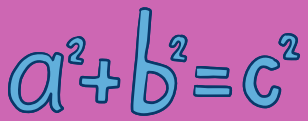
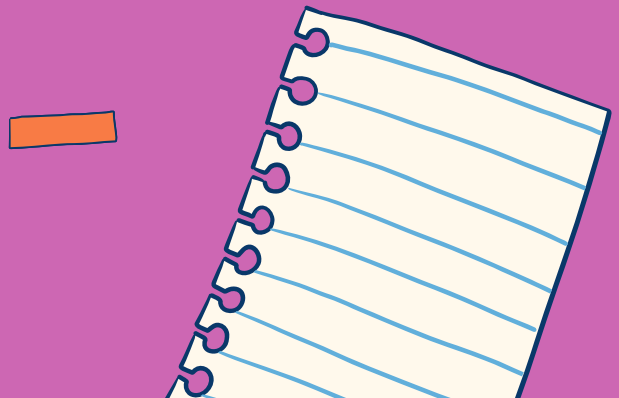




You should have a question taped to your back

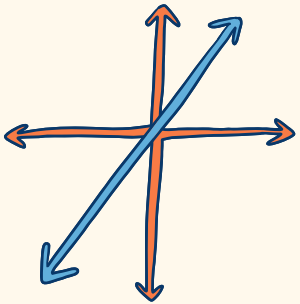
**SHHHHH** don't read any questions aloud!

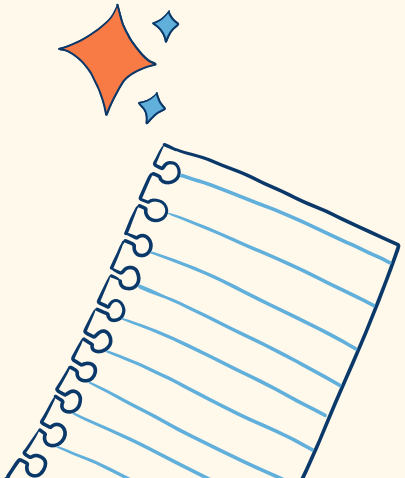
# Data-Rich Experiences for Engaging Students' Statistical Reasoning

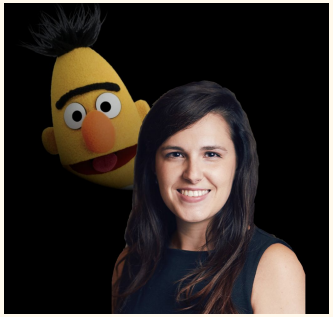
https://z.umn.edu/MCTM25

# Who are we?

## Lab Advancing Statistics Education Research (LASER) @ UMN







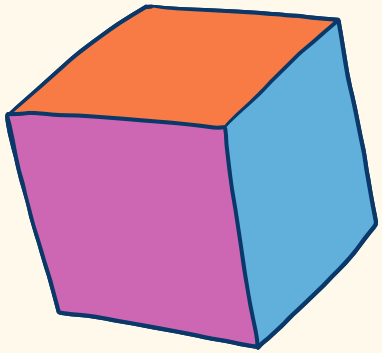
**Chelsey**
Our boss and LASER Lab webmaster

**Regina**
Minister of style and design

**Laura**
Senator of Off-Task Conversations

**Andy**
Just here for the ride

# Let’s play a game!



- Everybody should have a question taped to their backs
- As you walk around, you will answer others’ questions and record people's responses to your question
- **Don’t tell anybody what their question is!**
- **Don't include "units" or other context clues with your answers!**

# Consider your data

How did you record your data? (table, description, tally, etc.)

Who did you sample?

How might that affect the conclusions you make about your data?

 9.1.1.15

 9.1.1.2

 9.1.1.3

# Create a data visualization!

- Create a visualization of the data you collected
- Think about the kind of data you recorded
  - Is it numerical? Categorical?

9.1.1.10

# Describe your plot!

- What do you notice? What do you wonder?
- How would you describe it to someone else?
- Can you start to piece together a takeaway message?

9.1.1.10

# Guess your question!

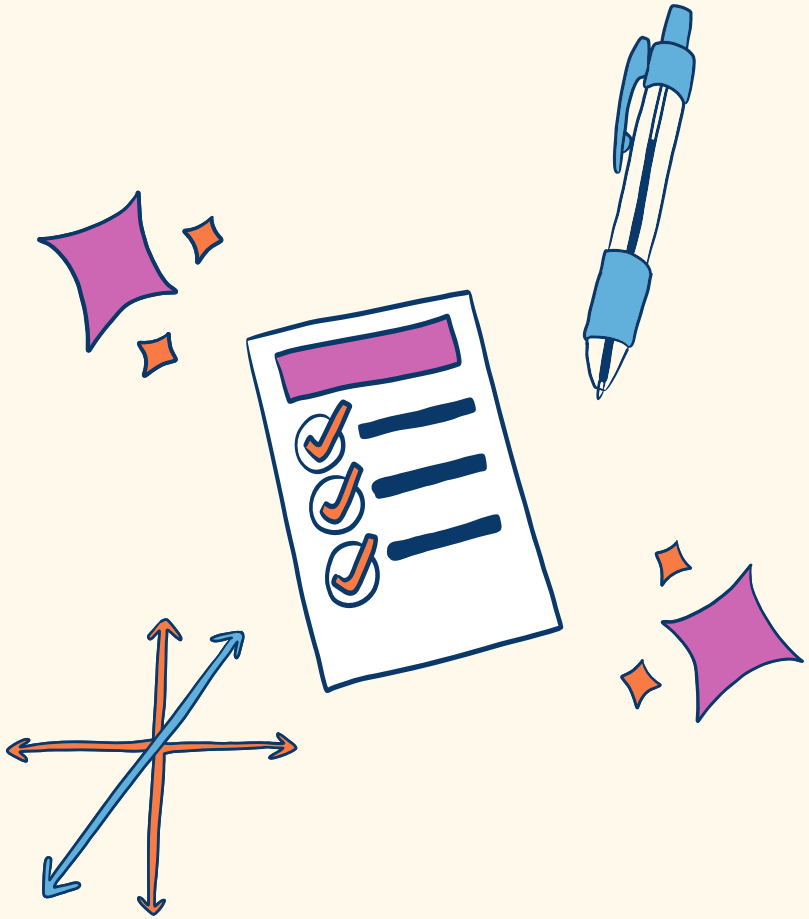
- Using your data visualization, attempt to identify what the question on your back is!

