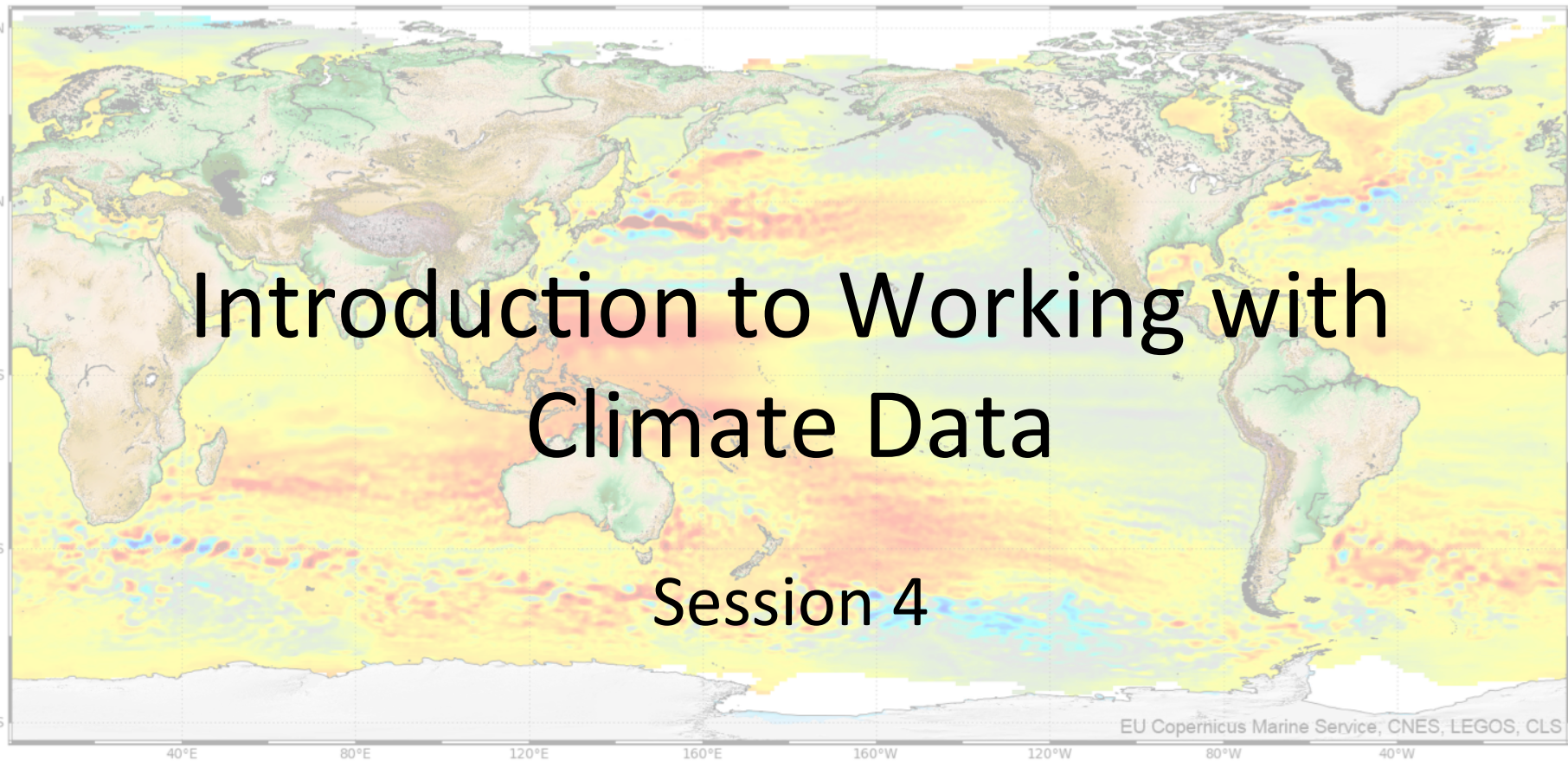


Introduction to Working with Climate Data

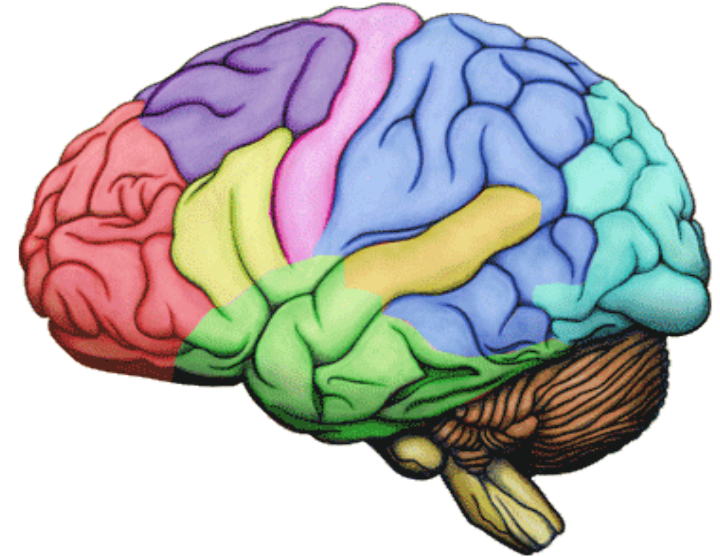
Session 4



-10.0 -7.5 -5.0 -2.5 0.0 2.5 5.0 7.5 10.0
Sea Level Trends (mm/yr)

Think-Pair-Share

- Describe what you think are the most important ideas from each section.
- How can the ideas about learning described in the reading be useful and relevant to you as a learner?
- When you teach, how might you use what you know about how people learn to help your learners *make sense* of the science?



Session Goals

- **Climate science ideas:** Understand that:
 - The ocean warms cold air and cools warm air. The ocean keeps temperatures more even all over the planet. (OSS 1.4)
- **Using Data:** Continue to build on skills covered in previous sessions and explore ways to:
 - Find high quality and reliable sources of data online.
 - Articulate what the different variables (controls, independent, dependent) are within an investigation or data visualization.
 - Engage students at three different levels with data visualizations—orientation, interpretation, and synthesis.
- **Teaching & Learning:** Discuss the importance of using local ecological data as a pedagogical tool to improve the relevancy of concepts, ecological processes, and global change.
- **Framework/ NGSS:** Experience shifts in teaching and learning as described in the Framework for K–12 Science Education and NGSS. Read selected Science and Engineering Practices and Crosscutting Concepts.

Nonsense Data Activity

What is it like for learners to work with information that is new and overwhelming?

Nonsense Data Activity Instructions

- Note what skills you are using in order to answer the questions;
- think about what you paid attention to;
- reflect on how you arrived at your answers;
and
- think about what you could and could NOT answer.

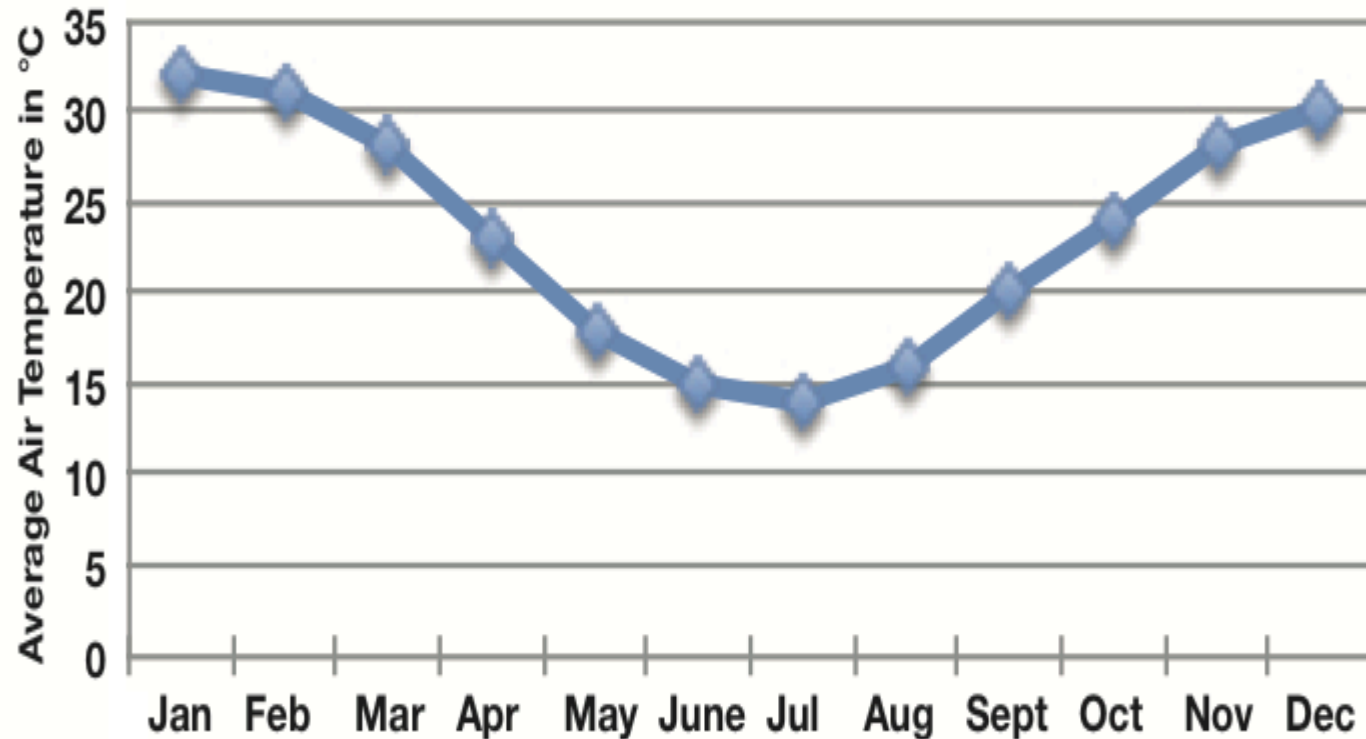
Activity Debrief

1. Were you able to answer the questions on Handout A?
2. What about the questions on Handout B?
3. Were the questions difficult or easy?
4. Where did you find the information you needed?
5. What skills did you use to answer the questions?
6. How did you report this information?
7. What skills or information would you need to be able to answer your unanswered questions?

