt + V	default if in new slide or if original object is moved.
Zoom in/out	Ctrl + "+" or "-"	"+" or "-"	Ctrl + scroll up / down
Move canvas	Spacebar + click & drag	Spacebar	Scroll.
Duplicate	Hold Alt + drag (hold Shift down as well to keep aligned)	Ctrl + D duplicates the object in the same location as the initial object.	Hold Ctrl + drag (hold Shift down as well to keep aligned)
Resize with locked proportions	hold Shift while dragging	hold Ctrl while dragging	hold Shift while dragging
Rotate	Hover outside object while selected to see rotation icon	Click once, then twice on object to show rotation handles	Rotate with rotation icon above object when selected
Reflect	Object> Transform> Reflect	H for horizontal reflection or V for vertical reflection	Arrange> Rotate> Flip Horiz/Vertical
Edit points of path/object	Use direct selection (V) tool to select path segments or points	Double click on object to enter "Edit Path by Nodes" where you can select path segments or points	Right click line or path and select "Edit Points"

SOFTWARE & WORKFLOW

RASTER GRAPHIC



Photoshop



Procreate



GIMP

VECTOR GRAPHIC



Illustrator



Inkscape

COMPOSITING



Using
Creative
Cloud
Libraries

Illustrator

Basics of creating vector graphics

ILLUSTRATOR: TOOLS TO KNOW

1. Selection (and Direct Selection) Tools
2. Artboard tool
3. Pen tool
4. Pencil tool
5. Eyedropper tool
6. Layers/Paste in Place
7. Grouping
8. Clipping Masks

USES OF ILLUSTRATOR

VECTOR GRAPHICS

Outline your study organisms to create flexible, custom vector graphics for use across platforms.

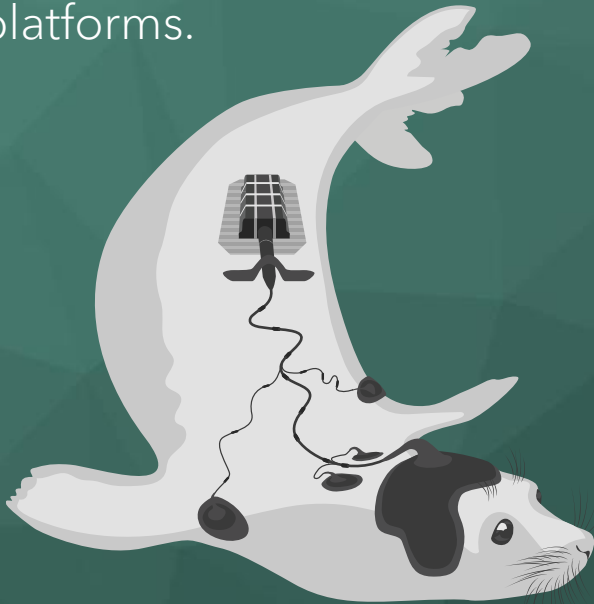
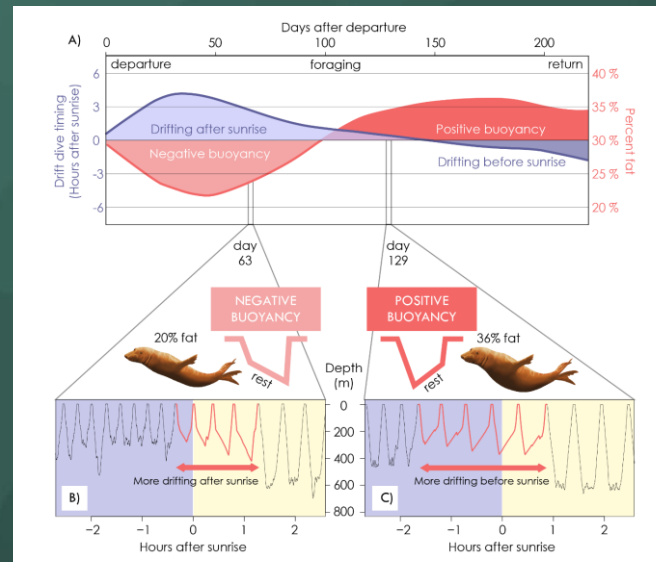


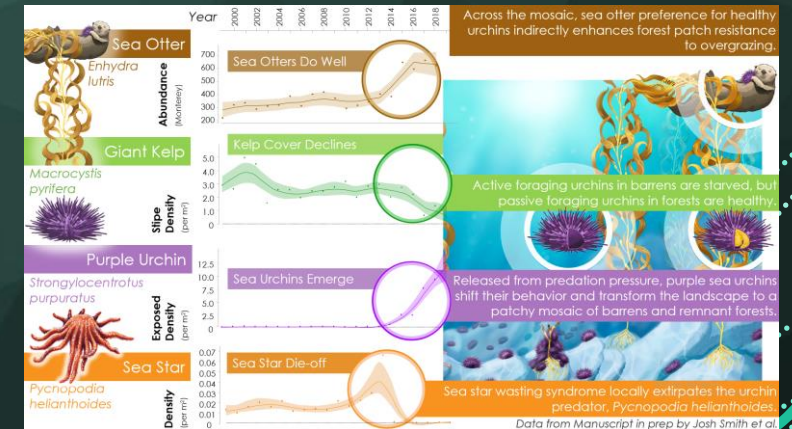
FIGURE EDITING

Create visually appealing figure layouts and which adhere to figure submission guidelines.



COMPOSITING

Combine your raster and vector graphics into one cohesive figure.



CUSTOM VECTOR GRAPHICS

KEY TOOLS:

1. Selection tool (and Direct Selection)
2. Pen tool
3. Pencil tool
4. Blob Brush
5. Fill & Stroke
6. Stroke Profile

KEY STEPS:

1. Find reference image
2. Create outline using the pen tool
3. Add fill & stroke
4. Add details
5. Apply stroke profiles to details & export.

1) FIND REFERENCE IMAGE

OUTLINING YOUR STUDY ORGANISM

- Put your reference photo into Illustrator by dragging & dropping or Importing it.
- Also drag this reference image into your CC Library and name it.



2) CREATE OUTLINE

OUTLINING YOUR STUDY ORGANISM

- Use pen tool / Bezier tool (Shift + F6) to draw your outline like is shown to the right. Create a CLOSED loop outline, starting and ending on the same point.
- Have patience.



PEN TOOL CHEAT SHEET

See our "Helpful Links" page for more resources.



Pen Tool cheat-sheet (Photoshop, Illustrator, InDesign)



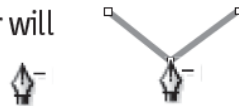
Click to create points, each point will create a **straight** connecting line.



Click and **PULL** to create points with (bezier) **handles** that will form **curved** lines.



With the pen tool, hover over an **existing point** and the cursor will *automatically* change to the **DELETE Anchor Point Tool**.



With the pen tool, hover over an **existing line segment** and the cursor will *automatically* change to the **ADD Anchor Point Tool**.



To **select and move a point**, hold down the **CONTROL** key (and the pen tool will change to the **DIRECT SELECTION Tool**).



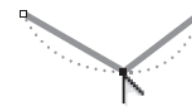
To **MAKE handles** from a point that has none, hold down the **ALT** key; the pen tool will change to the **CONVERT Anchor Tool**. Click on the point and pull.



To **select and move a handle**, hold down the **CONTROL** key and the pen tool will change to the **DIRECT SELECTION Tool**. Click on the handle and pull or rotate.



To **REMOVE** handles from a point, hold down the **ALT** key; the pen tool will change to the **CONVERT Anchor Tool**. Click on the point, the handles go away.



Here are some helpful & condensed tips for using the pen tool in illustrator, but you also just need to ***practice!***

For free weekly tips for Mac-based designers, check out creativetechs.com/tips

PEN, PENCIL, AND BLOB BRUSH TOOL

PEN TOOL

A bit frustrating at first but very useful for smooth curves with few anchor points. Use for outlining body shape, symmetrical logos, etc.