# Data Analysis

- Formulate a statistical investigative question that you might be able to answer with your data.
  - 9.1.1.1 
- Turn to your neighbor and discuss the answer to your research question, citing statistical evidence.
  - 9.1.1.14 

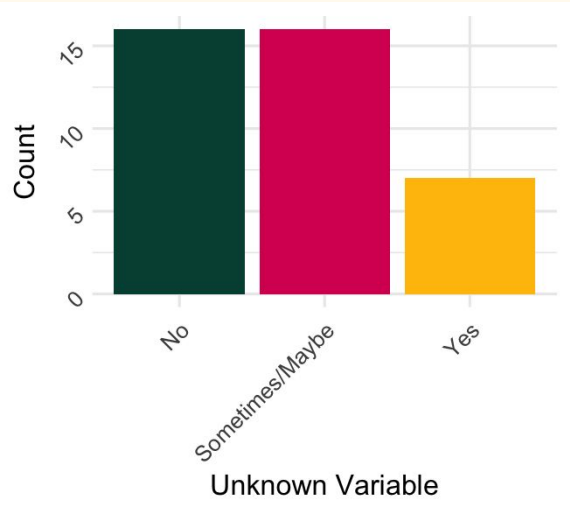
# Software to Use:

- R/RStudio
- TinkerPlots
- CODAP

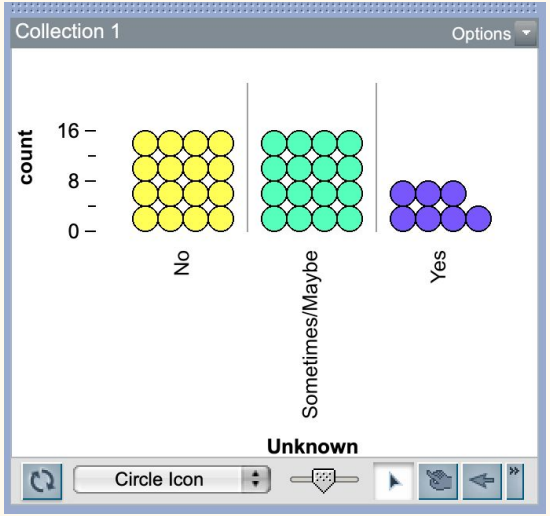


9.1.1.15

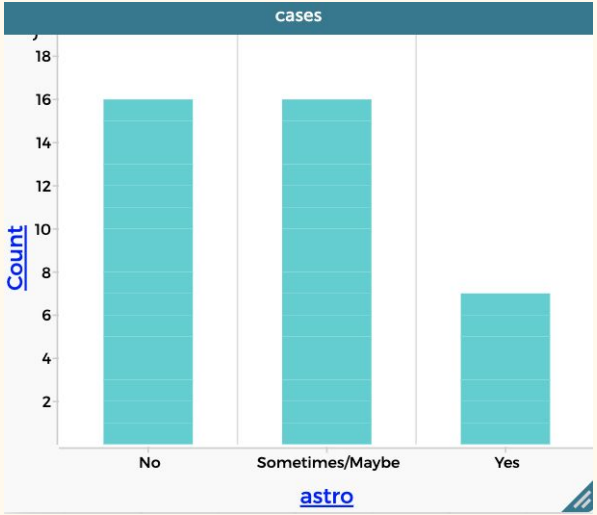
# Categorical Variable




R/ggplot2

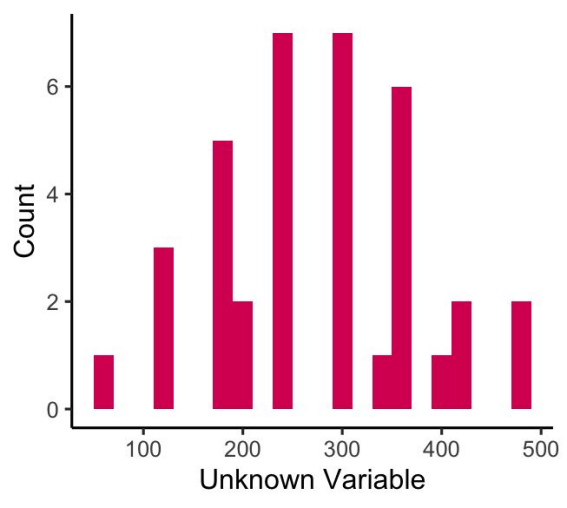



TinkerPlots

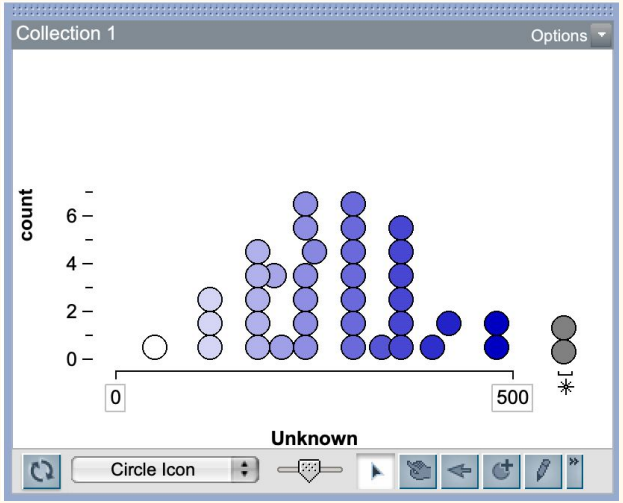



CODAP

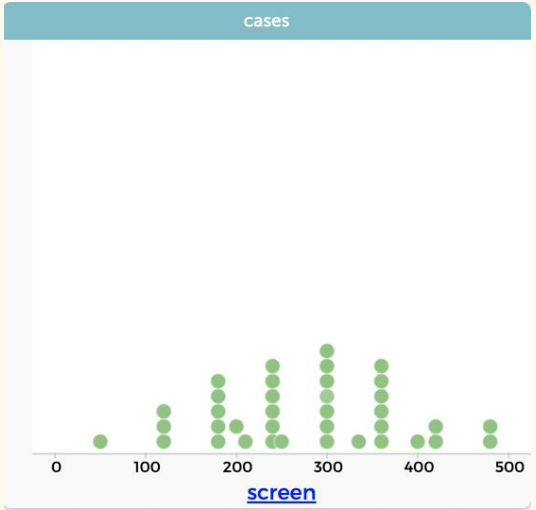
# Quantitative Variable




R/ggplot2




TinkerPlots

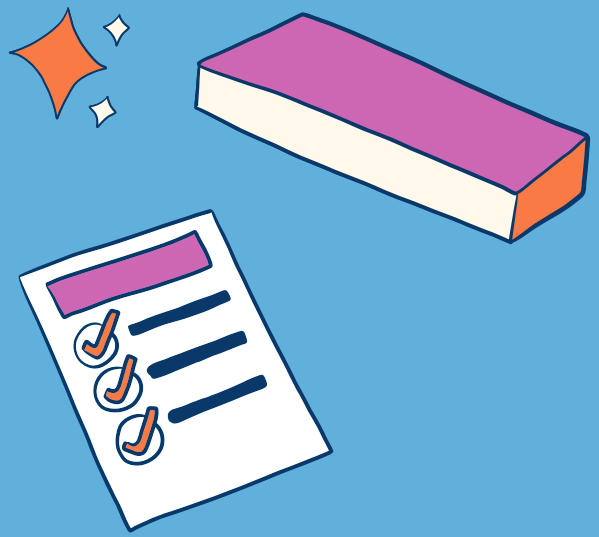



CODAP

# Wrap Up

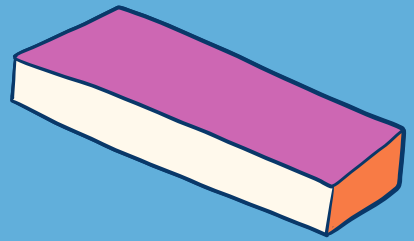
- This is an engaging activity to help students:
  - Gather data
  - Plot data
  - Explore variability
  - Discuss distributions
  - Extension: consider how the role of context makes statistics different from mathematics

# Additional Resources



- Activities
- Curriculum
- Bite-Sized

# Activities



### Spotify Playlists

Students explore what make a shuffled playlist "random".

### Greyscale Photos by Anna Ferguson

Students explore features of distributions by comparing grayscale images to corresponding dotplots.

