Creating a Classroom of “Data Doers”

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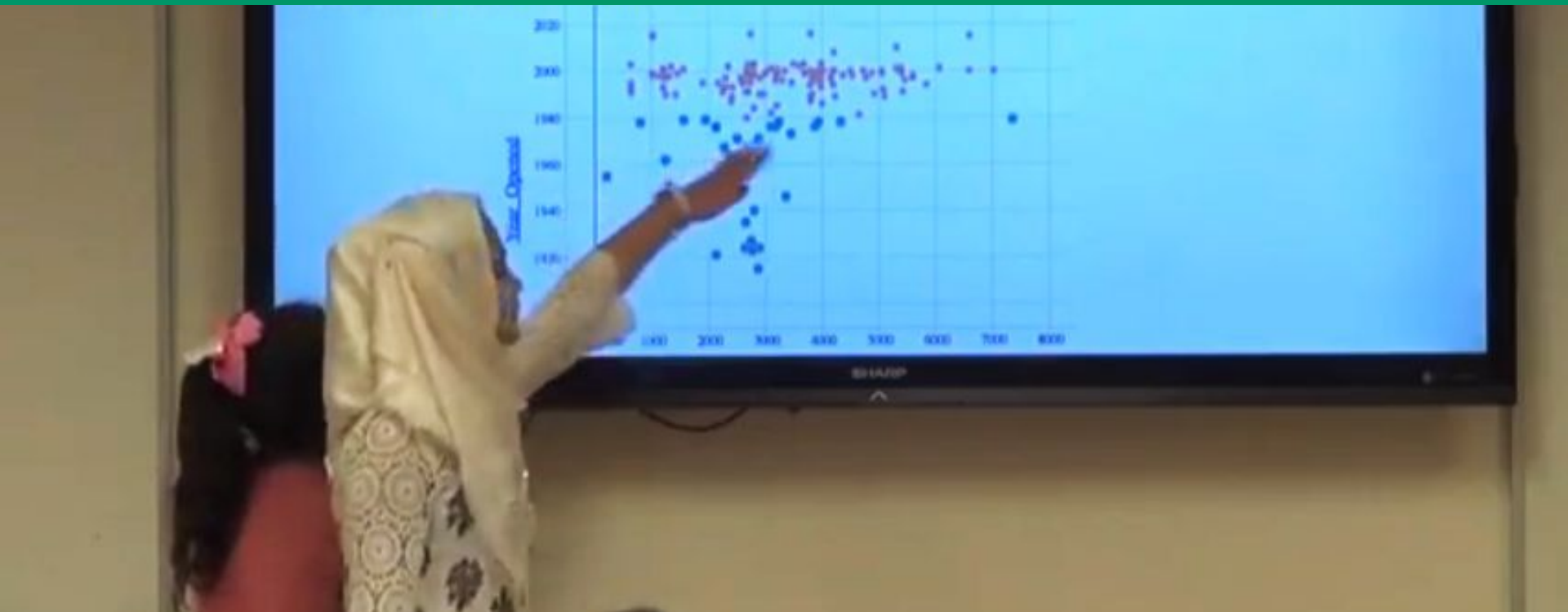
NCTM April 18, 2024



Our Plan

- Introduction of Draft Position Statement
- Doing Data Across Disciplines
- Example Across Grades and Disciplines
- Resources

https://www.teachforamerica.org/one-day/top-issues/why-its-important-to-break-computer-science-stereotypes

Changing the future for who can learn with and from data

NCTM NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS

ASA AMERICAN STATISTICAL ASSOCIATION
Promoting the Practice and Profession of Statistics®

Five Organizations

A Unified Position

CSTA

NCSS National Council for the Social Studies

nsta National Science Teaching Association

Proposed Joint Position Statement

Draft version.

Data science bridges disciplines and thus should be introduced and **taught across the curriculum in K-12** schools to help develop informed users of data....

All subjects in school should recognize the contribution of data to their discipline and take curricular approaches that **integrate data with disciplinary lessons** where appropriate.

Four Guiding Principles in the Proposed Joint Statement

1. Data science is contextual and multidisciplinary.
2. Data science is an investigative process.
3. Data science understandings and experiences are for everyone.
4. Data science educators must develop and practice ethical uses of data.

Draft version

Where are opportunities for data science in middle and high school curricula?

Opportunities to “Do Data” in Disciplines

Mathematics	Interpret differences in shape, center, and spread in the context of the data sets, **accounting for possible effects of extreme data points (outliers)**.
Science	**Analyze and interpret data** to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
Social Studies	**Identify, describe, and evaluate evidence** about events from diverse sources (including written documents, works of art, photographs, **charts and graphs**, artifacts, oral traditions, and other **primary and secondary sources**).
English Language Arts	**Integrate and evaluate multiple sources** of information presented in diverse formats and media (e.g., **quantitative data, video, multimedia**) in order to address a question or solve a problem.
Computer Science	(3-5) **Organize and present collected data visually** to highlight relationships and support a claim. (6-8) **Collect data using computational tools and transform the data** to make it more useful and reliable

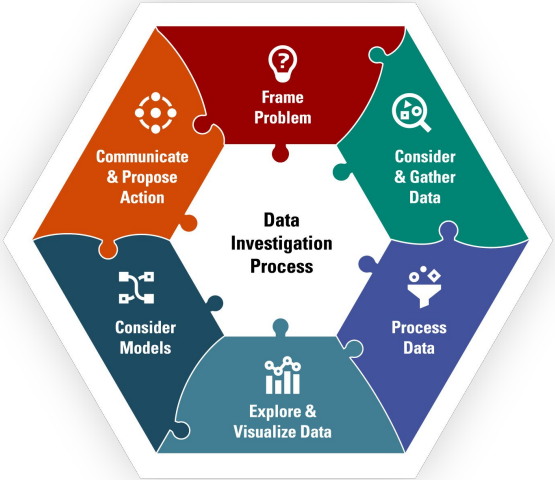
Every Subject

All learners K-12

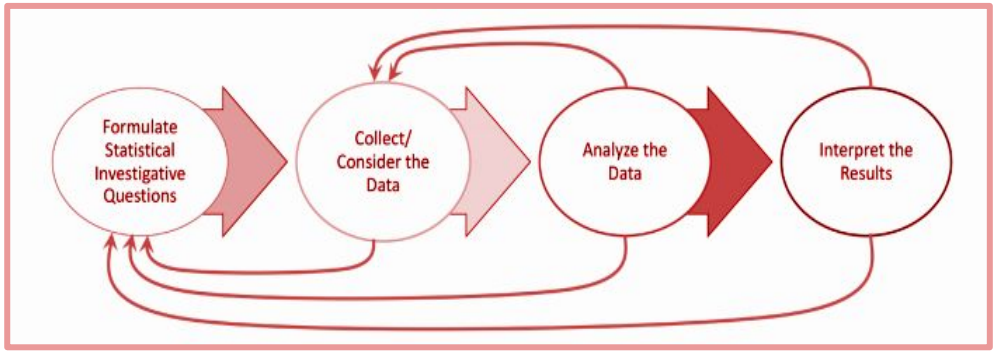
Who can be a Data Doer?

You and your students!