It's tempting to want to start out with the pencil tool right away, but please learn this!

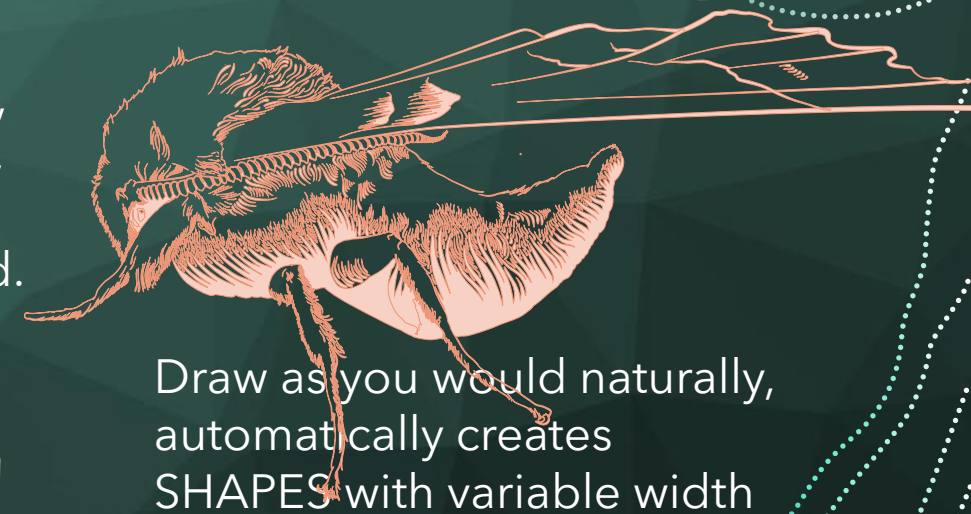
PENCIL TOOL

Draw as you would naturally, automatically creates a path, but often creates more anchor points than you need.



Can edit by revisiting subsections of your path with the pencil tool, but many points make it harder to edit after the fact with the direct selection tool.

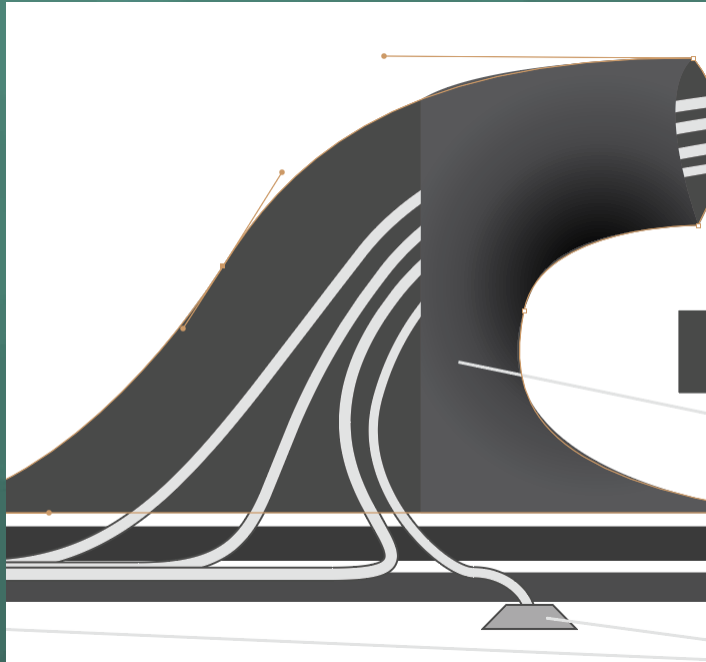
BLOB BRUSH



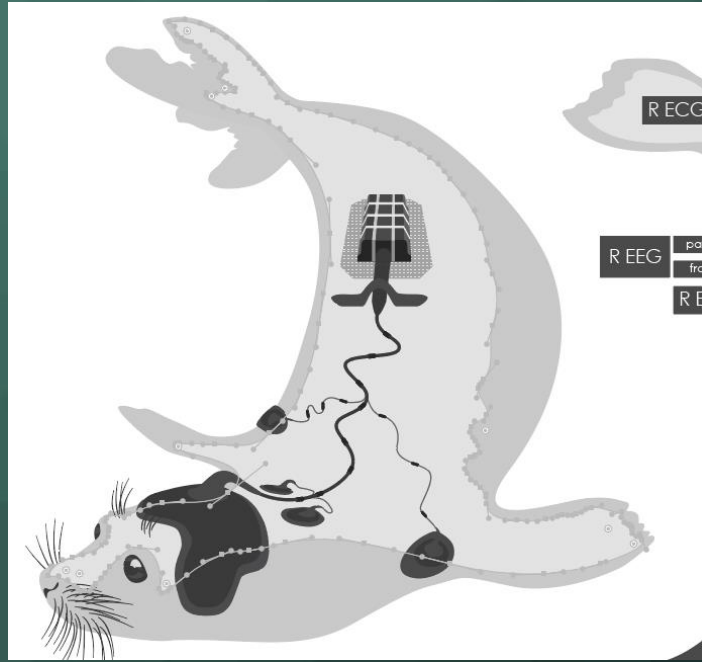
Draw as you would naturally, automatically creates SHAPES with variable width (with a fill and a stroke, unlike a path which only has a stroke). Very hard to edit after the fact.

