

Stability and Change in Global Atmospheric Carbon

Session 9

Session Goals

- **Climate science ideas:** Explore local and global changes in atmospheric and ocean CO₂ and use proxies as scientists do to think about global patterns.
- **Using data:** Learn about the strategies and practice the skills needed to use archived professionally-collected data from online data portals. Interpret data and use it as evidence (i.e. draw conclusions); and use best fit lines to calculate long-term trends in data.
- **Teaching and Learning:** Experience a variety of effective practices for teaching and learning, as well as practice designing a testable question.
- **Framework/NGSS:** Learn about the crosscutting concepts: Stability & Change and Scale, Proportion & Quantity; and the Science and Engineering Practice: Obtaining, Evaluating, and Communicating Information.

Topic Area Question →
More Focused
Questions

Final Projects

Example of refining questions

How are light energy (PAR) and dissolved oxygen related?

- A. Make it more specific **by where (spatially)**:
 - a. What is the relationship between light energy (PAR) and dissolved oxygen (DO) concentration *in the Jacques Cousteau Research Reserve*?
 - b. Does the relationship between light energy (PAR) and dissolved oxygen (DO) concentration *vary north to south? east to west? inland vs. coastal?*

Example of refining questions

How are light energy (PAR) and dissolved oxygen related?

- A. Make it more specific by where (spatially)
- B. Make it more specific **by when (temporally)**:
 - a. What is the relationship between light energy (PAR) and dissolved oxygen (DO) concentration *throughout a day?* *across the seasons?* *over a year?* *over a decade?*
 - b. Does the relationship between light energy (PAR) and dissolved oxygen (DO) concentration *vary throughout a day?* *across the seasons?* *over a year?* *over a decade?*

Example of refining questions

How are light energy (PAR) and dissolved oxygen related?

- A. Make it more specific by where (spatially)
- B. Make it more specific by when (temporally)
- C. Make it more specific **by what other variables of interest:**
 - a. What is the relationship between light energy (PAR) and dissolved oxygen (DO) concentration *as it changes with tides*?
 - b. Does the relationship between light energy (PAR) and dissolved oxygen (DO) concentration *vary in a hurricane*?

Partner Work

1. Discuss and write down questions about other aspects of your Topic Area Question that you think would be of interest to investigate.
2. For each More Focused Question, make a prediction (i.e. hypothesis) about the patterns or relationship you expect to see. Include your rationale.



Data Export System Powered By The Centralized Data Management Office

Choose Reserve

Choose Sampling Station

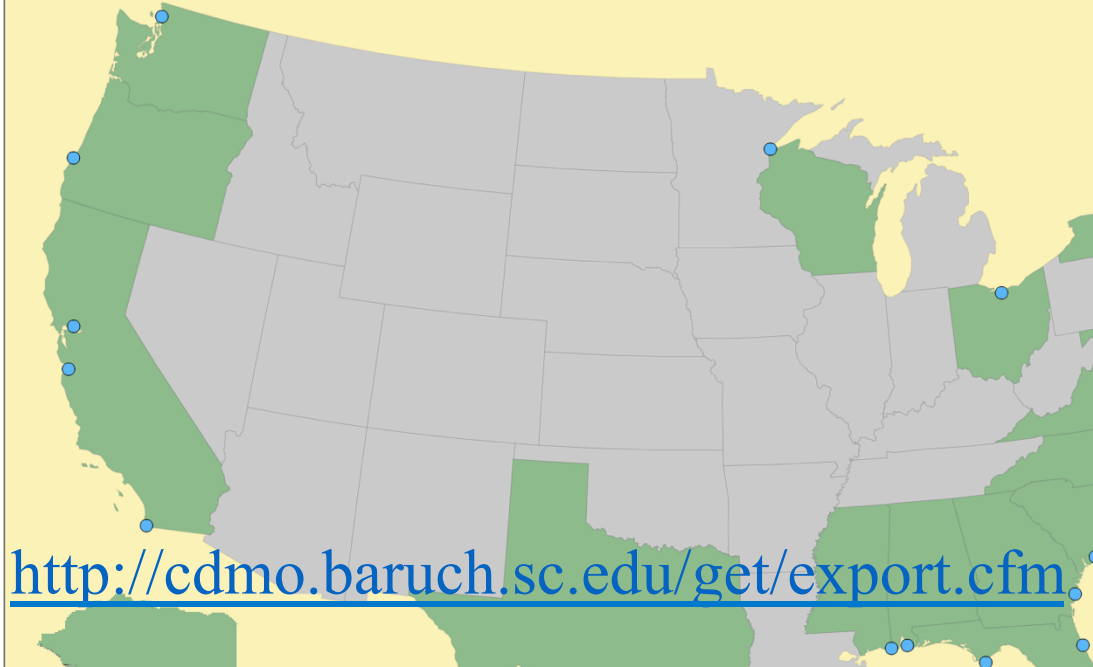
View or Download Data

Submit Info

Complete!

Please select a Reserve from the map below:

If you already know the station code, enter it here. If not, choose a Reserve from the map below.



