### Analyzing & Interpreting Data

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<tr>
<th>AWARENESS FRAMEWORK</th>
<th><strong>Rationale</strong></th>
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<tr>
<td><strong>Science</strong></td>
<td>Scientific investigations produce data that must be analyzed in order to derive meaning. Because data usually do not speak for themselves, scientists use a range of tools—including tabulation, graphical interpretation, visualization, and statistical analysis—to identify the significant features and patterns in the data. Sources of error are identified and the degree of certainty calculated. Modern technology makes the collection of large data sets much easier, thus providing many secondary sources for analysis.</td>
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<td><strong>Engineering</strong></td>
<td>Engineers analyze data collected in the tests of their designs and investigations; this allows them to compare different solutions and determine how well each one meets specific design criteria—that is, which design best solves the problem within the given constraints. Like scientists, engineers require a range of tools to identify the major patterns and interpret the results.</td>
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<tr>
<th>AWARENESS QUESTIONS</th>
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<tr>
<td>1. From the background information, what new awareness do you have about analyzing and interpreting data?</td>
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<td>2. How does this practice support analyzing and interpreting data?</td>
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<td>3. In a 3-Dimensional Classroom, who do you think needs to be analyzing and interpreting data?</td>
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<td>4. What questions did the background raise for you?</td>
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<tr>
<th>EXPOSE BELIEFS</th>
<th>Analyzing &amp; Interpreting Data podcast</th>
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<td><a href="#">NGSS @ NSTA</a></td>
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| EXPOSE BELIEF QUESTIONS | 1. What are your current beliefs about the analyzing and interpreting data practice?  
2. What beliefs do you have from prior knowledge, education or professional development regarding this practice?  
3. How well do you feel you meet the expectations of this practice as a teacher? |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CONFRONT BELIEFS        | Conceptual Change Activities:  
Asking Questions Activity #1: Pendulums  
Asking Questions Activity #2: Old Faithful Eruption  
Asking Questions Activity #3: Most Average Person |

### Developing Conceptual Understanding of Analyzing and Interpreting Data Activities Background

The purpose of the activities is to engage teachers in the practice of analyzing and interpreting data, so importance is placed on generating lots of data and having learners analyze and interpret the data. The emphasis is NOT on the activity itself, but rather conceptual change related to the practice. Consumers of this Toolkit are reminded not to get wrapped up in the activity, but rather continually reflect on the conceptual nature of the practice to gain deeper understanding.

Since the following activities are NOT lesson plans, in some cases only a brief explanation of the activity has been provided. The facilitator should encourage learners to direct their own investigations and intervene only as needed to redirect.

#### Analyzing and Interpreting Data Activity #1: Pendulums

**Common Language:**

- Frequency (measured in cycles per second)
- Hertz (also called frequency)
- Period (seconds per cycle)
- Cycle (from starting point and back to the start position)
- Amplitude (how far back you held the pendulum in start position)

**Investigation:**

In this activity learners find what variables affect the frequency of a pendulum: mass, string length, placement of structure, and amplitude.
Materials:

- Washers
- Paperclips
- String
- Masking tape
- Stand to hold pendulums
- Rulers
- Stopwatch

Learners are allowed to choose the materials listed they want to find the frequency of the pendulum at different string lengths and mass to determine what influences frequency.

One possible approach: Tape the string to the stand. Have groups determine the number of washers and determine the degree angle to be released. Test the variable mass keeping other variables constant. Record the amount of time it took the pendulum to cycle 10 times. With each trial, add or discard washers. With this data collection, find if mass affects the frequency.

Second, use 10 different string lengths. Complete 3 trials for each string length. Keep all other variables constant. Take the average time for each string length trial. Record this data in a line graph and determine if frequency is affected by string length. Use graphing and predicting to analyze data. Look for patterns in numbers and find relationships.

See the Pendulum Activity in Planning and Carrying Out Investigations.

**Analyzing and Interpreting Data Activity #2: Old Faithful Eruptions**

Background: Old Faithful Geyser in Yellowstone Park erupts somewhat predictably. The pattern of eruptions can be determined by investigating the relationship between the duration of an eruption (the time it erupts) and the interval (time between eruptions).

Learners can use websites that provide information regarding eruption periods of Old Faithful. Make sure you find information on both the interval duration. Create a scatter plot to analyze the data. Discuss how you can interpret the data and then use the data to predict future eruptions.

Some possible links:
www.geyserwatch.com
www.geysertimes.org
Analyzing and Interpreting Data Activity #3: Most Average Person

Challenge learners to find the most average person in the group. This can be done by measuring hand span, height, head circumference, arm length, and stride length. Learners measure and record the data for all participants. This is an excellent opportunity to introduce learners to spreadsheets. Once all data has been collected, learners determine the most average person in the group.

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<th>RESOLVE BELIEFS</th>
<th>Debrief the activity(ies) by focusing on the conceptual understanding of the practice using the following prompts:</th>
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| RESOLVE BELIEF QUESTIONS | 1. In what ways did this activity change your beliefs about analyzing and interpreting data?  
2. How difficult do you find it to analyze and interpret data?  
3. Discuss the progression of skills needed to analyze and interpret data that you need in order to successfully complete these activities with your students?  
4. How can technologies such as graphing calculators, table apps and spreadsheets support this practice? |
| EXTEND THE CONCEPT QUESTIONS | 1. How do you currently help students collect, interpret, and graph data in your classroom?  
2. Review a recent lesson you taught and evaluate the effectiveness of engaging students in analyzing and interpreting data.  
3. What is the relationship between this practice and others? |
| GO BEYOND QUESTIONS | 1. Challenge yourself to learn how to use different types of graphs bar graphs or histograms, pie charts, line graphs, scatterplots, etc. appropriate for the level you teach.  
2. Use different technology (probeware) and/or programs to build tables and graphs.  
3. Use the EQuiP Rubric for Lessons & Units: Science to evaluate a recent science lesson you taught.  
4. Ask a colleague to observe one of your lessons OR video yourself teaching and reflect specifically on defining problems and identifying constraints. |

Learning Progression for Analyzing and Interpreting Data

**Elementary:** Students need support to recognize the need to record observations.

**Middle School:** Students should learn standard techniques for displaying, analyzing, and interpreting data.
High School: Students should use greater diversity of samples and use computers or other digital tools to support analysis.

See p. 9 Appendix F Science and Engineering Practices in the NGSS for a more thorough grade band progression.

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