Britannica Expedition:LEARN!

Teacher Toolkit

Mathematical Reasoning: Grades 3–5

OVERVIEW:

Mathematics, computational thinking, and mathematical reasoning are tools for understanding science and evaluating engineering designs. Mathematical reasoning is associated with the skill of analyzing and interpreting data as students logically interpret results to explain phenomena and draw conclusions about solutions. Students who can effectively use mathematical reasoning can more easily design experiments that address key questions and problems, recognize and compare important patterns in data sets, better connect experimental results to information they've learned through reading, and have a better understanding of how the analysis of empirical data contributes to advancements in scientific knowledge and technology.

For this skill, students are expected to differentiate between qualitative and quantitative data and determine which will provide the best evidence for explaining a phenomenon or evaluating an engineering design. They must also organize and graph data to reveal relationships between variables and use scientific tools and standard units of measurement to collect and analyze quantitative data.

The following strategies are designed to scaffold and support students in mathematical reasoning in science texts.

Mini-Lesson I

Qualitative Versus Quantitative Data (15 minutes)

Background: As part of mathematical reasoning, it is important for students to understand how data was collected and whether it is qualitative or quantitative. This lesson uses images from the *Expedition: Learn!* lesson "Seasons and Weather."

- Share with students that when scientists collect data, there are two types of data they can use—*qualitative and quantitative.*
- Explain that qualitative data is descriptive and based on observations through the senses. Qualitative data can be seen, heard, tasted, smelled, or touched. Examples include observations of properties such as color and texture.
- Explain that quantitative data is based on measurements using scientific tools. In other words, quantitative data is numbers. Examples include properties such as length or mass.
- Display the two images titled "Tokyo Weather Through the Seasons." Explain that these graphs contain data showing the temperature and rainfall in Tokyo. Because this information can be measured and represented with a number, it is quantitative.
- Place students in groups of three and assign them either qualitative or quantitative data. Ask them to generate a list of data for their category. After three to five minutes, invite student triads to partner with a group that worked on the other type of data and share their lists. Alternatively, provide student triads the example below and ask them to sort them into "qualitative" and "quantitative" categories.
- Invite student groups to share out and generate a class-wide list. For example:
    - **qualitative:** *smell, taste, flavor, shape, descriptors (sharp, soft), types (type of fabric, type of weather, type of exercise)*
    - **quantitative:** *width, height, volume, speed, temperature, duration*

Mini-Lesson II

Collecting Data with Scientific Tools (15 minutes)

Background: As students engage in science lessons, they will read and learn about various types of quantitative data collection. This data collection is done using a number of scientific tools intended to gather different types of information. Consider partnering with the school's science laboratory teacher in order to facilitate this lesson.

- Share with students that when gathering quantitative data, scientists have a variety of tools that they use, depending on what they are trying to learn.
- Display each of the following one at a time and ask students what a scientist might be trying to measure with each use of the following scientific tools:
    - **rulers or measuring tapes** - *length, width, height*
    - **scales** - *mass*
    - **graduated cylinders** - *volume*
    - **thermometers** - *temperature*
    - **stopwatches** - *time*
- After students have identified what each tool is for, demonstrate how to use each one.
- Set up a station for each of the tools and divide students accordingly. For example:
    - **Station 1:** Use the ruler or measuring tape to measure the length of several pieces of string or the height of the desk, the width of the door, etc.

  - **Station 2:** Use the scale to measure the mass of a few objects (e.g., a paper clip, a roll of tape, a marker).
  - **Station 3:** Use the graduated cylinder to measure a small amount of water (provide a small cup or pitcher of water).
  - **Station 4:** Use the thermometer to measure temperature (provide a small pitcher of water).
  - **Station 5:** Use the stopwatch to measure the time it takes each student to complete a task (e.g., reciting the alphabet, writing their first and last name, spinning around five times)
- Invite groups to cycle through each station.
- After students have completed all the stations, debrief with the entire group. Ask students which tools were the easiest and hardest to use, which they enjoyed the most, or which they think provides them with the most valuable data.

Check for Understanding

If you observe ...	Then try ...
students struggling to distinguish qualitative from quantitative data	inviting students to consider the following questions: • Can you use a tool to measure it? • Does it include a number? • Would this data help you to draw the object?
students struggling to use a scientific tool or understand its use	conducting small group demonstrations of each tool, using it to perform its function and then brainstorming with the group about when you might want this kind of data.