### Contagious Yawns

Students explore experimental variability to determine whether or not yawns are contagious.

# Activities: Spotify Playlists

- Develop "rules" for determining if a playlist seems random
- Test those rules
- Discuss how "random" might not be what they think it is

## Spotify's Random Playlists: Training Set

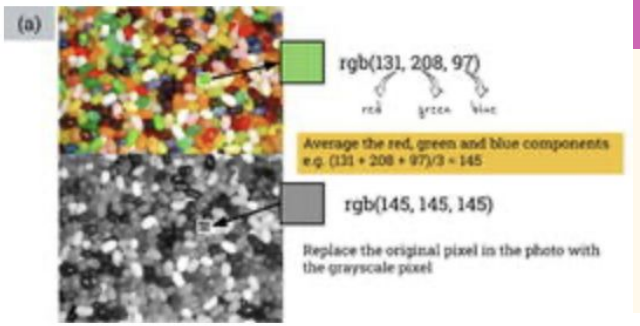
PUBLISHED
January 7, 2025

These 25 playlists were generated from Mr. Hoffman's library using a genuine random number generation method. Use them to develop your rules.

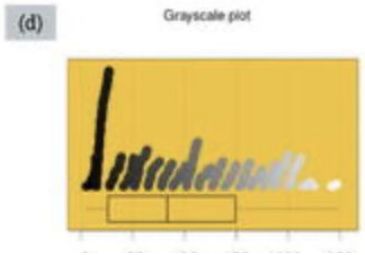
### Playlist #1

| SONG | ARTIST | ALBUM | YEAR | PEAK |
|---|---|---|---|---|
| We Are Never Ever Getting Back Together | Taylor Swift | Red | 2012 | 4 |
| God Is A Woman | Ariana Grande | Sweetener | 2018 | 4 |
| Objection (Tango) | Shakira | Laundry Service | 2001 | 17 |
| Sweet Dreams | Beyoncé | I Am...Sasha Fierce | 2008 | 5 |
| 7 Rings | Ariana Grande | Thank U, Next | 2019 | 1 |
| Controlla | Drake | Views | 2016 | 18 |
| What's My Name | Rihanna | Loud | 2010 | 1 |
| Don't Bother | Shakira | Oral Fixation Vol. 2 | 2005 | 9 |
| Jumpman | Drake | What A Time To Be Alive | 2015 | 58 |
| Grenade | Bruno Mars | Doo-Wops & Hooligans | 2010 | 1 |
| Drunk In Love | Beyoncé | Beyoncé | 2013 | 9 |
| Disturbia | Rihanna | Good Girl Gone Bad: Reloaded | 2008 | 3 |

