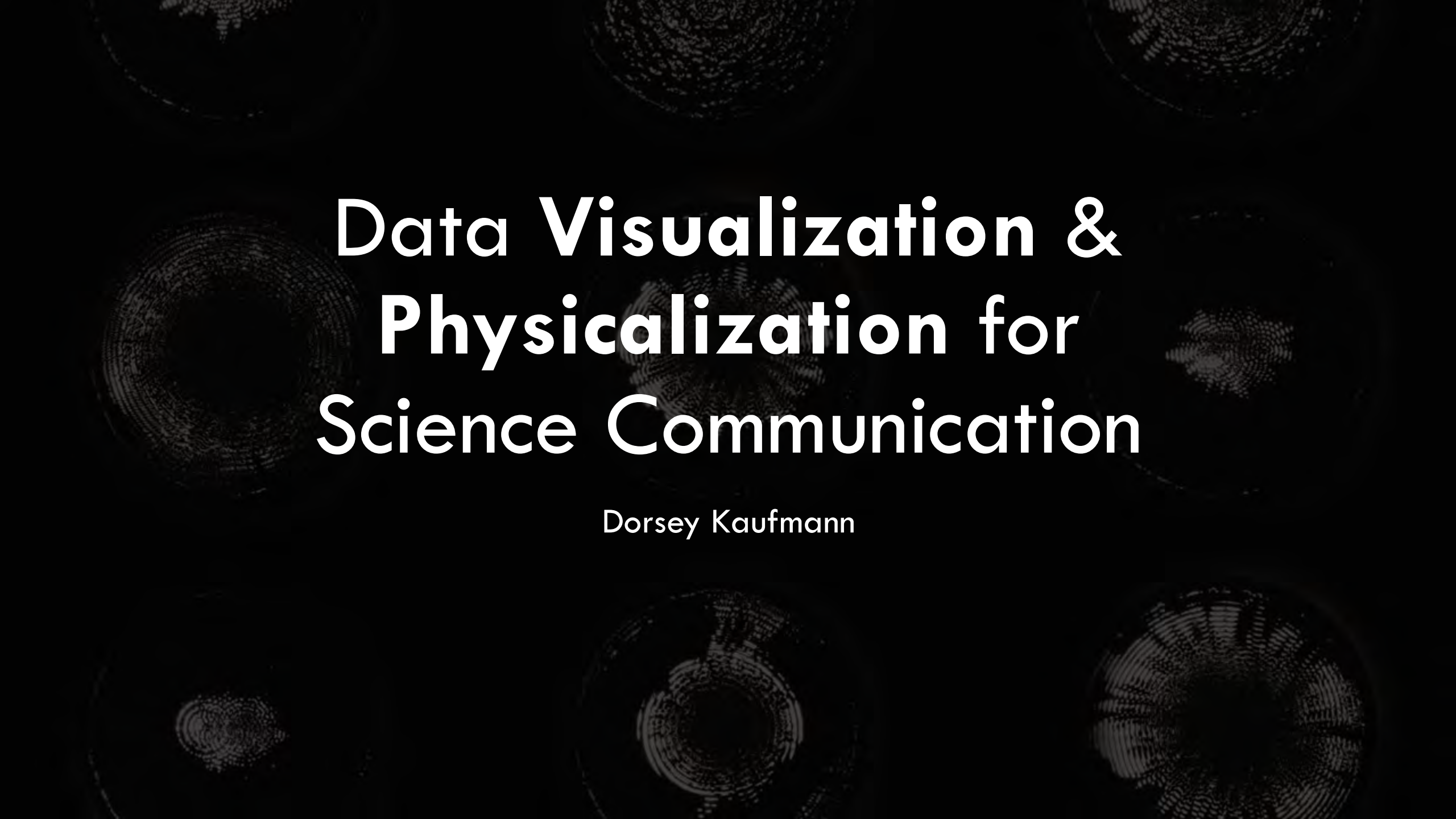


Data **Visualization** & **Physicalization** for Science Communication

Dorsey Kaufmann

Agenda

- Introduction
- Methods for communicating data
- Form vs. Function debate
- Encoding & Decoding Visualizations
- Miro exercises
- 4pm Break
- Case study: Ripple Effect

Barnett, J & Breakwell, GM 2003, 'The social amplification of risk and the hazard sequence: The October 1995 oral contraceptive pill scare', Health Risk & Society, vol. 5, no. 3, pp. 301-313. https://doi.org/10.1080/1369857031000160699 6

https://pmc.ncbi.nlm.nih.gov/articles/PMC27461/

In the following months…

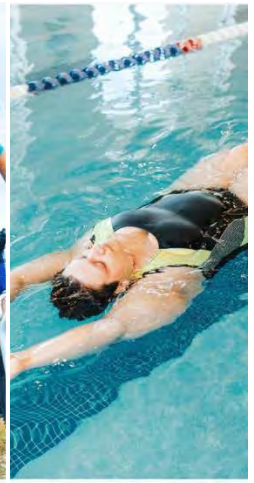
UK pregnancies	↑5%
Abortions	↑8%

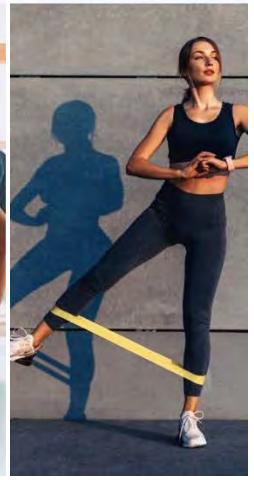
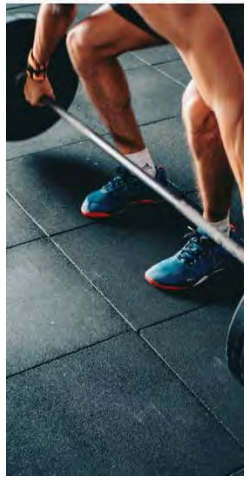
Dillner L. Pill scare linked to rise in abortions. BMJ. 1996 Apr 20;312(7037):996. doi: 10.1136/bmj.312.7037.996. PMID: 8616388.

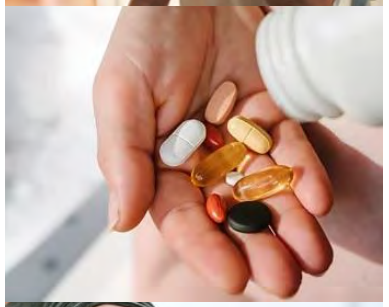
https://academic.oup.com/humupd/article-abstract/5/6/627/745753?redirectedFrom=PDF

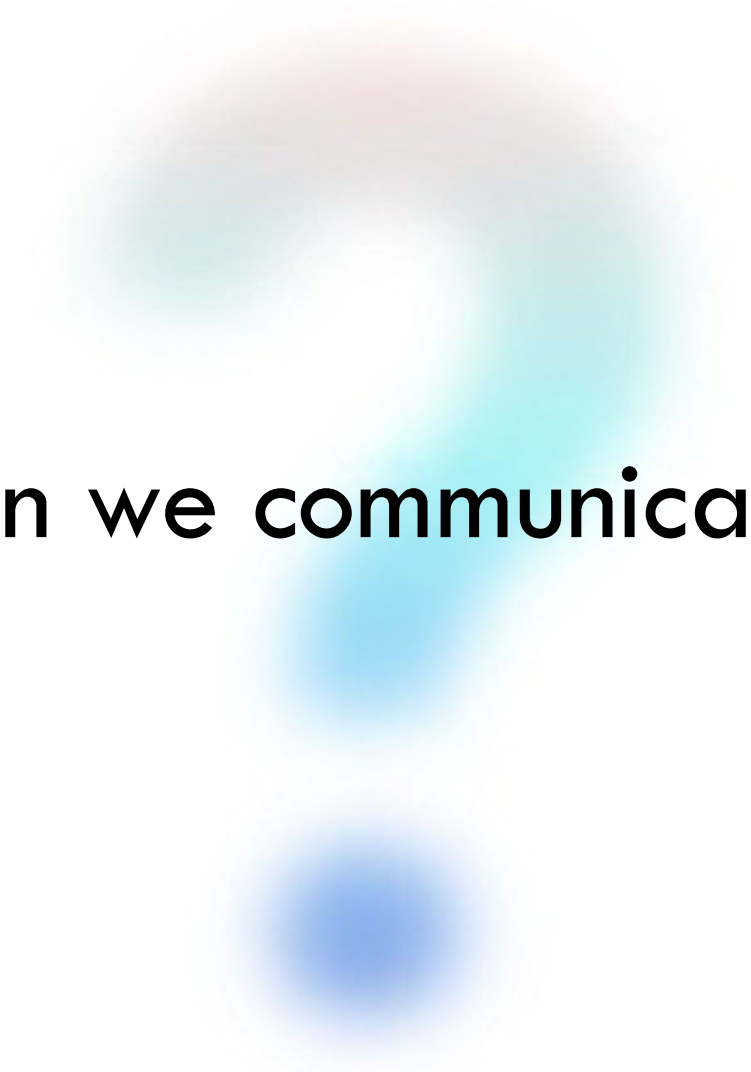
Science is integral to our lives





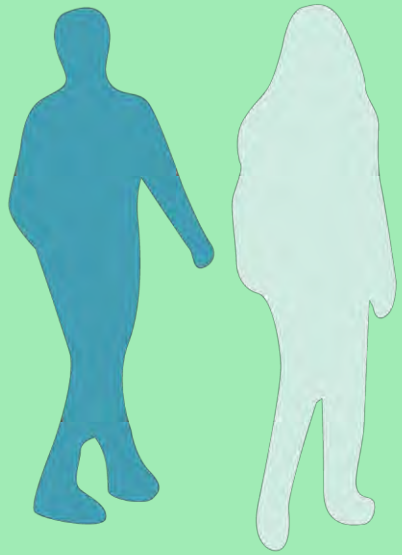




How can we communicate data

"I wish I could find a way for my research to be put to use."

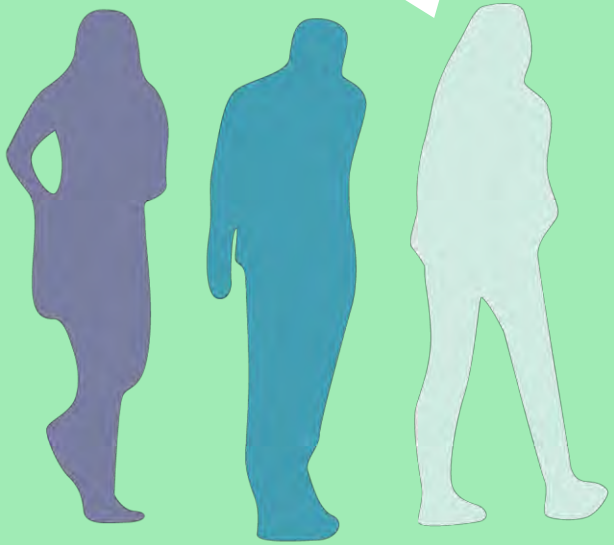


Scientists, Educators, and Researchers

Science Communication works to bring these two groups together in a meaningful exchange that works toward mitigating environmental problems and informing environmental health decision making.

(Allen, 2017)

"We want to know what the science is to apply data to the decisions we make in our everyday lives."



Stakeholders and Community Members

Let’s jump into Miro

- Brainstorm the methods for communicating data/ science

Experiential Sensorial	Interactive, Hands-on	Visual	Writing, Discussion	Personal	Community	Online Engagement
Art Installation	Game	Presentation	Mind-mapping	Gift	Building infrastructure	Video
Outdoors activity	Online Interface	Informational Booklet	Drawing Together	Swag	Community Gathering	Social Media Content
On-Site photography	3-D Installation	Take-home materials	Sticky Notes	Personalized Materials	Neighborhood Exchange	Website content
Performance or Reading	Field work	Poster				

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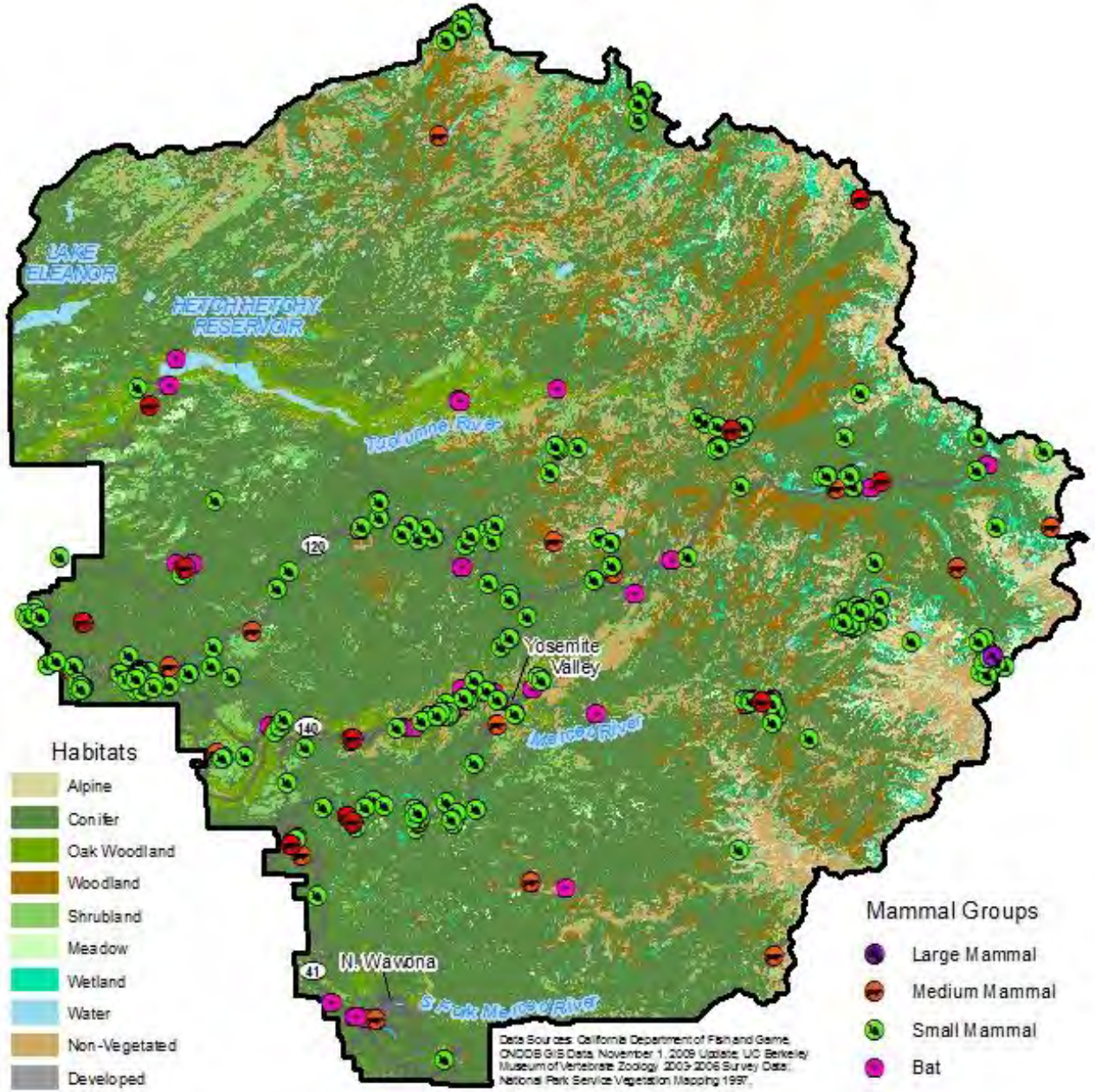
Performance or Reading	Field work	Poster				

Student questions

- When translating complex data into visualizations, sounds, objects, and interactions, how to establish a fair balance among scientific accuracy, public accessibility and creative expression?
- What strategies can help us strike a better balance between artistic expression and practical relevance in our work?
- What challenges do artists and designers face when trying to communicate complex scientific data accurately while still keeping their work accessible and creative?
- How can data visualization balance artistic expression with clear communication of information?

