Data Visualization Best Practices Workshop Teacher Report

Name: Justin Kuncz

Area(s) of Teaching: Chemistry

Where You Teach: Cumberland High School

Please describe your activity goal:

Goal of this activity is to find data (advanced) or use provided data (beginners) on elemental composition of the Earth's crust and/or the Earth's atmosphere. Students will then use this data to create a visual representation of the data using the best graph choice (pie chart in these examples) and explain the data using their visual representation.

What is the intended visualization?

The intended visualization will be at least one pie chart, but ideally multiple pie charts. The pie charts when using all the elements in the atmosphere are 78% nitrogen and 21% oxygen. The remaining 1% of composition is a group of molecules that will not show up in a pie chart that includes nitrogen and oxygen. Students can manipulate the data (what is included in the pie chart) to better represent the minor molecules that make up a very small portion of the Earth's atmosphere.

This same plan can be used for the Earth's crust. The major difference is that the Earth's crust contains far more elements than the atmosphere. Students will need to develop a plan to drill down data (what are the students trying to show?) in order to present the best visualization for the message intended.

Please provide the activity wordings presented to the students:

In our study of the periodic table, there are 118 known elements found in the Universe. Some of these elements are naturally occurring while others are created using very sophisticated machines (particle accelerators). Where can some of these elements be found? How much of each type of element (or molecule) makes up our environment?

Goal: Your assignment is to create a visual representation showing the elemental/molecular composition of one of the following:

A) The Earth's atmosphere

B) The Earth's crust

The visual representation should show either the entire composition (example: all the elements in the Earth's crust) or smaller subsets of the data (10 most common transition elements in the Earth's crust). Please note: It is extremely important that the visualization you choose (ie. The type of chart) is the best way to represent this data. It is a good idea to create multiple different charts (a bar graph, line graph, pie chart, scatterplot, etc.) to see which of these visuals best shows the data you collected.

Materials needed:

- Chrome Book
- SimpleChartsRI.com website to create the visual representation
- A reputable source (or sources) from which to collect the data

Assessment:

You will be assessed based on the following criteria

- Accuracy of the dataset
- Correct choice of data visualization output (proper graph)
- Ability to explain findings verbally using the data image (graph)
- Does data visualization show all data (how can visual be manipulated to show very small portions of the dataset - two charts, for example)

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Please describe the nature of the activity (e.g. In class activity? Homework? Something else) and the rationale behind your choice.

This activity is an in-class activity. For advanced students, one outcome might be different looking graphs (pie vs. line vs. bar) and/or different data. Did the students use reputable data source(s) to create their visual representation?

Were students engaged?:

By making this an in-class activity, student engagement was much higher than had the same activity been done at home. Although collaboration is encouraged, at-home collaboration is cannot be monitored to ensure student questions or misunderstandings are addressed at the time of the activity.

What is/are the dataset(s) that will be used for the activity? How students will access the dataset(s)?

Dataset #1: Earth Atmosphere

https://www.engineeringtoolbox.com/air-composition-d_212.html

Dataset #2: Earth's Crust

https://en.wikipedia.org/wiki/Abundances_of_the_elements_(data_page)

What tool(s) are students going to use? How will students have access to the tool(s)?

Students will use the following:

- School issued Chrome Books
- SimpleChartsRI.com

How you are going to grade the activity? (e.g. Rubric)

Activity will be graded on the following criteria:

- Accuracy of the dataset
- Correct choice of data visualization output (proper graph)
- Ability to explain findings verbally using the data image (graph)
- Does data visualization show all data (how can visual be manipulated to show very small portions of the dataset - two charts, for example)

Do you think you will keep incorporating data visualization in the future?:

The goal is to use SimpleChartsRI.com as the foundational building block on creating "simple charts". Once students become comfortable making and interpreting the most common types of visual data (line, bar, pie charts, for example) I can begin to consider using more advanced data to visual tools (Infogram) to show how data presentation can be used to engage an audience.

Data Visualization Best Practices Workshop Teacher Report

Name: Justin Kuncz

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Area(s) of Teaching: Chemistry - Grade 10

Where You Teach: Cumberland High School

Please describe your activity goal:

Goal of this activity is to review raw data and visualized data to determine if there is a relationship between surface temperature and water temperature during the months of June through October.

Students will select an appropriate data visualization to tell a story about the warming cycle of the ocean.

What is the intended visualization?