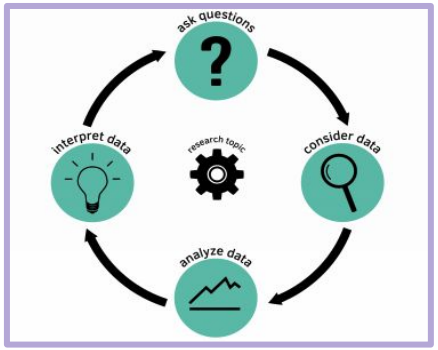
Process for Working with Data: Phases of Data and Statistical Investigations



Lee, Mojica, Thrasher, & Baumgartner, 2022



Statistical Problem Solving as an Investigation Process (GAISE II, 2020)



Data Cycle (Gould et al., 2016)

Example - Climate Change in our Community

- A changing climate is one of the most important challenges of our time
- Around the world, extreme weather presents unprecedented structural and economic challenges for humans
- Students in a 5th grade class wondered how the personal environments in their community were being affected by climate change
- They posed the following investigative question:

What are typical climate challenges that affect our community?

Activity developed by Anna Bargagliotti & Anna Gralnik (5th grade teacher)

Investigative Process

Multiple facets and data sources were used by the students including:

- New York Times interactive map
- Data students collected on their own using the map
- Photovoice project that captured perceptions of climate change through their eyes
- Articles with contrasting opinions about climate change
- Essay about their thoughts on climate change (opinion)
- Class debate (assigned sides) using evidence from articles written by Greta Thunberg and Naomi Seibt

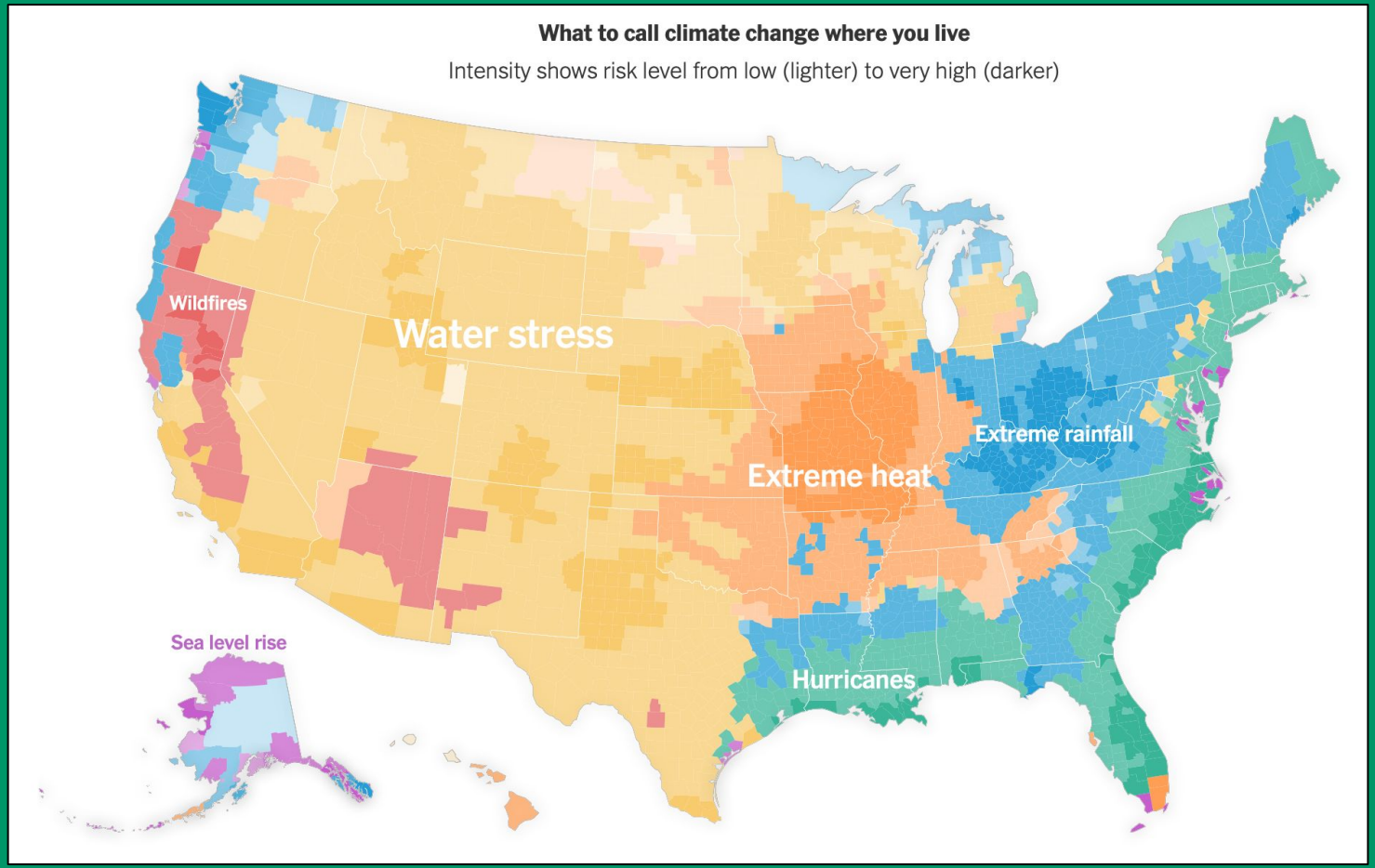
Overall the activity focused on **thinking like a data scientist using a cross-disciplinary approach**

A Collaboration between the American Statistical Association (ASA) and the New York Times (NYT)

THE LEARNING NETWORK

The New York Times

What's Going On in This Graph?



Interact with the Map https://www.nytimes.com/2020/10/15/learning/whats-going-on-in-this-graph-climate-threats.html

Static Map Example Noticings

The colors on the chart make sense to what they are representing. Yellow is like the Earth without water or like the desert; blue is like water, for rain; and red is like fire.	Our community is mostly really dry, which makes us prone to wildfires. Most of it is basically a desert and really hot. We have warm waters and lots of drought. We also have some places that have heavy rainfall.	Since the sea levels are rising, people who own property by the beach might get flooded, so they would be forced to move in-state

Important Noticings from the Static Map

- Each color represents a type of environmental risk (6 colors). The categories are:
  - Wildfires
  - sea level rise
  - extreme drought and water stress
  - extreme heat
  - extreme rainfall
  - hurricanes.

- Different areas of the United States are subject to different environmental risks.
  - Large portions of the United States are subject to water stress.
  - Extreme heat is focused mostly in the mid-South and lower rust belt.
  - Extreme rainfall is in the Northeast, and hurricanes hit the Atlantic Coast and southeastern states.
  - The Pacific West Coast has some extreme rainfall in the Northwest, as well as wildfires.

Guiding Questions for Students Interacting with the Map

- What does the color coding represent
- What does the darkness/lightness of the color represent?
- Where did the data come from? What data were collected to make this map?
- What are you noticing now?
- Explain what features of the interactive map help you notice.
- What conclusion can you draw based on your discoveries?
- Continue exploring and noting your discoveries.
- What are you noticing about your own community?
- What are you noticing about other states in the United States?