# Activities: Greyscale Photos





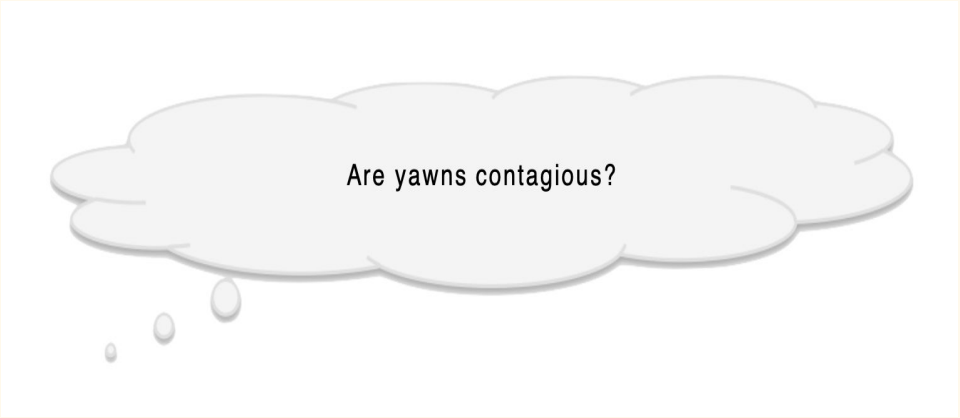




Allows for discussions around features of distributions

Fergusson, A., & Pfannkuch, M. (2024). Using Grayscale Photos to Introduce High School Statistics Teachers to Reasoning with Digital Image Data. *Journal of Statistics and Data Science Education*, *32*(4), 345–360. https://doi.org/10.1080/26939169.2024.2351570

# Activities: Contagious Yawns

- Create a two way table
- Learn about dummy coding categorical variables
- Create a model to explore experimental variability in TinkerPlots
- End with a hypothesis test to answer the research question



# Curriculum

**AIMS**

Activities + Lesson Plans

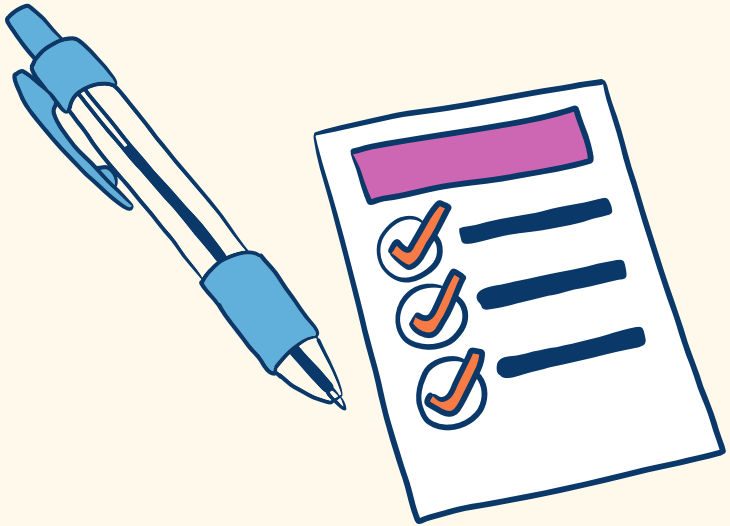
**CATALST Curriculum**

Class activities + online textbook

**OpenIntro**

Online textbook + data sets

# Curriculum: Adapting and Implementing Innovative Material in Statistics (AIMS)



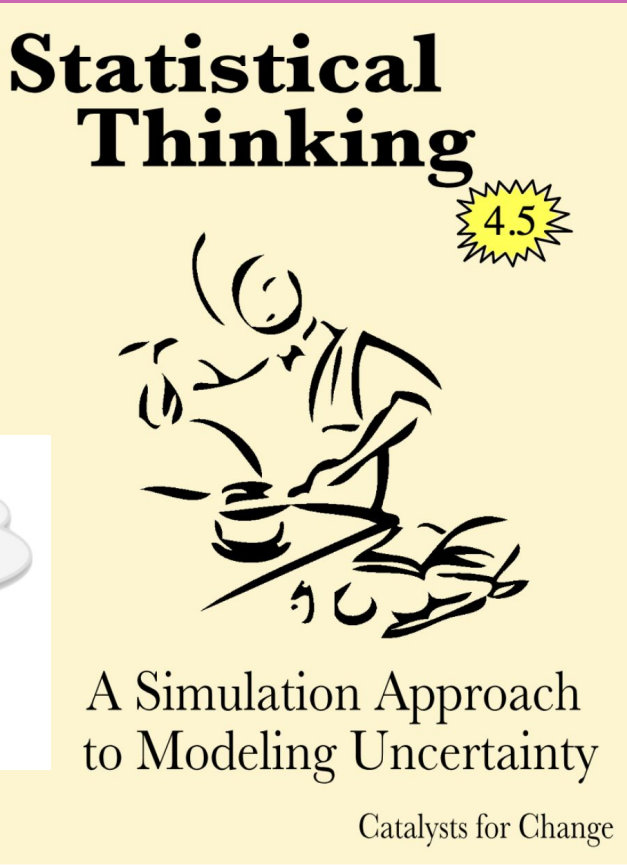
- Emphasize statistical literacy and develop statistical thinking
- Use real data
- Stress conceptual understanding
- Foster active learning in the classroom
- Use technology for developing conceptual understanding and analyzing data
- Use assessments to improve and evaluate student learning