Activity Implications

- What aspects of this activity did you find surprising?
- What implications could this activity have on how you teach with data to your middle school students?

What helps us make sense of data?



Three Levels of Engagement with Data Visualizations

...once you have the data in a data table and/or figure OR you have the model output...

Orientation - What is there on the page?

Levels of Engagement with Data

As users interact with data, whether they are novices or experts there are multiple levels of engagement that they go through. At each level, key questions are asked and specific skills are required to understand and interpret the data.



Orientation

Key Questions

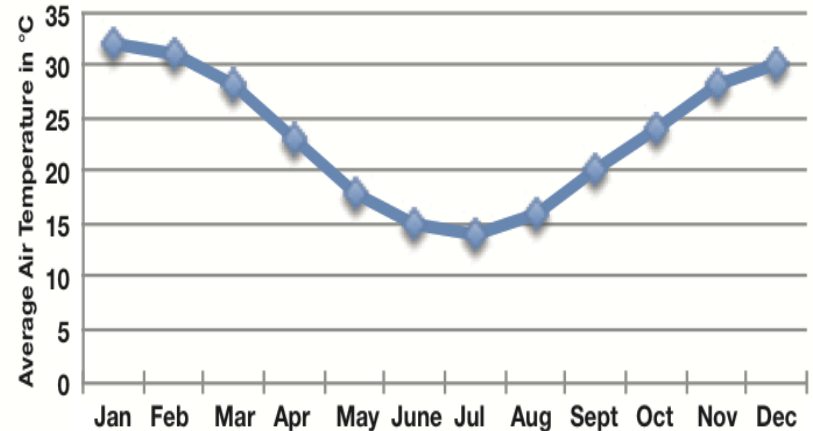
- What are the units of measure?
- Where was the data collected?
- What does this data mean to me?

Orientation Skills are:

- Collecting, recording, and labeling observations
- Including a title and axis labels and descriptions on a plot
- Identifying relationships and recognizing basic patterns in a plot
- Comparing predictions to experimental results
- Citing the data when discussing a relationship or pattern in data



1



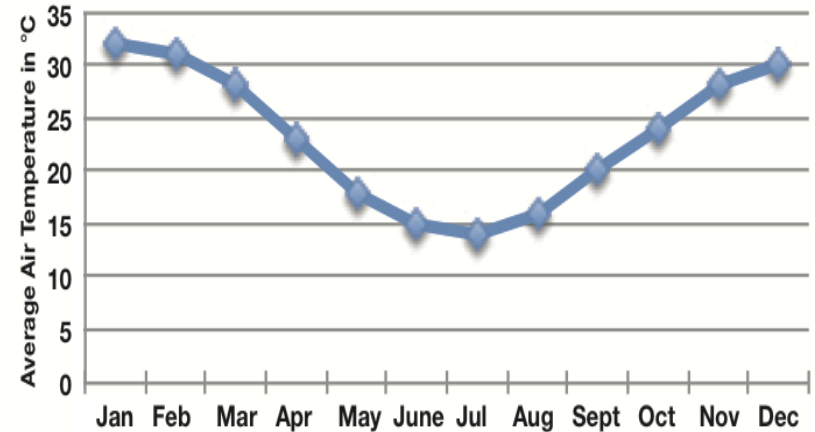
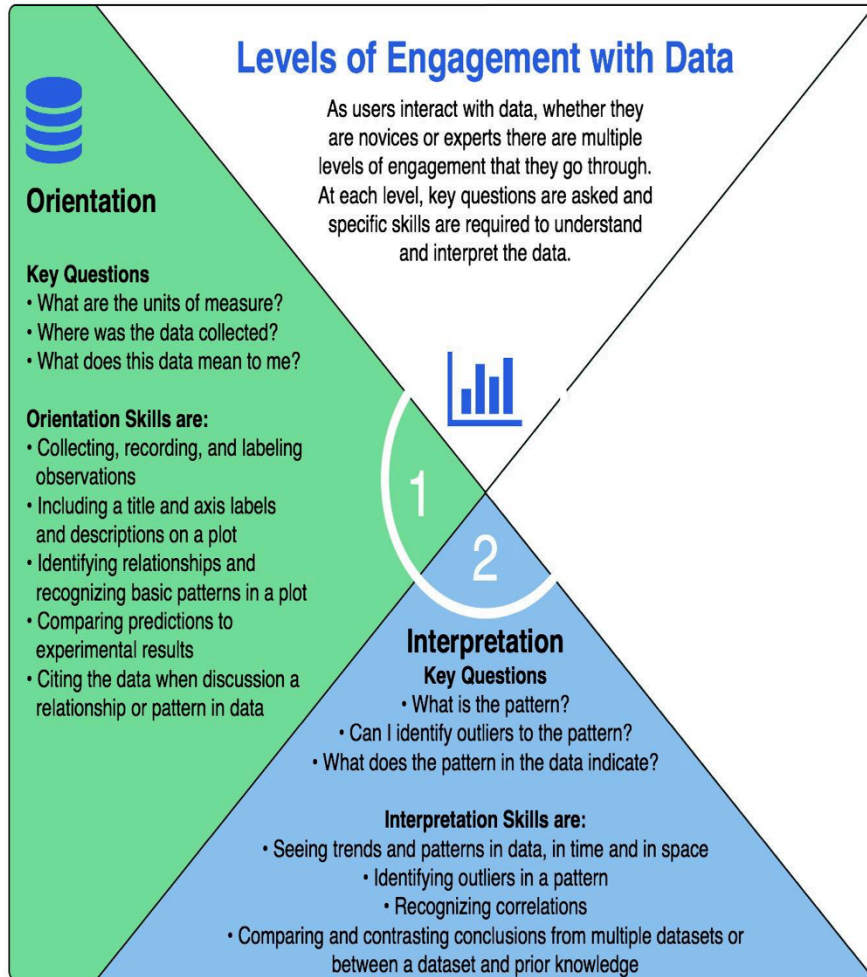
Example

I am looking at air temperature (°C) and time (months)...

...I cannot tell from the graph where the data were collected.

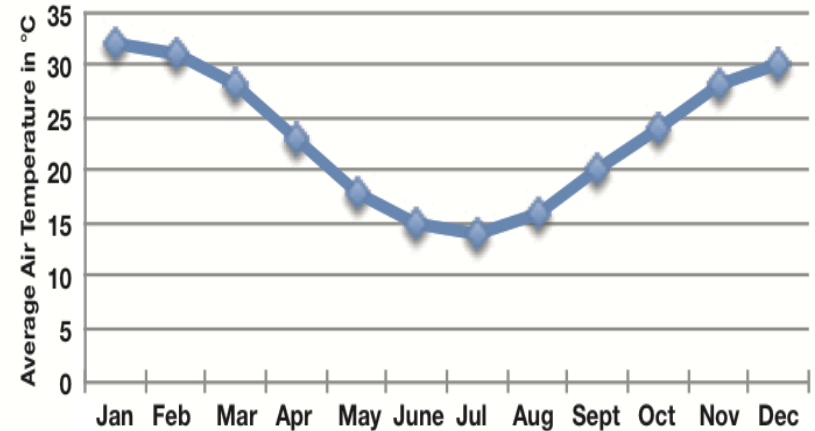
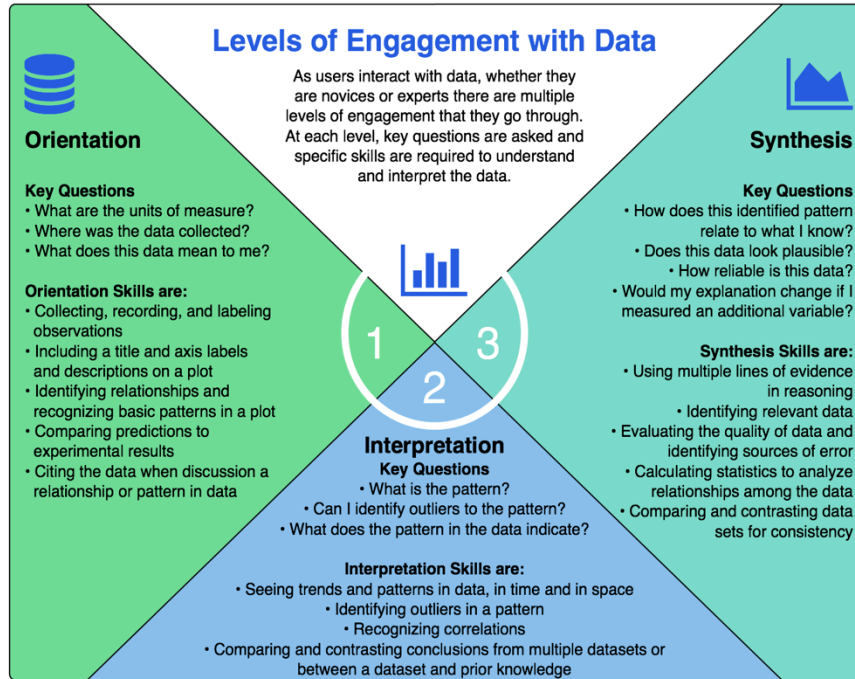
This means to me that there are changes in air temperature over the year at this location.