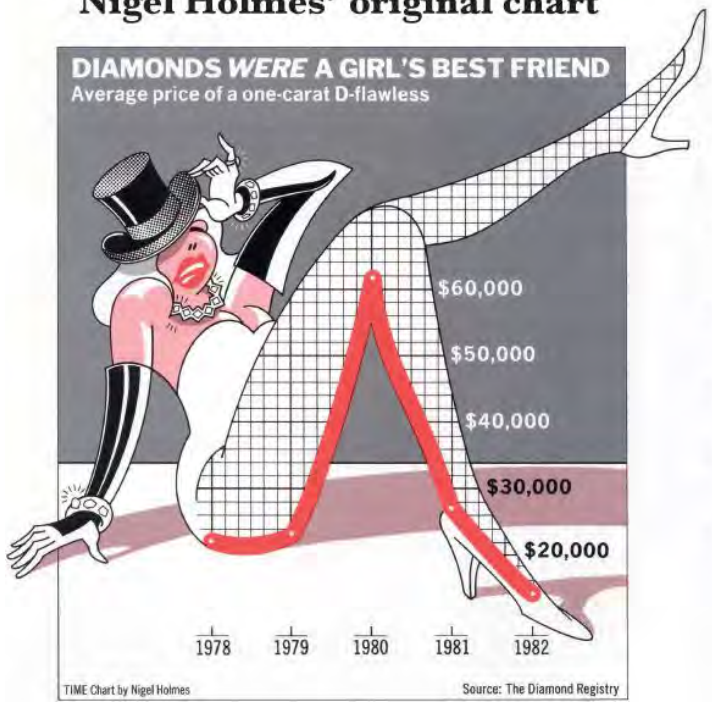
Common and Special-Status Mammal Observations

Yosemite National Park

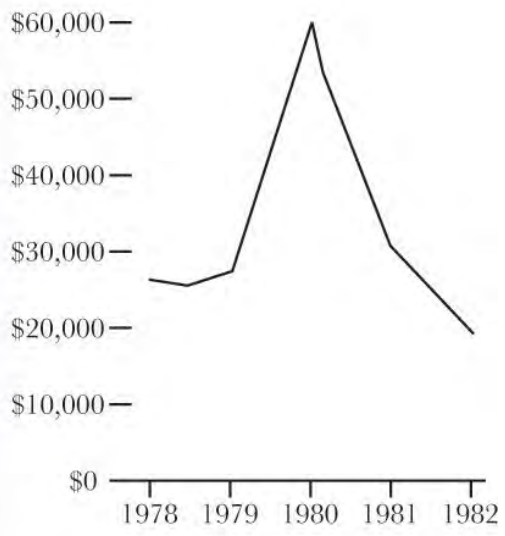


Form Vs. Function Debate

Nigel Holmes' original chart



Minimalistic version

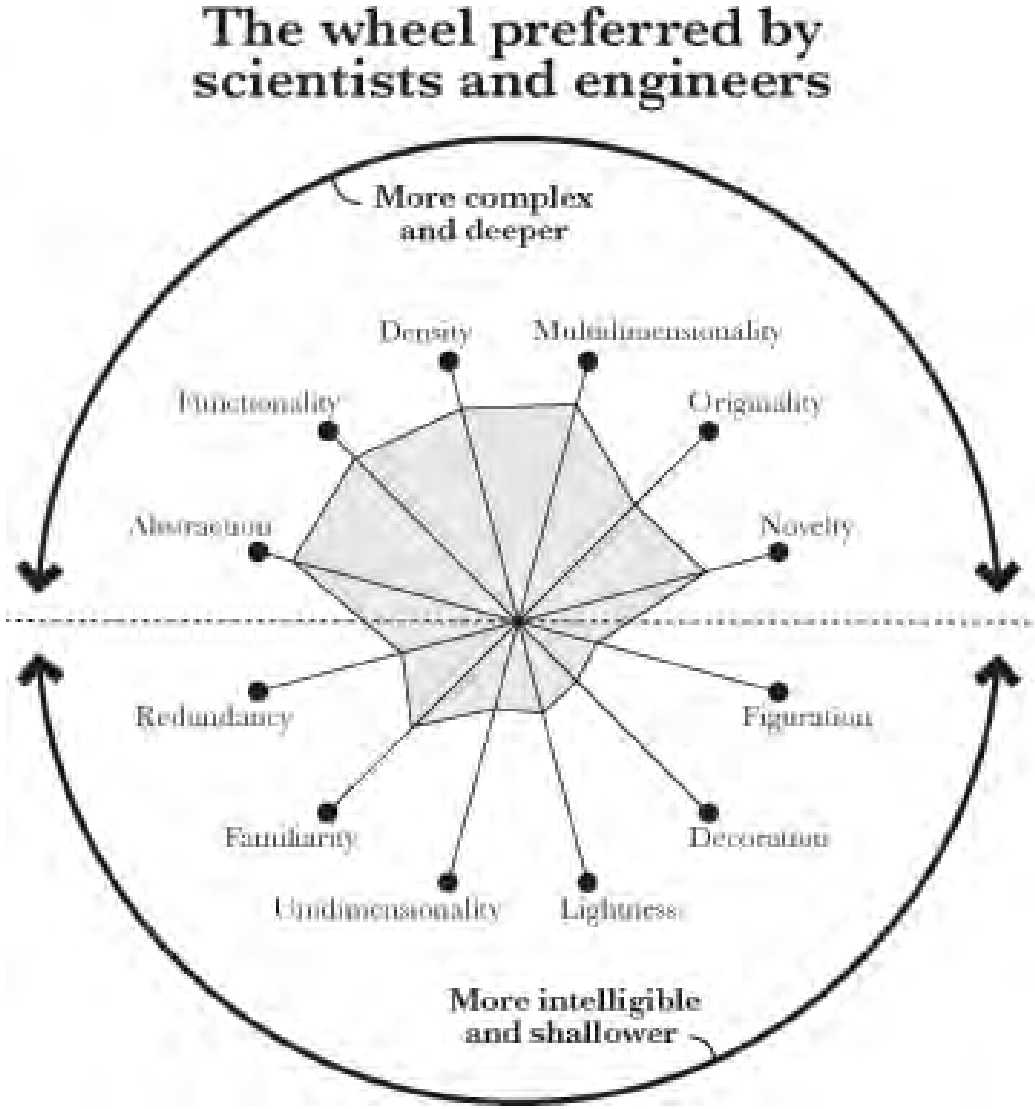


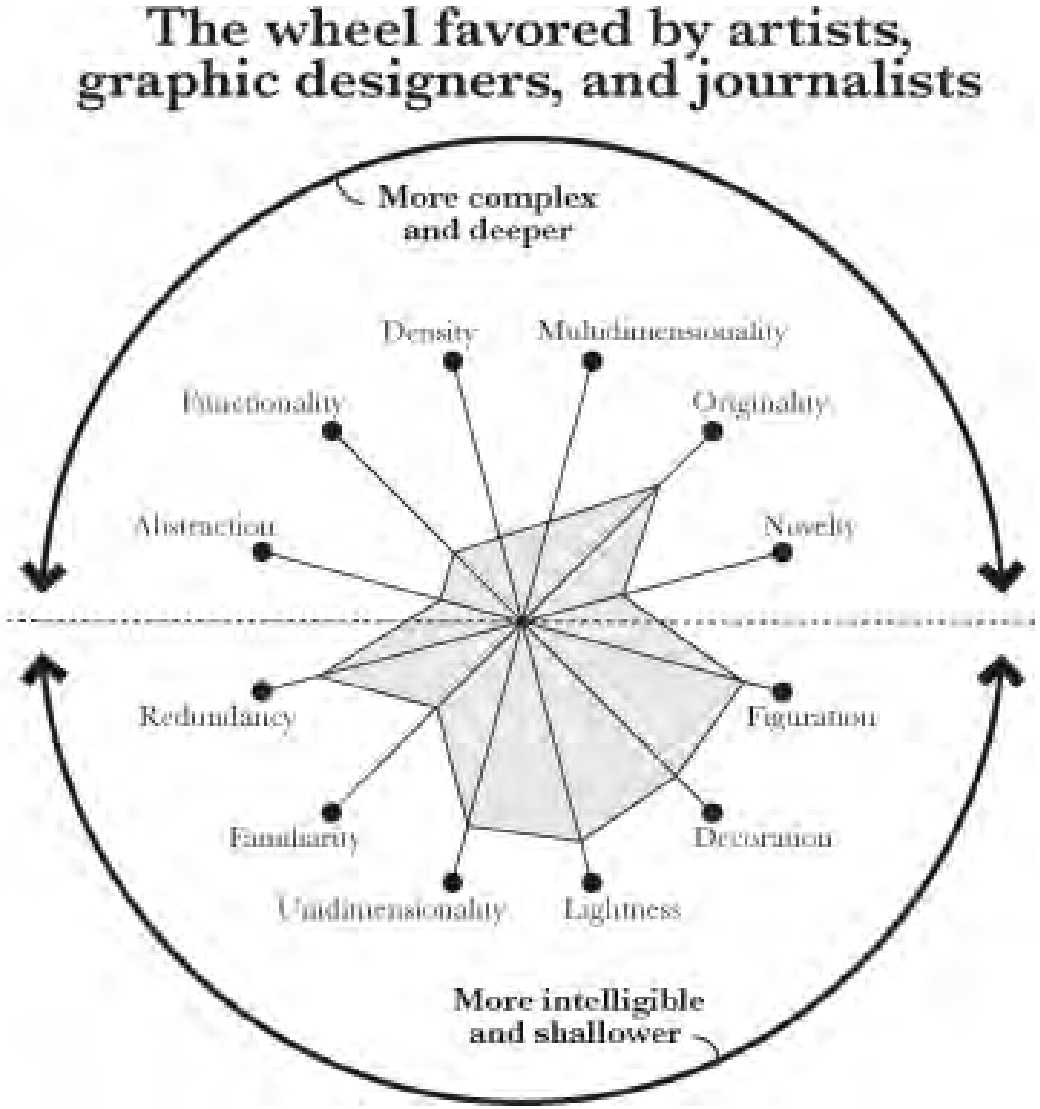
Nigel Holmes

Edward Tufte

Student comment

- Neurologically speaking, people are classified as having one of two types of brains: either more creative or more objective. Theoretically, you would assume graphs and reports would cater to more objective individuals who value quantifiable metrics while artistic representations would cater to the former.





The Functional Art, Alberto Cairo

Let’s jump into Miro

- Where do the communication methods you brainstormed fall in the form vs. function debate?
- What about static vs. interactive?
- Which do they prioritize more?