# Curriculum: CATALST

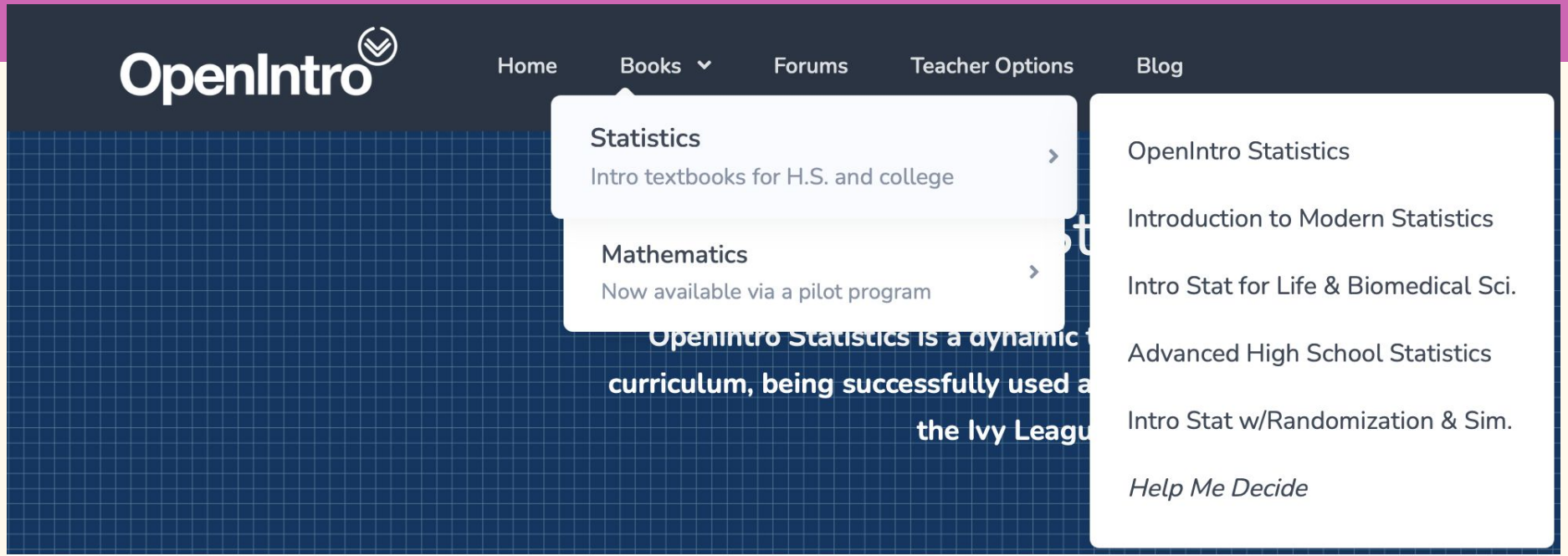
Are infants able to notice and react to helpful or hindering behavior observed in others?

Does the effect of sleep deprivation last, or can a person "make up" for sleep deprivation by getting a full night's sleep in subsequent nights?

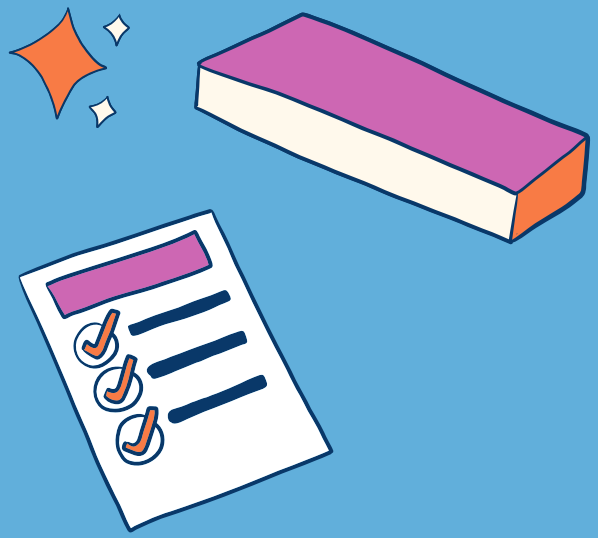
TinkerPlots™
DYNAMIC DATA EXPLORATION



# Curriculum: OpenIntro



# Our Favorite Bite-Sized Resources

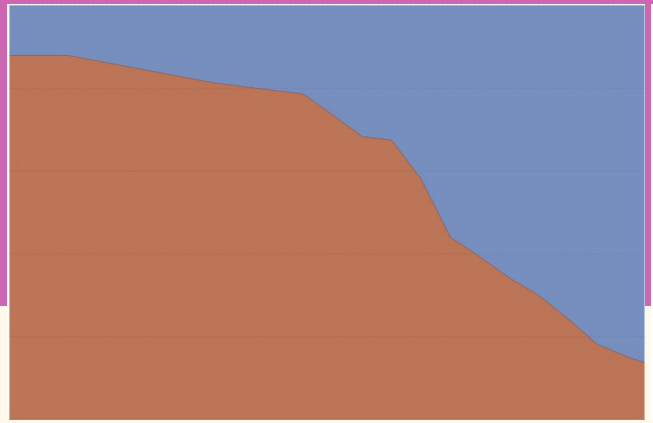


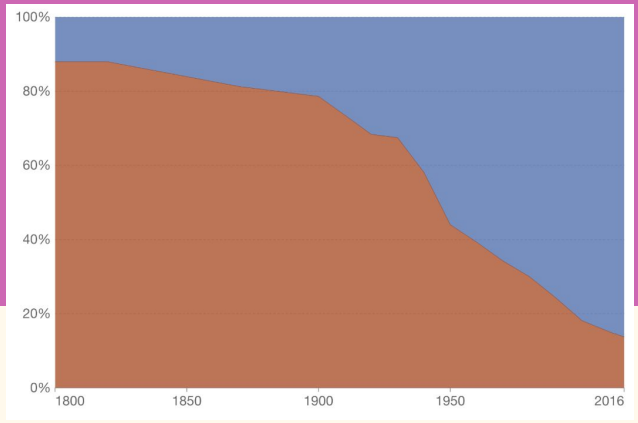
- Slow Reveal Graphs
- What's Going on in this Graph?
- Data Talks
- Graph of the Week
- Our World in Data