Interpretation - What does the data show?



<i>Example</i>
I see an decrease and then an increase over time pattern...
There are no outliers.
Therefore the air temperature rises and falls over a year.

Synthesis - What does the data pattern allow me to explain about what is not on the page?



Example

I know there are seasons and the air temperature changes across them. That is like these data changing.

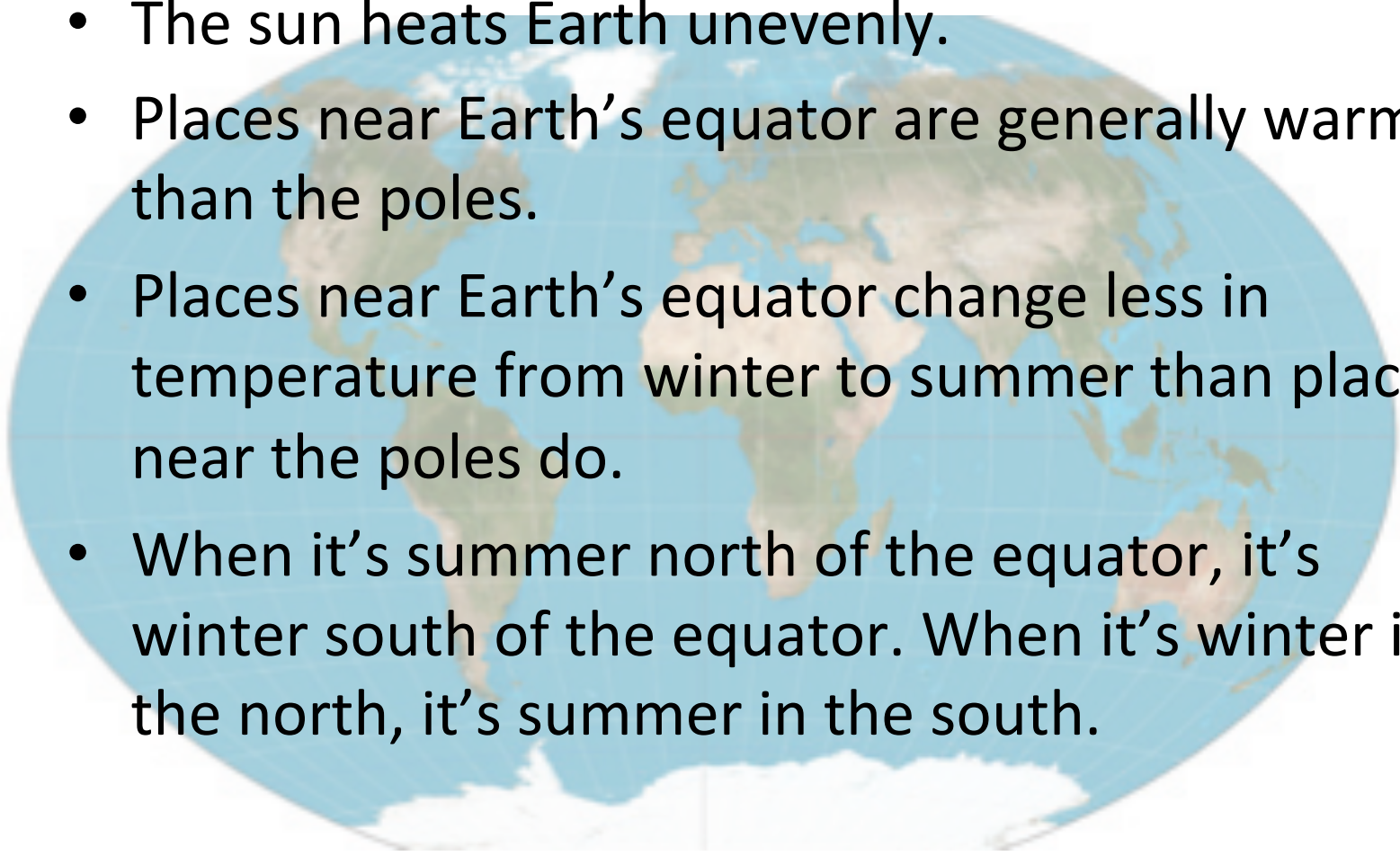
Yes, the data look plausible and I believe they are reliable.

My explanation would not change if I measured an additional variable, but I may be able to understand the processes better if I had data on other weather variables.

Summary

- All three levels of engagements with data visualizations are critical to understand and make sense of data
- Important to engage in all three repeatedly
- Only with much practice can expert scientists move quickly or skip some steps.

Earth is Heated Unevenly

- The sun heats Earth unevenly.
 - Places near Earth's equator are generally warmer than the poles.
 - Places near Earth's equator change less in temperature from winter to summer than places near the poles do.
 - When it's summer north of the equator, it's winter south of the equator. When it's winter in the north, it's summer in the south.
- 

Quick Write: Reflection

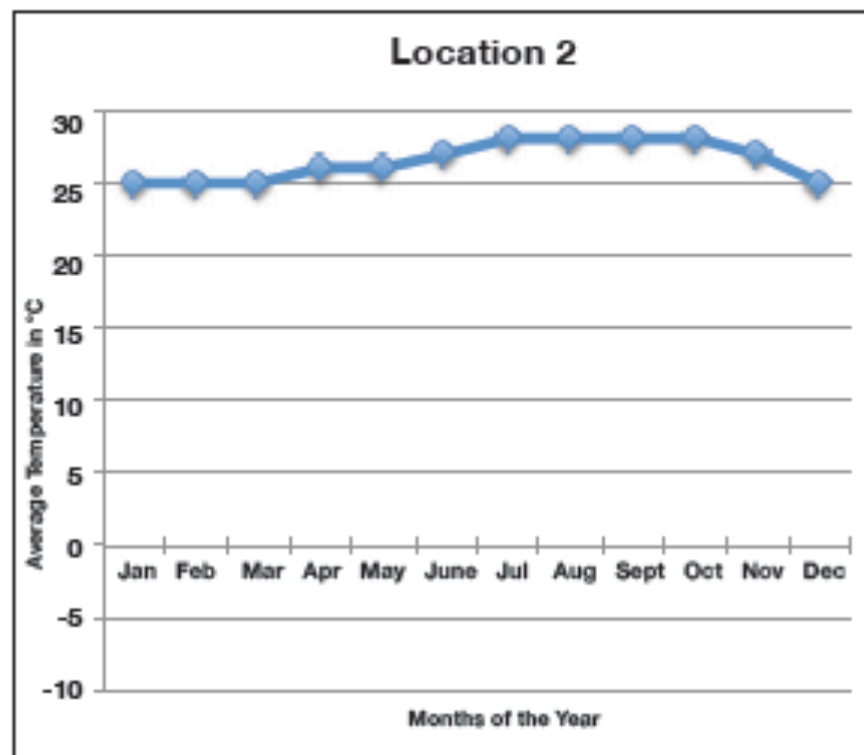
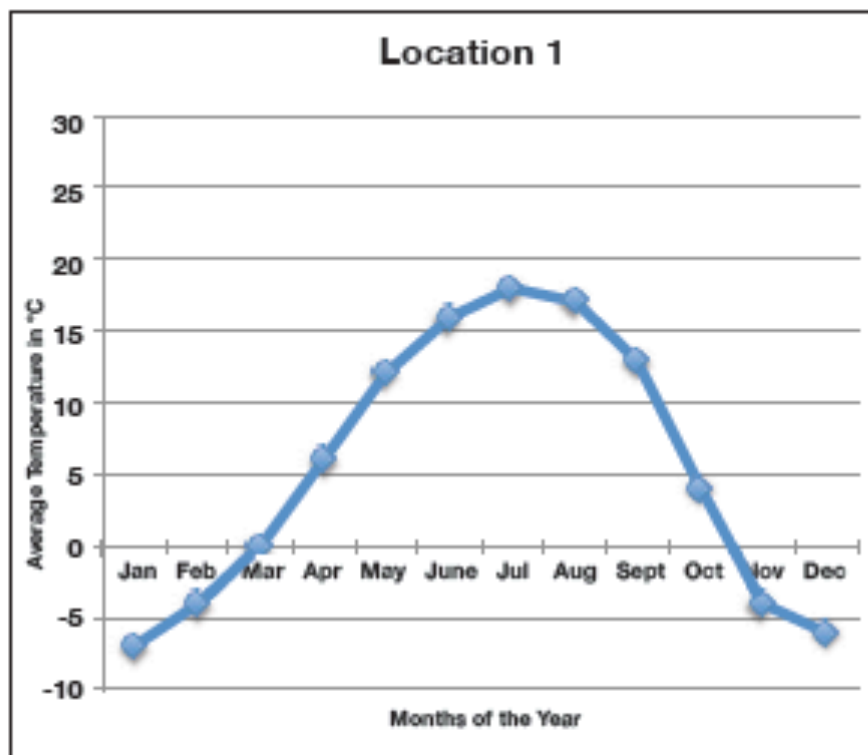


- What skills did you need as a learner to be successful with each step of the activity – answering the orientation questions, answering the interpretation questions, and then answering the synthesis questions?
- What did the instructor (or worksheet) do to support you in the learning experience?