Student Work Examples

- *Water stress or wildfires + rain make mudslides/landslides. So in CA, we have water stress, wildfires, and rain. When wildfires burn the plants or when water stress makes them dry, their roots can't hold the soil together. Then when it rains, the water washes through the soil, making it watery and turning it to mud.*

- *On the map, Hawaii was all purple, which means the sea levels rise. Maybe in a couple of decades, the island might be under water.*

- *Hawaii seems to be covered by rising sea levels, and since it is not too far from us, it can affect us by pushing the waves over, putting us in a position of rising sea levels too.*

- *We compared Arizona and California. We discussed whether Arizona or California had more wildfires. We decided that Arizona has more wildfires, but California has more severe cases of wildfires because California has more vegetation.*

Digging Deeper Into Your Community

In groups, students are asked to collect data on local counties using the map

Example work from one group: Counties in California

created by one group of students.

	A	B	C	D	E	F	G
1		**Extreme Rainfall**	**Water Stress**	**Heat Stress**	**Wildfire Risk**	**Sea Level**	**Hurricanes**
2	Sierra	Medium risk	High risk	Low risk	Very high risk	No risk	No risk
3	Siskiyou	Medium risk	High risk	Low risk	High risk	No risk	No risk
4	Sedona	Medium risk	Medium risk	Medium risk	Medium risk	Low risk	No risk
5	Sonoma	Medium risk	Medium risk	Medium risk	High risk	Low risk	No risk
6	Stanislaus	Medium risk	High risk	Medium risk	Medium risk	No risk	No risk
7	Sutter	Medium risk	Medium risk	High risk	Medium risk	No risk	No risk
8	Tehama	High risk	Medium risk	Low risk	High risk	No risk	No risk
9	Trinity	High risk	Medium risk	Low risk	High risk	No risk	No risk
10	Tulare	Very high risk	Medium risk	High risk	Low risk	Low risk	No risk
11	Tuolumne	Medium risk	High risk	Low risk	High risk	No risk	No risk
12	Ventura	Low risk	Very high risk	Low risk	Medium risk	Medium risk	No risk
13	Yolo	High risk	Medium risk	Medium risk	Medium risk	No risk	No risk
14	Yuba	High risk	High risk	Medium risk	Medium risk	No risk	No risk

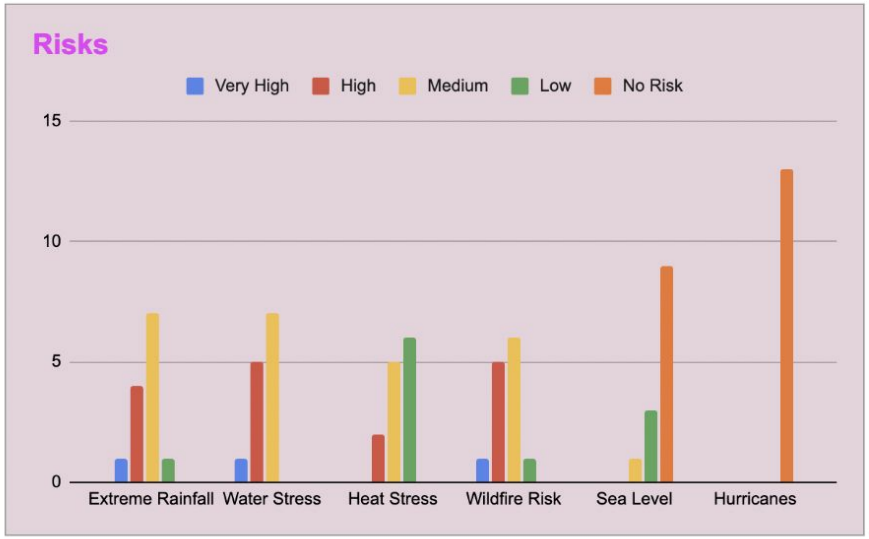
Students Re-code and Make New Variables

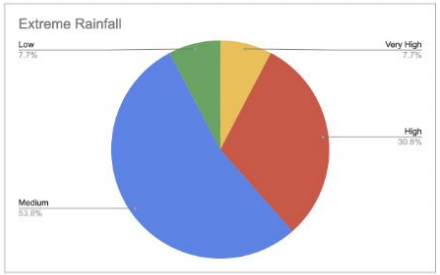
For each county, students recorded the severity of each of the risks.

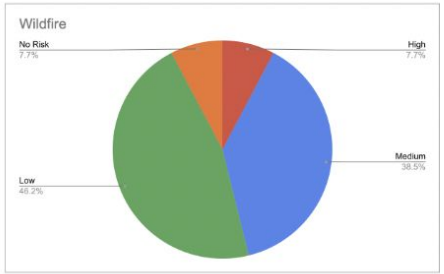
They tallied the risks into a table and made additional graphical displays to help illustrate the risks in their local community

	Extreme Rainfall	Water Stress	Heat Stress	Wildfire Risk	Sea Level	Hurricanes
Very High	1	1	0	1	0	0
High	4	5	2	5	0	0
Medium	7	7	5	6	1	0
Low	1	0	6	1	3	0
No Risk	0	0	0	0	9	13

New Graphical Displays Based on Summary Data







There is real no risk of hurricanes around us. There is very little risk of the sea level rising anywhere in our community.

Water-stress and wildfire risk are our two main climate issues.

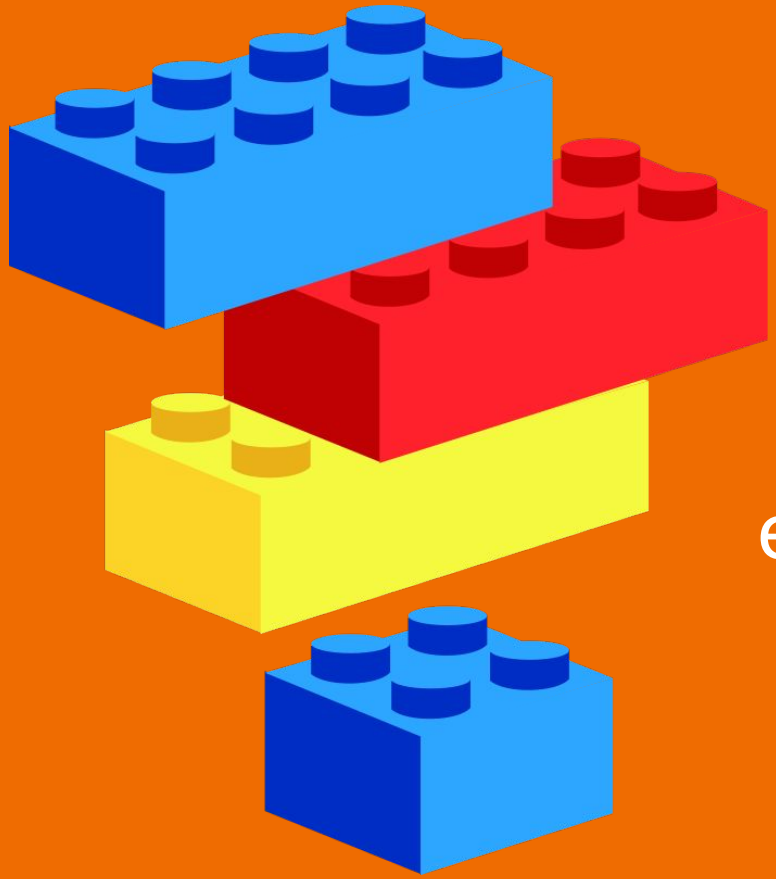
Heat stress is surprisingly a lower risk, that may be because the ocean brings in a breeze.