PEN, PENCIL, AND BLOB BRUSH TOOL

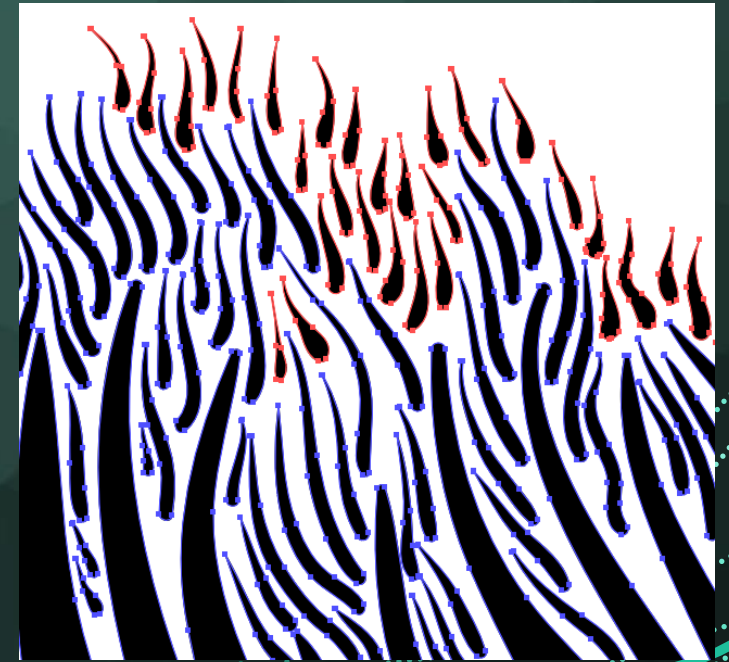
PEN TOOL



PENCIL TOOL



BLOB BRUSH

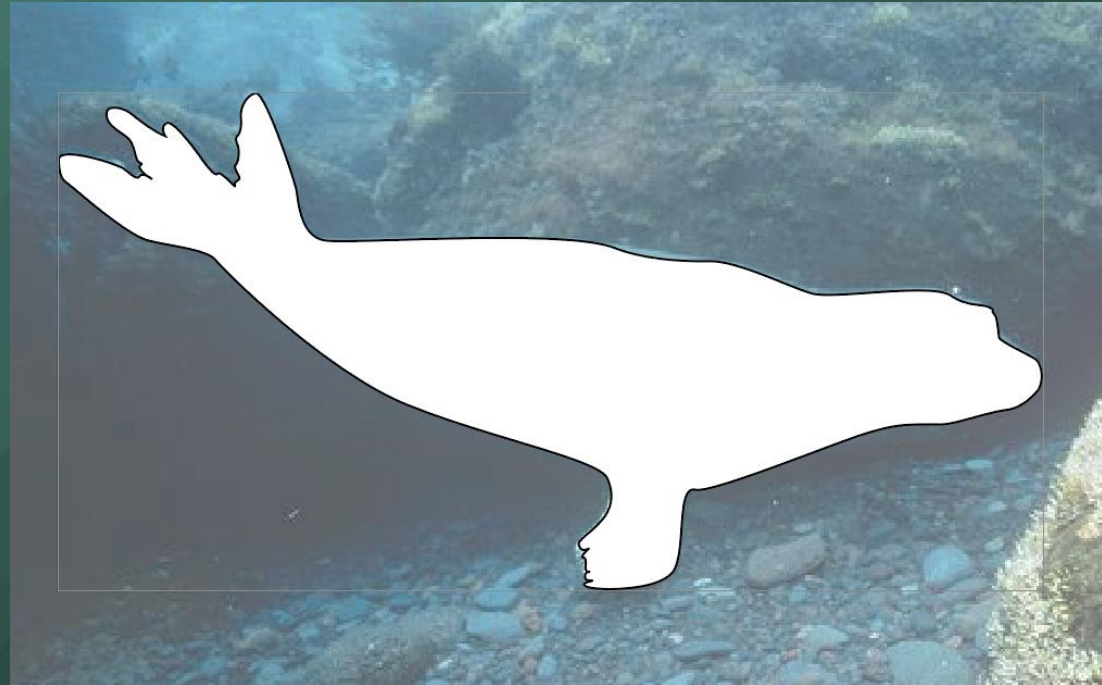


3) ADD A FILL & STROKE

OUTLINING YOUR STUDY ORGANISM

- Add a white fill to your outline, and a thin black stroke, so that it pops out from your reference photo.

You can do this in the Fill/Stroke panels in Illustrator and Inkscape and in "Shape Outline" and "Shape Fill" in PowerPoint.



4) ADD DETAILS

OUTLINING YOUR STUDY ORGANISM

- Add lines to make the body outline more meaningful and detailed.

In Inkscape: Select the Pen/Bezier tool and select "Triangle In" to create a triangle stroke effect along your path (a tapered line).

In Illustrator, you can create the lines in the pen tool and flexibly change the stroke effect afterwards by changing the "Profile" of your stroke in the Stroke effects panel.



5) FINISH UP

OUTLINING YOUR STUDY ORGANISM

- Next, add in any other details to your study organism using these same methods.
Make sure to start a new layer each time you add something new.
- Drag your finished graphic into your CC Library & name it.

Then, digitally paint it in!
See next slides...



RASTER



Jamie Kendrick

VECTOR



Digitized in Illustrator using pen tool and brush

PART 4

WORK TIME

30 min - Stop & break at 4:00 PM



B R E A K

10 min - Return at 3:00 PM



PART 5

DEMO

Photoshop - Raster Graphics

Create a digital painting in Photoshop -
20 min



Photoshop

Basics of digital painting



PHOTOSHOP: TOOLS TO KNOW

1. Brush tool
2. Layers
3. Adjustment Layers
4. Blending Modes
5. Clipping Masks

1) FIND & IMPORT REFERENCE IMAGE

PAINTING YOUR STUDY ORGANISM

- Put your reference photo into Photoshop by dragging & dropping from your CC Library or Importing it.



2) CREATE CLIPPING MASK

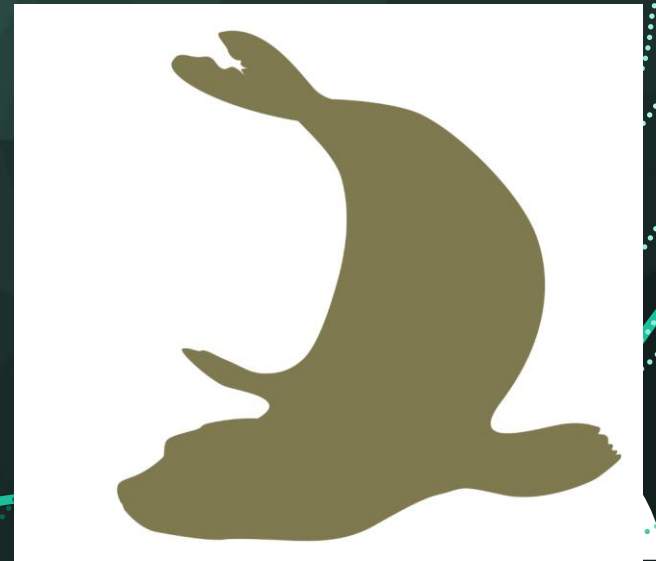
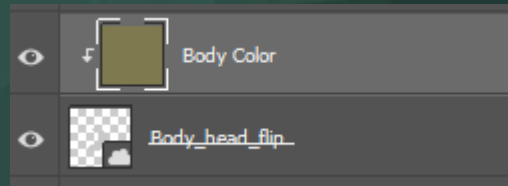
PAINTING YOUR STUDY ORGANISM

- Import your vector graphic by dragging & dropping from CC libraries.
- Make a separate layer above your vector graphic and create a clipping mask by holding ALT and clicking between the two layers.

This makes it so that in that layer, you can only color within the lines.

- Then fill that layer with a color to use as the body color of your study organism.

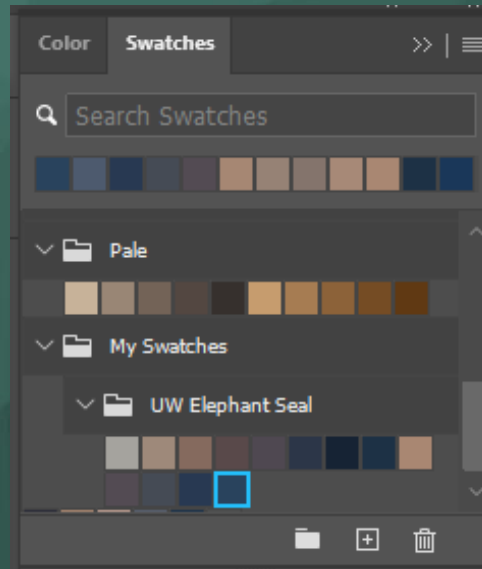
Cool trick! try going back to Illustrator, opening up your linked graphic and changing the outline, your clipping mask should change automatically when you save.



3) PICK SOME COLORS

PAINTING YOUR STUDY ORGANISM

- Insert your reference photo and make swatches of the colors you see (lightest highlights, midtones, and shadows of each color). These swatches will automatically be saved to your CC Library.



4) AIRBRUSH SHADOWS AND HIGHLIGHTS

PAINTING YOUR STUDY ORGANISM

- Give your painting some depth by adding highlights and shadows with a large (500px), soft (hardness 0%) round brush on a separate layer.
- When you are happy with the overall shading, you can add another layer and make your brush smaller to add more detail.
- Try to stick to the same soft airbrush for this entire process.



5) ADD DETAILS

PAINTING YOUR STUDY ORGANISM

- Either use other vector graphics as clipping masks for details or you can draw them yourself



Color adjustments
and adding
details with
pressure-sensitive
stylus, etc.