The intended visualization will be a line graph with dates (x-axis) vs. temperature (y-axis). Up to 3 data sets (surface water temperature, deep water temperature, air temperature). Data will be limited to May through October as these are the typical months in RI that students are likely to be at the beach and able to "feel" the temperature of the water.

Please provide the activity wordings presented to the students:

1. Present Surface and Bottom Temp Data to Students
2. Students pair discuss for a minute or two
3. Group discussion about what they saw. / Difficulty of seeing trends in raw data
4. Students will use a data visualization program, in this case Google Sheets, to translate the raw data into a graph

Please describe the nature of the activity (e.g. In class activity? Homework? Something else) and the rationale behind your choice.

This activity will be a teacher-led activity that will coincide with thermodynamics of water (specific heat and heat capacity). The ultimate goal is for students to see that water and air absorb and release heat at different rates, which is due to the differences in specific heat of each substance. Students will be introduced to the idea that an exceptionally warm day in May will not lead to ideal beach water temperatures (especially in deeper water). Teacher will lead this activity as it will be an introduction to data visualization.

Were students engaged?:

Student engagement will be determined by not only the completion of the activity, but also the ability to make interpretations based on the raw data in a visual form (line graph). Students will be asked follow up questions (see below)

What is/are the dataset(s) that will be used for the activity? How will students access the dataset(s)?

Data set will be a modified data set taken from the following master source: *https://docs.google.com/spreadsheets/d/1WywzBJazFGCMDQ4vvi7-PXOSpAxmJX6Ku5UwAN33kIA/edit#gid=47637028* *(for water temperatures)*

https://www.usclimatedata.com/climate/kingston/rhode-island/united-states/usri0033 (for air temperatures)

What tool(s) are students going to use? How will students have access to the tool(s)?

Tools will include access to the data sets (above) and access to data visualization programs (likely Google Sheets due to IT allowed access for Chromebooks). Google Sheets is an acceptable tool for this small sample of data and the level of analysis being completed.

How are you going to grade the activity? (e.g. Rubric)

This activity in itself will be formatively assessed due to the introductory nature of the activity. Further summative assessment(s) will occur after students have practiced interpreting and analyzing different data sets.

Do you think you will keep incorporating data visualization in the future?:

The most difficult part of creating data visualizations is finding data sets that represent and/or correspond to curricular topics. The activity above was pieced together using two different data sets to show correlation between air temperature and water temperature.

Have you ever been to the beach on an exceptionally hot day in June and gone into the water expecting a water temperature that matches the air temperature? When you jumped into the water, how did you feel afterwards? Refreshed? Shivering? Wishing you had made a better choice?

Have you ever gone into the water to "warm up" when at the beach?

*Review the data in the table below for **60 seconds**. Do you see anything? Does it make sense?*

Date	Surface Water Temp	Deep Water Temp	Air Temp
6/1/2010	16.03	13.19	26.72
6/4/2010	17.03	13.89	28.28
6/15/2010	15.74	14.65	25.61

6/21/2010	18.05	14.62	31.72
6/28/2010	17.46	15.22	32.78
7/6/2010	21.61	13.89	37.22
7/12/2010	19.47	17.32	31.72
7/19/2010	21.73	18.36	32.22
7/26/2010	19.79	15.12	30.00
8/6/2010	20.69	15.99	26.67
8/12/2010	19.86	18.31	28.89
8/20/2010	21.12	17.92	31.11
8/25/2010	19.43	18.94	22.78
8/31/2010	20.41	17.62	34.39
9/8/2010	17.25	16.52	28.28
9/18/2010	17.09	16.4	21.11
9/20/2010	18.6	18.56	22.78
9/27/2010	16.38	15.9	20.00
10/6/2010	15.42	15.46	16.11
10/12/2010	14.64	14.8	19.39
10/18/2010	13.14	12.74	19.39
10/25/2010	11.17	11	12.78
5/30/2012	16.2	14.18	28.89
6/4/2012	16.48	16.23	25.00
6/8/2012	16.67	15.14	24.44
6/18/2012	18.92	17.09	21.67
6/26/2012	18.47	16.81	23.33
7/5/2012	20.39	17.61	31.11
7/16/2012	22.55	18.93	32.22
7/23/2012	21.44	19.34	27.78