I am most worried about water stress in our community! I see a lot of the counties our class researched that have medium risk of water stress.

Extension

To culminate the investigation and to relate their data to their own experiences, the sixth grade students were asked to take four to five pictures of their environment. The pictures were used as part of a photovoice study the students completed as part of the larger unit.

Note: A photovoice study asked the students to collect photos and record their thoughts about their environment and how the photos relate to the data, articles, other photos they had been investigating in class.



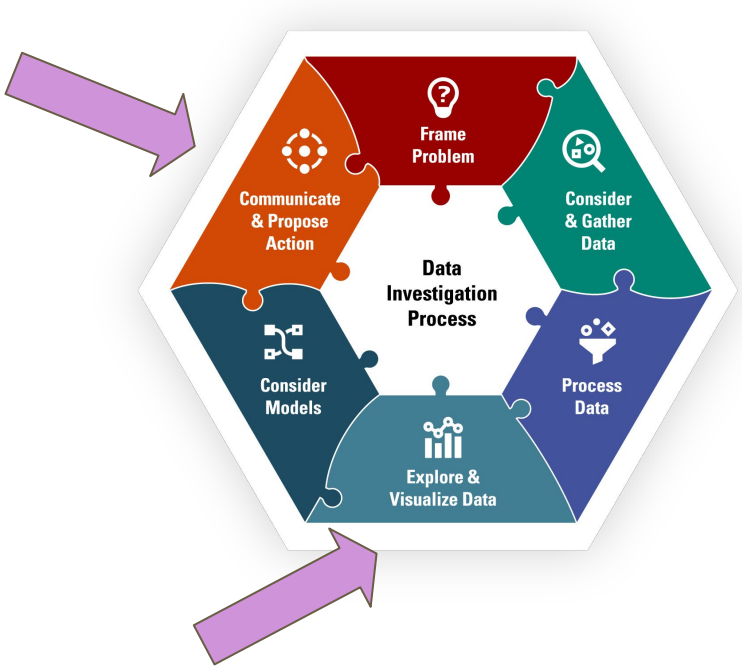
More with this example...

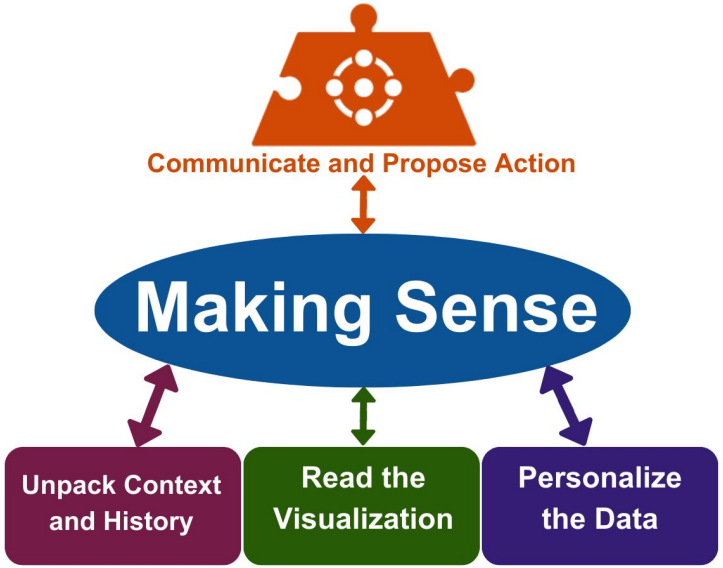
expanding to other subjects

and grade levels

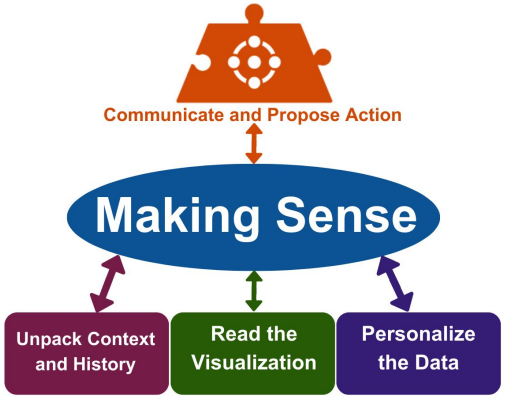
Making Sense of Data Visualizations

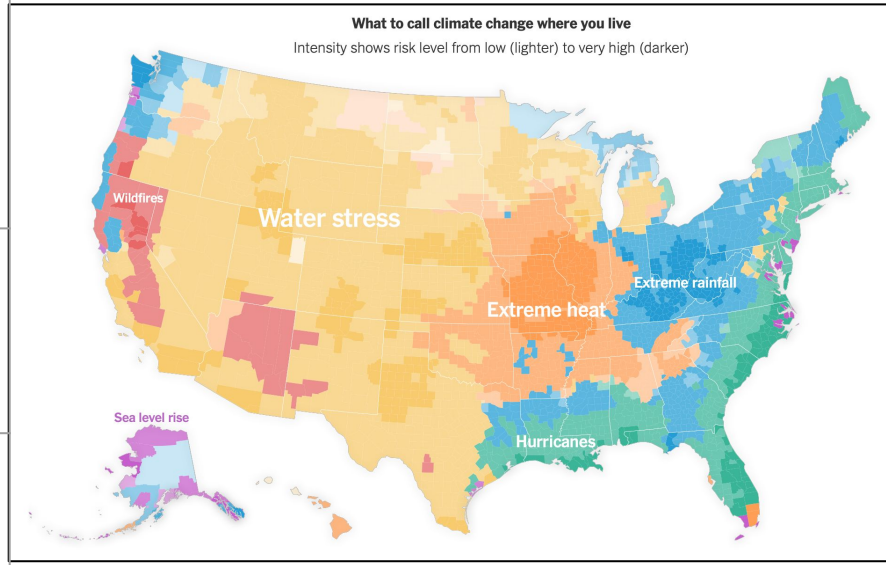
Framework for Discourse





Read the Visualization	What does intensity of the color represent?
Unpack Context and History	Why does land along the southeastern U.S. have a high threat of hurricanes? What do you know about where hurricanes form and how they tend to travel? While Hawaii and Alaska are represented, territories of the U.S. are left out, such as Puerto Rico and U.S. Virgin Islands. What do you think about that? What do you anticipate may be different if data had been collected for a different country or in a different time period (say 100 years ago)?
Personalize the Data	How does this map make you feel? Have you or your family experienced any of these climate events in those regions? What may others experience?
Communicate and Propose Action	Who should we show this map to? What discussions should we have or new data might we collect to further investigate?