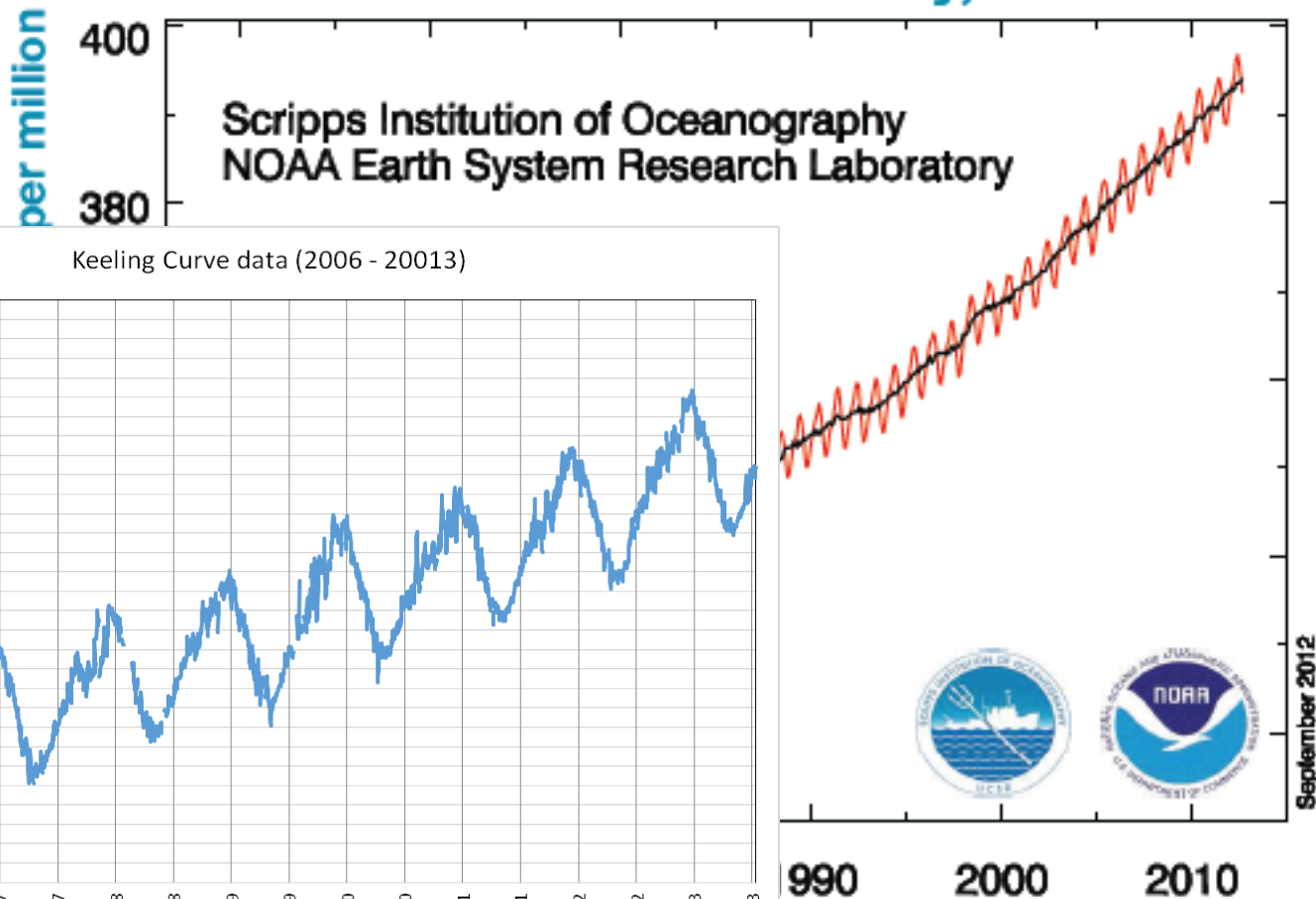
<http://cdmo.baruch.sc.edu/get/export.cfm>



Data Activities: *Using
Environmental Data to
Investigate Ocean
Acidification*

Keeling Curve: CO₂ Levels in the Atmosphere

Mauna Loa Observatory, Hawaii



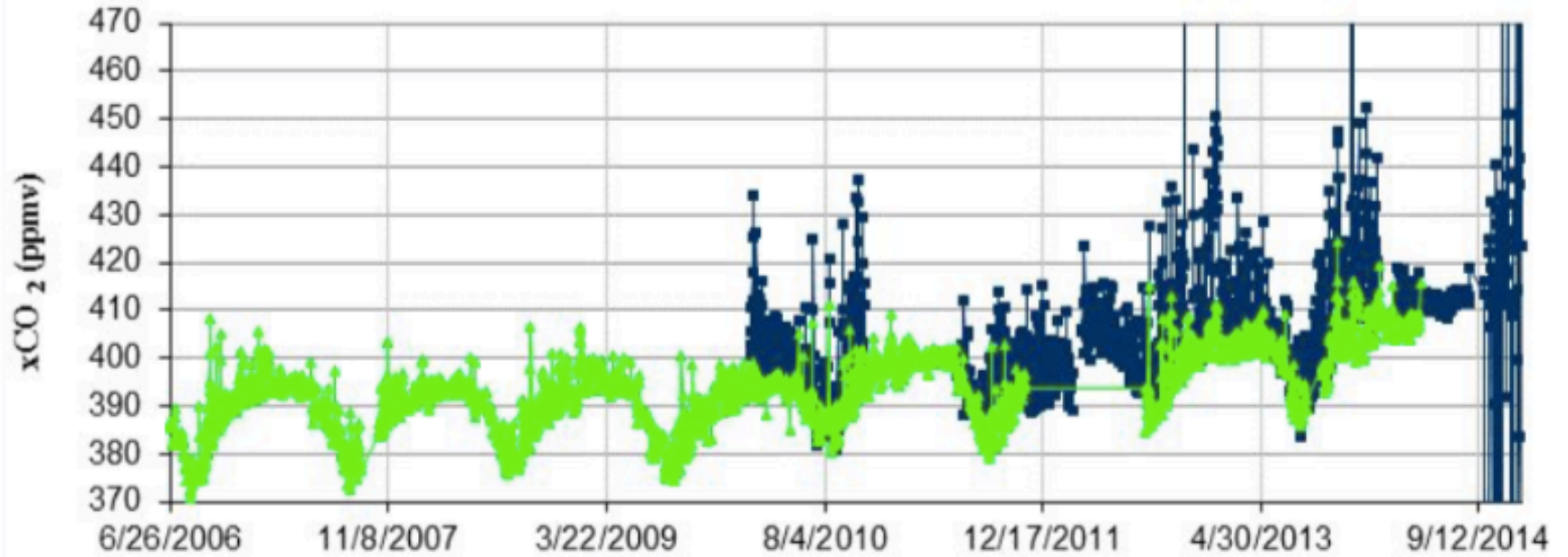
Proxy

- A measured parameter used to estimate or predict another parameter that cannot be measured or quantified directly.
- Why do you think that this location in Hawaii was chosen to represent, or be the proxy of, the global levels?