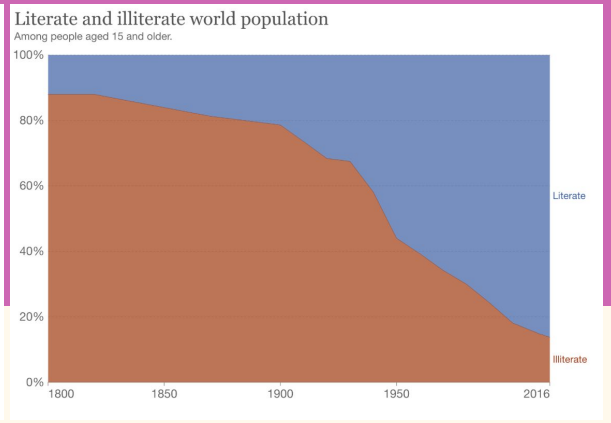
# Bite-Sized: Slow Reveal Graphs

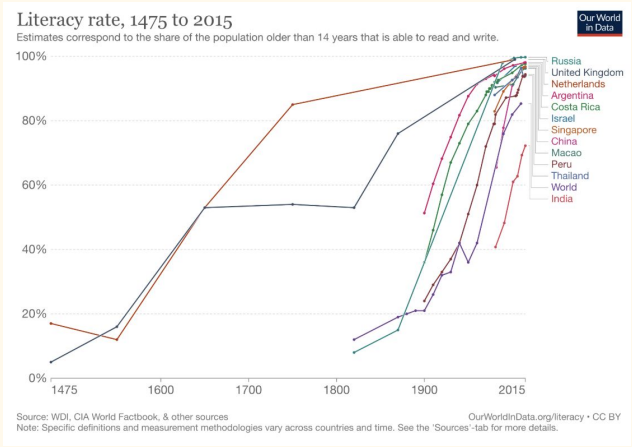
Jenna Laib

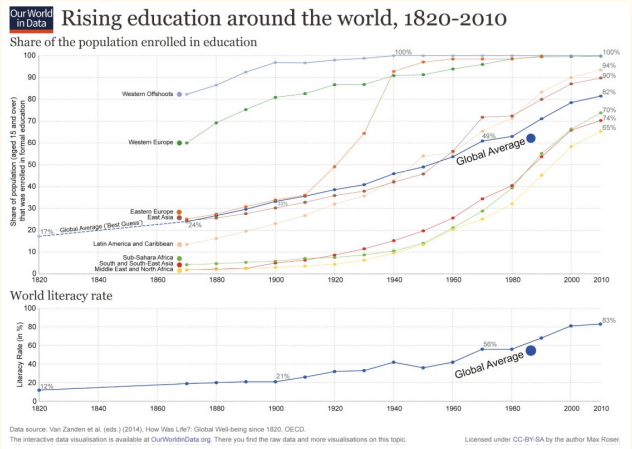
- “Instructional routine”
- Scaffolded visuals and discourse
- Slide decks w/ discussion prompts
- K-12+




100%
80%
60%
40%
20%
0%
1800
1850
1900
1950
2016


Literate and illiterate world population
Among people aged 15 and older.
100%
80%
60%
40%
20%
0%
1800
1850
1900
1950
2016
Literate
Illiterate


Literacy rate, 1475 to 2015
Estimates correspond to the share of the population older than 14 years that is able to read and write.
Our World in Data
100%
80%
60%
40%
20%
0%
1475
1600
1700
1800
1900
2015
Russia
United Kingdom
Netherlands
Argentina
Costa Rica
Israel
Singapore
China
Macao
Peru
Thailand
World
India
Source: WDI, CIA World Factbook, & other sources
OurWorldInData.org/literacy • CC BY
Note: Specific definitions and measurement methodologies vary across countries and time. See the 'Sources'-tab for more details.

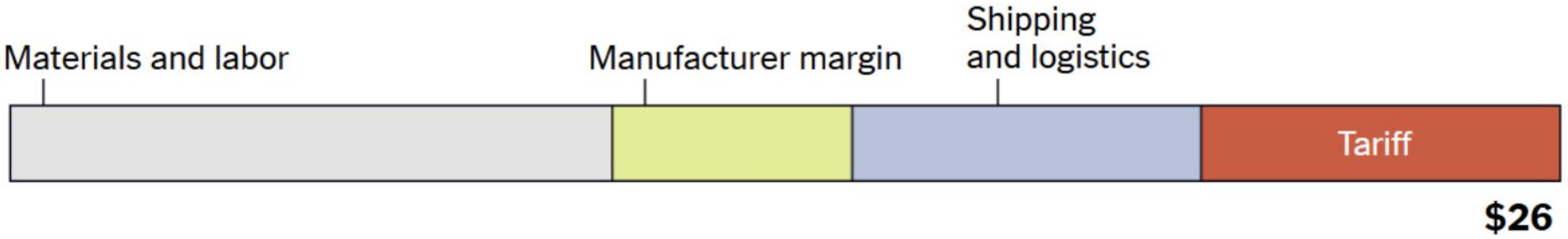

Our World in Data
Rising education around the world, 1820-2010
Share of the population enrolled in education
Share of population (aged 15 and over) that has received some schooling
Western Offshoots
Western Europe
Eastern Europe
East Asia
Latin America and Caribbean
Sub-Sahara Africa
South and South-East Asia
Middle East and North Africa
Global Average
Global Average (Best Guess)
17%
24%
33%
45%
70%
74%
82%
94%
100%
World literacy rate
Literacy Rate (in %)
12%
21%
56%
83%
Global Average
1820
1840
1860
1880
1900
1920
1940
1960
1980
2000
2010
Data source: Van Zanden et al. (eds.) (2014), How Was Life?: Global Well-being since 1820, OECD.
The interactive data visualisation is available at OurWorldInData.org. There you find the raw data and more visualisations on this topic.
Licensed under CC-BY-SA by the author Max Roser.