Example: Mystery Locations

Which average temperatures are for Hawaii? Alaska?

What is your evidence?



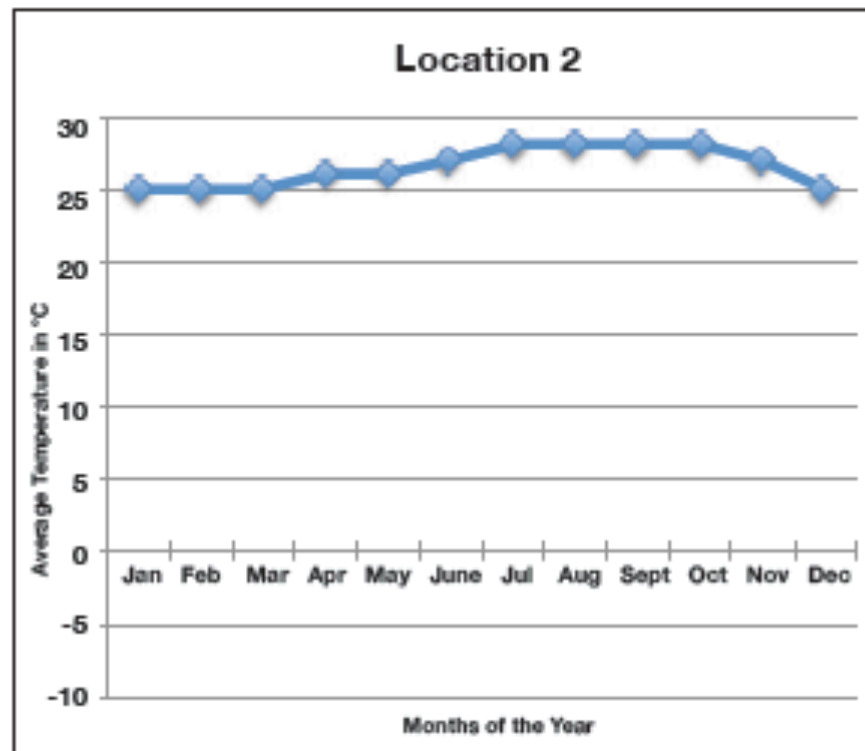
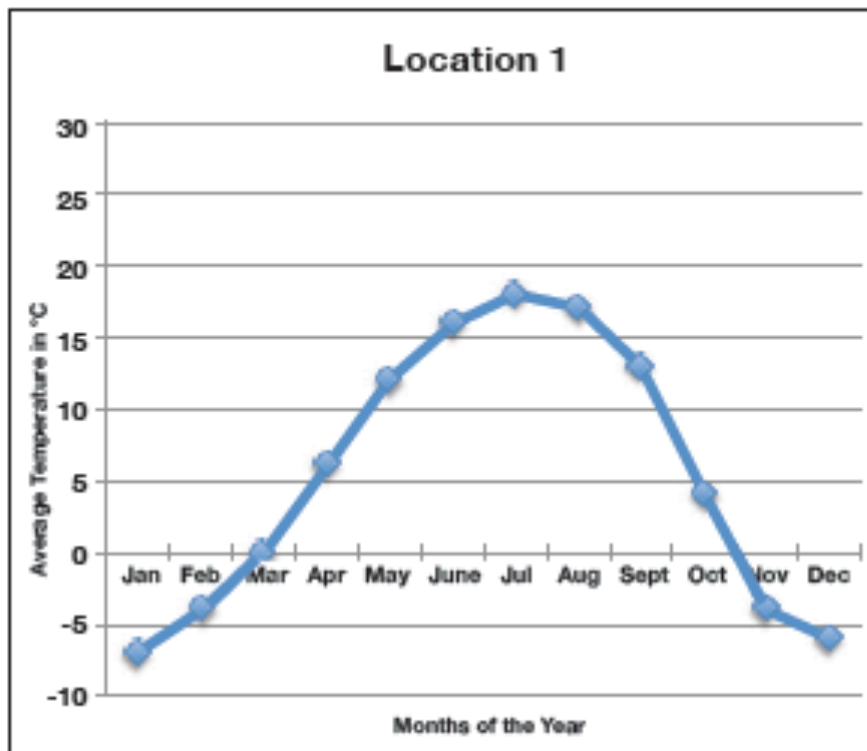
Scientific Evidence

- Evidence is a clue that helps answer a question or explain something.
- Evidence can come from...
 - our own investigations.
 - other people’s investigations.
- Evidence includes reasoning about WHY or HOW the data help to answer the question or explain something.
- Scientific explanations are based on evidence.

What's wrong with this explanation?

Explanation #1:

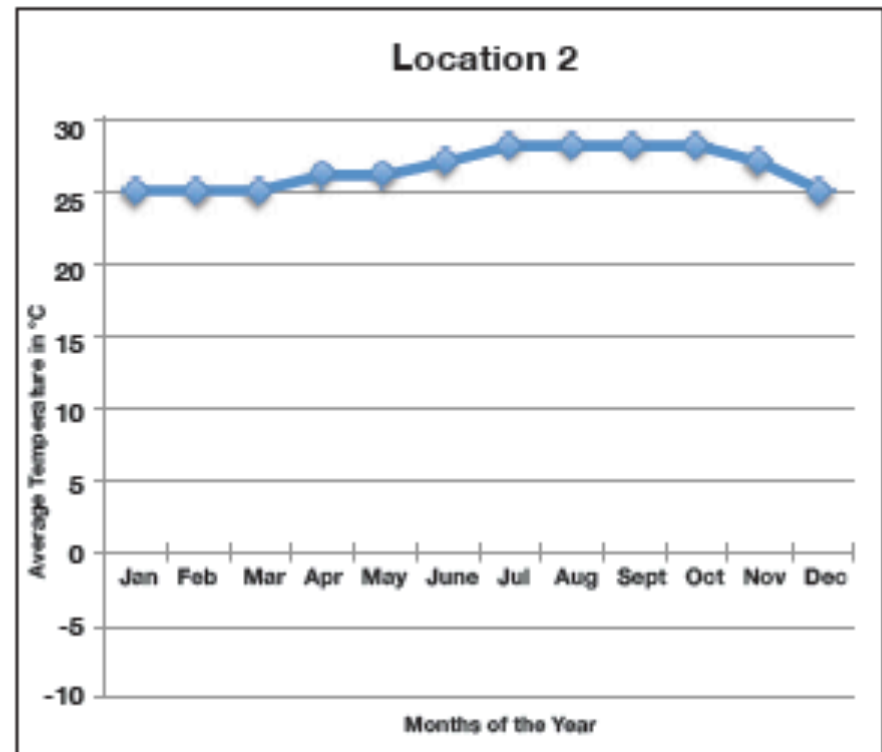
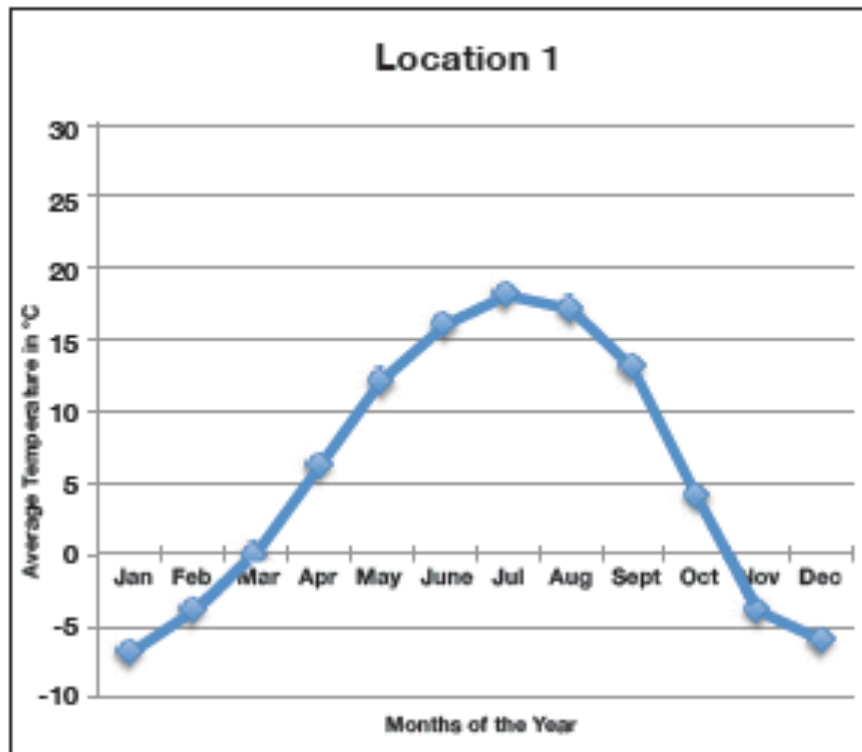
“I think Location 1 is Alaska. I don't know why. I just think that!”