Using Environmental Data to Track Ocean Acidification

- Complete the handout with a partner
- Read directions carefully
- Ask for assistance if you have questions

Seattle and WA Coast Seasonal CO₂ data

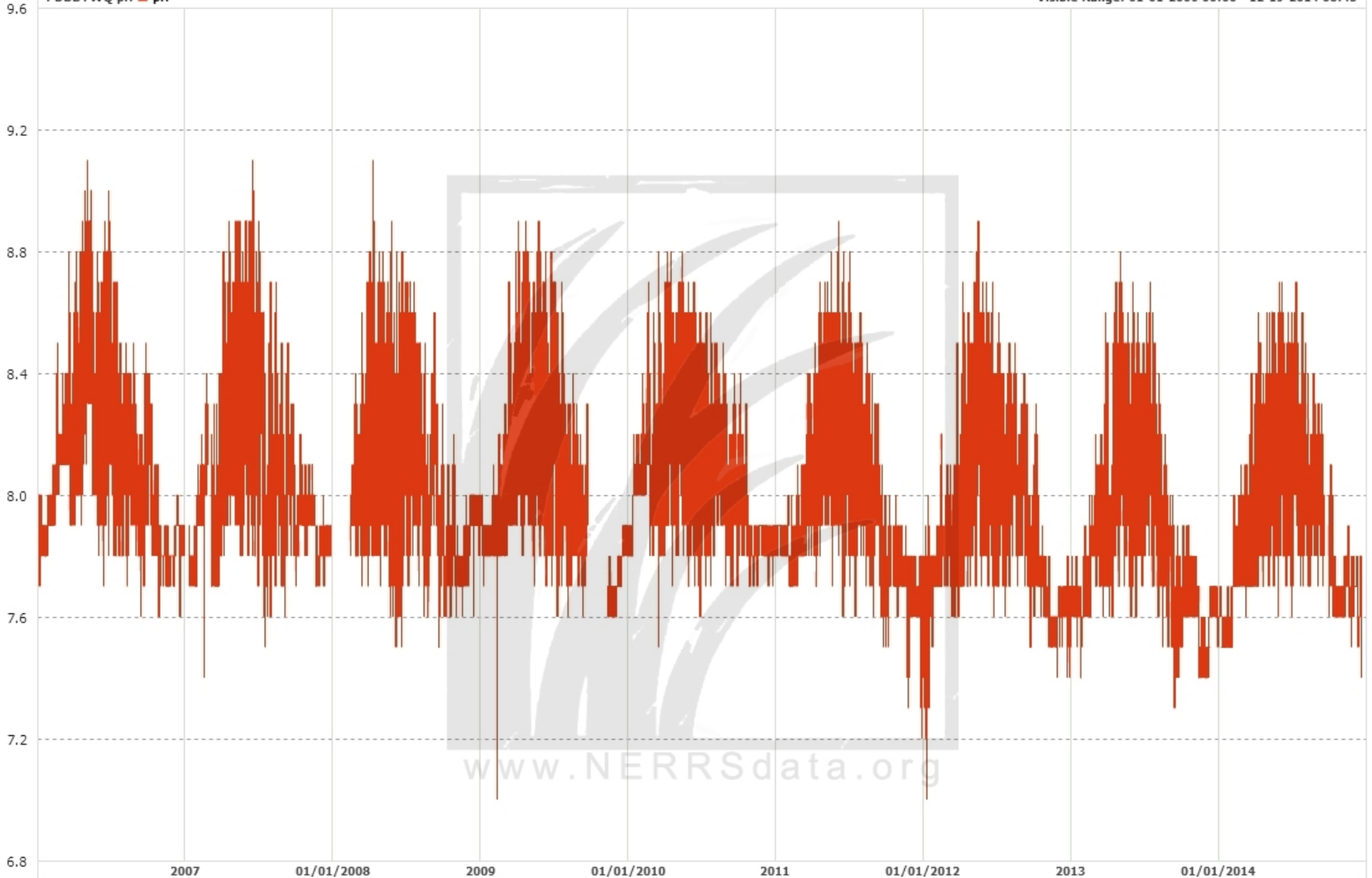


Seattle and WA coast Seasonal CO₂ data collected by PMEL

PDBBYWQ pH ■ pH

Visible Range: 01-01-2006 00:00 - 12-19-2014 08:45

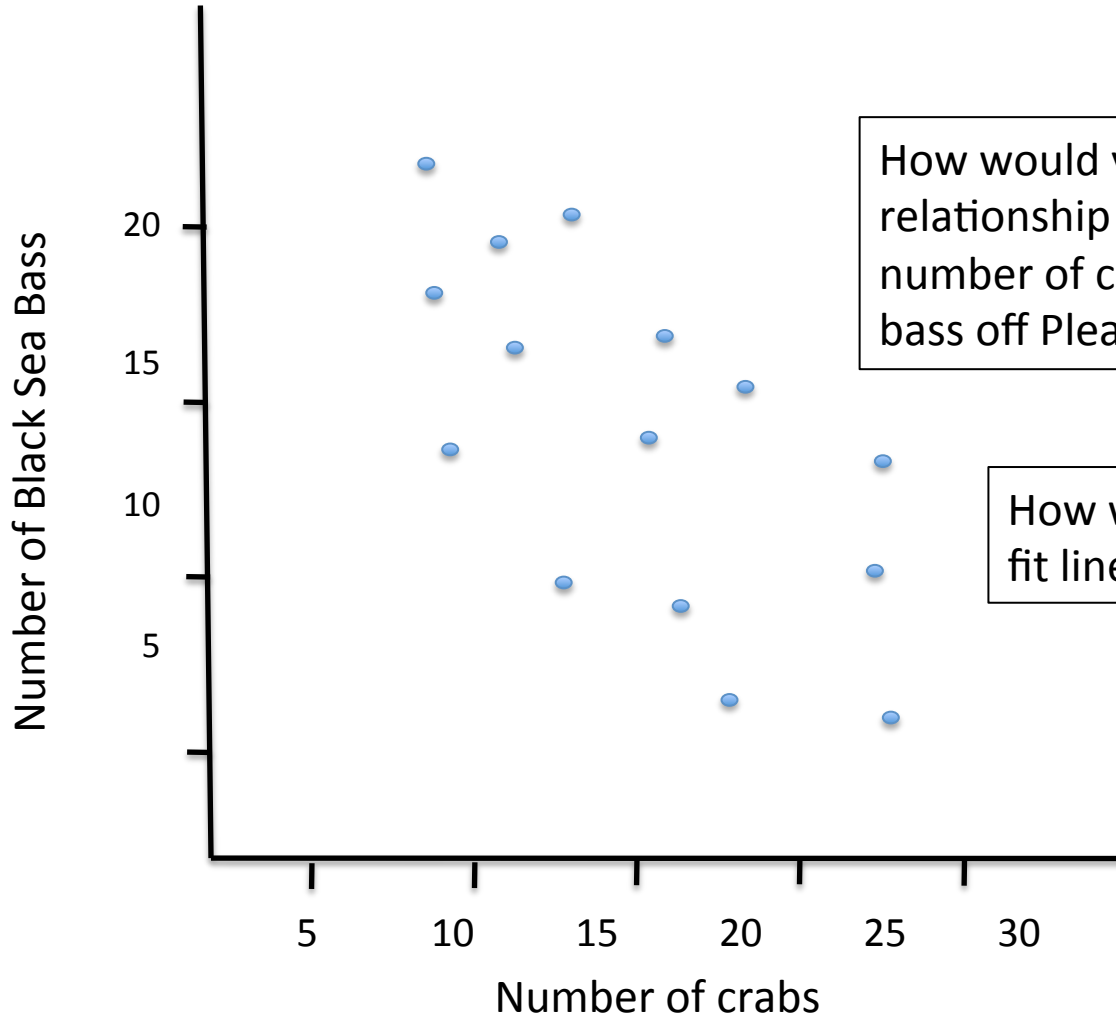
Standard Units



www.NERRSdata.org



Black Sea Bass and Crabs off Point Pleasant, NJ



