Britannica Expedition: LEARN!

Teacher Toolkit

Analyze and Interpret Data: Grades 6–8

OVERVIEW:

The foundation of all scientific and engineering endeavors is the collection of data as empirical evidence. That data must then be analyzed and interpreted to reveal patterns that are used to support conclusions, explain phenomena, and evaluate engineering designs. Students who can effectively analyze and interpret data are better able to evaluate experimental design and can more easily recognize and compare important patterns in data sets. They can also more easily find meaning in data and connect that meaning to information they've learned through reading, and they have a better understanding of how the fields of science and engineering make advancements in knowledge and technology.

To successfully analyze and interpret data, students should practice organizing data into tables, displaying it in graphs, charts, and diagrams that highlight relationships between variables, and using mathematical reasoning to find trends in data.

The following strategies are designed to scaffold and support students in analyzing and interpreting data in science texts in *Expedition: Learn!* While each of the mini-lessons below are based on passages and lessons within *Expedition: Learn!,* they can be adapted to meet the needs of your classroom.

Mini-Lesson I

Understanding Independent and Dependent Variables (20 minutes)

Background: To organize data and make sense of it, it is important for students to understand the variables included in an experimental design and how those variables are best organized in tables and visualized in graphs. The teaching suggestions below are based on the *Expedition: Learn!* lesson "Kinetic Energy."

- Share with students that science is based on what we are able to see or observe. Scientists look for occurrences or patterns in their environment, form hypotheses, and design experiments to prove these hypotheses.
- Explain that when designing an experiment, scientists will consider two variables—the independent variable and the dependent variable.
- Explain that the independent variable is the factor that the experimenter changes during the experiment. Deciding on the independent variable is part of the experimental design, with the hypothesis that changing this variable will cause an effect.

- Share that the dependent variable is the change or changes that occur as a result of the independent variable. For example, if you wanted to test how water affects plant growth, the amount of water given to different plants is the independent variable and the plant growth that results is the dependent variable. If you were testing a bridge prototype, the independent variable might be the amount of weight applied to the bridge and the dependent variable is the amount of time the bridge prototype can hold the weight without breaking.
- Explain that when using a graph to represent data, the independent variable is on the x-axis and the dependent variable is on the y-axis.
- Display the graph "Mass and Kinetic Energy" on page 4-Build in the lesson. Invite students to turn and talk to identify the independent and dependent variables.
    - *Independent - mass in kg*
    - *Dependent - kinetic energy in J*
- Emphasize that because the mass, or weight, of an object can be changed, it is the independent variable. Because the kinetic energy depends on the mass of the object, it is the dependent variable.
- Display the graph "Velocity and Kinetic Energy" on page 4-Build. Invite students to turn and talk to identify the independent and dependent variables.
    - *Independent - velocity in m/s*
    - *Dependent - kinetic energy in J*
- Reiterate that knowing which variable is dependent and which is independent helps us to understand how something works and to analyze the data.

Mini-Lesson II

Interpreting Graphs in Science Texts (30 minutes)

Background: Scientific texts often include graphs to illustrate the results of experiments, the distributions of materials, or patterns over time. Knowing why different graphs are used helps students to both interpret existing data and choose an appropriate graph type when representing the results of their own work. The teaching suggestions below are based on the *Expedition: Learn!* lessons "Graphing and Describing Motion" and "How People Use Water."

- Share with students that an important part of analyzing and interpreting data is understanding the type of graph that best shows trends in particular data. The main types of graphs they will see in *Expedition: Learn!* science texts are line graphs and pie graphs.
- Display the graph titled "Comparing Data Sets on a Position-Time Graph" on page 5-Build of the lesson "Graphing and Describing Motion."
- Invite students to turn and talk, discussing what they notice in the graph. For example:
    - *titled "Position-Time Graph"; x-axis titled "time (s)"; y-axis titled "position (m)"; both axes numbered 1-10; four lines labeled A-D; line D is horizontal; lines A-C are sloped upward*
- Share with students that this graph is a line graph, and that line graphs are typically used to show change over time.
- Display the graph titled "Water and Hospitals" on page 2-Build in the lesson "How People Use Water."
- Invite students to turn and talk, discussing what they notice in the graph. For example:
    - *titled "Water and Hospitals"; has seven different colored slices; slices are labeled medical equipment, laundry, kitchen/dishwashing, landscaping, cooling and heating, restroom, and other; restroom,cooling, and heating take up more than half the pie; each slice has a percentage*
- Share with students that this graph is a pie graph, and that pie graphs are typically used to show parts of a whole. If students did not already make the observation, point out that the percentages add up to one hundred.
- Explain that scientists choose the appropriate graph to represent their findings or data so that people can understand what their findings were. Learning to use the correct graph can make students better scientists.

Mini-Lesson III

Understanding Correlation and Causation (40 minutes)

Background: As part of data interpretation and mathematical reasoning, students should understand the difference between correlation and causation.

- Correlation is the relationship or association between two variables. For example, a correlation occurs when one variable increases along with another variable. Correlation can be observed and can generate questions that can then be explored with experimentation. For example, the number of people wearing shorts and the number of ice cream sales both increase during the warm months of summer. There is a correlation between wearing shorts and ice cream sales, but an increase in one does not cause the other to increase.
- Causation is a direct cause-and-effect relationship between two variables. In other words, changing the independent variable causes a direct change in the dependent variable. Well-designed experiments are required to show causation. An example of causation is when a person with an hourly-paid job works more hours, their paycheck increases. Working more hours is the direct cause of getting a larger paycheck.
- For additional information on teaching correlation and causation, refer to the Middle School Cause-and-Effect Toolkit.

Check for Understanding

If you observe …	Then try …
students struggling to identify the independent and dependent variable	providing students with sets of variables to practice identifying which variable depends on the other. For example: • independent - hours studied; dependent - score on test • independent - temperature; dependent - speed of egg hatching • independent - type of breakfast; dependent - level of hunger before lunch