“Doing Data”

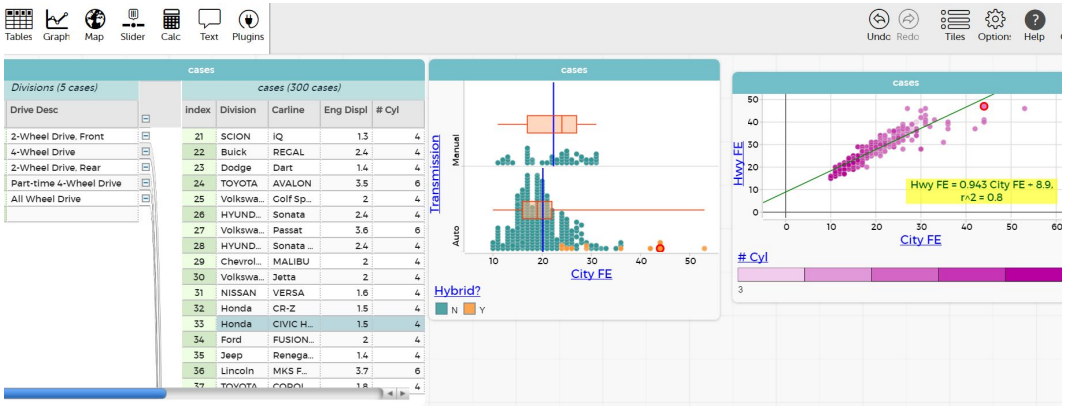
Involves Accessing and Working with Large Real Data

codap.concord.org

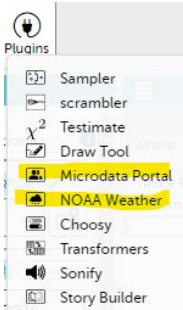
Free
Web-based
No login required
Easy to use
Under continual development

Works best in Chrome or FireFox

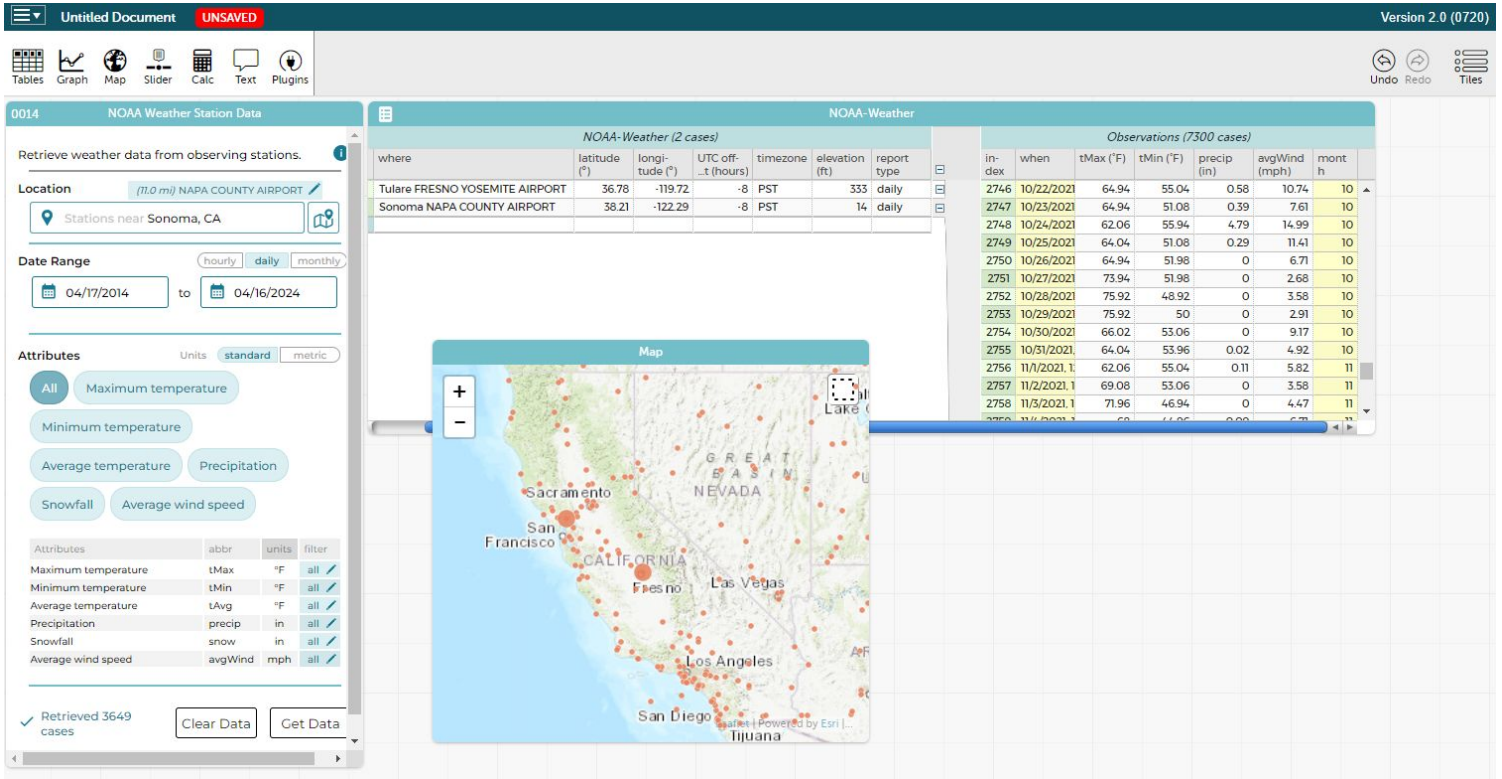
Optimal on computer or chromebook or large tablet