How would you describe the relationship between the number of crabs and black sea bass off Pleasant Point?

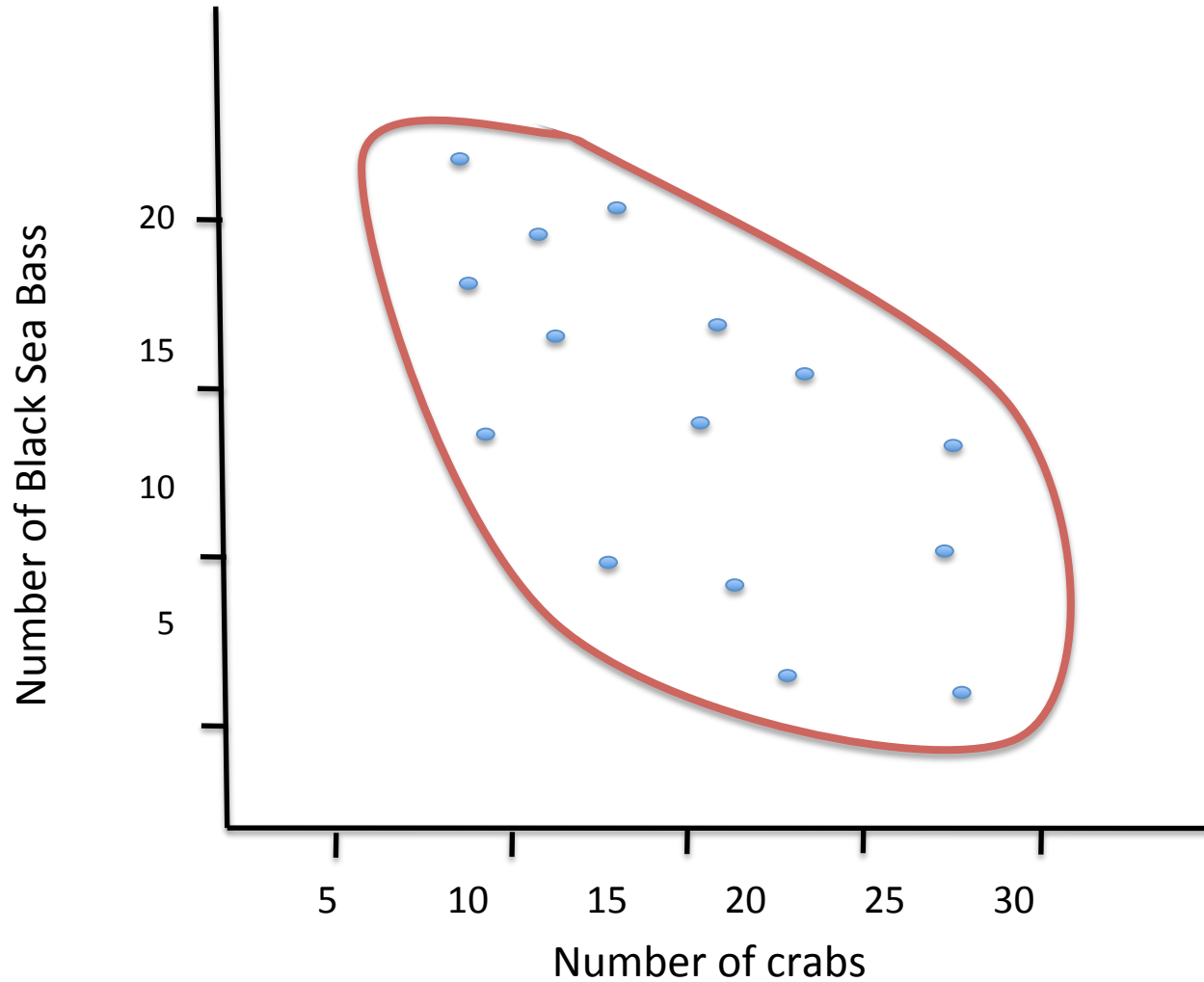
How would you draw a best fit line for these data?

One way to draw a best fit line

- Draw a line encircling the entire set of data points, trying to enclose the data as best as possible. The resulting ellipse should be as small as possible.
- Draw a line dividing the ellipse along its longest axis such that there are equal areas on either side of the line.
- This is your best fit line.