What's wrong with this explanation?

Explanation #2:

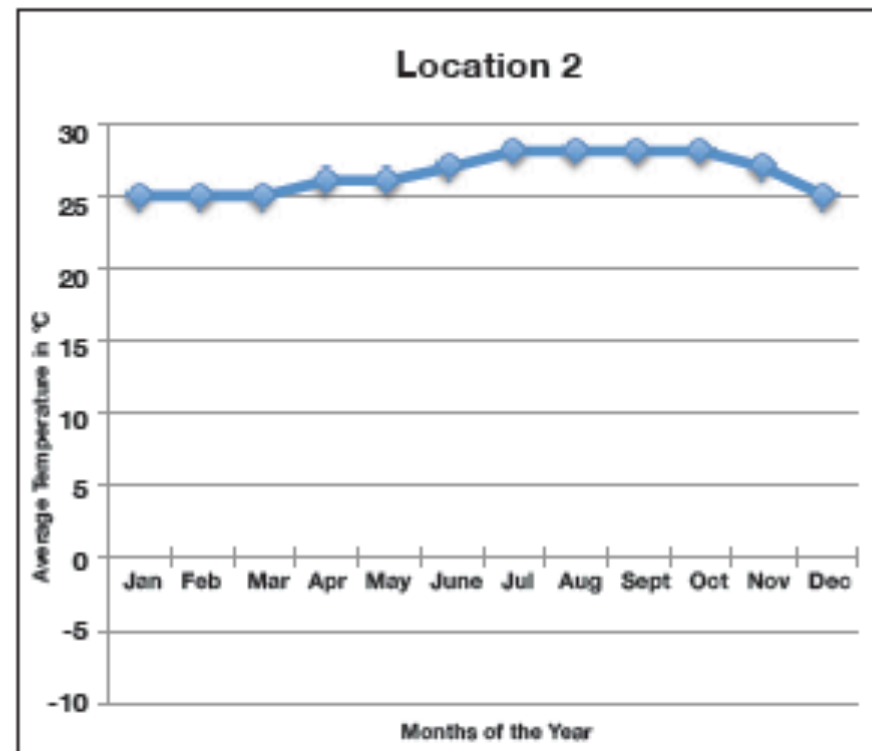
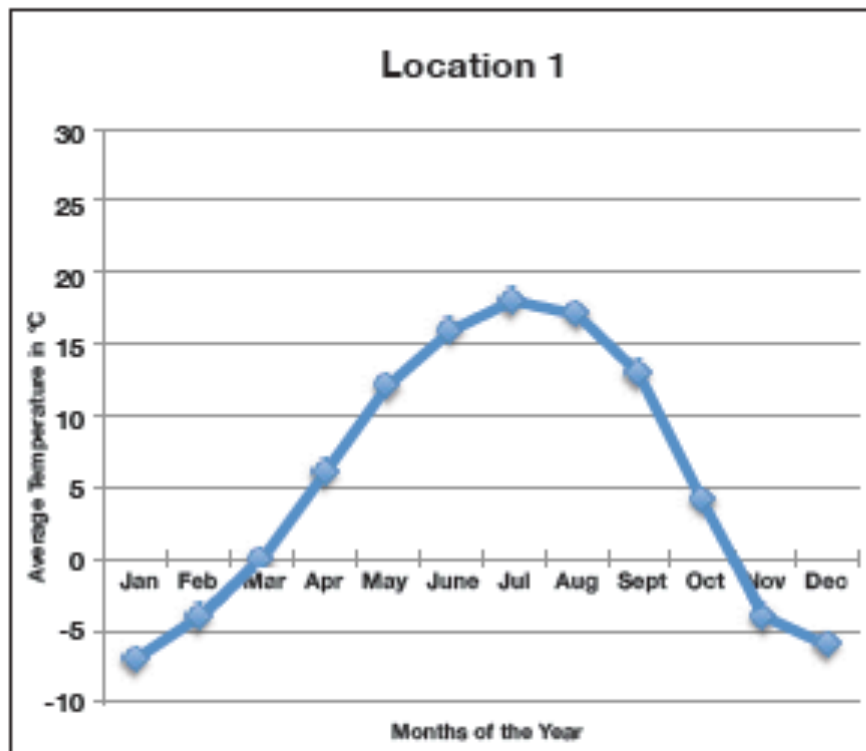
“The second one is Hawaii, because of the evidence.”



What's wrong with this explanation?

Explanation #3:

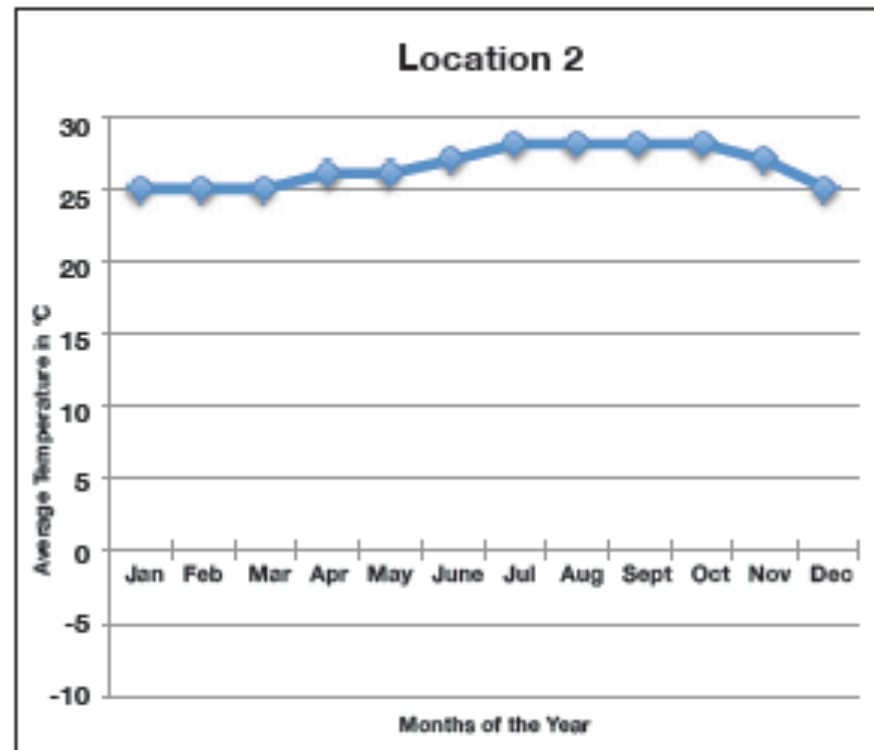
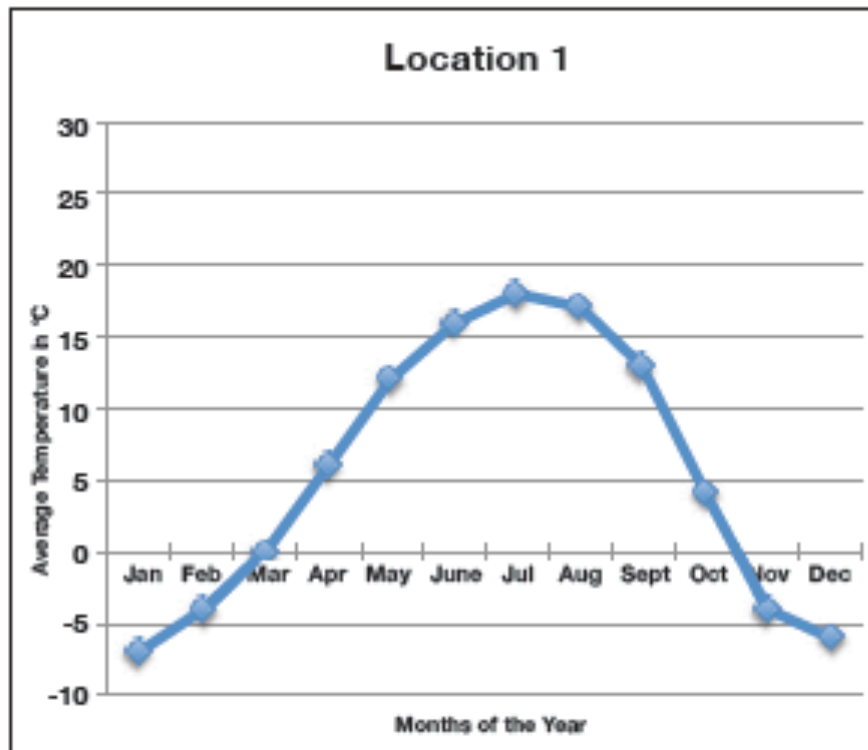
“I went to Hawaii once, and it was really warm there that week. I haven't been to Alaska, but my grandma has, and she said it was really cold. Also, when I've seen pictures of Alaska, it looks cold. That's why the first one is Alaska, and the second one is Hawaii.”