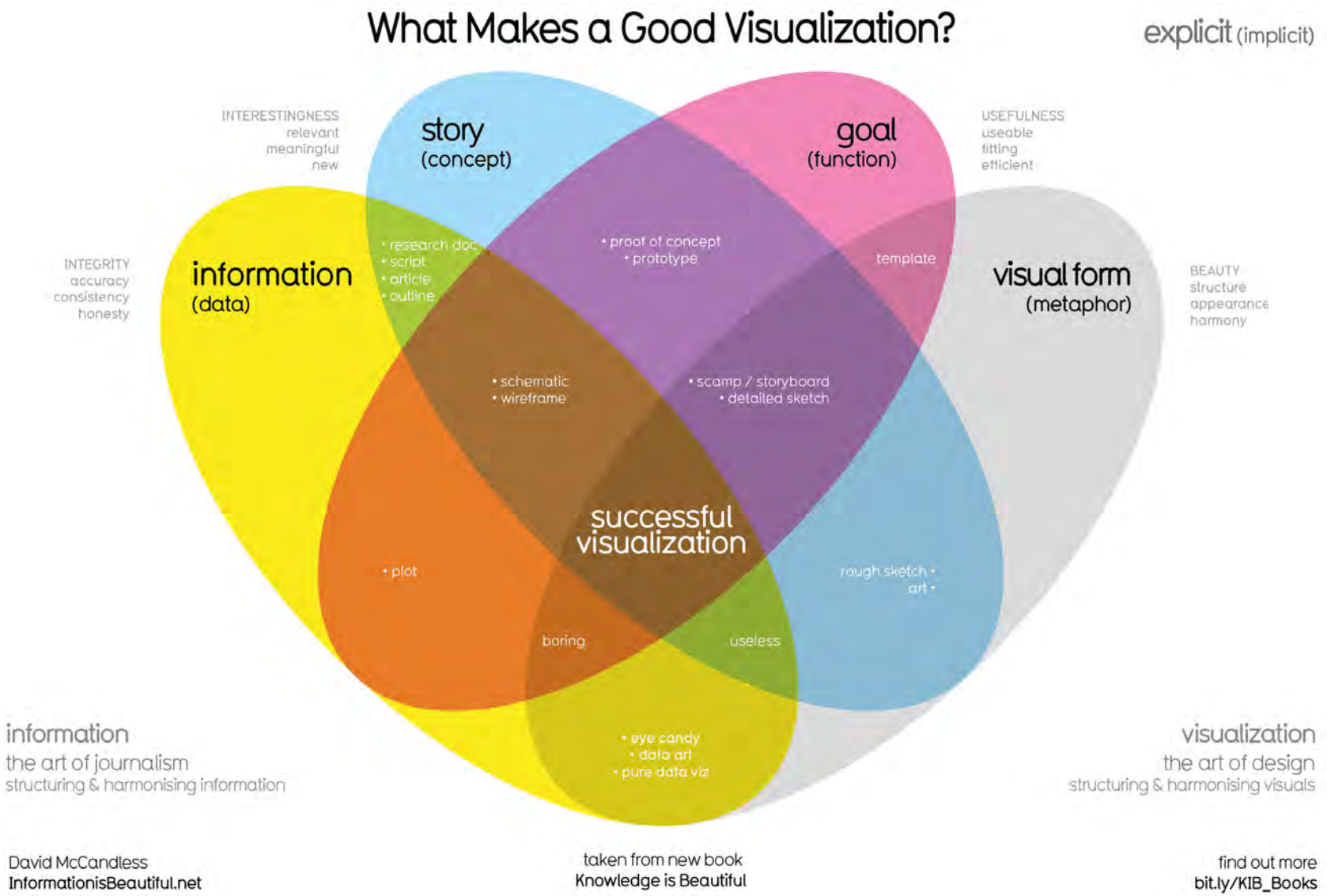
Next exercise

- What strengths come along with that communication method and being in that placement on the spectrum?

Next exercise

- What drawbacks come along with that communication method and being in that placement on the spectrum?

Design: A balancing act

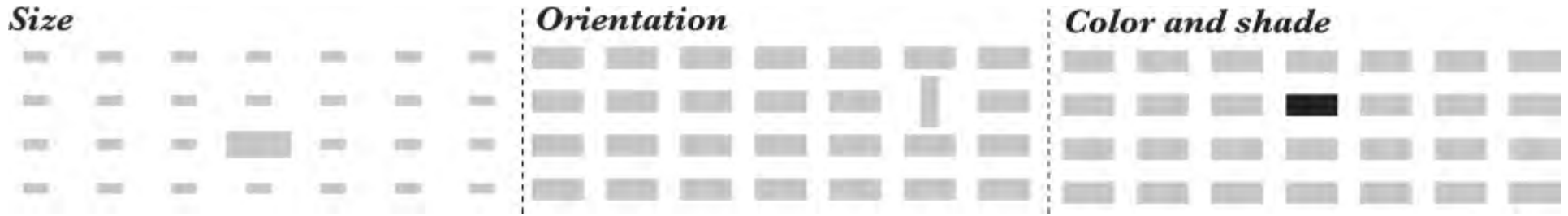


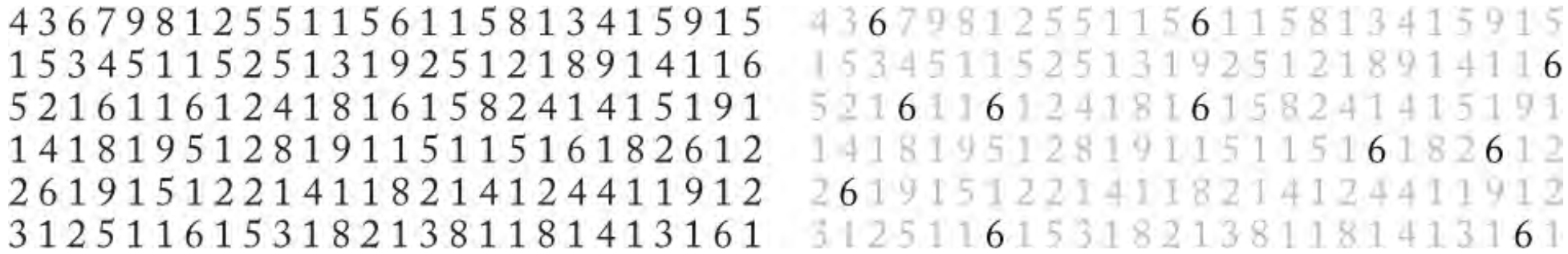
David McCandless
InformationisBeautiful.net

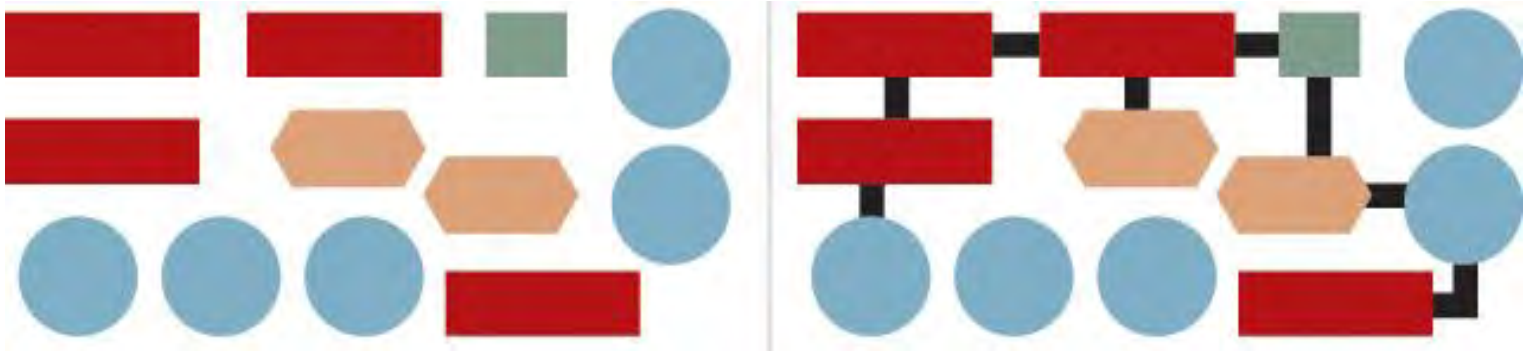
taken from new book
Knowledge is Beautiful

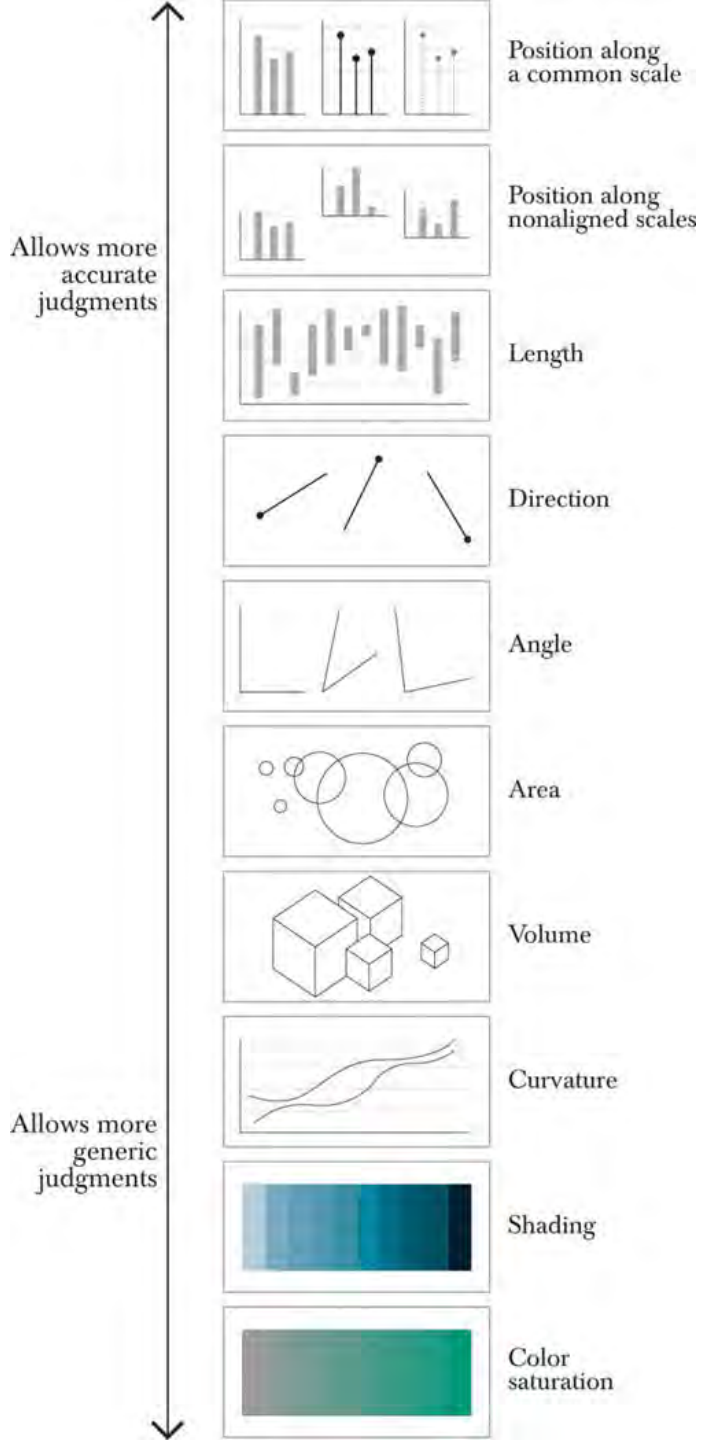
find out more
bit.ly/KIB_Books

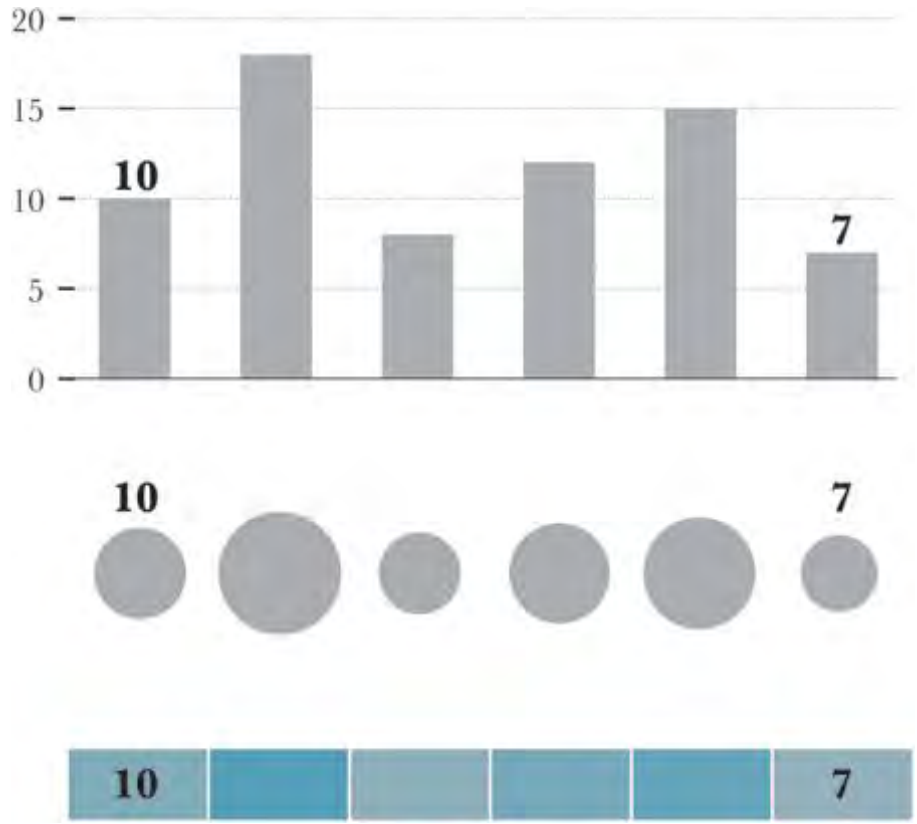
Perceptual principles inform design








Allows more accurate judgments
Position along a common scale
Position along nonaligned scales
Length
Direction
Angle
Area
Volume
Curvature
Allows more generic judgments
Shading
Color saturation