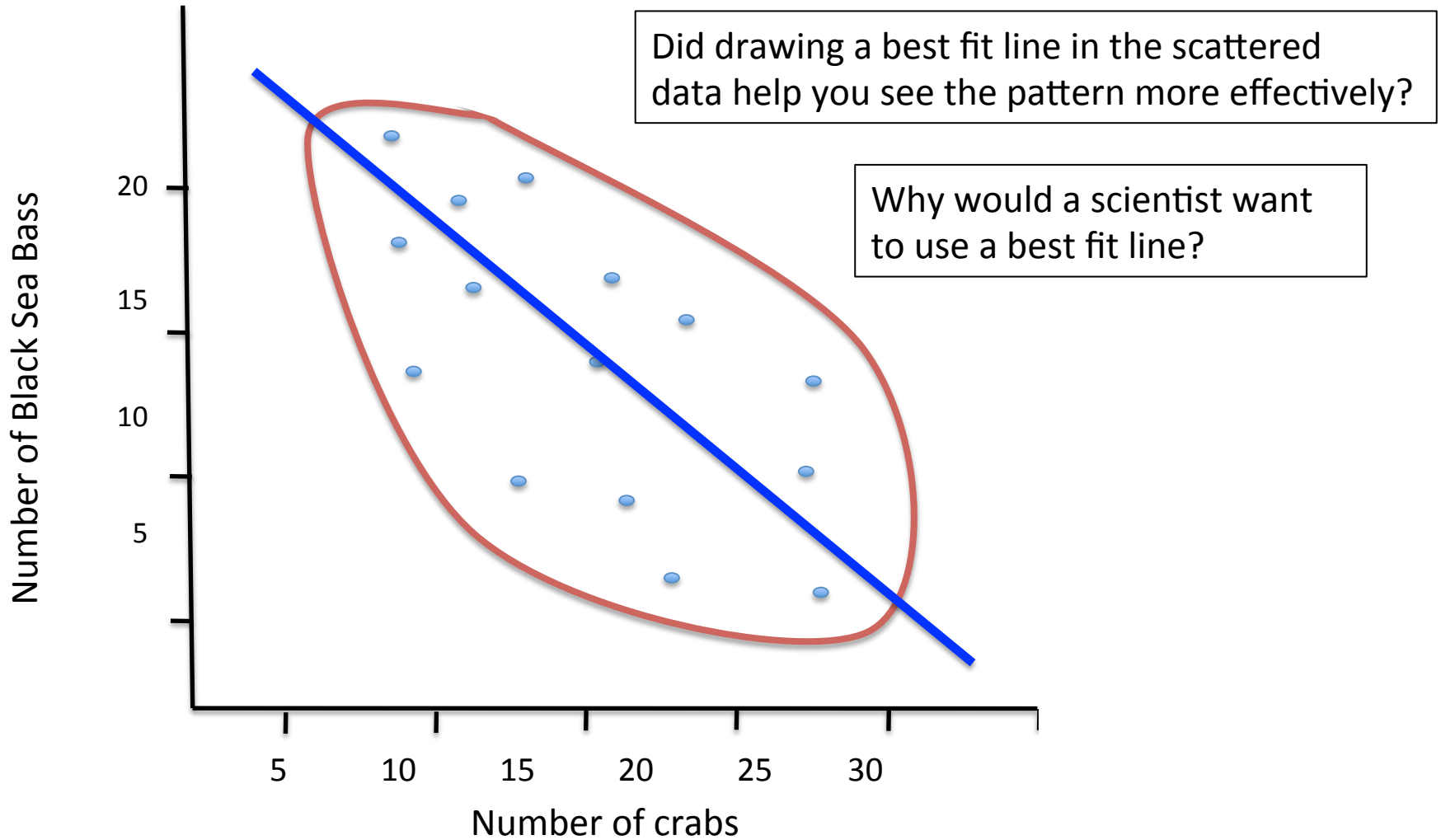
Best Fit Line Step 1: Draw a circle around the data, enclosing the data as tightly as you can

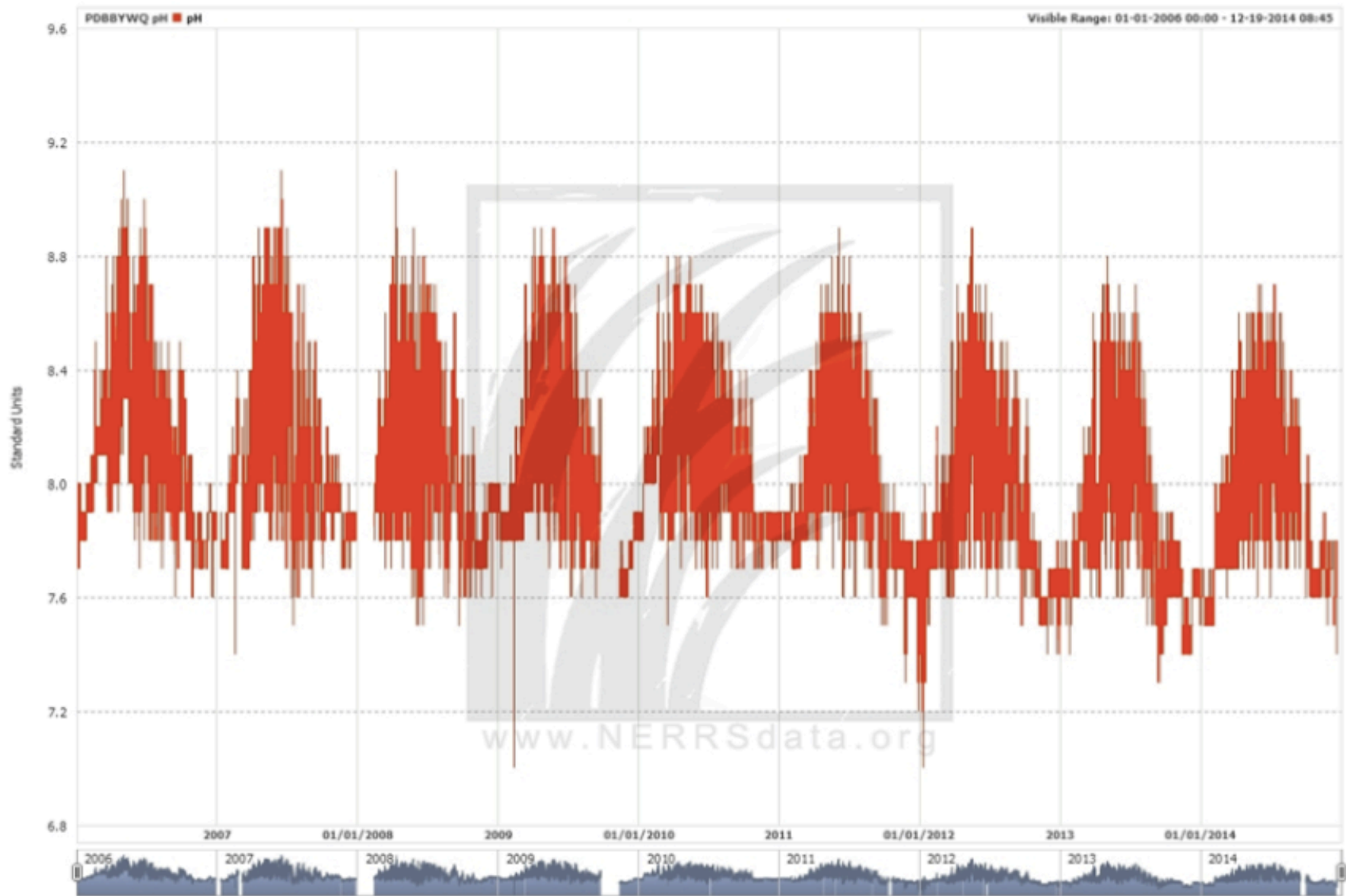
Black Sea Bass and Crabs off Point Pleasant, NJ