6) COMPOSITING IN PHOTOSHOP

PAINTING YOUR STUDY ORGANISM

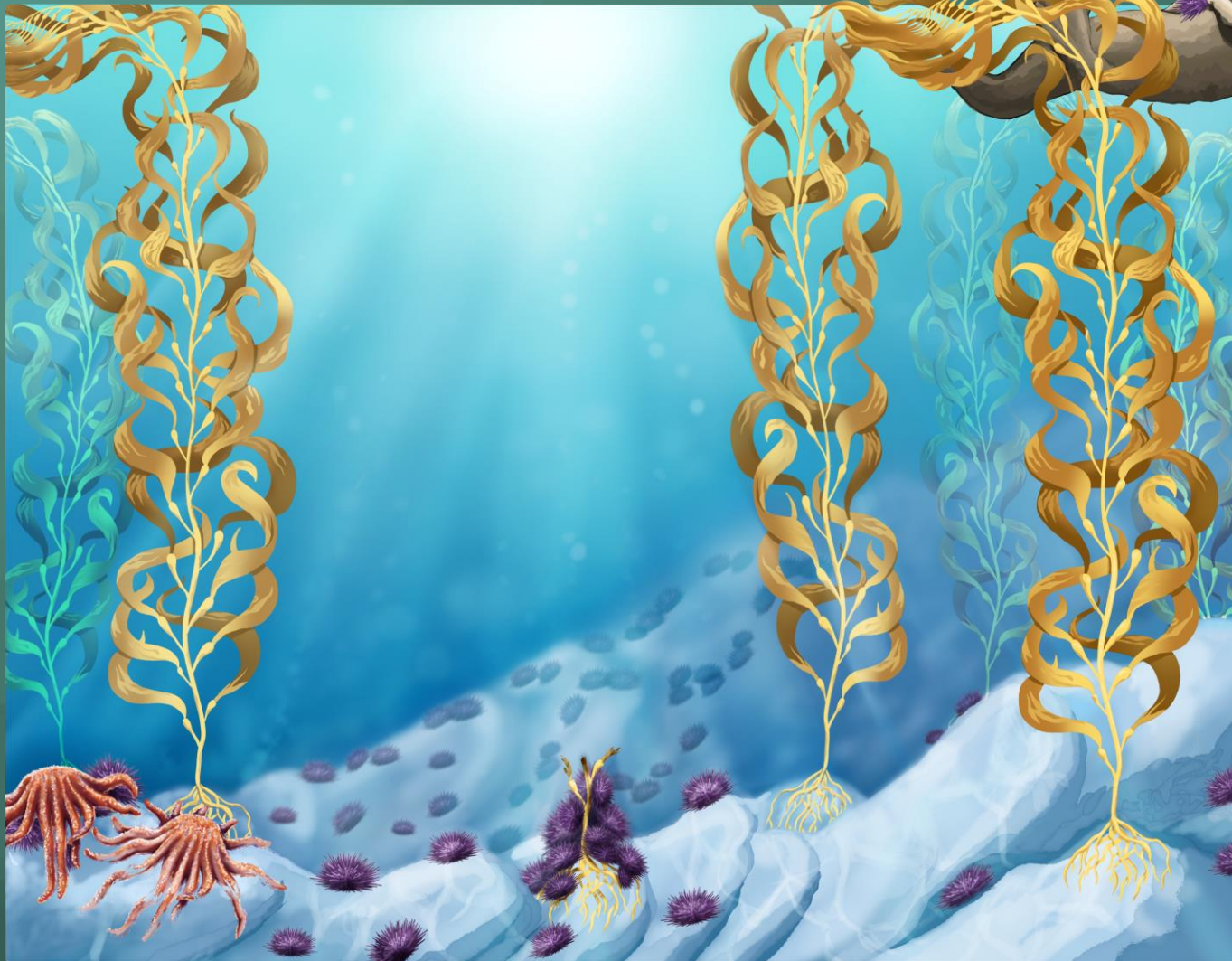
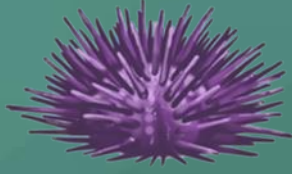
- Use the gradient tool or a solid color to make a background
- Add details as necessary to fill in the scenes
- Add layers for shadows and highlights and use blending modes

Compositing tips:

- When painting backgrounds, the foreground has higher contrast and brighter colors.
- When creating watercolor or artistic effects, it helps to add "glow" around your objects.



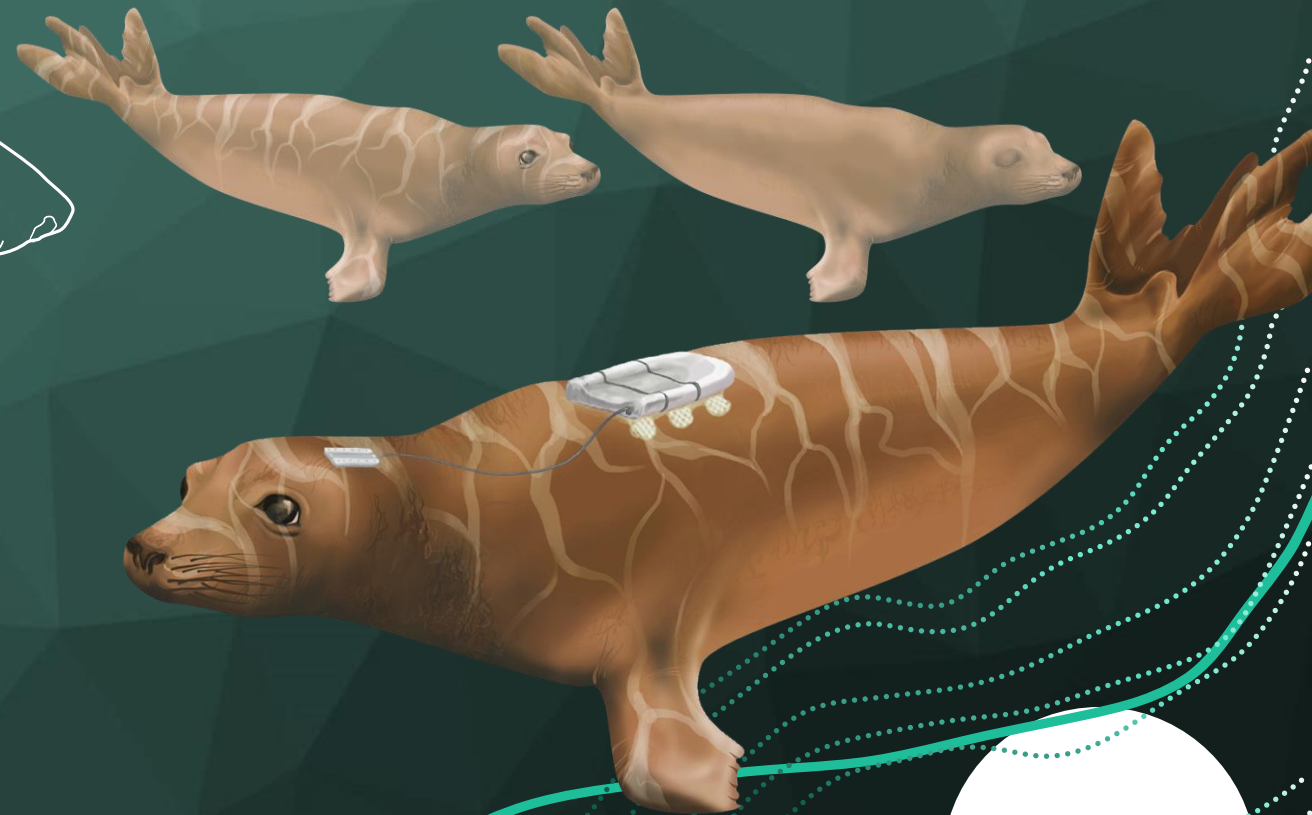
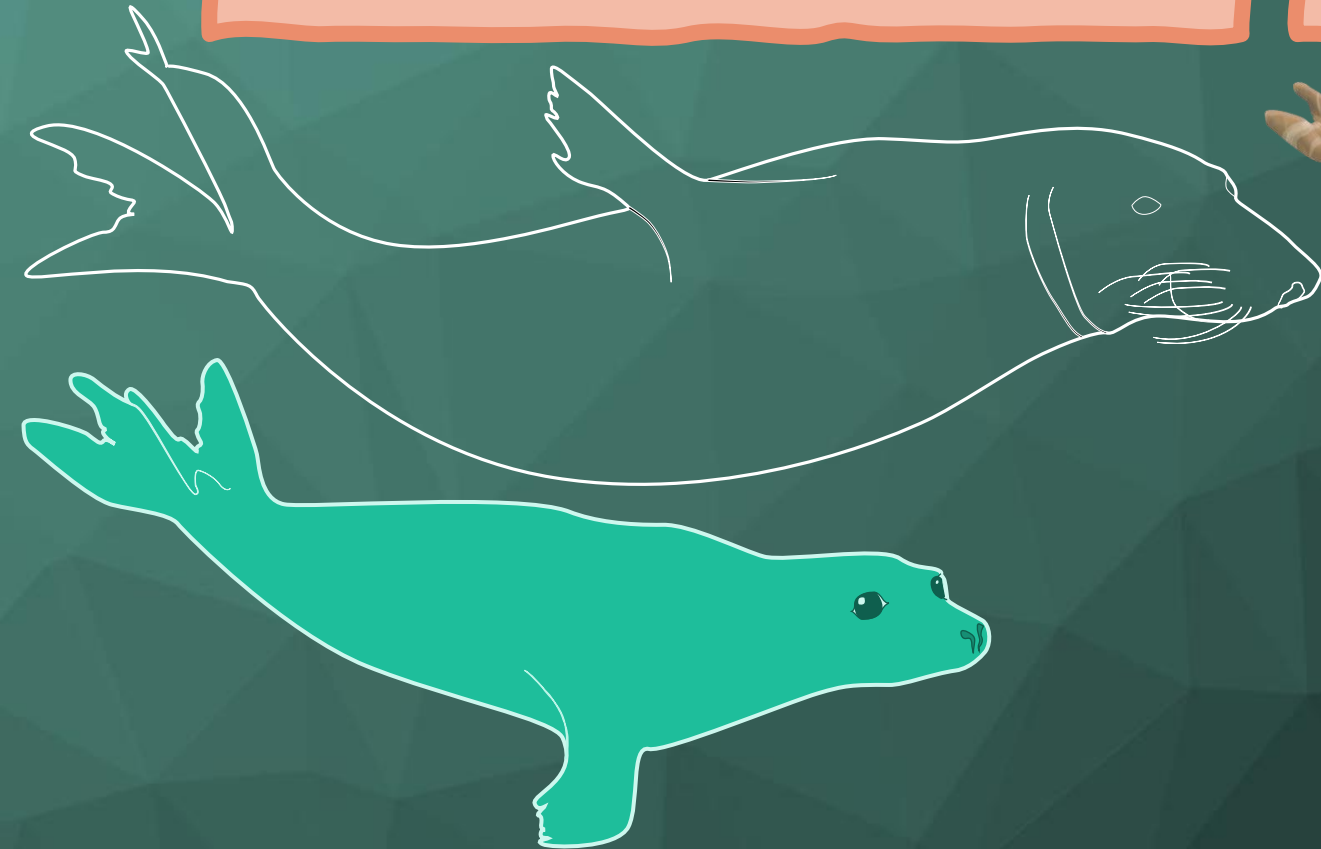
EXAMPLE