What's wrong with this explanation?

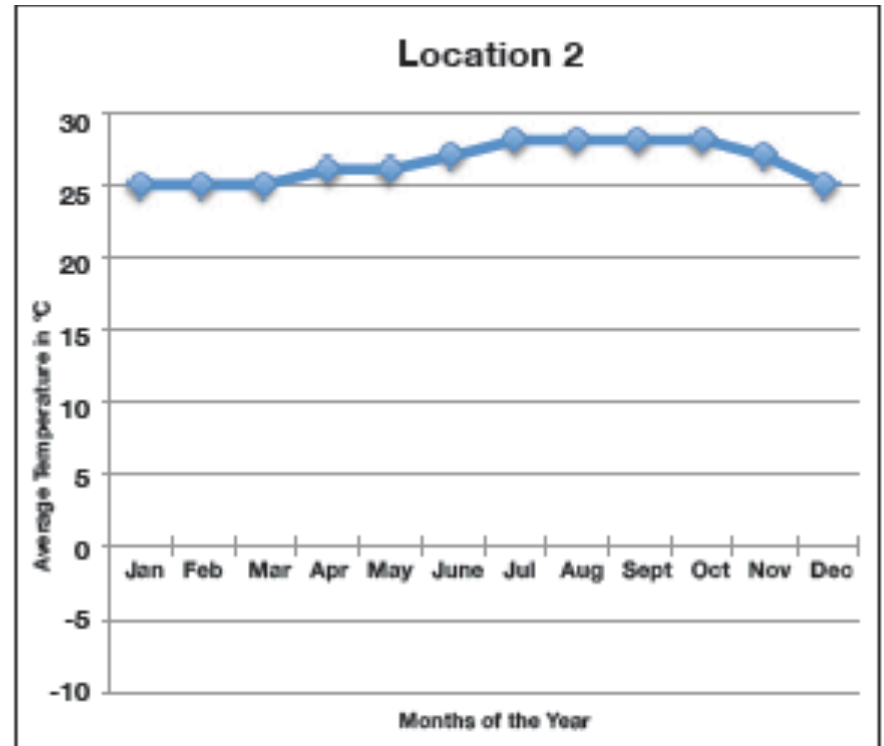
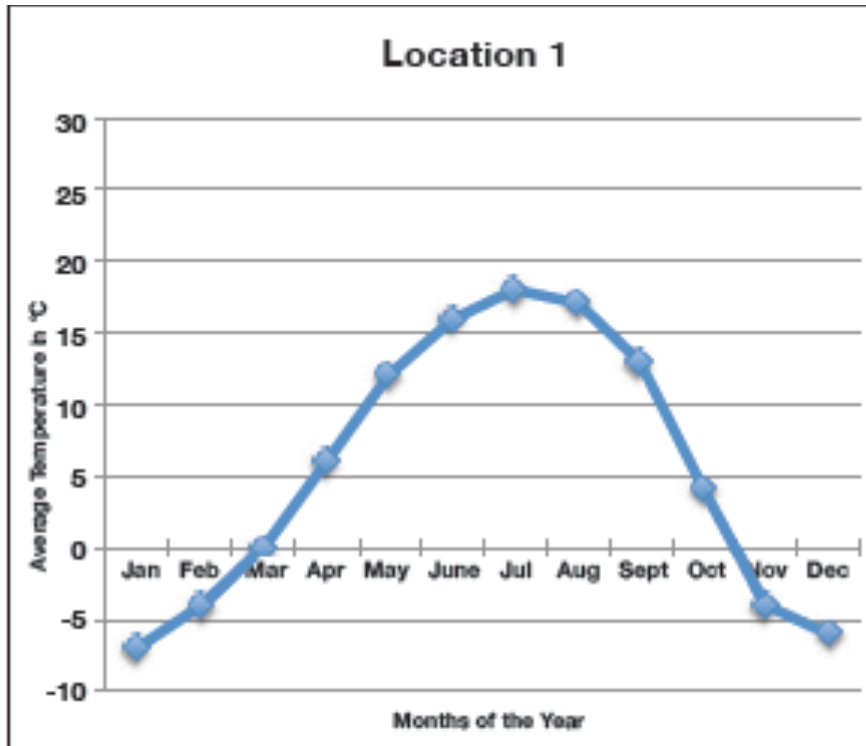
Explanation #4:

“On the world map, Alaska is near the North Pole, which means days are long in summer and short in winter. There would be a bigger difference between summer and winter temperatures. The graph shows a huge difference from winter to summer at the first location. That's why I think Location 1 is Alaska.”



Explanation #5:

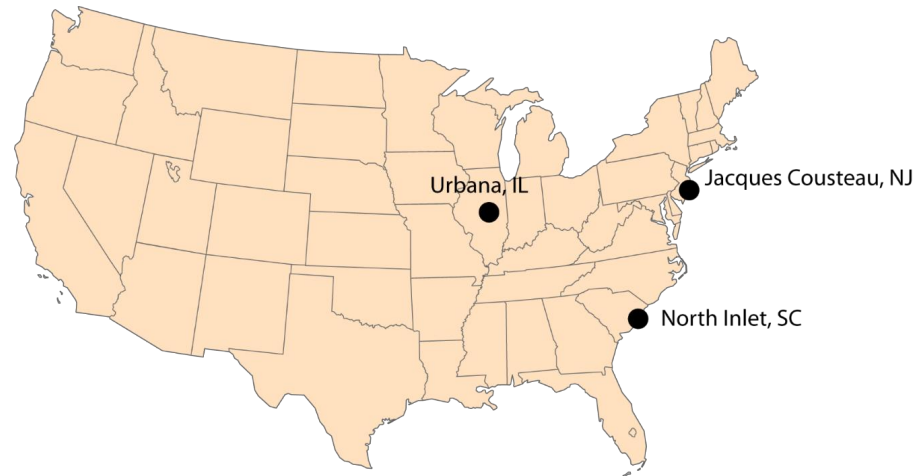
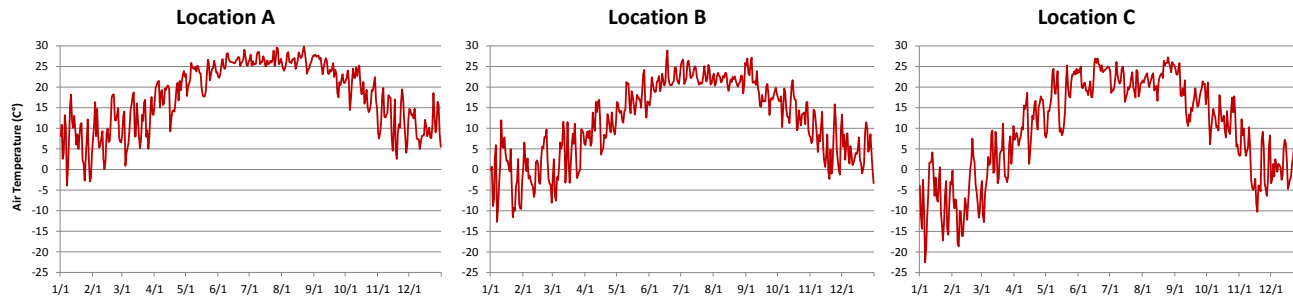
On the world map, Alaska is near the North Pole, which means days are long in summer and short in winter. There would be a bigger difference between summer and winter temperatures because temperature is dependent on the number of hours of sunlight received in an area. The graph shows a huge difference from winter to summer at the first location. This means that the area is receiving very different amounts of sunlight at different parts of the year and must be very far from the equator. Therefore, I think Location 1 is Alaska.



What makes a good scientific explanation?