20
15
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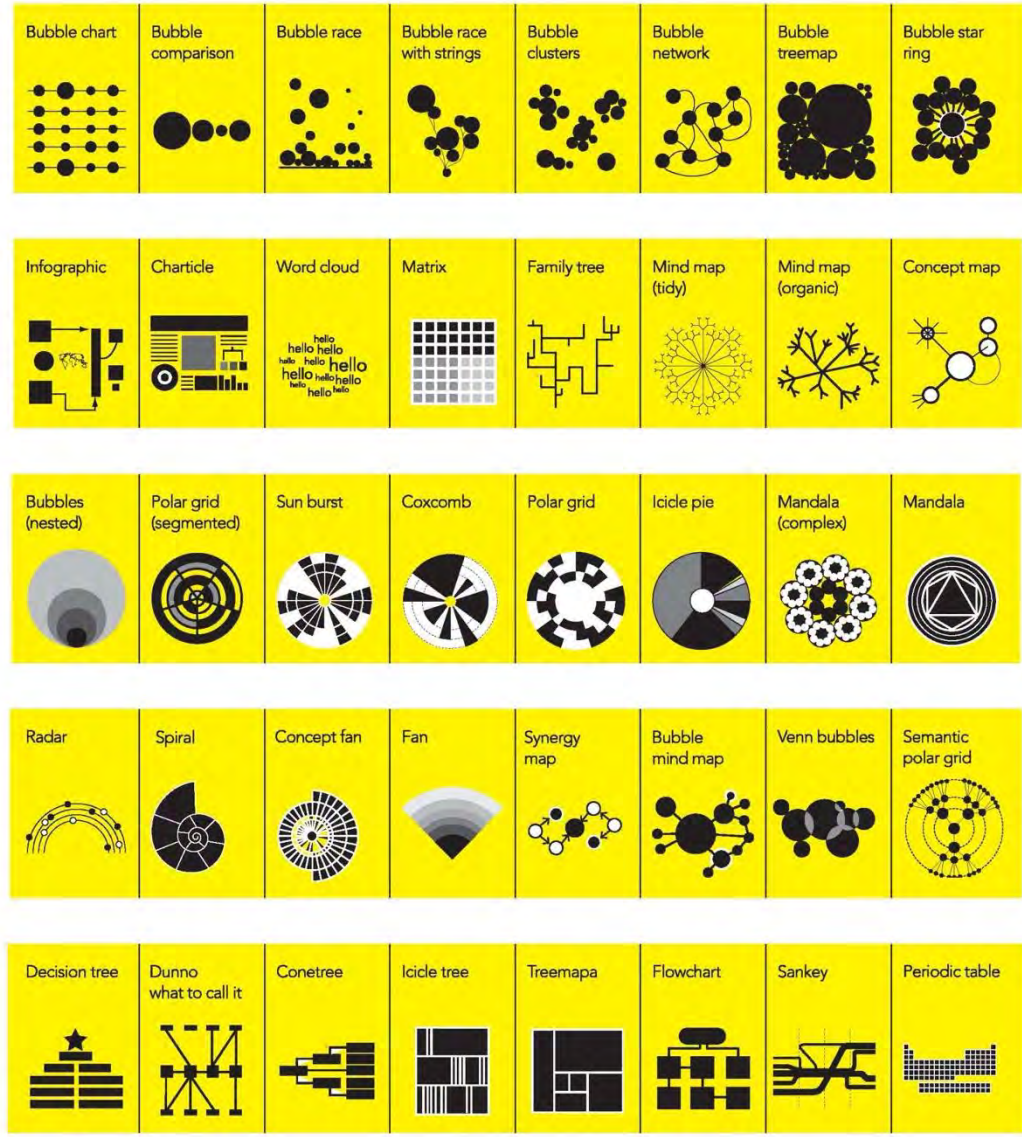
7