# Bite-Sized: What's Going on in this Graph?

New York Times

- Graphs, maps and charts from The Times — and an invitation to students to discuss them live.
- What do you notice? What do you wonder? What surprises you? How does this relate to you and your community? Create a catchy headline that captures the graph's main idea.
- 1-2 weeks posting schedule

**Cost components of an imported sneaker from China**




**Notes:**

- The $26 cost is the import cost of the shoes. The price to the consumer (the shoe buyer) might be closer to $145 because it includes other costs including the retailer's (shoe store's) markup.
- The tariff is $6, of which $2 is the 10 percent tariff imposed by President Trump in February. The additional 10 percent tariff imposed March 4 is not included.

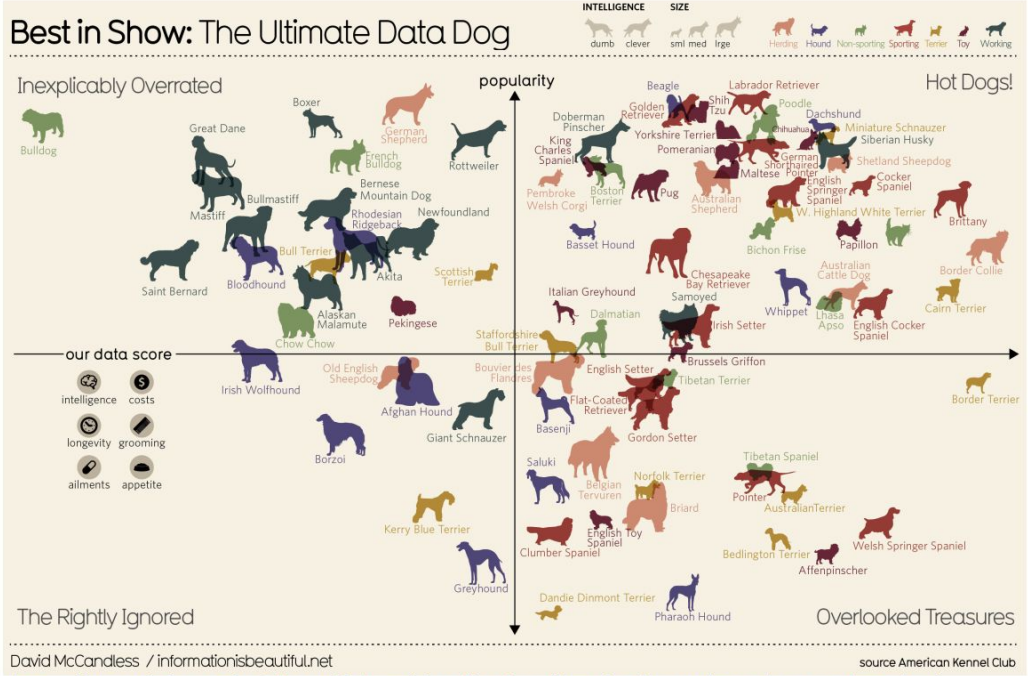
# Bite-Sized: Data Talks

YouCubed from Stanford University

- 5-10 minute data literacy focused discussions
- Varied material across K-12
- Starts with “What do you notice? What do you wonder?”
- Provides additional information and questions for instructors

**Youcubed Data Talk**
**We Love Dogs!**

What do you notice?
What do you wonder?
What is going on in this data visualization?




https://www.informationisbeautiful.net/visualizations/best-in-show-whats-the-top-data-dog/

# Bite-Sized: Graph of the Week

Kelly Turner

- Data literacy centered
- 1 page worksheet
- Archived material and new graph each week

**Graph of the Week** **Name**_____

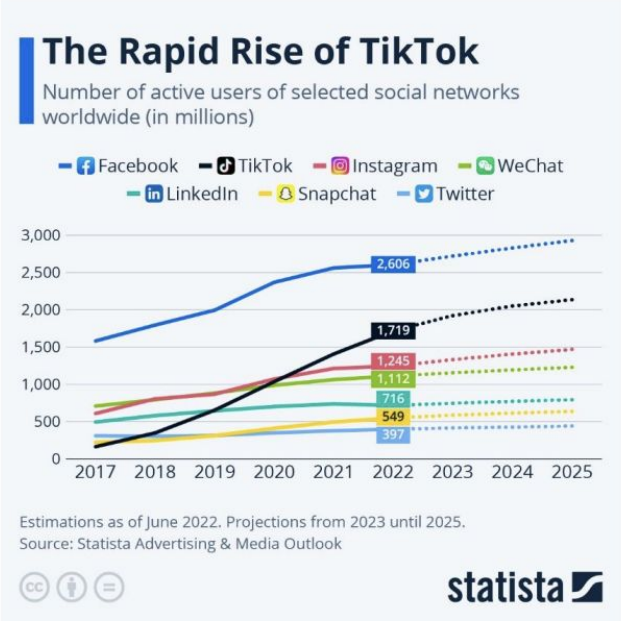
**April _____ 2025**

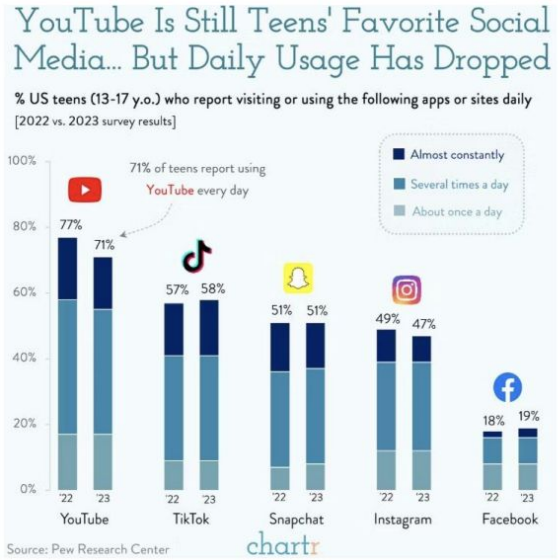
Analyze the graphs below and write a reflection on what you think the graphs are communicating to you. To guide you with your response, start with some observations.