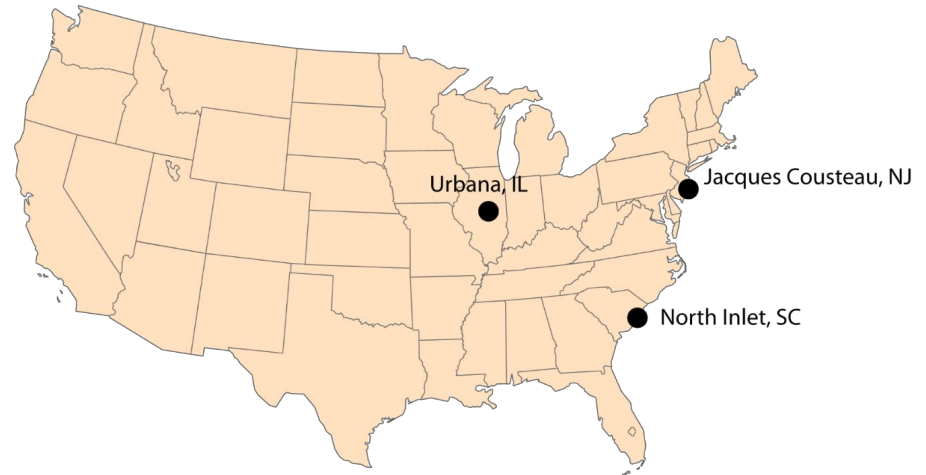
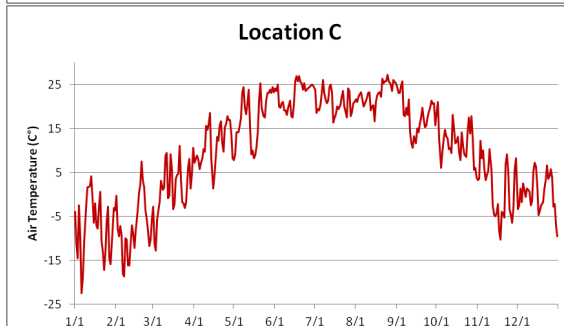
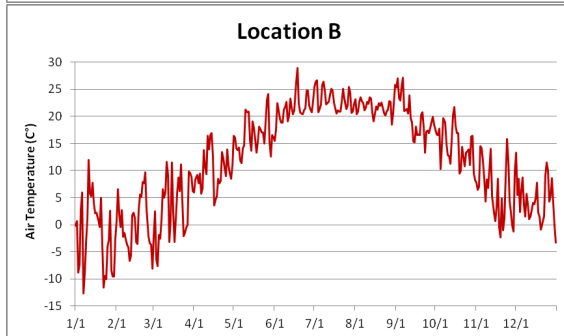
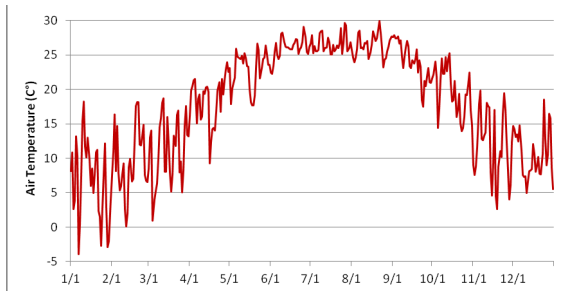
- The evidence supports the explanation.
- The evidence is based on carefully collected data and information, not just one casual observation.
- The evidence is from a reliable source.

Mystery Locations



Map showing the three mystery locations represented by the air temperature data in the graphs at the top of the page.

Mystery Locations



Map showing the three mystery locations represented by the air temperature data to the left.

Mystery Locations

Mystery Locations

Location A is _____

What evidence did you use to solve the mystery of location A?

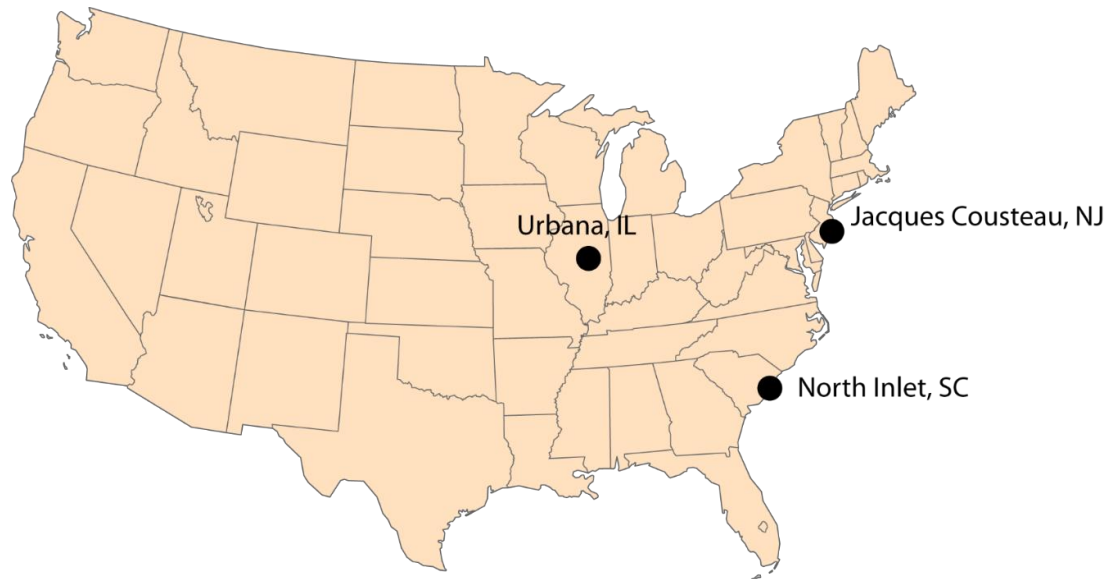
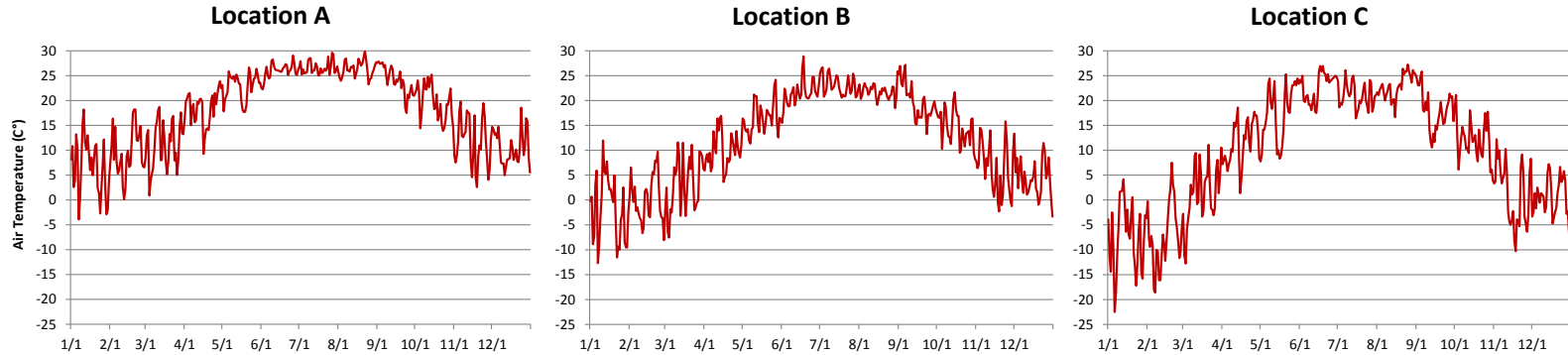
Location B is _____

What evidence did you use to solve the mystery of location B?

Location C is _____

What evidence did you use to solve the mystery of location C?

Three Corners Mystery Locations Activity



- What is the evidence that the data set matches the location of Jacques Cousteau Reserve on the map?
- What is the evidence that the data set does not match the location of Jacques Cousteau Reserve on the map?
- What is the evidence that this data set does not belong to one of the other locations?

Quick Write:

Challenges of accessing online data

- What challenges did you encounter doing the homework of finding and plotting data through the NERRS online data portal?
- Think about what challenges your students may face doing a similar task.



Think-Pair-Share

- THINK: about any previous experiences you have had using data or observations that were collected in local places or natural ecosystems with which you were familiar.
- PAIR: In what ways could using locally-collected data improve the ability to teach science to middle school students?
- SHARE

Summary

- Students make personal connections to their local natural environment and the patterns that are there through the data.
- Helps make abstract concepts more relevant and accessible because they are happening in the students' "backyard."
- Ecological processes and global change become more relevant when it is evident that they are impacting local waters and/or ecosystems.
- It is a portal (i.e. invitation) for engaging students in classroom activities when the data are relevant to activities of interest (e.g. sailing, surfing, outdoor sports) outside of school.
- Allows local, place-based investigations of nearby ecosystems without having to go in the field (for online real time data).
- Additional ideas related more generally to the value of working with authentic data include:
 - Allows students to formulate and test hypotheses using "real data."
 - Allows student to interact with data the way that scientists do.
 - Students can investigate the ocean without having to go to the ocean.

Homework

1. Read & use active reading strategy: Framework for K-12 Science Education Chapter 2 Guiding Assumptions and Organization of the Framework pp.23-38

Journal: What does it mean to teach in a 3-dimensional way? And, how might this be different from how science has been taught and assessed traditionally?

2. Read and record ideas about Science and Engineering Practices.

Read: Framework for K-12 Science Education Chapter 3. Science and Engineering Practices: Developing and Using Models, and Constructing Explanations and Designing Solutions

Chart: How have the instructor and the learner engaged in these Science and Engineering Practices as science content was learned in previous sessions?