Best Fit Line Step 2: Draw a line separating the circle into 2 equal parts or areas

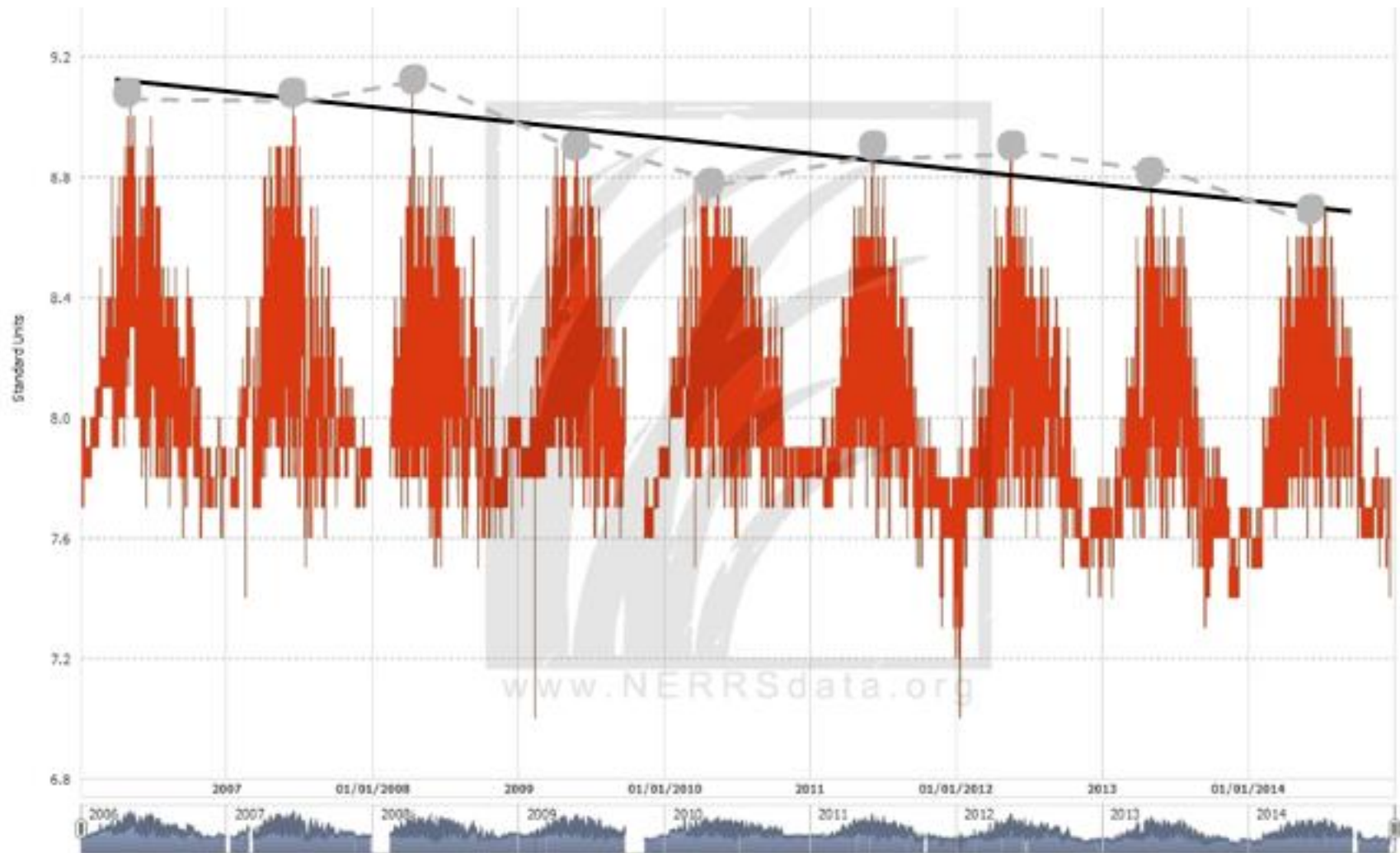
Black Sea Bass and Crabs off Point Pleasant, NJ





Tracking changes in surface water pH in local waters (Padilla Bay estuary)

Did drawing a best fit line in the pH data help you see the pattern more effectively?
How else could you have drawn the best fit line in the pH data?



Turn and Talk– Comparing atmospheric CO₂ & pH

What benefits could there be from looking at two different environmental variables from the same location over the same time period simultaneously?

Comparing pH and CO₂

- Compare your pH graph to your graph of atmospheric CO₂ concentration measured on Washington Coast.
 - Taken individually, what is similar between the data patterns of the ocean pH and the atmospheric CO₂?
 - What relationship do you notice between the two variables?
 - What extra information or understanding did we learn from looking at both of these environmental variables together, rather than only looking at them individually, or only at just one?

Quick Write

In what way(s) are the concentrations of atmospheric CO₂ and ocean pH related or not to one another? How do you know? Why does it matter?

Key Concept

Increases in atmospheric and ocean CO₂ and concurrent decreases in ocean pH can be observed locally and globally.

Crosscutting Concepts – thinking about the last activity

- Work with a partner and both read the same crosscutting concept from NRC *Framework for K–12 Science Education*. Read one of the following:
 - Stability and Change, pp. 98-101,
 - Scale, Proportion, and Quantity, pp. 89-91
 - Use the Active Reading strategies.
- When you finish reading it individually, discuss with your partner
 - your understanding of the crosscutting concept, and
 - How it was used to frame the phenomena in this session

Partner discussion prompts

Stability and Change:

1. What does the data tell us about how the system is stable or changes? What causes stability in this system?
2. What does the data tell us about what affects the stability of this system?
3. What causes change in this system?
4. What is already known about stability and change in this system?
5. What is the time scale for this system to remain stable or change?
6. If the system is changing, what would make it become stable? Are there feedbacks in the system?

Scale, Proportion and Quantity:

1. What scales are used to examine the phenomena?
2. How can we study nature at these scales?
3. How can we accurately measure at these scales?
4. What proportions are described by the data?
5. Why is a sense of scale important to look at this phenomenon?