- What is the topic of the graph?
- What quantities are being compared?
- What are some observations that you can make based on the graphs?
- What surprises you about the graph? What do you wonder?
- What do you foresee happening in the next 10 years?

Questions to ask when reading graphs:

- Is there an upward or downward trend?
- Are there any sudden spikes in the graph?
- What is being compared in the graph?
- What prediction can I make for the future?
- What inferences can I make about the graph?



# Bite-Sized: Our World in Data

University of Oxford + Global Change Data Lab

- Bite-sized insights on how the world is changing, published every weekday

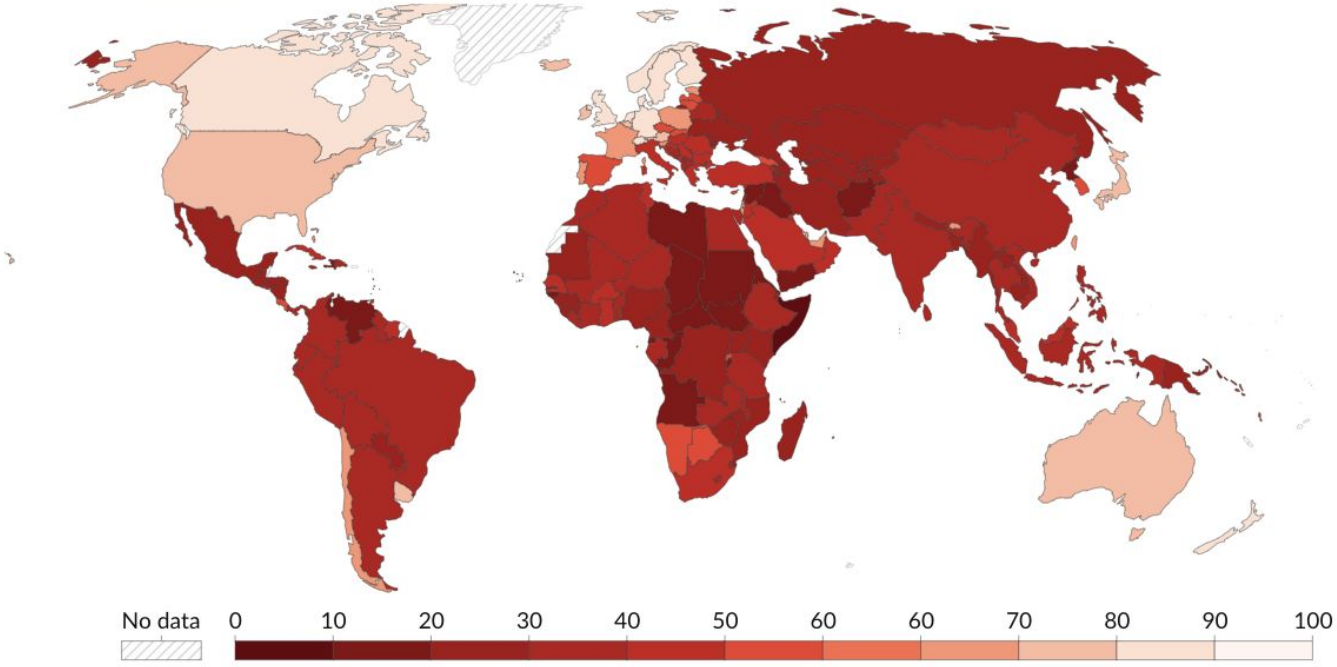
# Corruption Perception Index, 2016

Transparency International's Corruption Perception Index. Scores are on a scale of 0-100, where 0 means that a country is perceived as highly corrupt.

Our World in Data

Table | Map | Chart

World




**Data source:** Transparency International (2018) – Learn more about this data

OurWorldinData.org/corruption | CC BY

# Thank you!

Check out our work at:
laser-umn.github.io

Interested in statistics education in the Cities?
https://calegacy.github.io/stat-chat/

# Benchmarks We Covered Today

| | | |
|---|---|---|
| 9.1.1.1 | Formulate statistical investigative questions and pose hypotheses. These include questions about variation or the differences between groups, associations between quantitative and categorical variables or pairing together multiple analyses. | 9th–11th |
| 9.1.1.2 | Explain how choices concerning data collection methods can affect the quality, size, speed, accessibility and cost of the data. | 9th–11th |
| 9.1.1.3 | Analyze issues of bias by considering data collection methods and cultural perspectives. | 9th–11th |
| 9.1.1.4 | Explain the purposes of and differences among sample surveys, experiments and observational studies. Explain whether randomization in each allows for conclusions of causation and/or generalization of a population. | 11th |
| 9.1.1.10 | Create and analyze data displays, including scatter plots, histograms and boxplots using technology. | 9th |
| 9.1.1.15 | Identify and explain misleading uses of data along with how to use spreadsheets, tables or graphing technology to recognize and analyze distortions in data displays. Use interactive data visualizations to support and influence different points of view. | 9th–11th |