Uniting raster & vector graphics

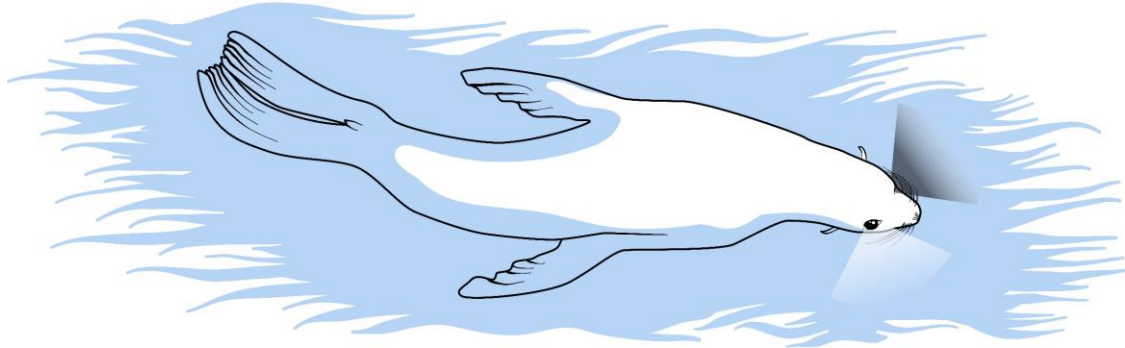
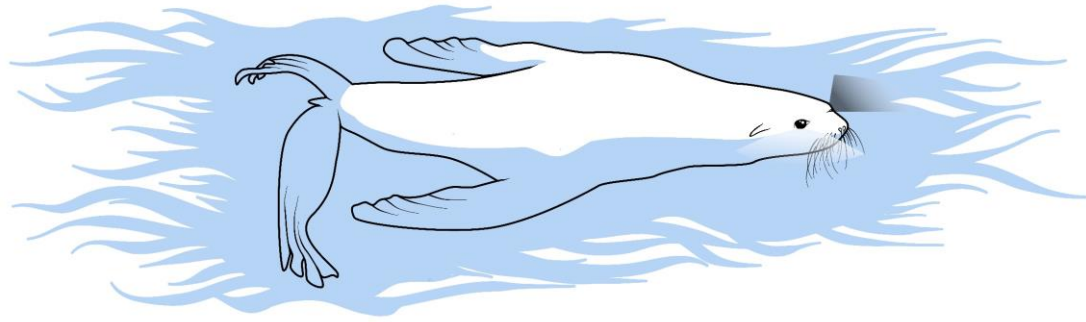
VECTOR

RASTER





Made in Illustrator using pen tool and blob brush.

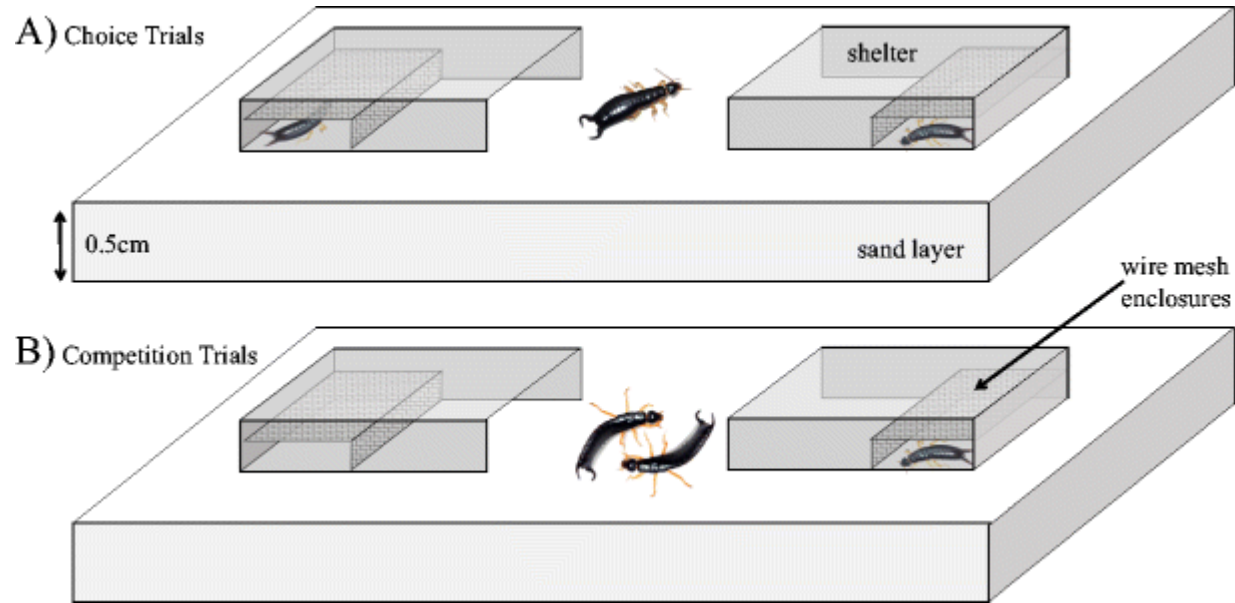


Demonstrating observations

Kendall-Bar JM, Vyssotski AL, Mukhametov LM, Siegel JM, Lyamin OI (2019) Eye state asymmetry during aquatic unihemispheric slow wave sleep in northern fur seals (*Callorhinus ursinus*). PLOS ONE 14(5): e0217025. <https://doi.org/10.1371/journal.pone.0217025>

