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| **Lesson Title : Collecting, Analyzing, and Presenting Data** | **Unit #: 1** | **Lesson #:** **2** | **Activity #:****4** |
| **Activity Title: Analyzing Data** |

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| **Estimated Lesson Duration:** | **6 days of class time, over the course of 3 weeks** |
| **Estimated Activity Duration:** | **1 day (or 2 days with optional portion included)** |

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| **Setting:** | **College classroom** |

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| **Activity Objectives:** |

Students will be able to:

1. Observe relationships in collected data.
2. Create graphs and/or charts to show relationships in collected data.
3. Use sentences to describe the relationships shown in graphs and charts.

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| **Activity Guiding Questions:** |

1. What do I see happening in the data?
2. How can I represent the data in a graph or chart so that it can be easily understood?
3. How can I clearly describe what is shown in a graph or chart?

| **Next Generation Science Standards (NGSS)**  |
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| **Science and Engineering Practices (Check all that apply)**  | **Crosscutting Concepts (Check all that apply)** |
| ☒ Asking questions (for science) and defining problems (for engineering) | ☐ Patterns |
| ☐ Developing and using models | ☐ Cause and effect |
| ☐ Planning and carrying out investigations | ☐ Scale, proportion, and quantity |
| ☒ Analyzing and interpreting data | ☐ Systems and system models |
| ☒ Using mathematics and computational thinking | ☐ Energy and matter: Flows, cycles, and conservation |
| ☐ Constructing explanations (for science) and designing solutions (for engineering) | ☐ Structure and function.  |
| ☒ Engaging in argument from evidence | ☐ Stability and change.  |
| ☐ Obtaining, evaluating, and communicating information  |  |

| **Ohio’s Learning Standards for Science (OLS)** |
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| **Expectations for Learning - Cognitive Demands (Check all that apply)** |
| ☐ Designing Technological/Engineering Solutions Using Science concepts **(T)** |
| ☐ Demonstrating Science Knowledge **(D)** |
| ☐ Interpreting and Communicating Science Concepts **(C)** |
| ☐ Recalling Accurate Science **(R)** |

| **Ohio’s Learning Standards for Math (OLS) and/or** **Common Core State Standards -- Mathematics (CCSS)** |
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| **Standards for Mathematical Practice (Check all that apply)** |
| ☐ Make sense of problems and persevere in solving them | ☐ Useappropriate tools strategically |
| ☐ Reason abstractly and quantitatively | ☐ Attendto precision |
| ☐ Construct viable arguments and critique the reasoning of others | ☐ Look for and make use of structure |
| ☐ Model with mathematics | ☐ Look for and express regularity in repeated reasoning |

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| **Unit Academic Standards (NGSS, OLS and/or CCSS):** |

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| **Materials**: (Link Handouts, Power Points, Resources, Websites, Supplies) |

1. Whiteboards
2. Large post-it notes
3. Air pollution data collected along a major roadway, generally showing larger concentrations of pollution in stretches of road that have steeper grades.

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| **Teacher Advance Preparation:** |

1. Prepare several sets of data, at least one of which can be represented well in a scatter plot, one in a bar graph, and one in a pie chart. (see 1.2.4f)

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| **Activity Procedures:** |

1. Give samples of various ways that data can be presented, and a quick overview of how Excel can be used to make various types of graphs.
2. Divide the class into several groups. Present the data in 1.2.4f and have student groups attempt to make scatter plots, bar charts, and pie charts from each set of data.
3. After they have attempted all three types of chart for the first data set, the groups choose which chart is the best way to represent the data, and make a version of this chart that can be posted on a wall. If the resources are available, the charts can be made in Excel and printed out. If not, they should be done on whiteboards. If the plots are to be done by hand, state that for pie charts the wedges should just be approximate, not measured.
4. Gallery walk. For each data set, every student chooses the chart that they believe is the best from among the charts the OTHER groups made, writes what makes it the best, and puts the post-it on the chart (along with the student’s name). I will photograph each chart along with the post-it notes.
5. Repeat steps 3 & 4 for the second set of data.
6. Optional: A second day can be used to analyze road pollution data. This will require students to decide physically what is going on to make high pollution on the sloped areas of the road, then decide on the relevant physical parameters, estimate the values of the relevant parameters, determine the independent and dependent variables, decide on what type of chart will make the best representation, and create the chart along with an explanation for what is observed. I will likely not do this because it is quite complex and I am afraid it will use too much class time.

**Formative Assessments:** Link the items in the Activities that will be used as formative assessments.

Monitoring as they work on the charts, assessing the quality of the charts and the feedback students give each other with the post-it notes.

**Summative Assessments:** These are optional; there may be summative assessments at the end of a set of Activities or only at the end of the entire Unit.

The summative assessment will be the final presentation at the end of the unit.

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| **Differentiation:** Describe how you modified parts of the Lesson to support the needs of different learners.Refer to Activity Template for details. |

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| **Reflection:** Reflect upon the successes and shortcomings of the lesson. |

This lesson seemed to be a good way to help students to decide what type of graphical representation to use for different types of data. I presented some examples of poorly executed graphs that I found online and the students were able to point out the problems and suggest ways that the information could have been presented more effectively. They uniformly made good choices in how to represent the sample data that they were given and gave good feedback to one another in the gallery walk. One of the groups included this activity in their engineering notebooks. BUT that group then made no effort at all to modify their original graphs (which were poorly done, and made as bar graphs when scatter plots would have been much more effective). So while it felt like an effective lesson, I didn’t see real changes in their projects as a result of having done this activity.

We did not do the optional activity because of a lack of time and also because I felt that the concepts required were too complicated for this group of students at the time the lesson was done. There were too many layers of understanding necessary to correlate the altitude information from Google Maps with the slope of the road and therefore the necessary power that the vehicles would need at various points along the road, and then to connect that with the air pollution created.