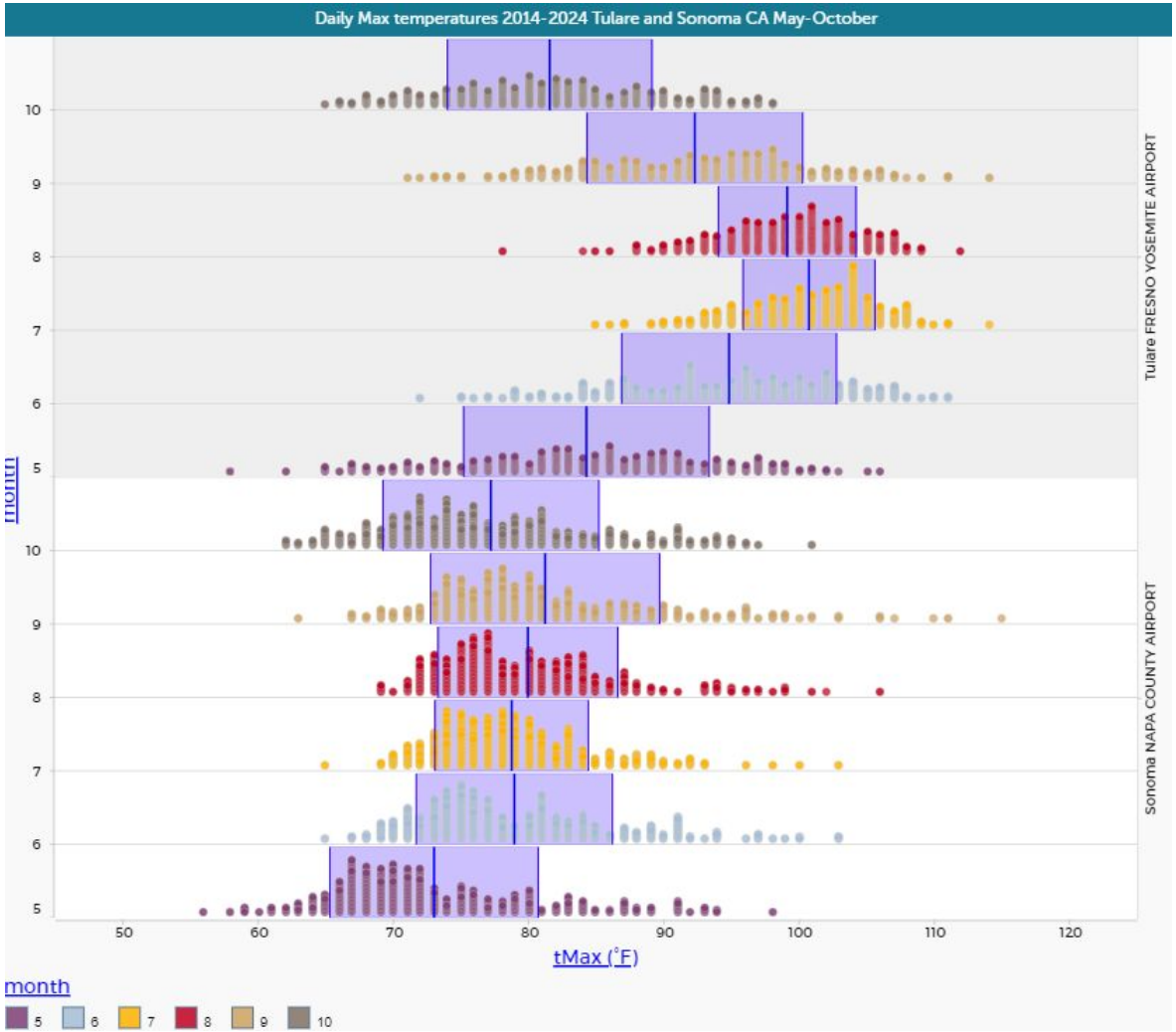
Includes “Plugins” that expand capability. TWO of these are data portals connected to NOAA and US Census!