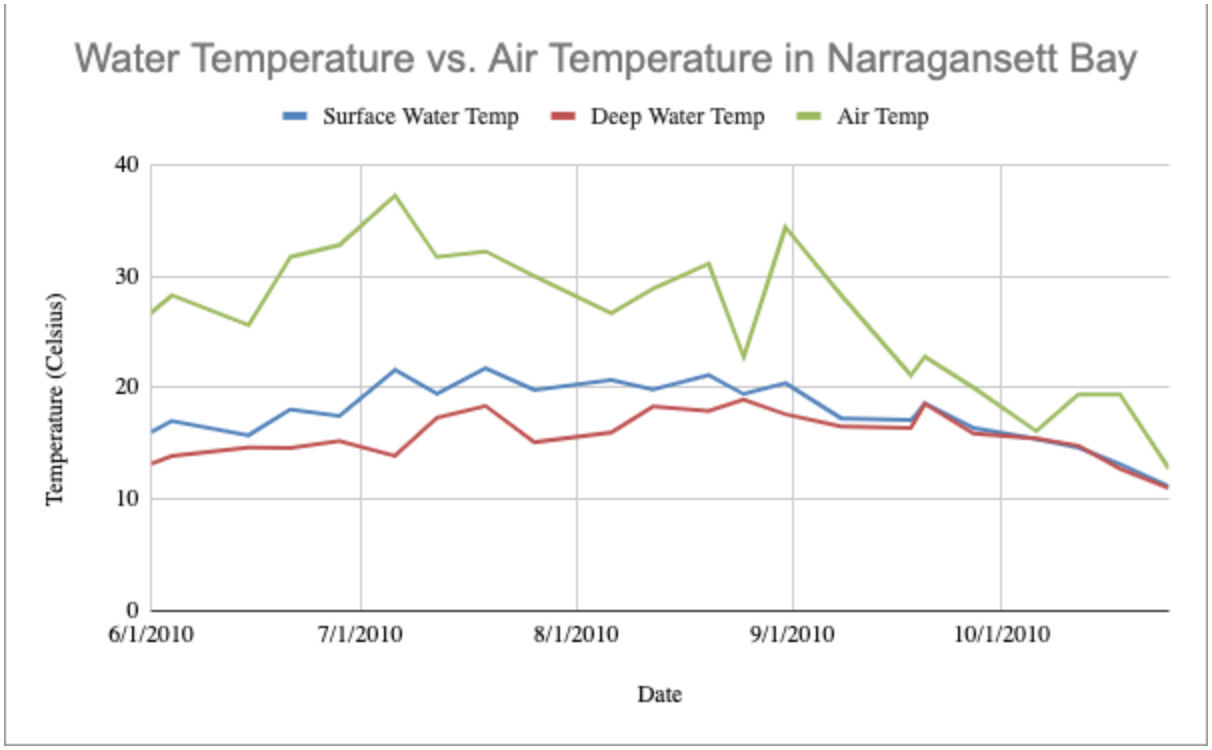
7/30/2012	22.36	20.76	26.67
8/7/2012	22.32	20.33	29.44
8/13/2012	23.99	20.79	29.44
8/17/2012	22.56	19.54	29.44
8/28/2012	22.21	21.09	29.44
9/4/2012	21.18	20.33	24.44
9/10/2012	21.59	20.34	22.78
9/17/2012	17.84	18.59	25.00
9/24/2012	19.24	18.42	21.67
10/1/2012	18.32	18.52	20.56
10/9/2012	17.77	17.93	15.00
10/18/2012	16.03	15.67	18.33
10/26/2012	15.51	15.53	19.44

What relationships can you see by looking at this set of numbers and dates? Is there any relationship between water and air temperature that jumps out at you?

Can you answer the following question?:

- *Does the rise and fall of air temperature exactly coincide with the rise and fall of surface water temperature AND deep water temperature?*

*Now, look at the same set of data in a different format. Review this graph for **60 seconds**. Does the data look different?*



*The above visualization contains the **exact** same dates and temperatures readings as the table preceding it. The data has been visually manipulated. Now, the same question is posed:*

- *Does the rise and fall of air temperature exactly coincide with the rise and fall of surface water temperature AND deep water temperature?*

Can you use the graph to answer the additional two questions below?

- *Is the hottest day (air temperature) also the day that has the warmest water temperature?*
- *Are there large spikes in water temperature that match spikes in air temperature?*
- *Does water experience the same extreme swings in temperature that air temperatures can experience?*

Which representation was easier to interpret and use to answer the question?

Both the chart of data and the line graph above are ways to visualize data. Let's use these visualizations to talk about thermodynamics and the heat capacity of water……..

ALternate Student Representations of this data.