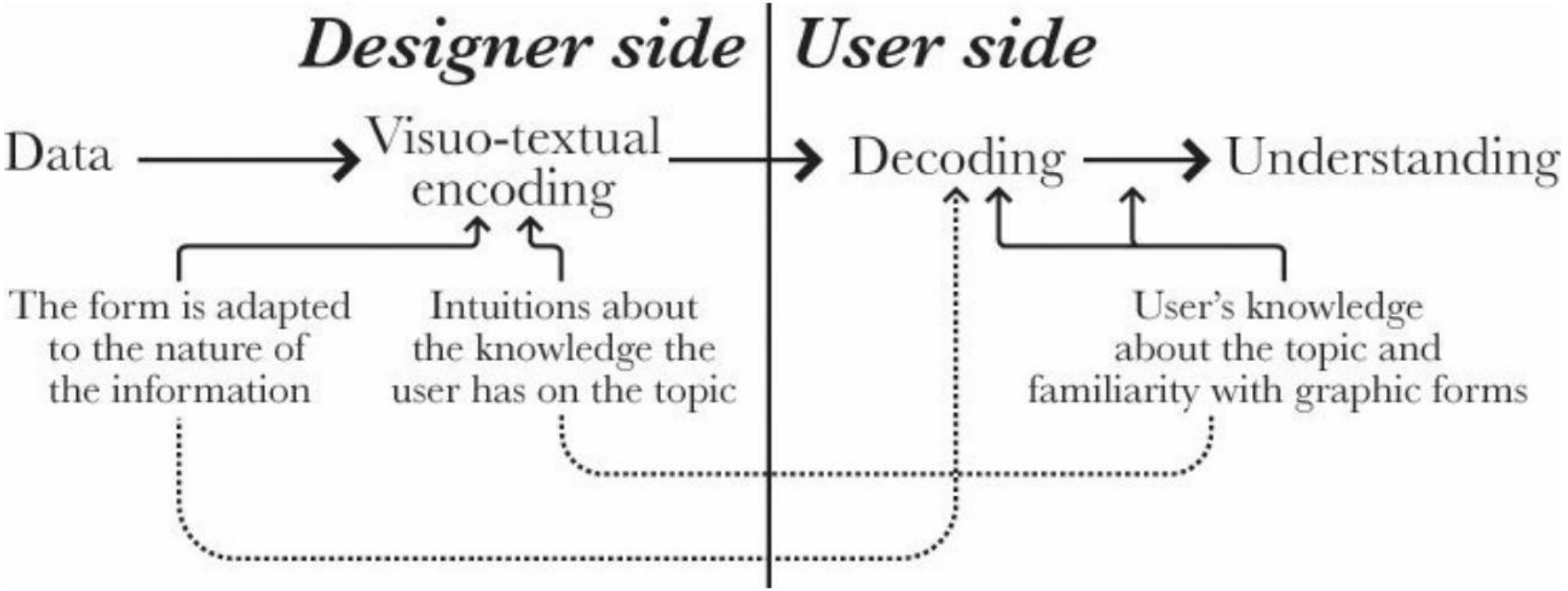


Types of Information Visualization

128 | 129

source: Edward Tufte, visual-literacy.org

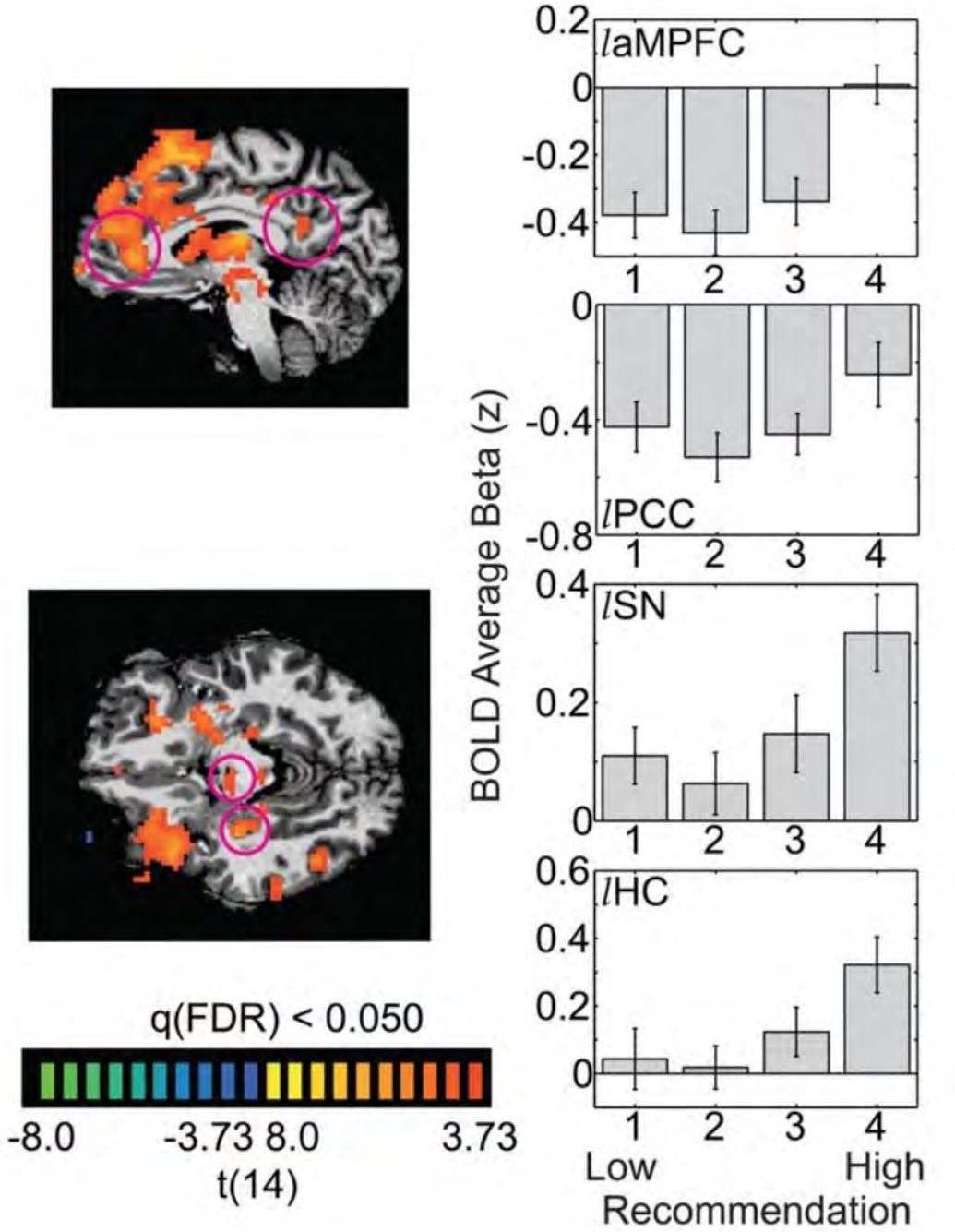
Interpretation



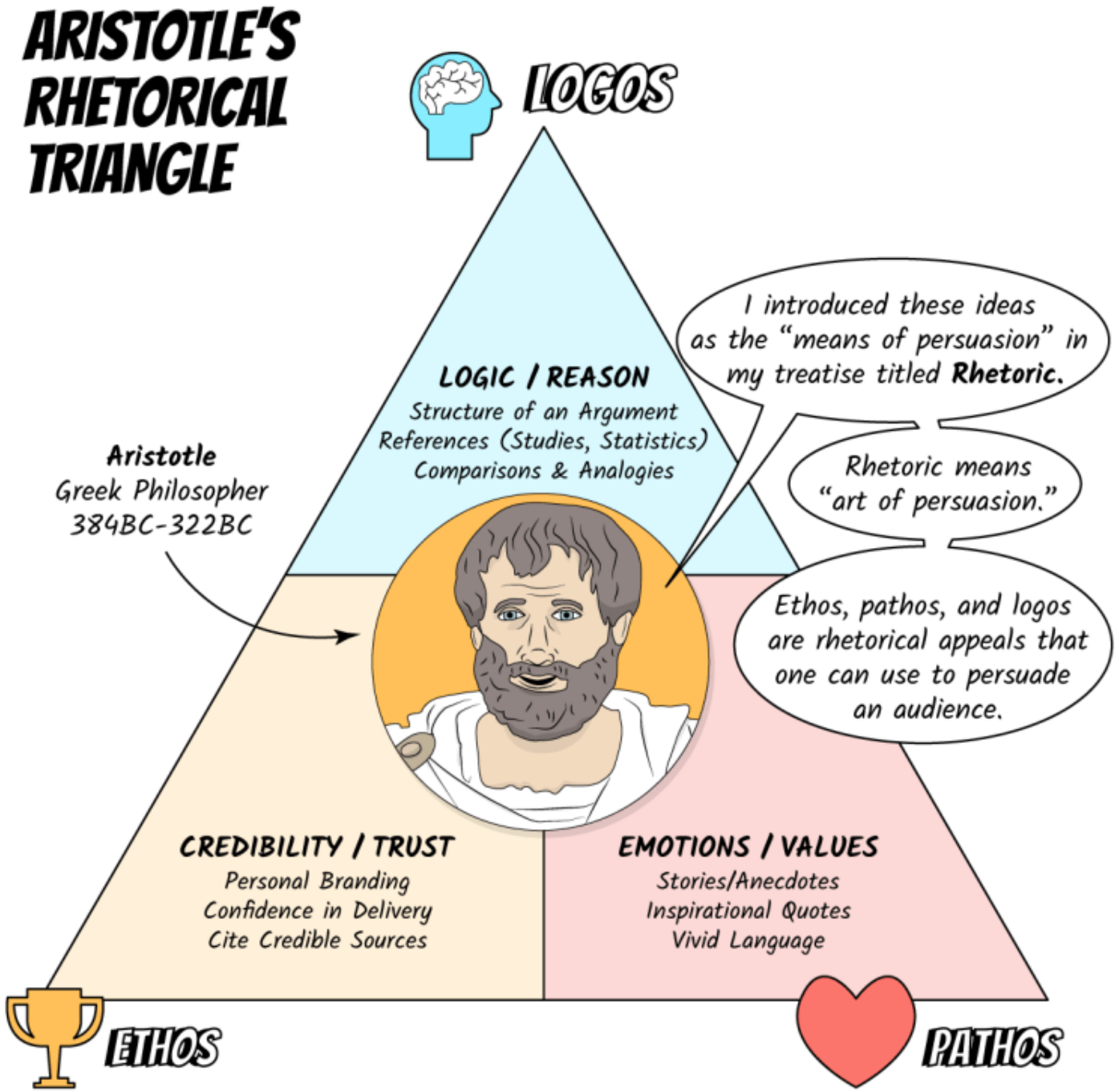
Your brain on art

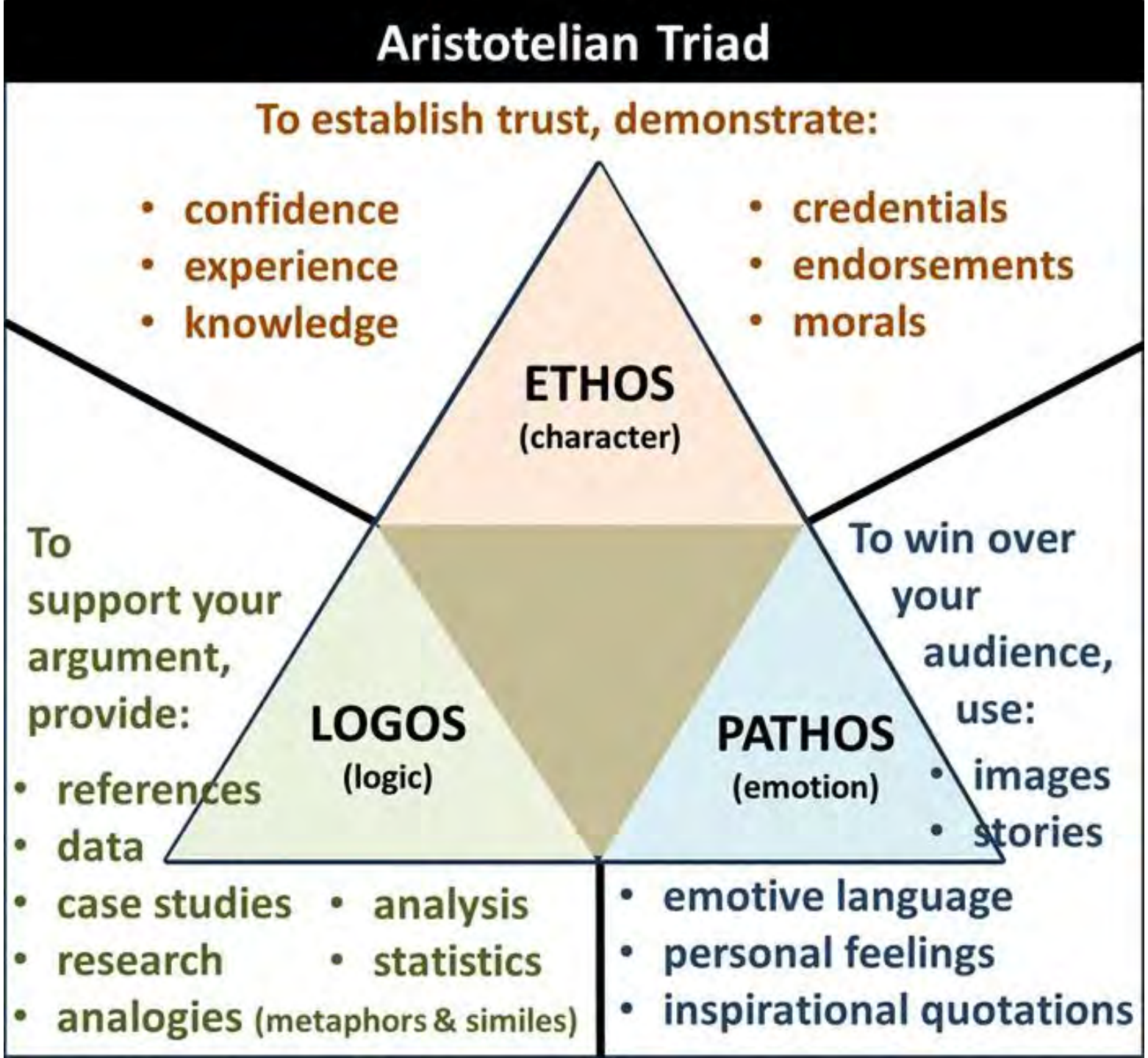
- University of Houston, Vessel et. Al

- laMPFC = left anterior medial prefrontal cortex;
- lPCC = left posterior cingulate cortex;
- lSN = left substantia nigra;
- lHC = left hippocampus



Let's refer to philosophy.




Aristotelian Triad
To establish trust, demonstrate:
• confidence
• experience
• knowledge
• credentials
• endorsements
• morals
ETHOS
(character)
To support your argument, provide:
• references
• data
• case studies
• research
• analogies (metaphors & similes)
• analysis
• statistics
LOGOS
(logic)
To win over your audience, use:
• images
• stories
• emotive language
• personal feelings
• inspirational quotations
PATHOS
(emotion)

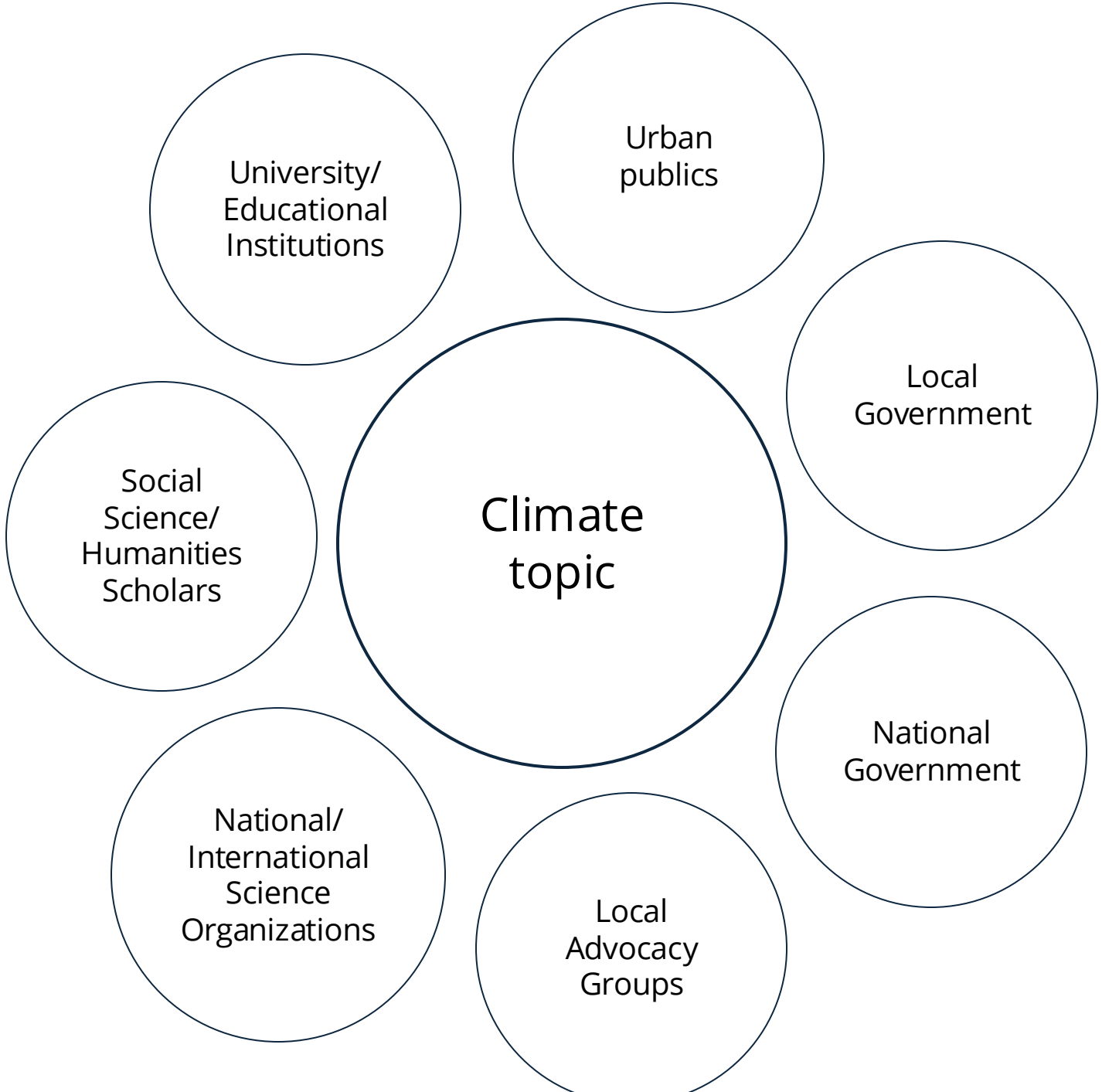
Student comment

- Sometimes when I think of ideas for exhibitions I get self-conscious about choosing a topic as "trite" as Climate Change, but wonder if I'm approaching this the wrong way. What are your thoughts on choosing a topic to tackle on exhibitions or projects?

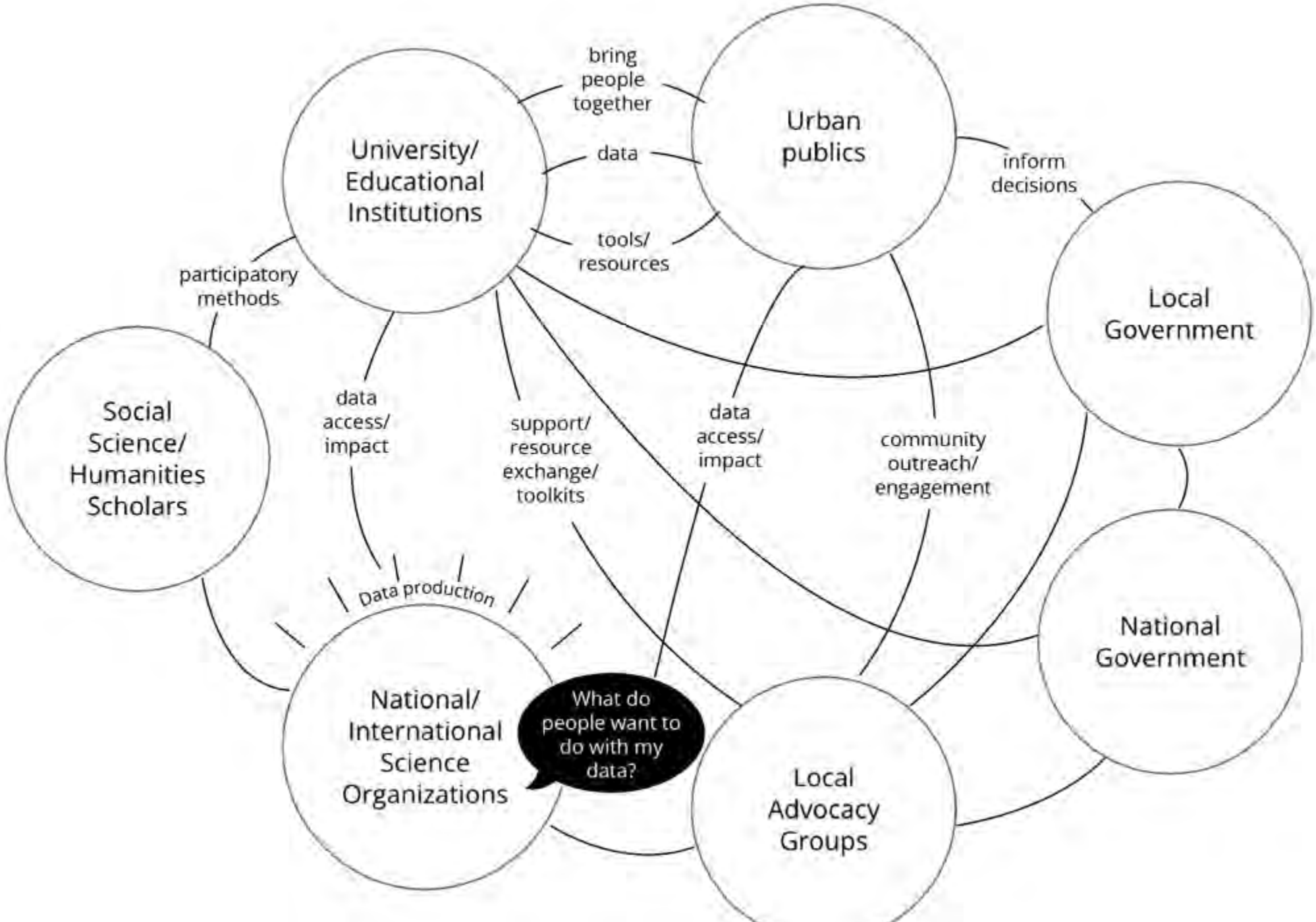
Data murals

"I wish this was" street art project **- Candy Chang**

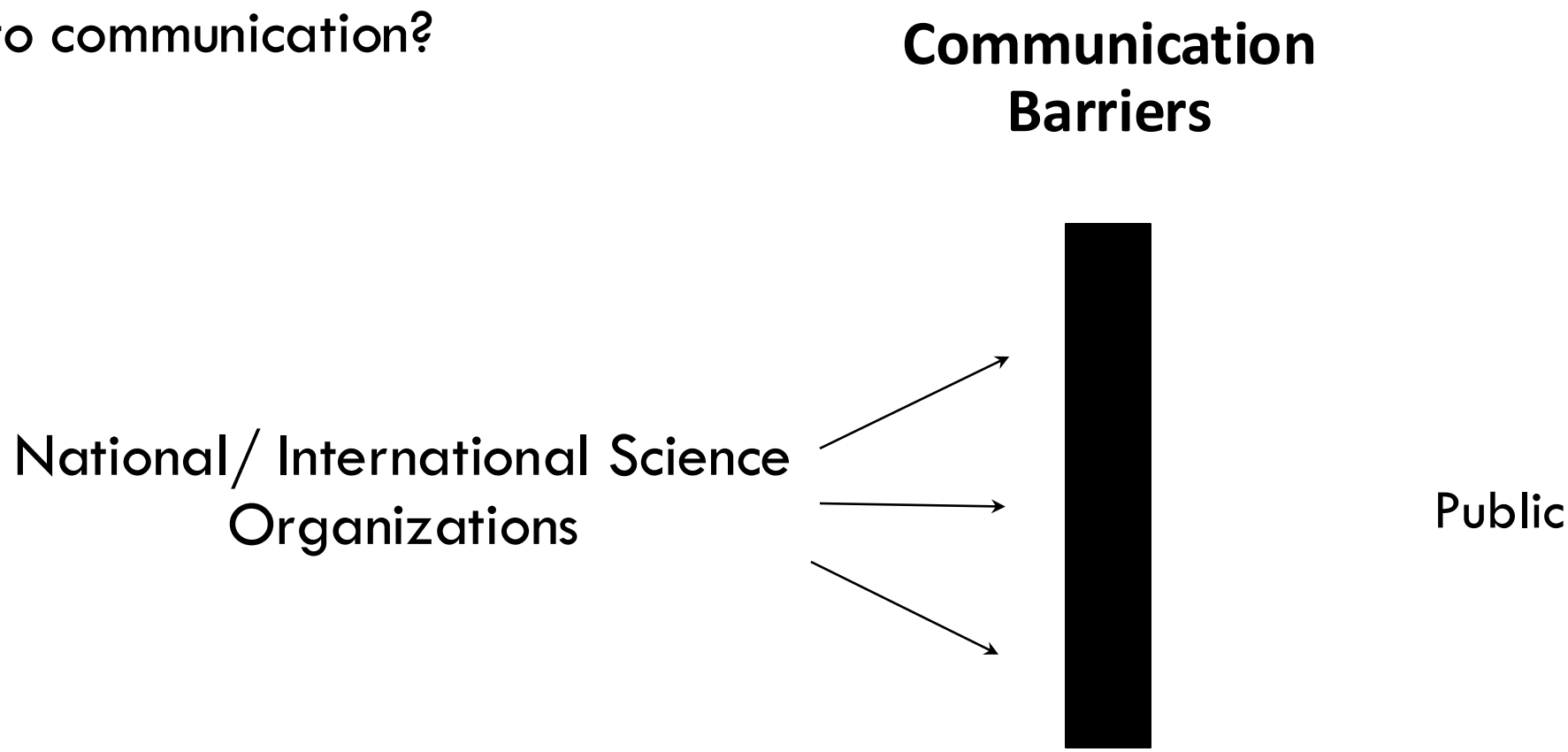
Topics and key actors will vary from city to city.