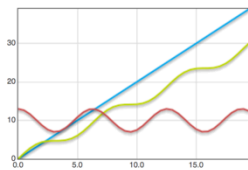
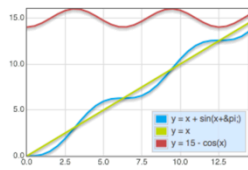
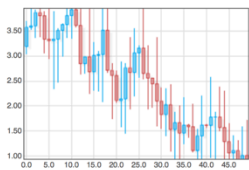
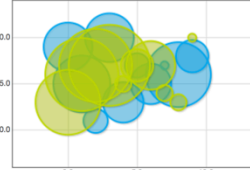
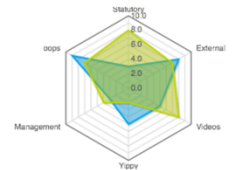
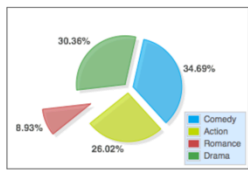
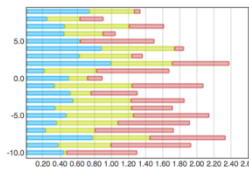
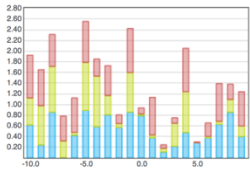
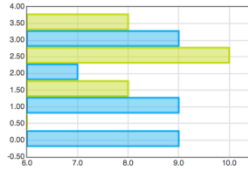
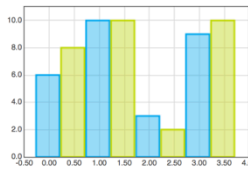
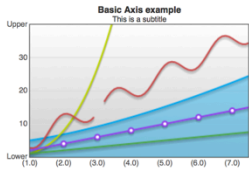
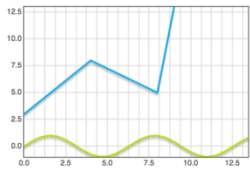
Group of 4: synthesizing & connecting ideas across CCCs

- How might a sense of scale, proportion and quantity support a learner's understanding of the phenomena? Why do you think that?
- How might a sense of stability and change support a learner's understanding of the phenomena? Why do you think that?
- Was it effective to frame the science concept and explain the phenomena in terms of both of the crosscutting concepts? Did your group feel that one crosscutting concept was more effective in helping to understand the phenomena than the other? Why do you think that?

Whole Group Discussion

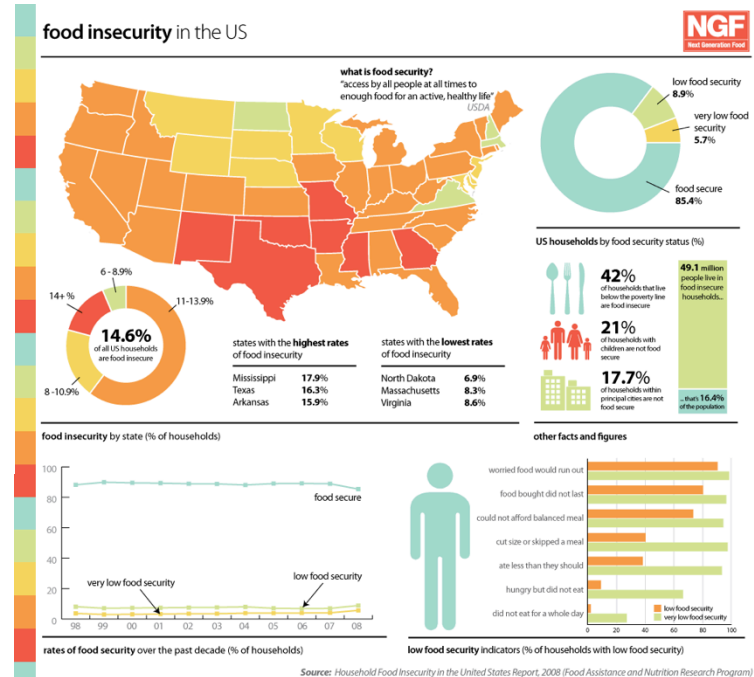
- Compare and contrast how each of the two crosscutting concepts frames the concepts.
- Think about how the two big ideas might affect a learner's understanding of the phenomena.
- Would one make more sense to use than the other to frame the activities we engaged with today? Explain your answer.

Variety of data visualizations



YUI3 DataTable with JSONP data from JAX-RS (Jersey)

Customer ID	Name	Address Line 1	Address Line 2	City	State	Phone	Fax	Credit Limit
1	Jumbo Eagle Corp	111 E. Las Olivas Blvd	Suite 51	Fort Lauderdale	FL	305-555-0188	305-555-0189	100000
2	New Enterprises	9754 Main Street	P.O. Box 567	Miami	FL	305-555-0148	305-555-0149	50000
25	Wren Computers	8989 Red Albatross Drive	Suite 9897	Houston	TX	214-555-0133	214-555-0134	25000
3	Small Bill Company	8585 South Upper Murray Drive	P.O. Box 456	Alanta	GA	555-555-0175	555-555-0176	90000
36	Bob Hosting Corp.	65653 Lake Road	Suite 2323	San Mateo	CA	650-555-0160	650-555-0161	65000
106	Early CentralComp	829 E Flex Drive	Suite 853	San Jose	CA	408-555-0157	408-555-0150	26500
149	John Valley Computers	4381 Kelly Valley Ave	Suite 77	Santa Clara	CA	408-555-0169	408-555-0167	70000
863	Big Network Systems	456 444th Street	Suite 45	Redwood City	CA	650-555-0181	650-555-0180	25000
777	West Valley Inc.	88 Northsouth Drive	Building C	Dearborn	MI	313-555-0172	313-555-0171	100000
753	Zed Motor Co	2267 NE Michigan Ave	Building 21	Dearborn	MI	313-555-0151	313-555-0152	5000000
722	Big Auto Parts	52963 Notouter Dr	Suite 35	Detroit	MI	313-555-0144	313-555-0145	50000
409	Old Media Productions, Inc.	4400 527th Street	Suite 562	New York	NY	212-555-0110	212-555-0111	10000
410	Yankee Computer Repair Ltd	9653 211th Ave	Floor 4	New York	NY	212-555-0191	212-555-0197	25000



Choosing the correct data visualization

What kind of data do you have and what are you trying to show: For example

- A comparison of values between variables, or
- The distribution of a variable across a range of possible values, or
- The composition of the components of the variables.