Weather Data Collected for 2 Weather stations: Tulare and Sonoma CA



10 years of daily Max Temps Shown for May-Oct



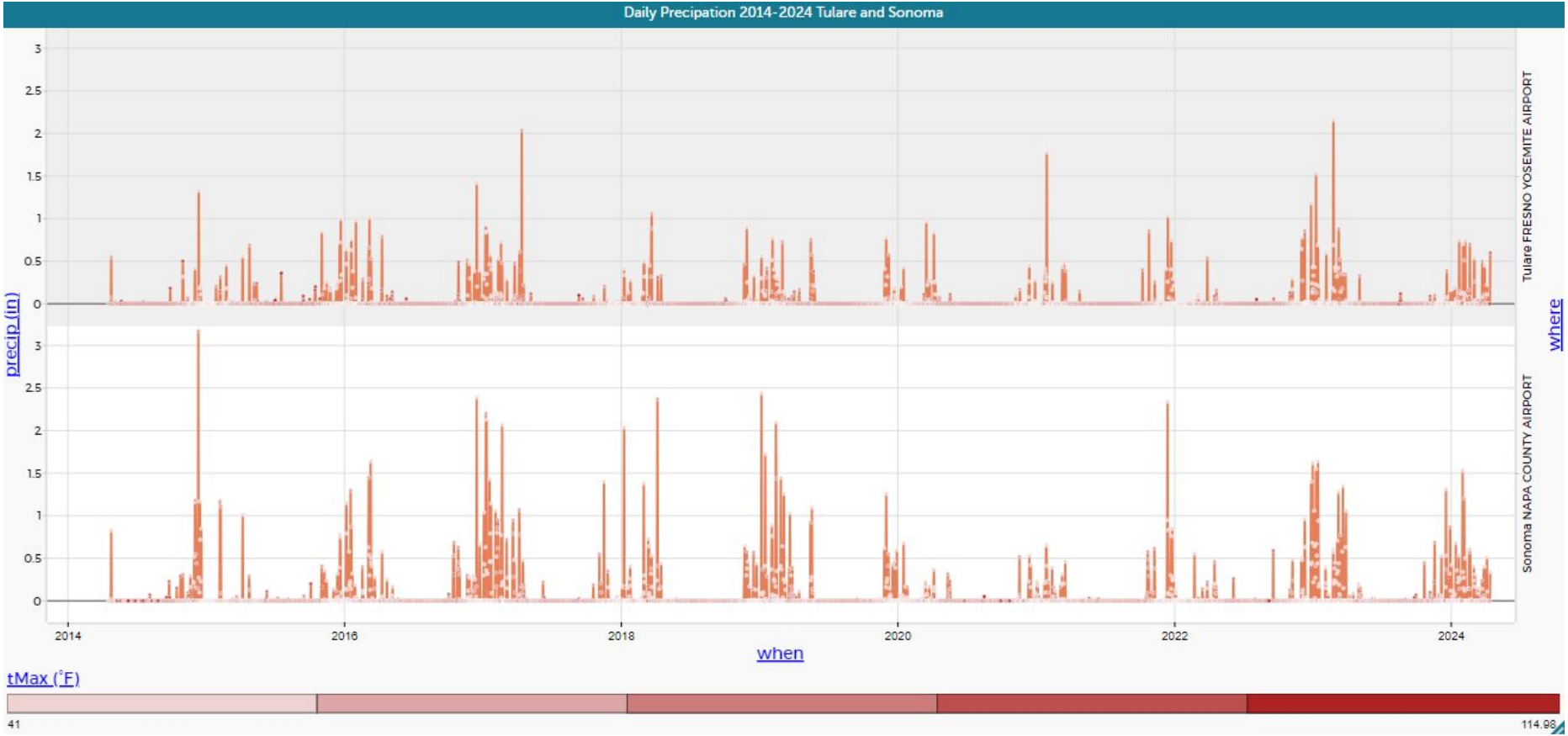
Tulare/Fresno

Sonoma

10 years of daily Avg Wind Speed Shown for May-Oct

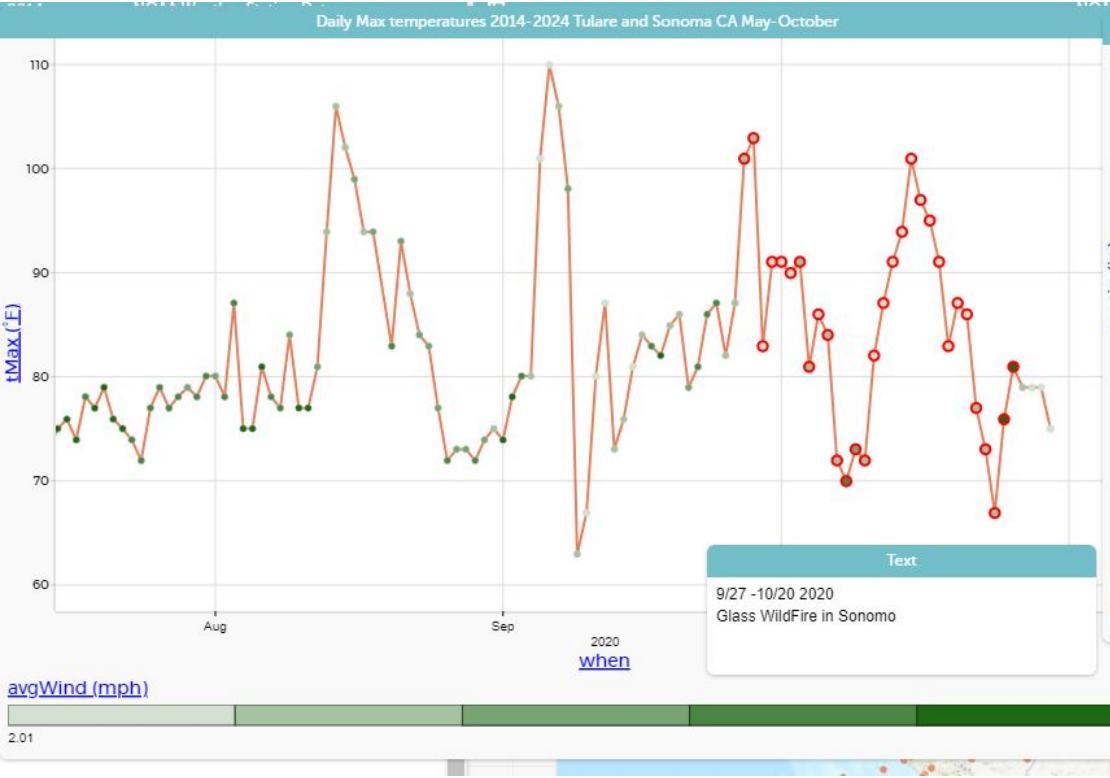
Tulare/Fresno

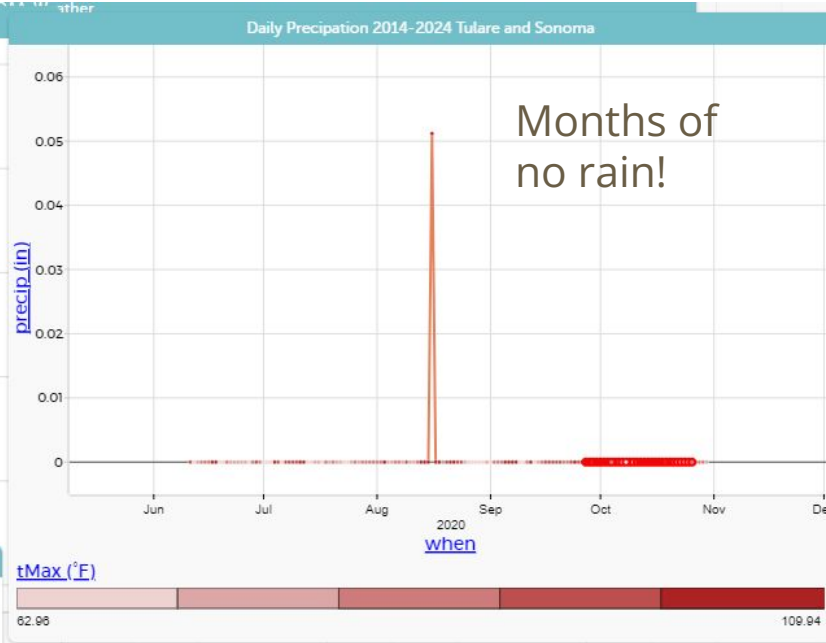
Sonoma



Both locations can have long periods of no rain!

9/27-10/20 2020 Wildfire in Sonomo





Months of no rain!

Where is Data Science?

Who is it for?

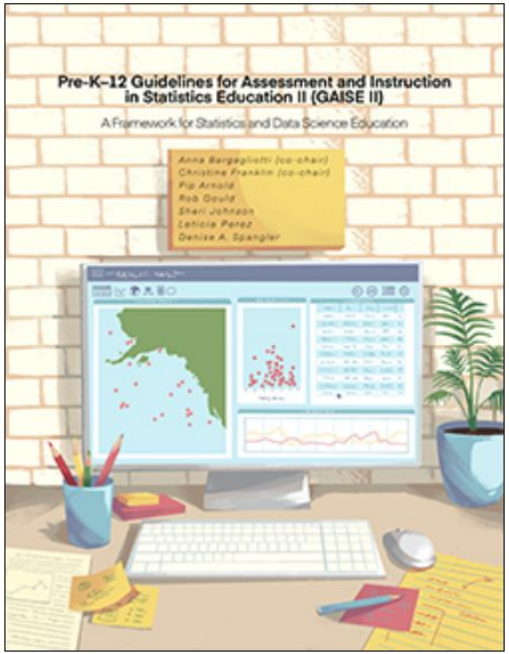
Support for More Learning!

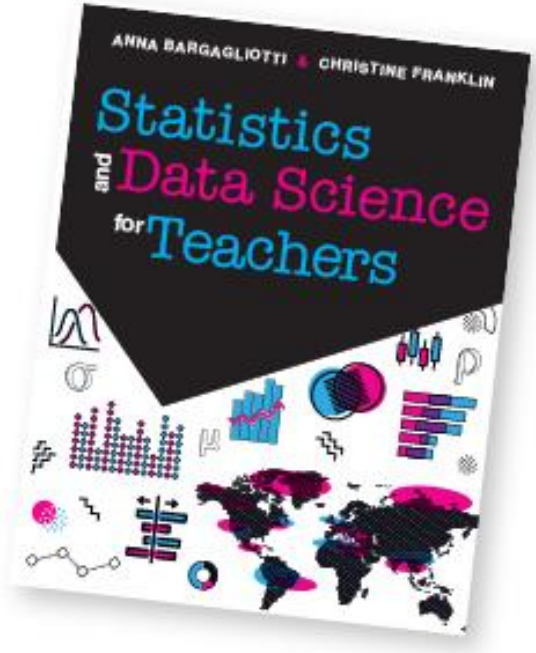
Data Viz Classroom Resources

- Discourse Prompts for Making Sense of a Data Visualization
- Large Collection of Data Visualizations to Use in Class--New York Times What's Going on in this Graph?
- Desmos Collection of Data Talk activities
- Data Bytes from *Writing Data Stories* project (sets of Google Slides in English and Spanish and a Teacher Guide)

Get Started with Articles from *Statistics Teacher* online journal

- Digging into Data: Illustrating a Data Investigation Process, 2022
- Using Photographs as Data Sources to Tell Stories About Our Favorite Outdoor Spaces, 2021
- Thinking Like a Data Scientist: A Cross-Disciplinary Investigation on Climate Change, 2021
- Using 2020 Census Data in Your Classroom, 2022





Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report: A Pre-K–12 Curriculum Framework provides recommendations and a curriculum framework with examples for teaching statistics in the pre-K–12 years.

Download **a low-resolution version** or **a high-resolution version** for free or **purchase from Amazon** for $30.

Bargagliotti, A., Arnold, P., & Franklin, C. (2021). GAISE II: Bringing data into classrooms. *Mathematics Teacher: Learning and Teaching PK-12*, *114*(6), 424-435.