How those actors communicate around the issue



What are the barriers to communication?

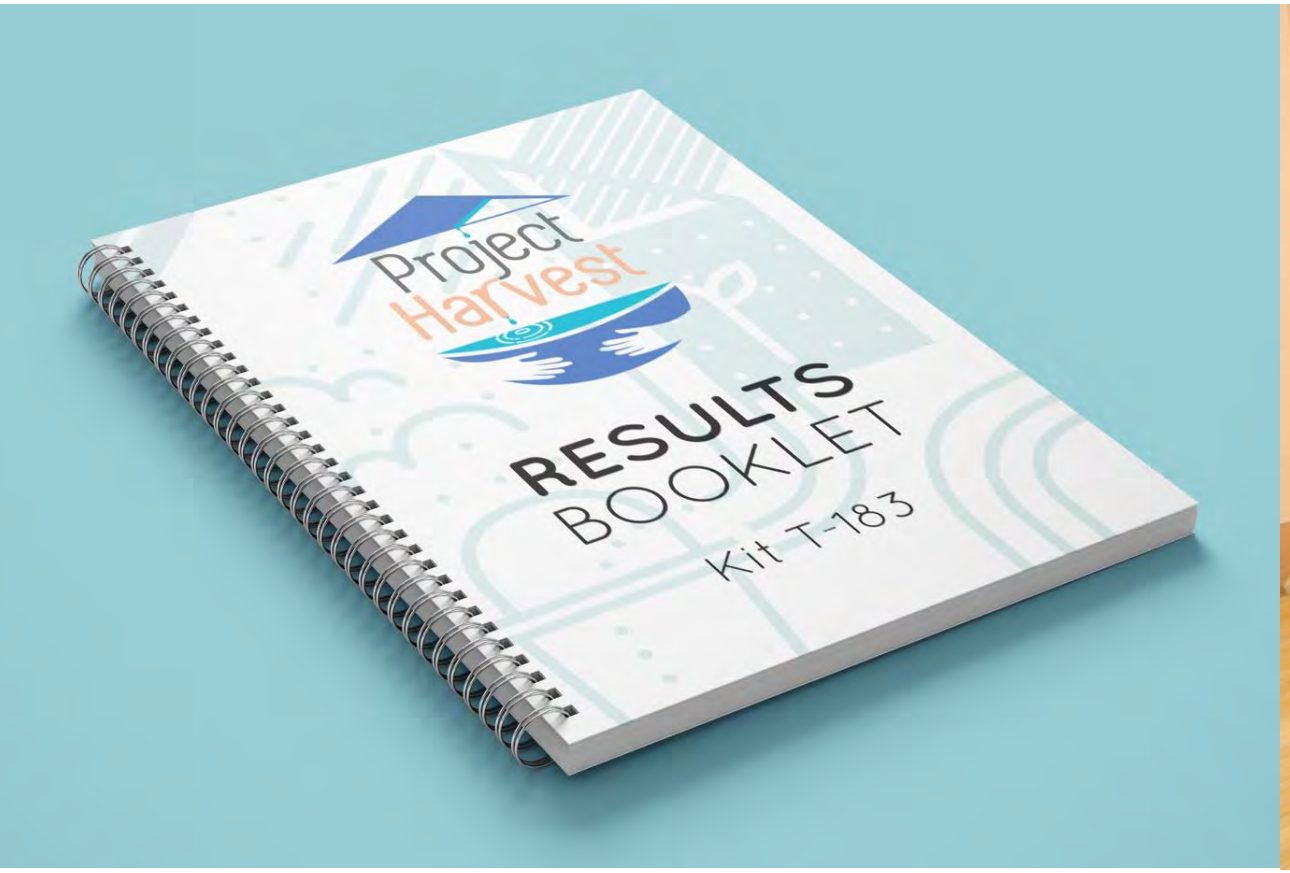


Let’s jump into Miro

- Think through a local issue, or an issue meaningful to you
- Who are the main actors
- What is the barrier to communication
- What strategies can potentially overcome those barriers


SCIENCE-
RM 1303

Case Control Study

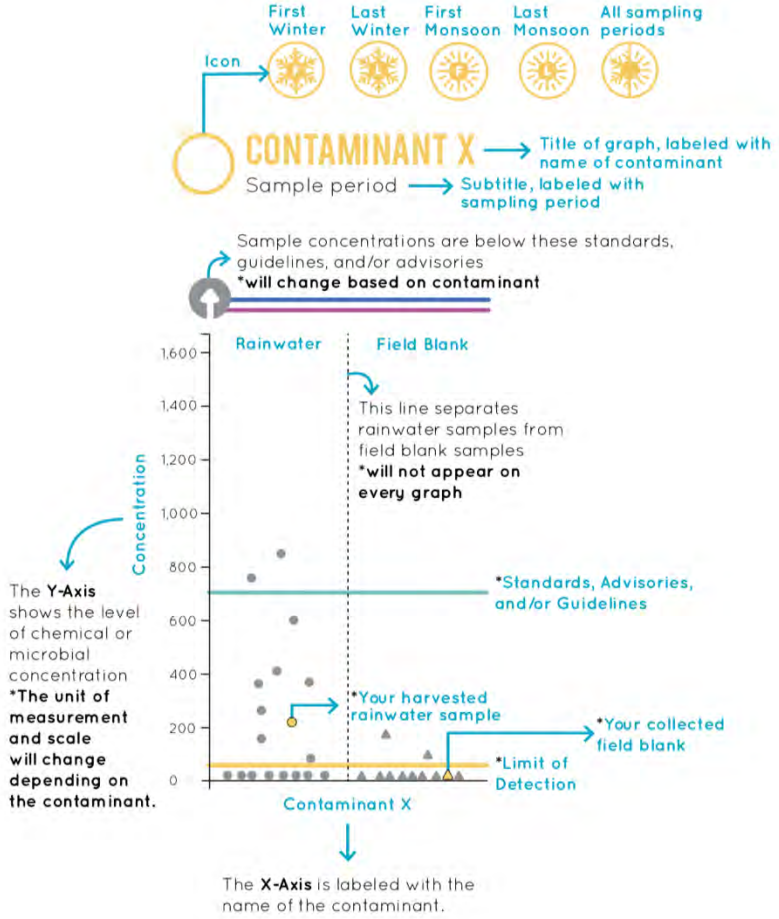


Booklet

Ripple Effect + Booklet

Booklet


Lead
Lead
Contaminant Name: Lead (Pb)
Contaminant Type: Heavy Metal
What is lead?
How can lead affect my health?
What happens to lead when it enters the environment?
Where can I get more information on Lead?
Other samples in your community
Please Note:
Rainwater
Field Blank
Lead
Concentration ug/L
26

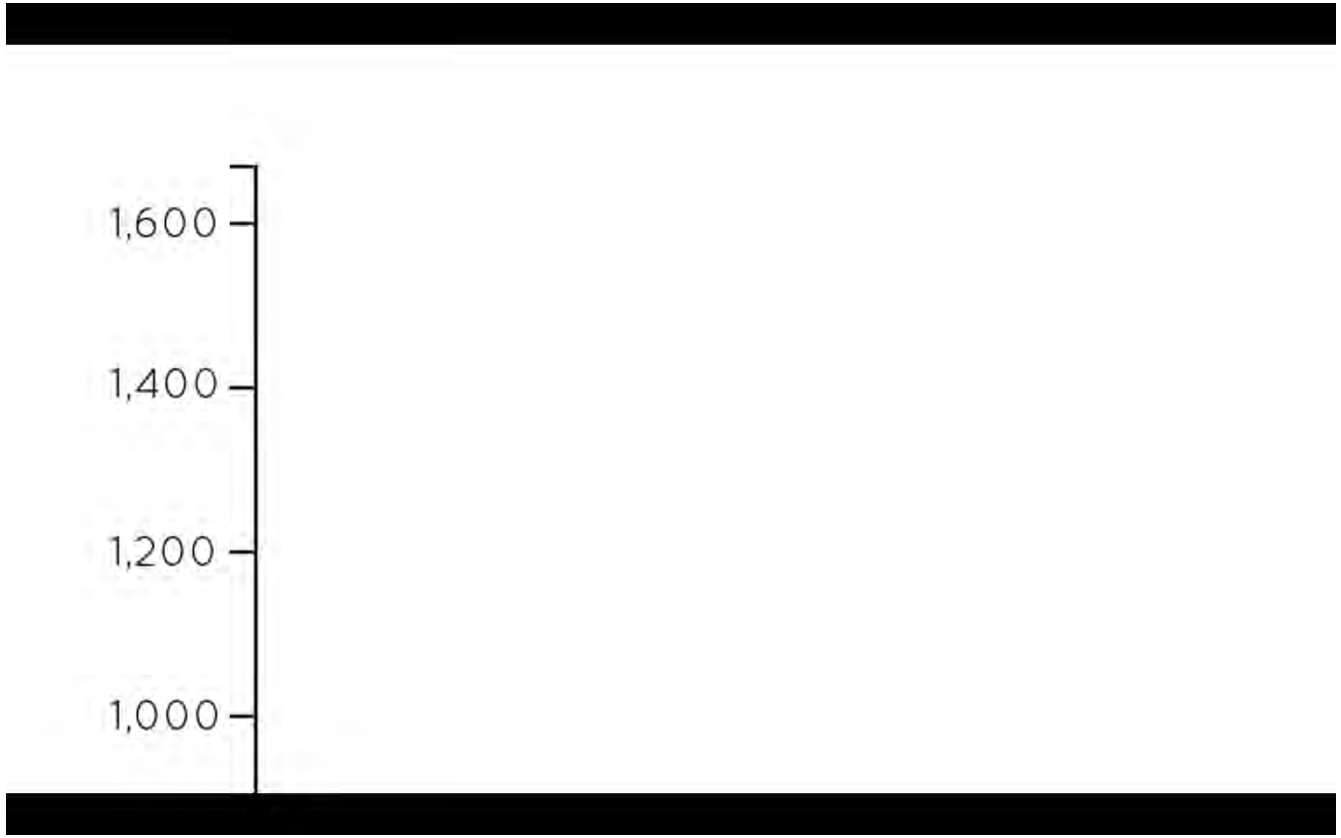

First Winter
Last Winter
First Monsoon
Last Monsoon
All sampling periods
Icon
CONTAMINANT X
Title of graph, labeled with name of contaminant
Sample period
Subtitle, labeled with sampling period
Sample concentrations are below these standards, guidelines, and/or advisories
*will change based on contaminant
Rainwater
Field Blank
This line separates rainwater samples from field blank samples
*will not appear on every graph
Concentration
1,600
1,400
1,200
1,000
800
600
400
200
0
The Y-Axis shows the level of chemical or microbial concentration
*The unit of measurement and scale will change depending on the contaminant.
*Standards, Advisories, and/or Guidelines
*Your harvested rainwater sample
*Your collected field blank
*Limit of Detection
Contaminant X
The X-Axis is labeled with the name of the contaminant.
Please Note:
* means that the location on the graph will change

Different standards/advisories were selected based on:

- How Project Harvest participants **currently** use their harvested rainwater
- Promotora recommendations and preferences
- Availability of useful standards or advisories

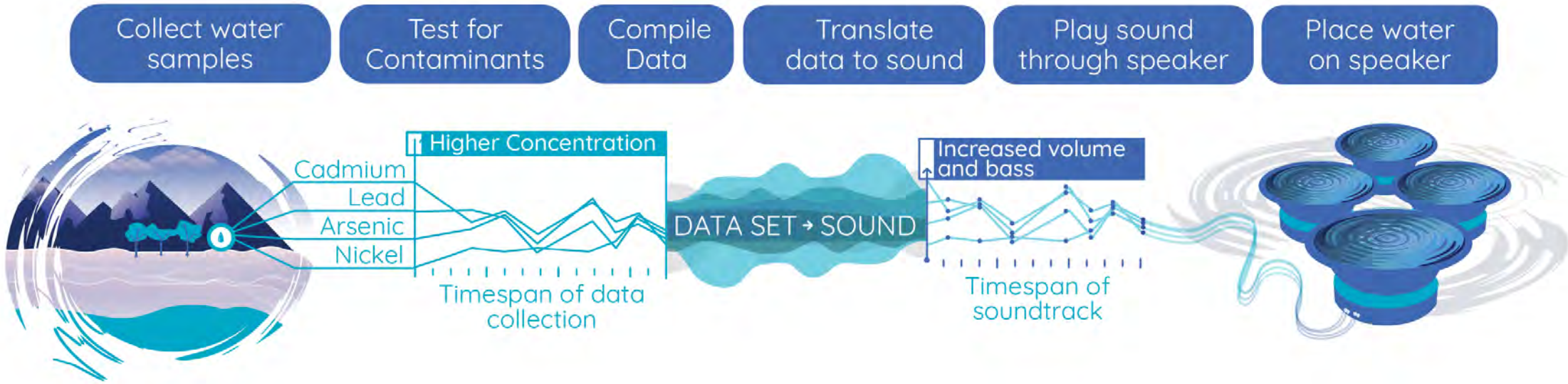
How do you use your water?
Look for the corresponding standard, advisory, and/or guideline on the graph to see if your rainwater sample is below or above the value, represented by a colored line.