Answer Key

What do you want to show?

Comparison

Among Items



Over Time

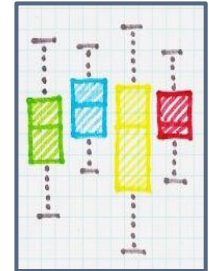
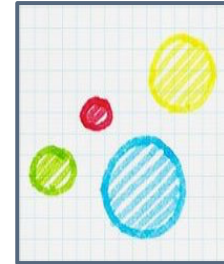
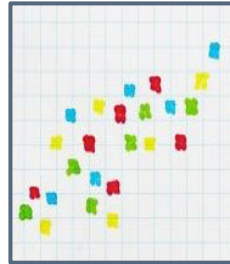


Distribution

Single Variable

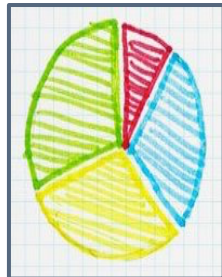


Two Variables

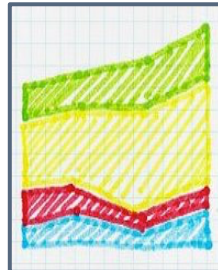


Composition


Static in Time



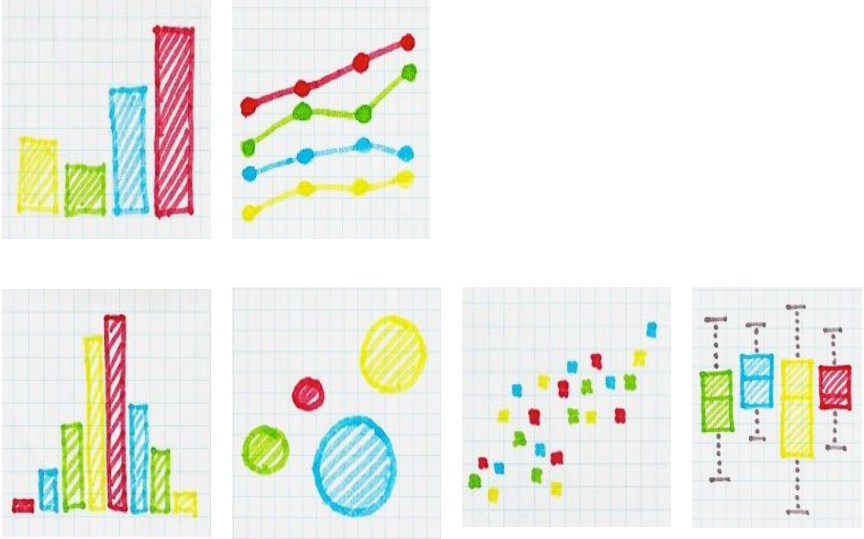
Changing Over Time



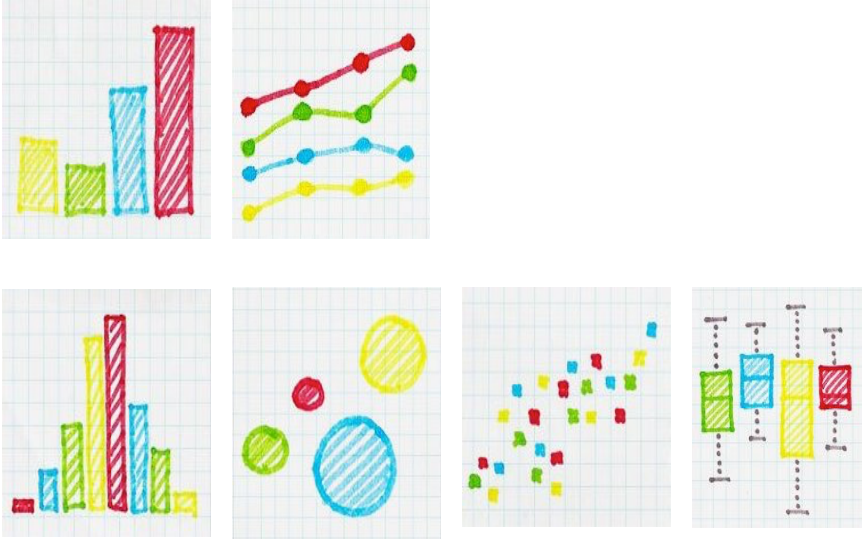
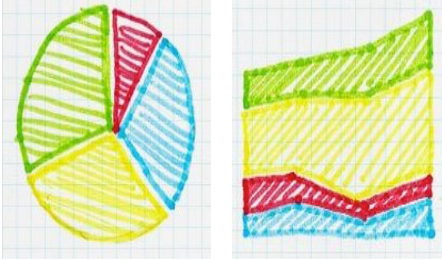
Matching words to figure type

	Words	Common Figure Types
Comparisons:	before/after, categories, compare, contrast, over time, peaks, rank, trend, types, valleys	

Matching words to figure type

	Words	Common Figure Types
<p>Comparisons:</p>	<p>before/after, categories, compare, contrast, over time, peaks, rank, trend, types, valleys</p>	
<p>Distributions:</p>	<p>cluster, distributed, from/to, plotted, points, spread, spread over, relative to,</p>	

Matching words to figure type

	Words	Common Figure Types
<p>Comparisons:</p>	<p>before/after, categories, compare, contrast, over time, peaks, rank, trend, types, valleys</p>	
<p>Distributions:</p>	<p>cluster, distributed, from/to, plotted, points, spread, spread over, relative to,</p>	

Accessing and using real
time and archived data

Turn & Talk

- What are good quality data?
- What is a reliable source of data and how can you tell?

Quick Write

- What are your overall reflections about using archived data during today's session.
 - Reminder: archived data “are older data (> 30 days old) that are important and necessary for long-term reference.”

Homework

- **Data Lesson Development**
 - See handout to **complete Parts 1, 2 and 3 of the *Data Components of Final Project* worksheet**. Work with your partner to complete the worksheet and bring it to the next class to get feedback from peers and instructor. Use the *Data Components Glossary* as needed.
- **Spurious Correlations**
 - Review the Spurious Correlations website, find a favorite correlation, and be prepared to share it with the group in the next session:
<http://www.tylervigen.com/spurious-correlations>
- **Reading**
 - Use the active reading strategy with “*Background on CO₂ and Ocean pH*”