Personalized Learning for Teaching Statistics and Data Science in Grades 6-12

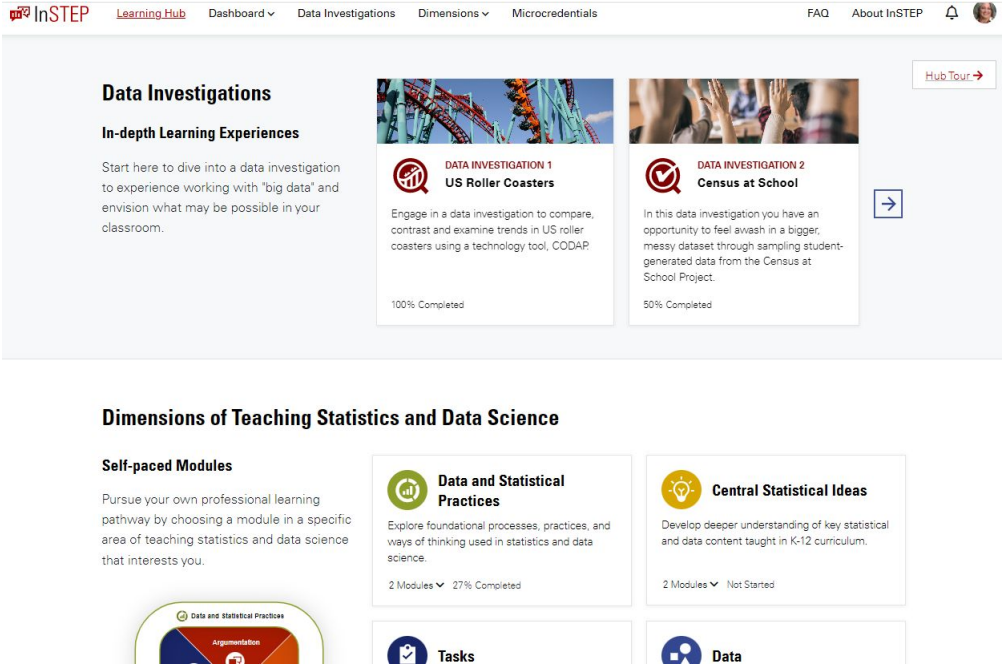
InSTEP

instepwithdata.org

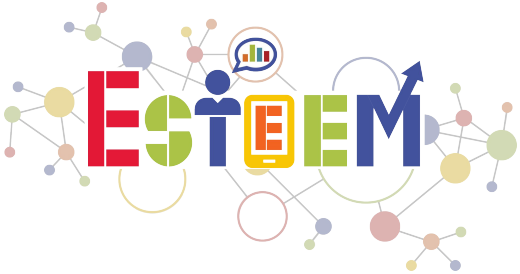
FREE for All!

Two Primary Pathways: Data Investigations & Self-Paced Modules

Use Variety of Tech Tools, but primarily CODAP



Enhancing Statistics and Data Science Teacher Education: Transforming & Building Community



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UNIVERSITY OF SOUTHERN INDIANA

The Concord Consortium

NSF

Contact Hollylynne to Join this Effort!

ESTEEM Network: Sample of Key Partners

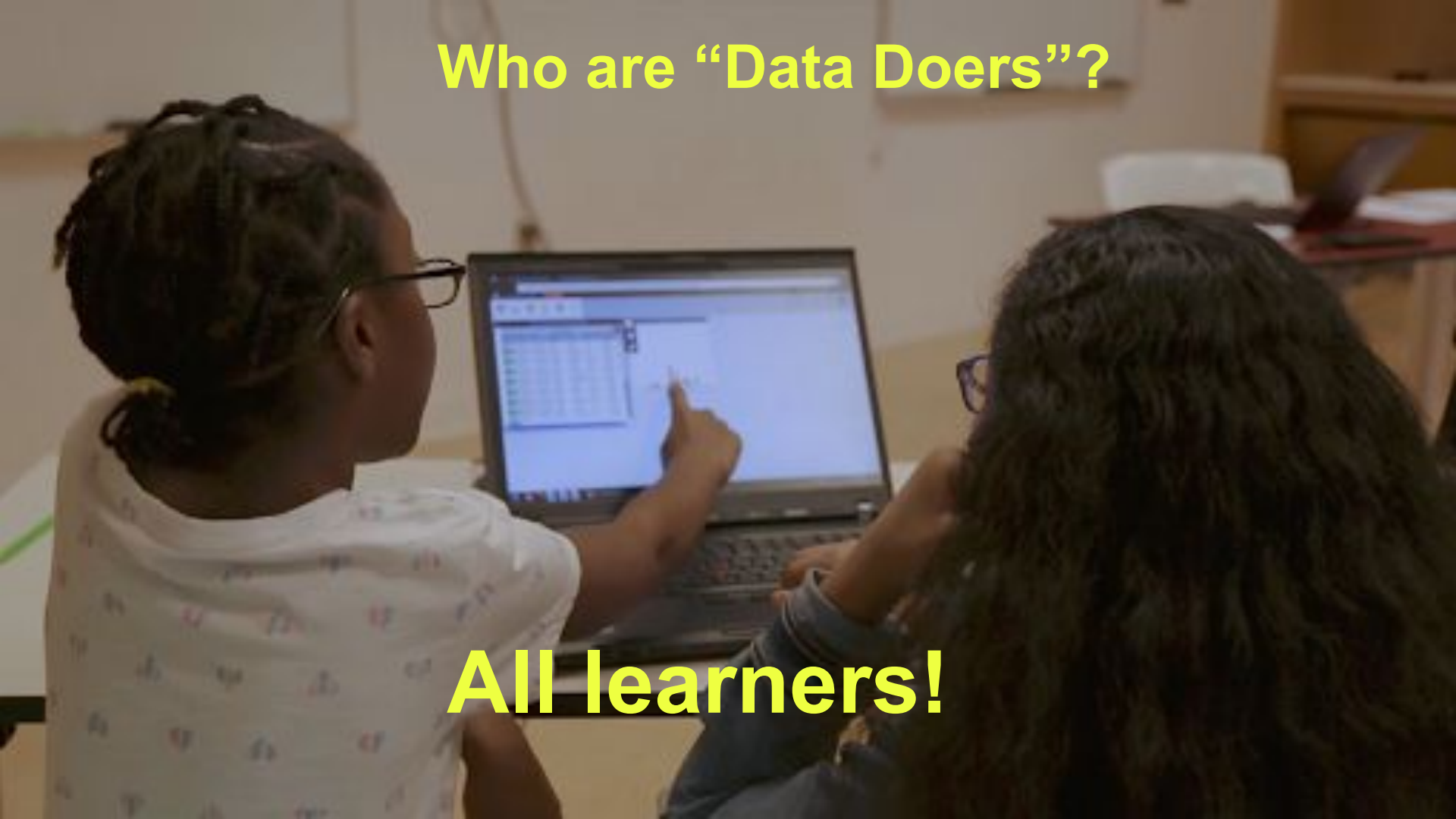
CODAP

MODULE(S²)

Mathematics Of Doing, Understanding, Learning and Educating for Secondary Schools

North Carolina School of Science and Mathematics

NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS


Who are “Data Doers”?
All learners!

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