- Drinking Water Standard
- Agricultural Irrigation Standard
- Livestock and Poultry Standard
- Surface Water - Partial Body Standard
- Surface Water - Full Body Standard
- Non-potable Indoor Use of Harvested Rainwater Guideline
- Lifetime Health Advisory
- World Health Organization Drinking Water Quality Guideline



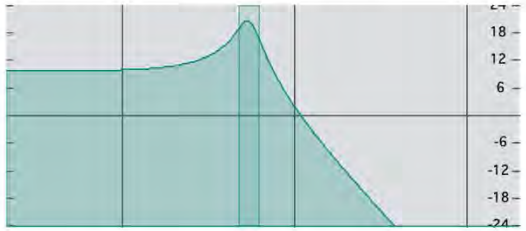
Ripple Effect

Data to Sound Translation



Data to Sound Translation in MAX/MSP

1) Open a CSV file
2) Open an audio file
3) Turn on the Speaker
4) Adjust the volume
5) Turn on the main control



turn on audio

read — open a CSV file

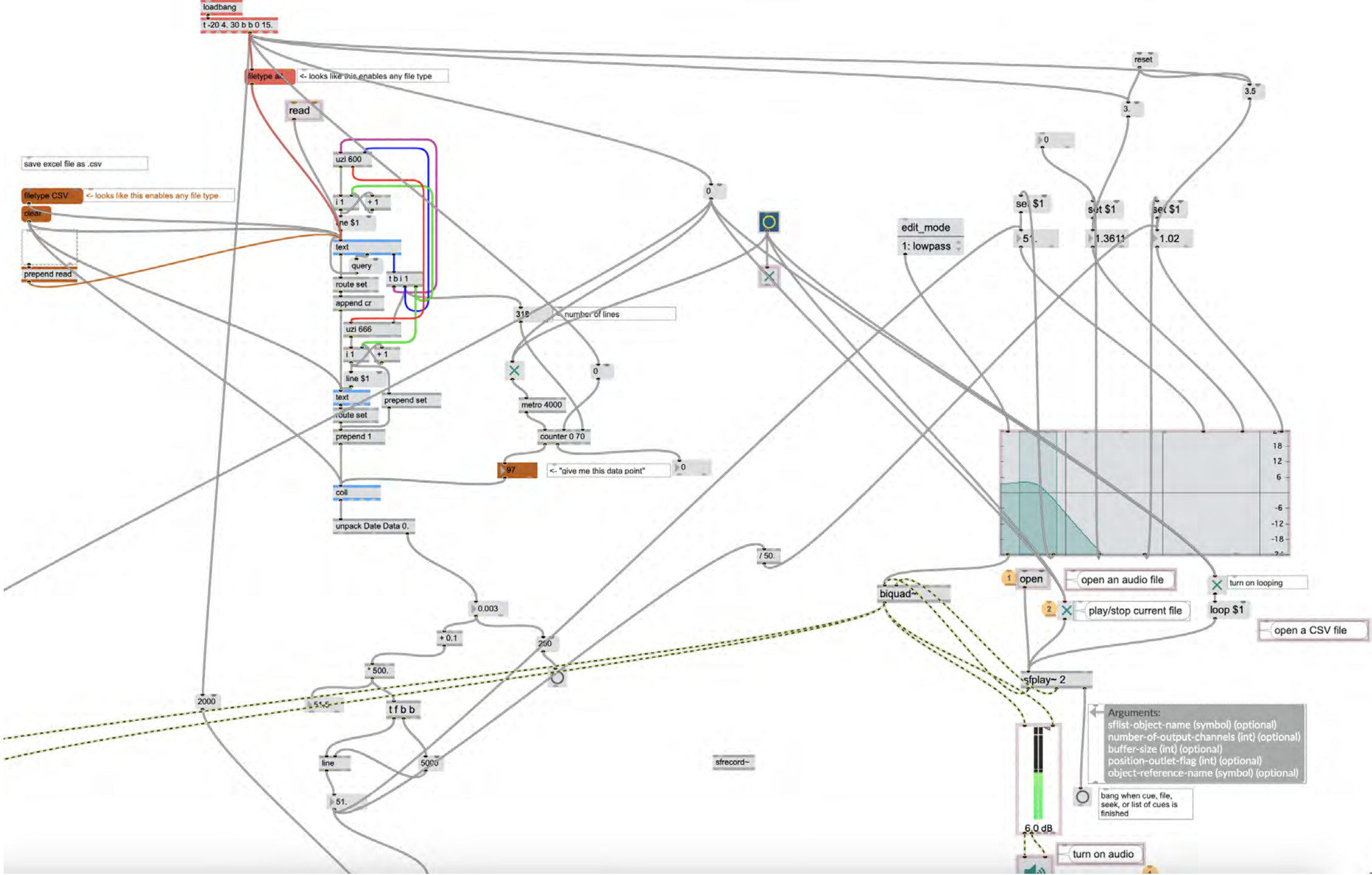
open — open an audio file

-inf dB

Main Control:
Click to Turn On

To Record
1) Open to select a file name
2) Click record to Start
3) Click record again to Stop

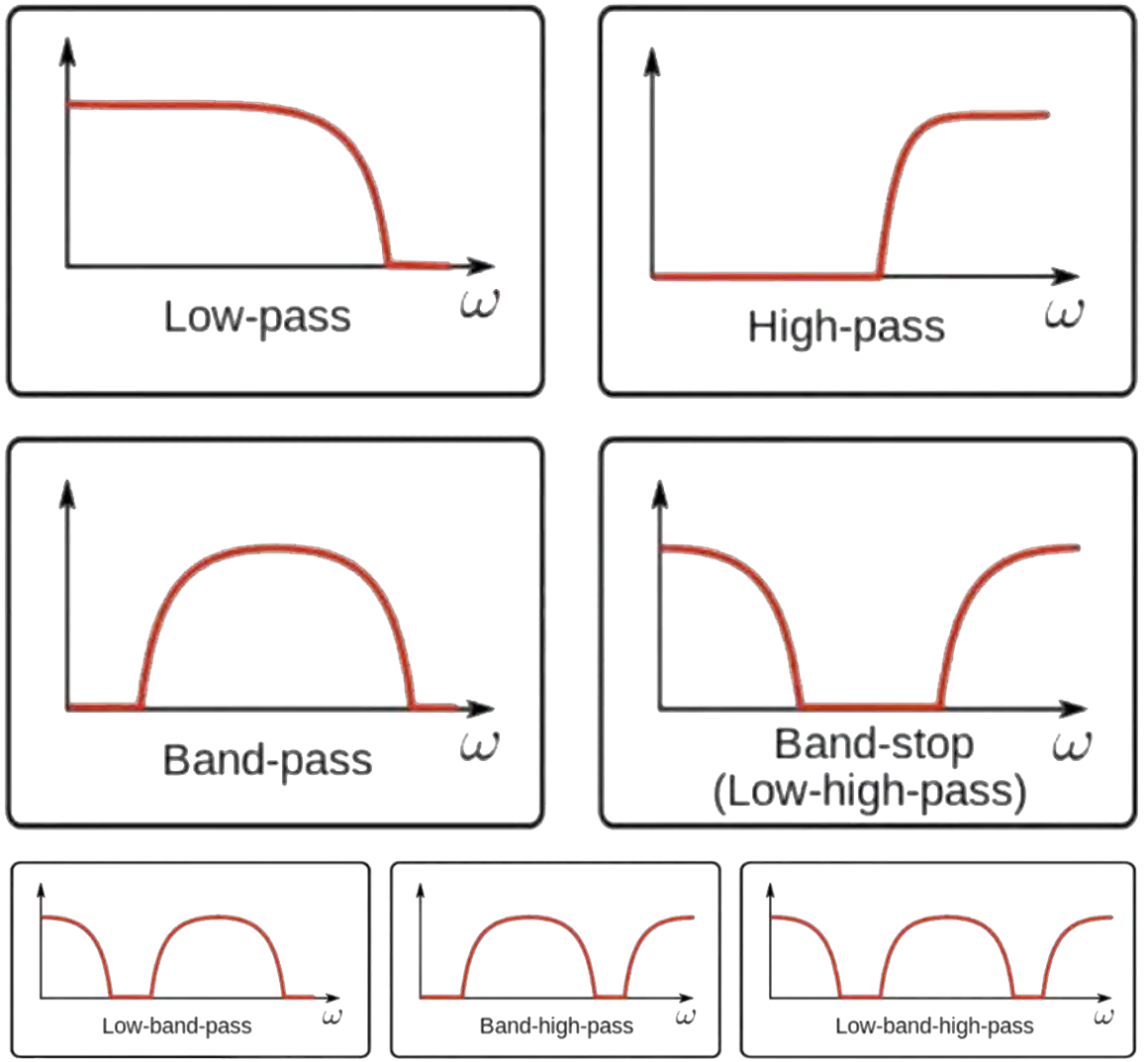
open — Click to Save the File


loadbang
t -20 4. 30 b b 0 15.
filetype a
<- looks like this enables any file type
read
save excel file as .csv
filetype CSV
<- looks like this enables any file type
clear
prepend read
uzi 600
i 1
+ 1
line $1
text
query
route set
t b i 1
append cr
uzi 666
i 1
+ 1
line $1
text
prepend set
route set
prepend 1
coll
unpack Date Data 0.
318
number of lines
metro 4000
counter 0 70
97
<- "give me this data point"
0
reset
3.5
3.
0
edit_mode
1: lowpass
set $1
1.3611
1.02
/ 50.
biquad~
0.003
+ 0.1
250
* 500.
2000
t f b b
line
5000
51.
sfrecord~
1 open
open an audio file
2
play/stop current file
turn on looping
loop $1
open a CSV file
sfplay~ 2
Arguments:
sflist-object-name (symbol) (optional)
number-of-output-channels (int) (optional)
buffer-size (int) (optional)
position-outlet-flag (int) (optional)
object-reference-name (symbol) (optional)
bang when cue, file, seek, or list of cues is finished
6.0 dB
turn on audio

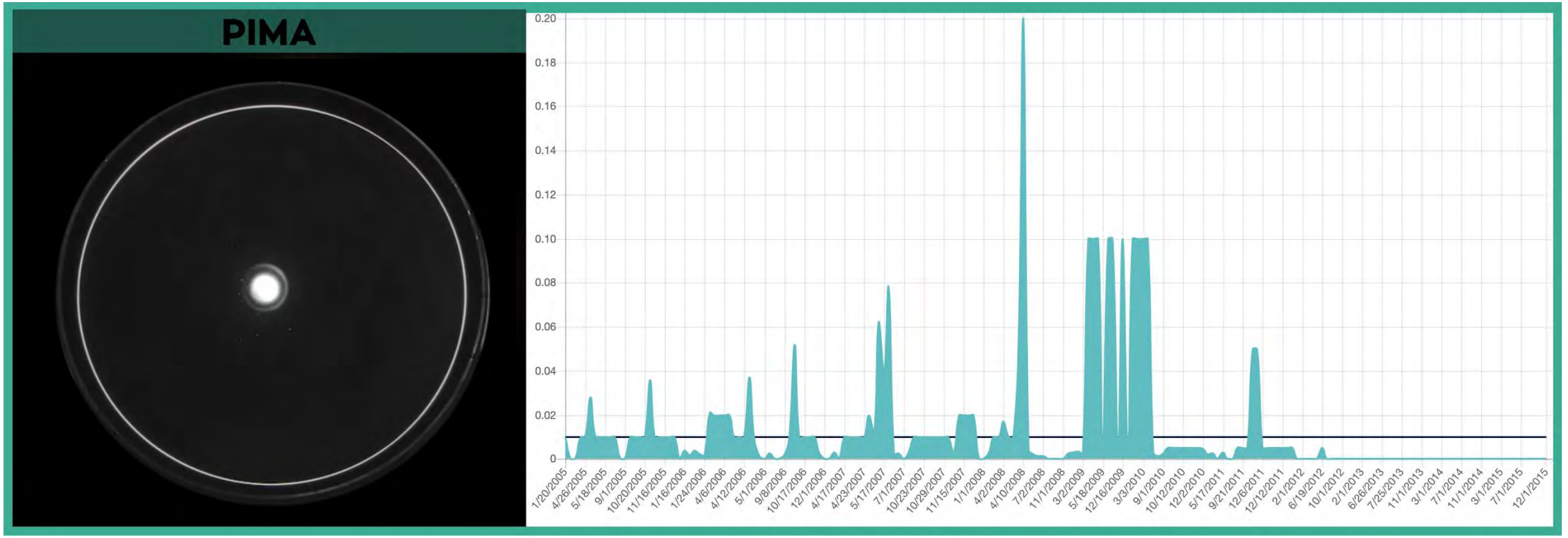
Sonic Variables and Filters

Auditory variables
(Duncan & Miriam, 2022)

Pitch, loudness, timbre (instrumentation, EQ), timing (duration, tempo, rhythm, sounds per time period), spatial position (pan), effects: reverb, distortion, etc etc...