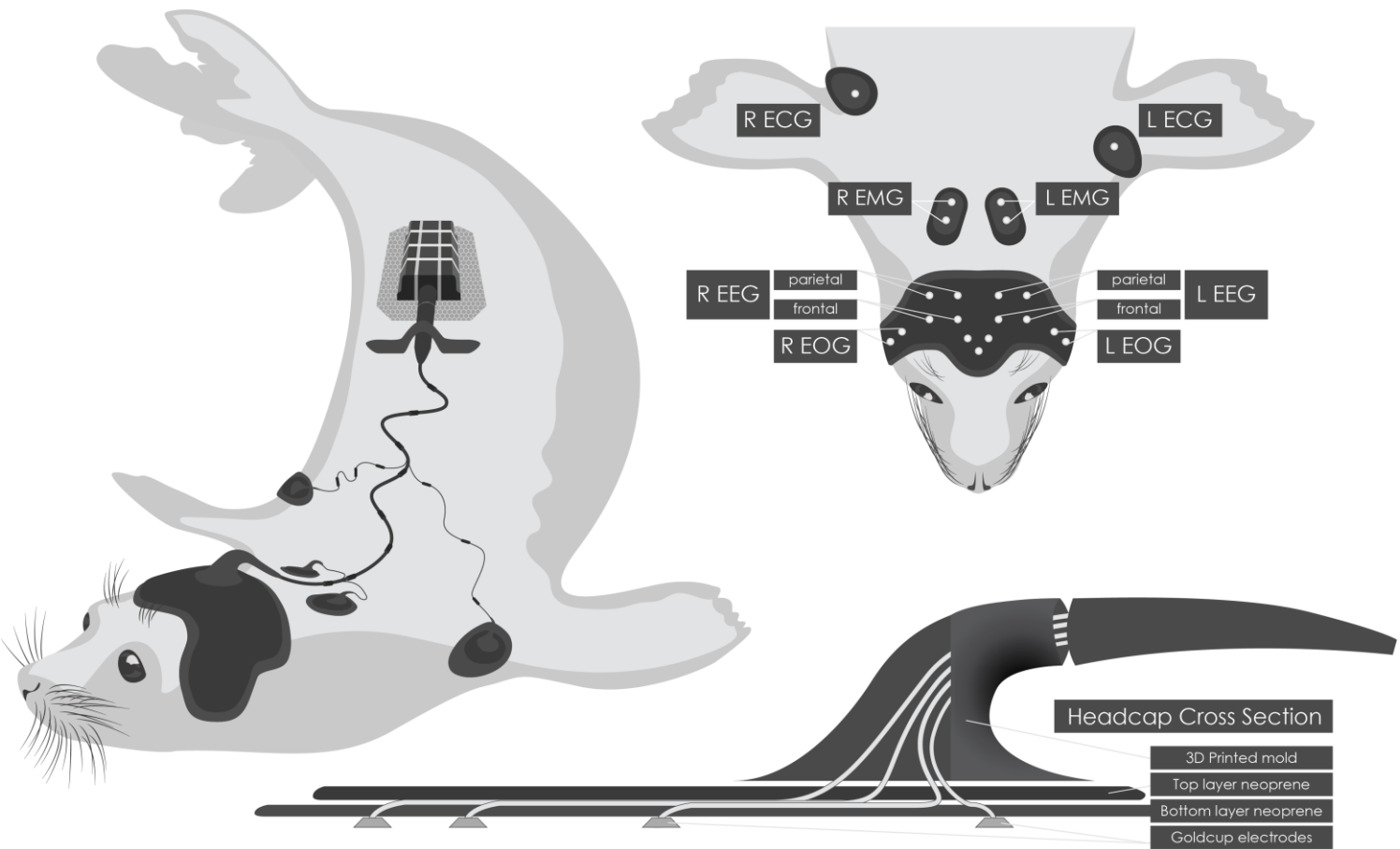
Earwigs: photos with backgrounds removed in Photoshop

Mating setup diagram: PowerPoint



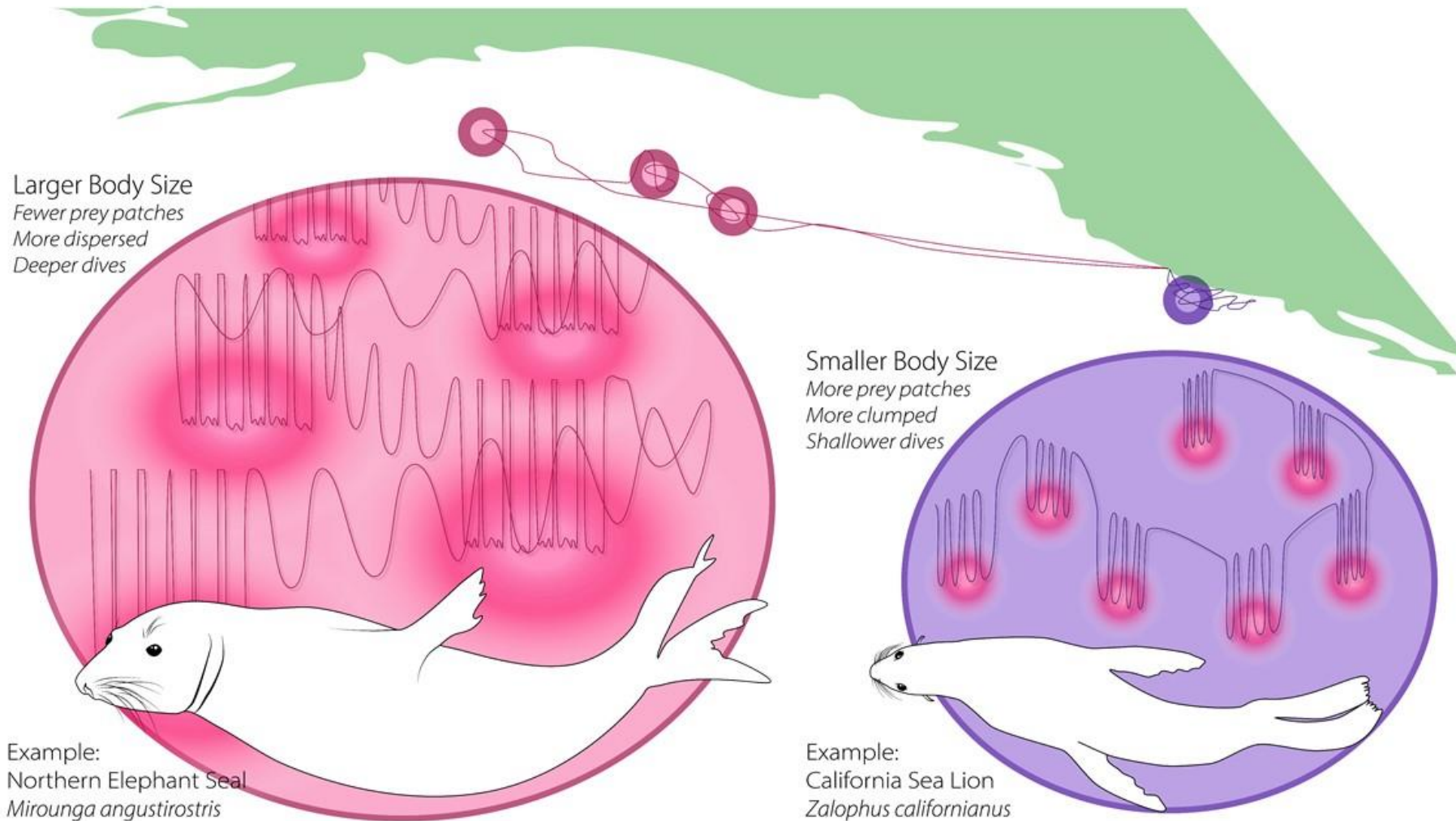
Demonstrating
experimental
design

Kendall-Bar, J.M., Iyengar, V.K. Sexual selection by the seashore: the roles of body size and weaponry in mate choice and competition in the maritime earwig (*Anisolabis maritima*). *Behav Ecol Sociobiol* 71, 8 (2017).
<https://doi.org/10.1007/s00265-016-2233-9>