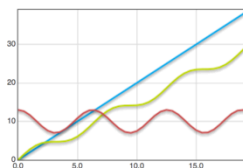
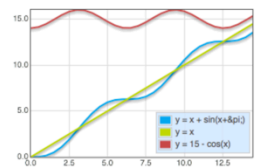
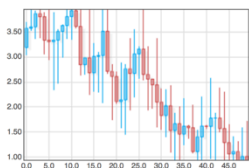
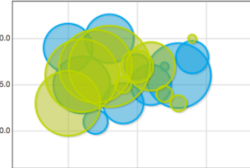
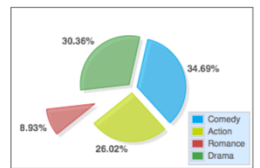
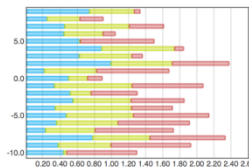
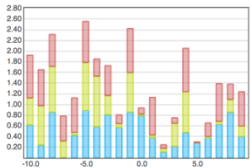
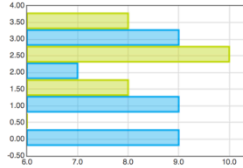
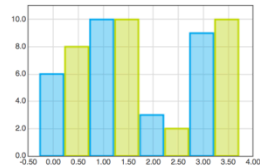
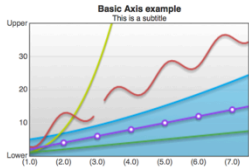
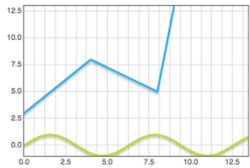
3. Read and record ideas about Crosscutting Concepts.

Read: Framework for K-12 Science Education Chapter 4. Crosscutting Concepts: Energy and Matter, and Systems and System Models.

Chart: How has the instructor and the learner used these Crosscutting Concepts as they learned science content in previous sessions?

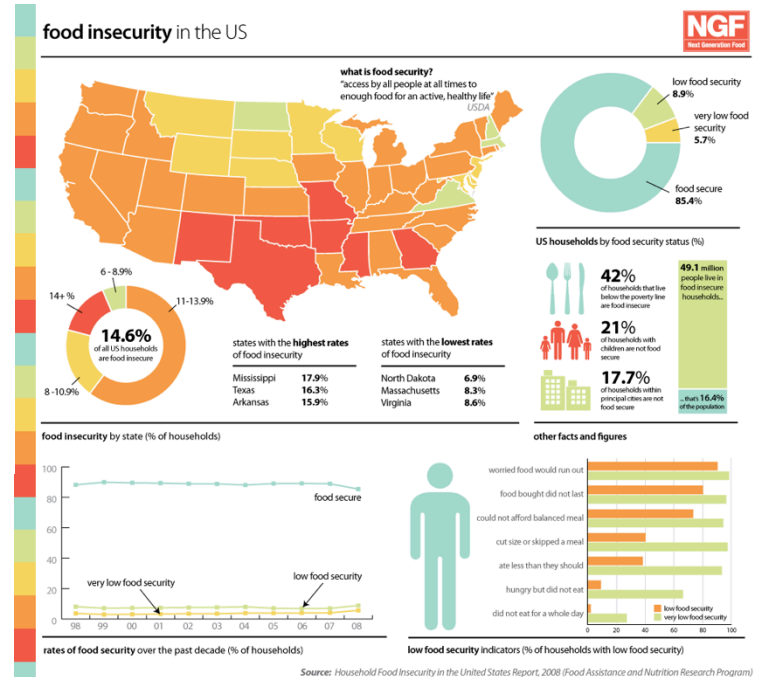
Optional Resources Slides

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



Key of Data Visualizations

What do you want to show?

Comparison

Among
Items

Over
Time

Distribution

Single
Variable

Two
Variables



Composition

Static in Time

Changing Over
Time

Key of data visualization share out

- What aspects of the organization were similar or different between the two groups?
- What aspects of the reasoning varied between the two groups?
- What additional questions do you have about how to choose a data visualization for your data?

Answer Key

What do you want to show?

Comparison

Among Items

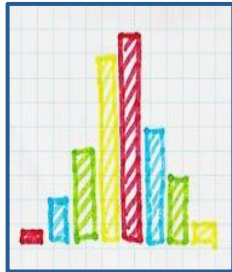


Over Time

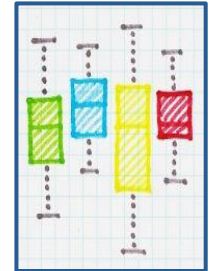
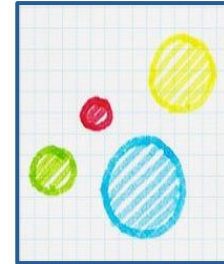
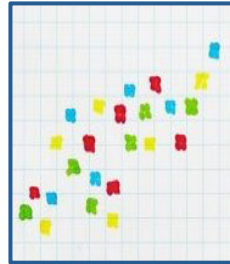


Distribution

Single Variable

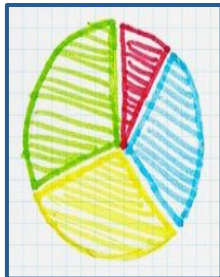


Two Variables

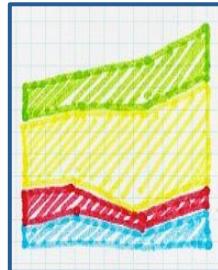


Composition



Static in Time



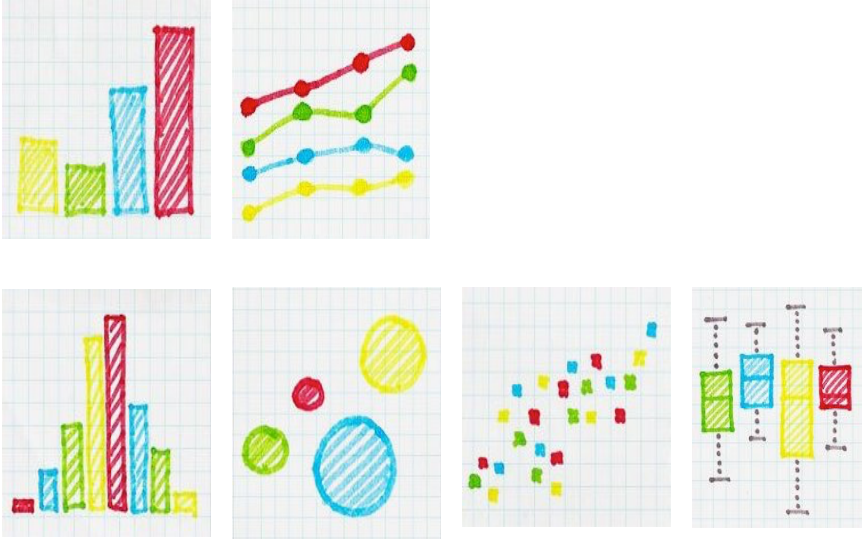
Changing Over Time



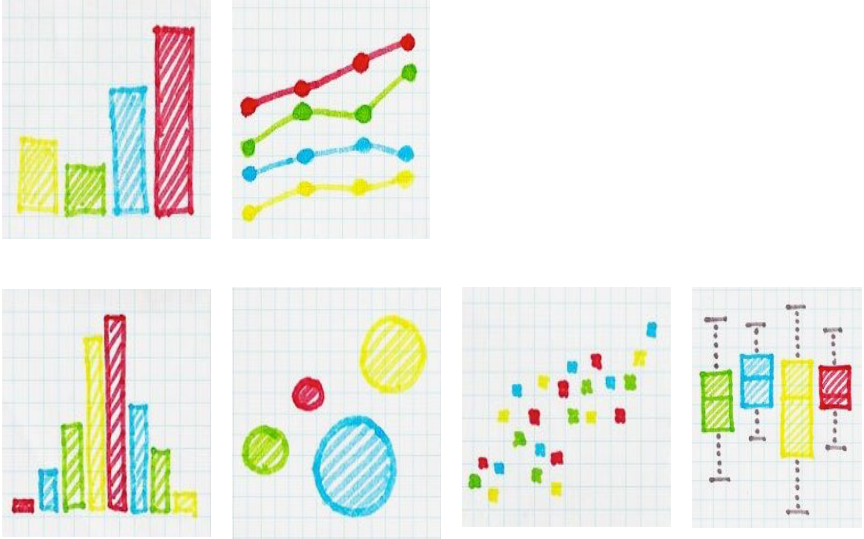
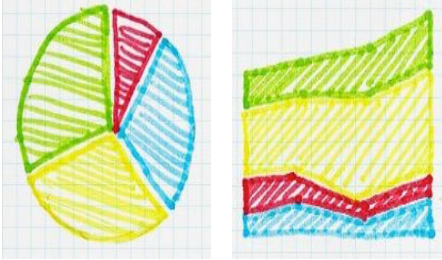
Matching words to figure type

	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

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<p>Distributions:</p>	<p>cluster, distributed, from/to, plotted, points, spread, spread over, relative to,</p>	

Variety of data visualizations

Any thoughts or opinions about learning the different data visualizations that go with the different ways you want to show data?

Any questions about choosing the appropriate data visualization for your data?