DATASET 1: ADEQ Groundwater Study



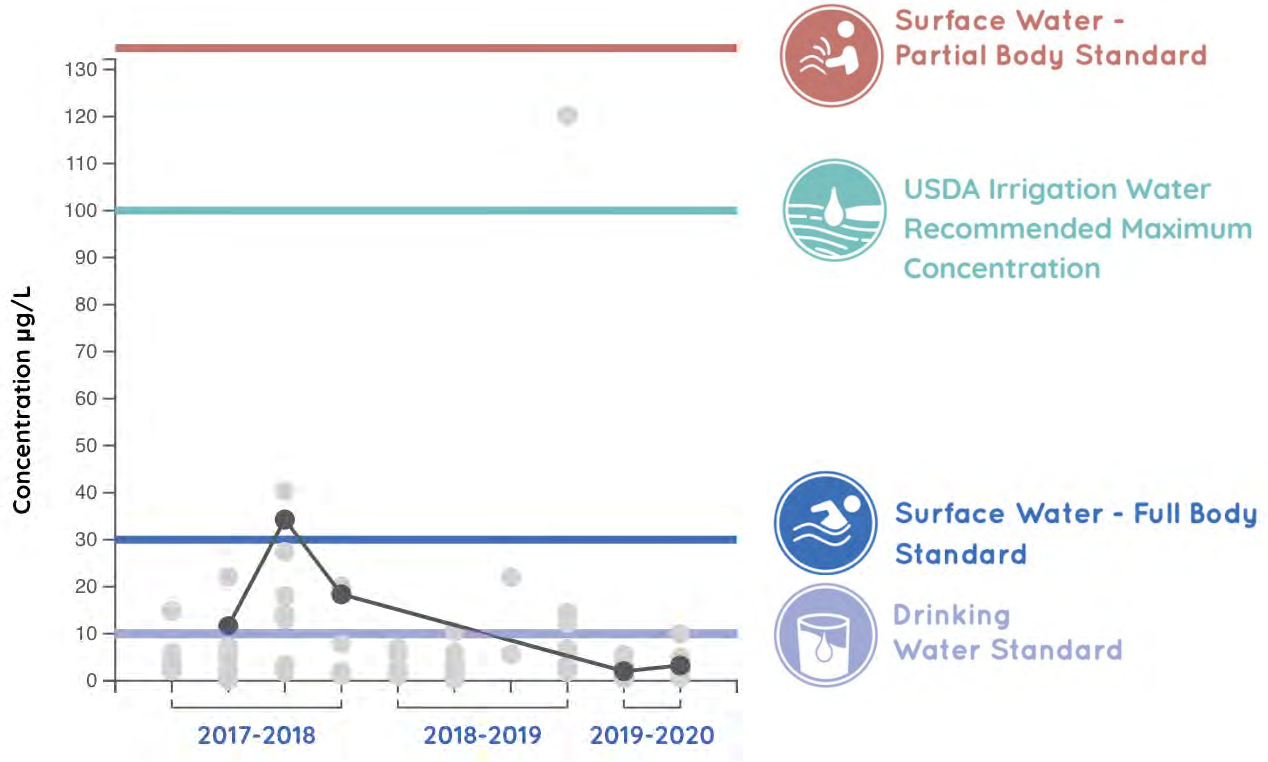
Arsenic
Pima County Exceedances

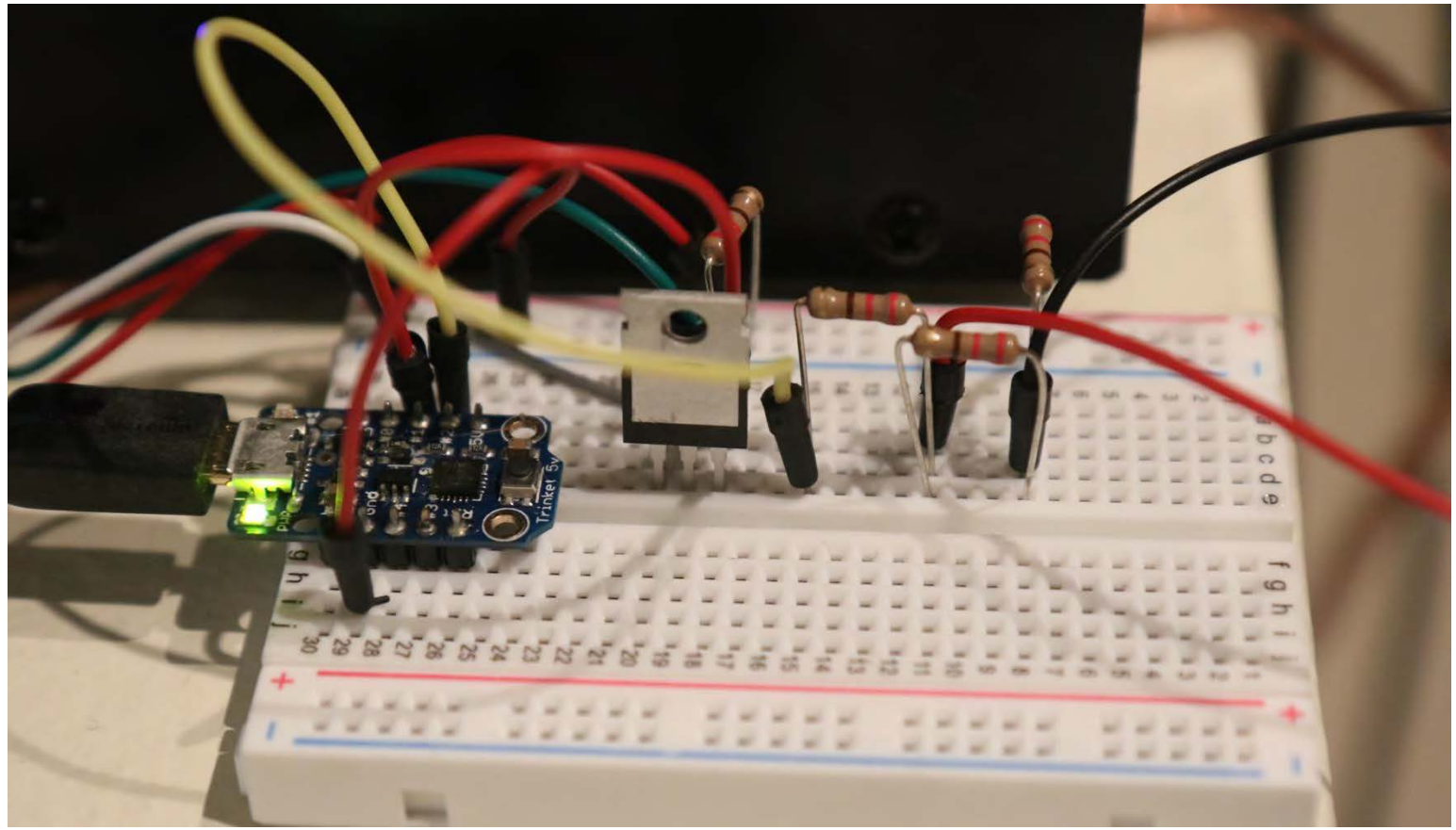
MCL
0.01 units

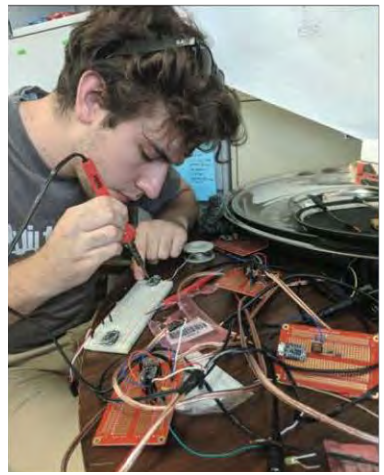
35.6% of samples exceed the MCL

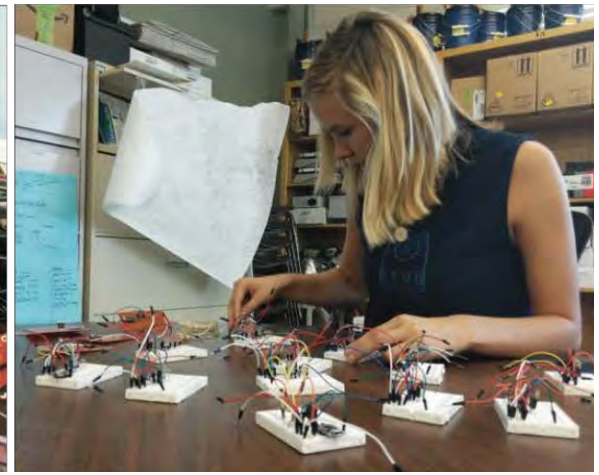
DATASET 2: Citizen Collected Data

Concentrations of Arsenic in Project Harvest Water Samples 2017-2020 (All years)

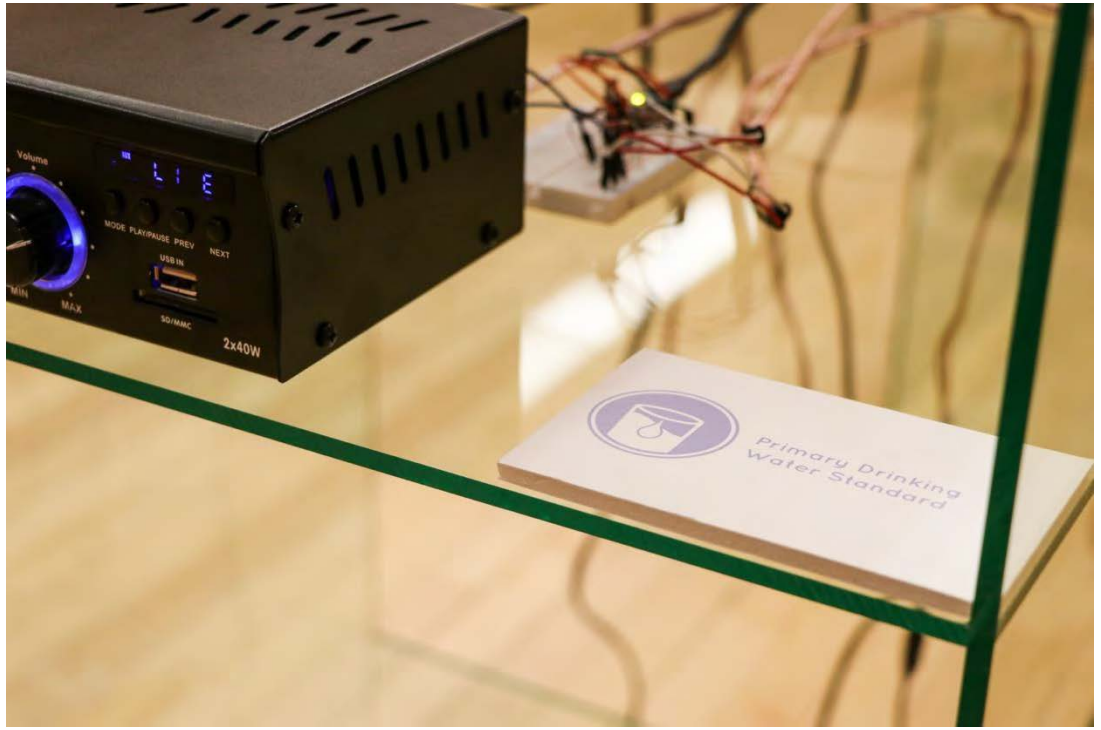




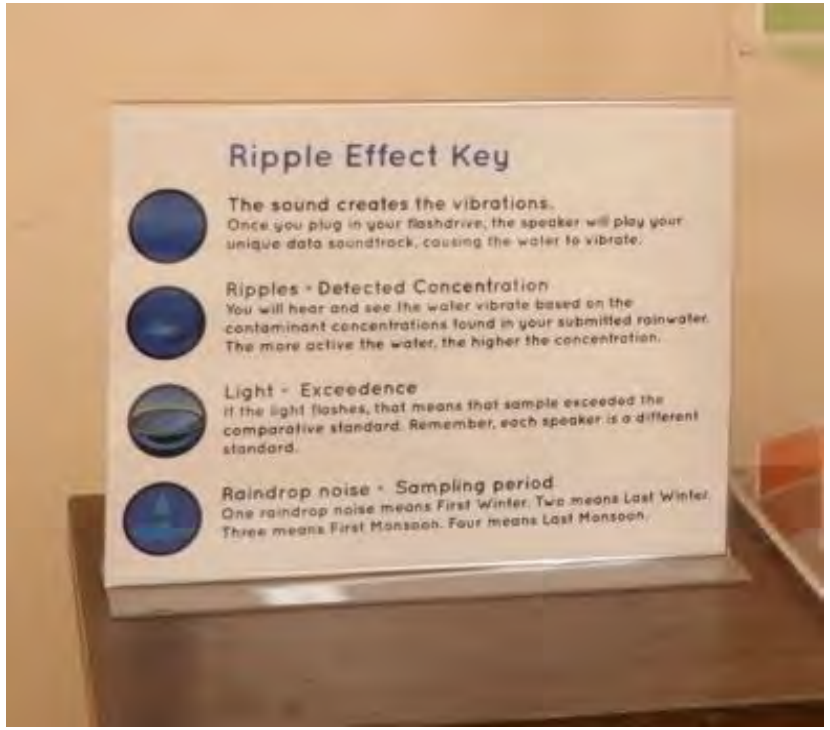




Sound stations organized by standard



Additional interpretive material




PYLE


PYLE
PYLE


Community health workers
Learning Research Team
Designers & Developers
Community members
Social Scientists
Environmental Scientists
Research Questions

Major Findings

- Ripple Effect affected the participants' senses, which caused them to pay more attention to their data. They also experienced heightened feelings of alarm and/or surprise compared to the booklet-only group.

> *"I'm a visual learner so I love that there is sound, light, and vibrations to feel. In my case, it affects all my senses."* - *Ripple Effect* Participant

Major Findings

- Participants in Ripple Effect developed a spatial, temporal, and embodied understanding of their data.

> *"Scientists tell you all the time how you can be part of your data or something like that… this is like a whole different consciousness and understanding of my environment."*
> - *Ripple Effect* Participant

Visiting a data art exhibition fostered more action from participants than only reading an informational booklet.

Participants who:

🎨 Visited Ripple Effect exhibition and read the booklet

📕 Only read the booklet

and...

...Took action
Increase or modified their rainwater

...Did not take any new action

Environmental Histories shared

"Right behind here used to run – remember, we used to have a water hose – what'd they call it?"

"Bloody tanks."

"Yeah"

"We had these water hoses up here. We didn't know any better. We'd go swimming in there. Right, when we were kids? And it was just fumes – there was discharge from the mines and everything else."

"It was pretty green water."

"The sulfuric acid made it green."

"And pretty soon all the plants were dying downstream."

"We didn't know any better."

Student questions – long term change

- How might sensory-based data experiences be designed to influence long-term environmental behaviours, not just provoke short-term emotional responses?
- Sensory art can provoke thought and evoke emotions, but does it truly lead to long-term behavioral change?
- To what extent can emotional engagement lead to long-term changes in public environmental attitudes and daily practices?

From Behaviour to Practice change