Demonstrating methodology

Demonstrating differences between species



Tracking data:
Google Earth

Organism vector
graphics: Illustrator

Final Composition:
Illustrator

FALL October-December

JUVENILE HAULOUT Juveniles & Subadult Males



Post-Molt FORAGING TRIP



SEA LION TAKEOVER Most elephant seals gone

SUMMER July-September

Graphics by Jessica Kendall-Bar.
Drone photos taken by Patrick Robinson
under NMFS permit 19108 and MBNMS-2017-018
and stitched by Sarah Wood and Roxanne
Beitran. We thank Steve & Phyllis Sooy for their
generous contributions to elephant seal research.
We thank the Costa Lab, past and present,
for their contributions to this effort:

REFERENCES: Costa, D. P. et al. *J. Zool.* 209, 21-30 (1984). McDonald, S. L. & Crocker, D. E. *Physiol. Biochem. Zool.* 79, 484-494 (2006). Robinson, P. W. et al. *PLoS One* 7, (2012). Goetsch, C. et al. *Front. Mar. Sci.* 5, 1-19 (2018). Ellis, S. S. (University of California Santa Cruz, 2019).

A year in the life of Phyllis... AN ADULT FEMALE NORTHERN ELEPHANT SEAL

What's in a name?

Phyllis migrates for 7 MONTHS, over 10,000 kilometers, swimming halfway to Japan and back to feed on abundant fish and squid in the open ocean. Phyllis was a real seal we tracked, who was named after a beloved Año Nuevo docent and philanthropist. The seal named Phyllis set a record by traveling farther west than any other tracked elephant seal.

Phyllis' diet:



Males vs. Females

The foraging patterns of females and males differ greatly, with males typically foraging along the continental shelf and females staying farther offshore.



560 kilograms!



1 Phyllis returns home from a 7-month trip to sea.

2 Phyllis gives birth to a 35 kg pup.

3 Phyllis feeds her pup 52% fat milk for 26 days.

4 Phyllis leaves to forage for food at sea.

5 Phyllis travels >5,000 km, diving to depths >800 m for >20 min each time.

75 days

400 kilograms

6 Phyllis returns to molt on land.

7 It takes about 10 days for Phyllis to abruptly molt her skin and fur.



280 kilograms!

8 After 6 weeks on land and losing over 100 kg, Phyllis returns to the sea.

WINTER January-March

BREEDING SEASON ADULTS & PUPS



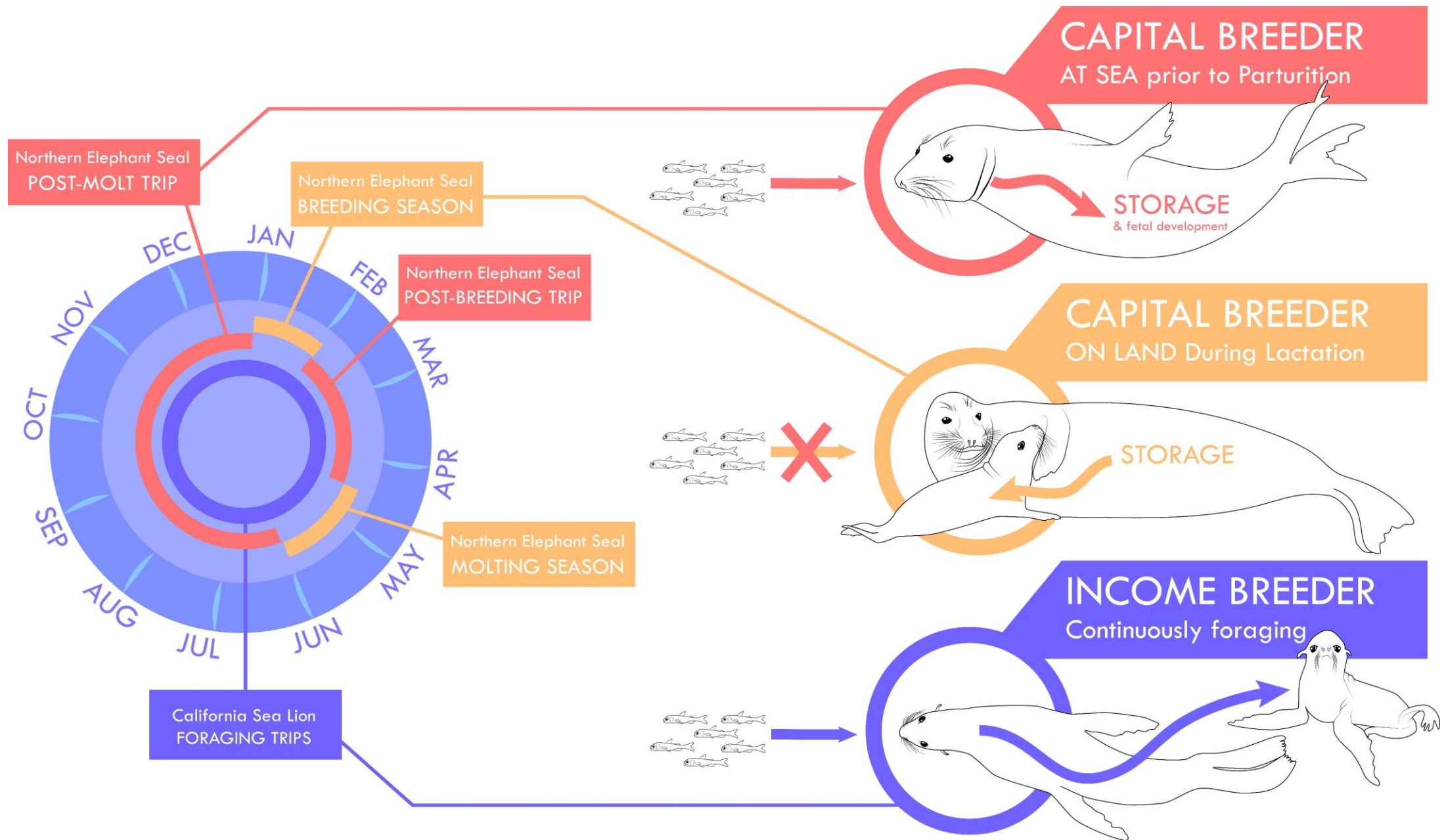
Can you spot the lightkeeper's house in all the photos? Follow shifts in beach morphology, animal abundance, and distribution across the seasons of Año Nuevo Island.

Post-Breeding FORAGING TRIP



MOLTING SEASON ADULTS & JUVENILES

SPRING April-June



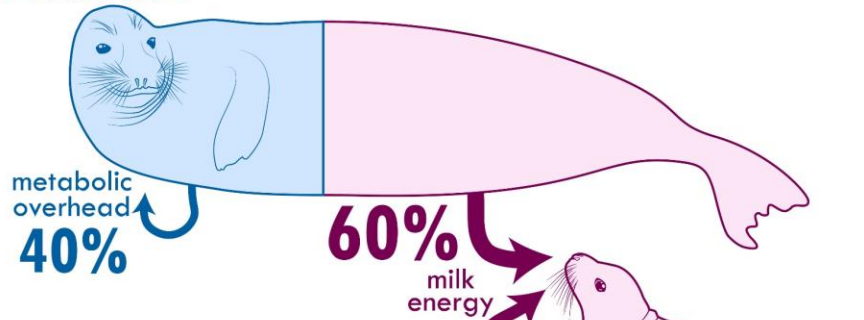
MATERNAL
MASS

&

LACTATION
DURATION

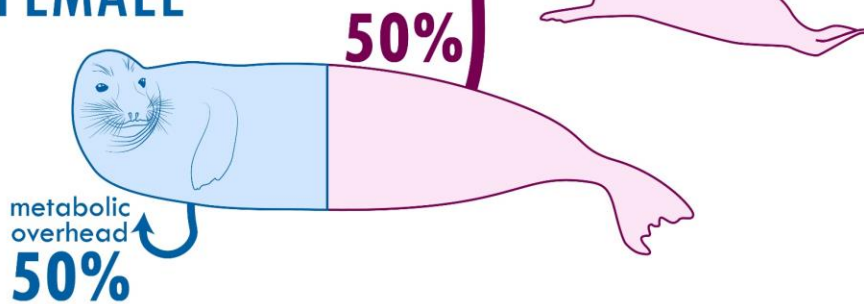
LARGE FEMALE

500kg



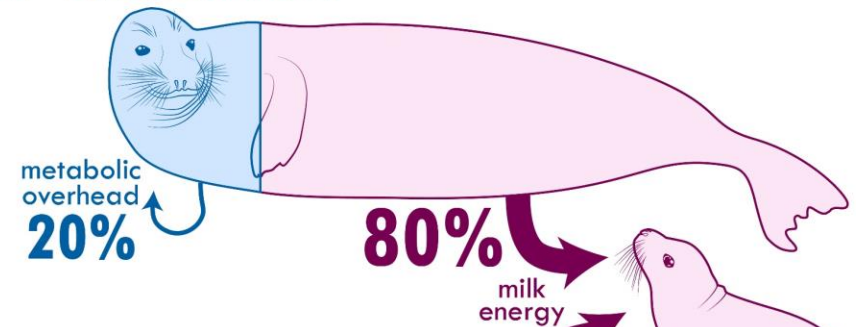
SMALL FEMALE

200kg



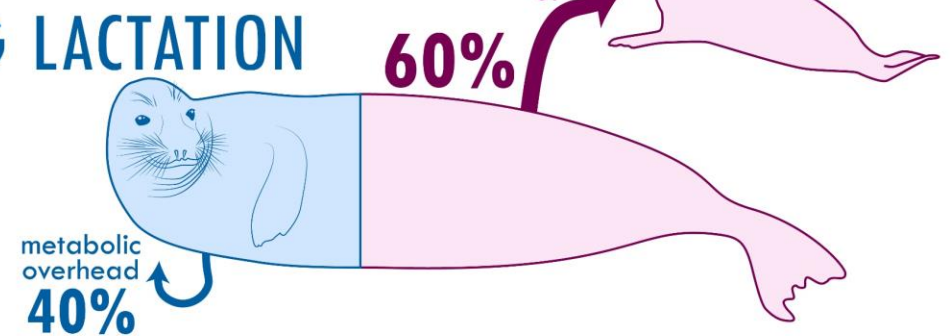
SHORT LACTATION

15
DAYS

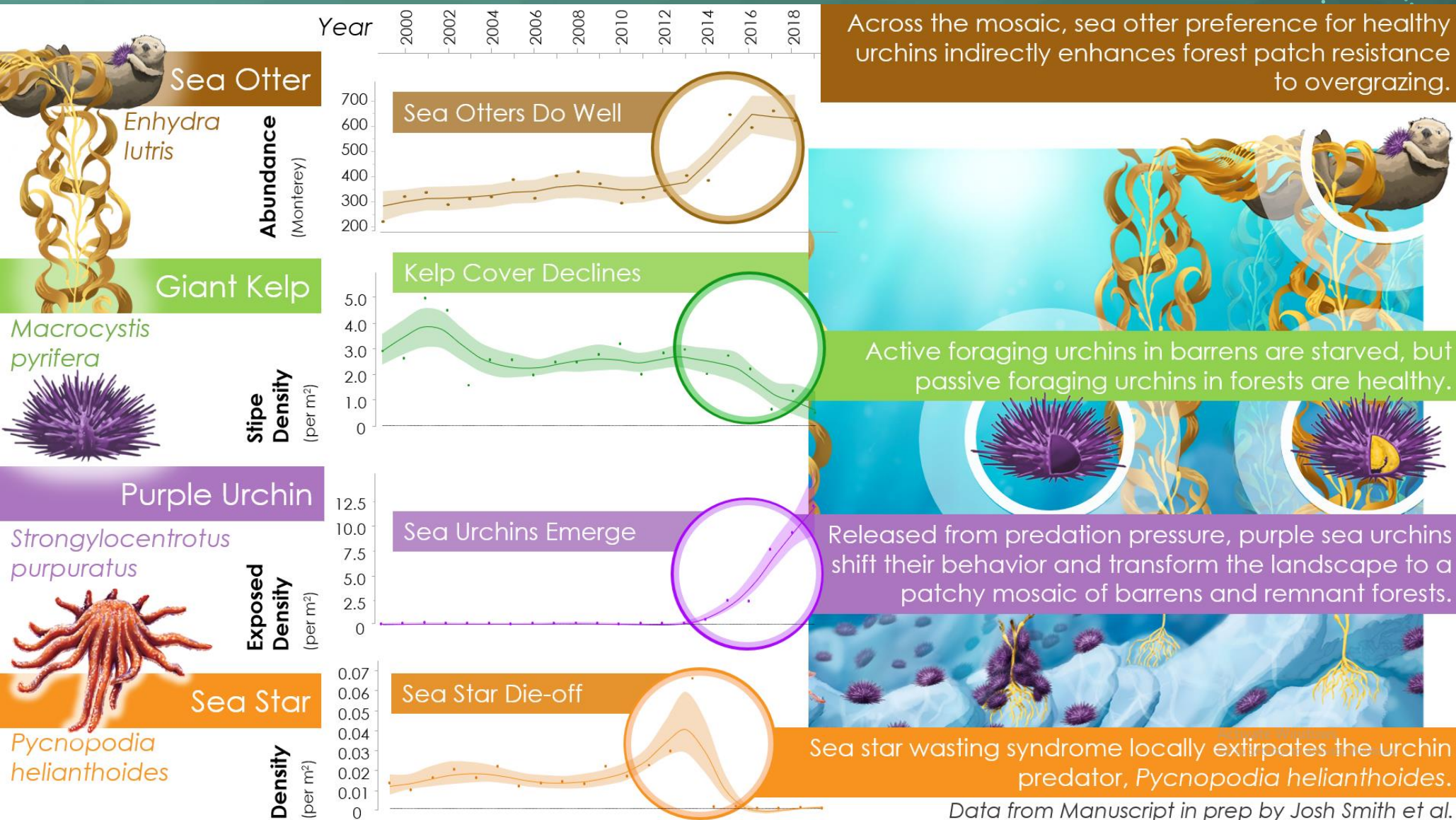


LONG LACTATION

30
DAYS



Demonstrating ecosystem dynamics across time.



Organism rasters:
Procreate & Photoshop
for iPad

**Kelp Forest
Composition:**
Photoshop for desktop

Figures:
made in JMP,
exported to .PDF, text
and line colors and
styles edited in
Illustrator

Final Composition:
Illustrator

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 key assets to the shared Google Drive & Canvas and name them:

- 03_Asset01_FirstName_LastName_AssetName.jpg

KEY ASSET RUBRIC

Vector Graphic	Completeness/Format (0.6)	Vector graphic is provided in .ai, .pdf, .eps, or .svg format and paths/curves are editable in Illustrator.
	Organization (0.6)	Provide a screenshot of your layer organization and explain your strategy and any challenges you faced.
	Effort/Technique (0.6)	Demonstrates use of at least 3 techniques provided in the digital painting demo.
	Output quality (0.6)	Outline is a continuous, closed path (can be accurately filled with a color).
	Path quality (0.6)	Points on outline path are kept to a minimum, lines are smooth (unless a sharp curve is warranted).
Raster Graphic	Completeness/Format (0.67)	Raster graphic is provided in 300 ppi and is large enough to be clearly visible if viewed full screen or at desired zoom level (suggest ~ 20 inches wide to be safe).
	Organization (0.67)	Provide a screenshot of your layer organization and explain your strategy and any challenges you faced.
	Effort/Technique (0.67)	Demonstrates use of at least 3 techniques provided in the digital painting demo.

DAY 3

GUEST SPEAKER

Scientific illustration for high-impact science

Alex Boersma

Freelance Scientific Illustrator;
Alex Boersma Illustration

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