iScience
Readers

Variables and Experiments:
Getting Across the River

by Emily Sohn and Frederick Fellows

Science Objective

This book introduces children to the way in which scientists work to answer their questions. They learn how to conduct experiments by first identifying the question they seek to answer. Then they set up the experiments in which they change one variable at a time and observe how that affects another variable. Tables and graphs help children find ways to record and analyze data.

iScience Puzzle: Water Crossing

The iScience Puzzle is based on a real-world problem of getting construction materials safely across a river. Children will try to solve a similar problem. Given the materials, they will explore how to move a grapefruit across a bowl of water without touching the fruit or completely submerging it. Using an experimental method common to scientists, children will work together to come up with and test ideas for solving the problem.

Objectives ➤ Children will:

- identify, control, and manipulate variables in simple experiments.
- state and test a hypothesis.
- record and analyze data in tables and graphs.
- run repeated trials of experiments, making observations and predictions in the process.
- investigate how a pendulum works.
- learn principles of bridge design.

Lesson Plan

Before Reading

Investigation	Science Concepts
Ask: *How would you figure out which kind of yo-yo lets you do the best tricks, or which paper airplane flies the longest?* Help children understand that before they could test the yo-yos or the planes, they would need to know exactly what they are trying to find out. That is, they would need to determine the question they want to test. Then ask: *How could you be sure you got results you could trust?*	Controlled experiments allow objects to be tested and retested for specific criteria.

Explain that children will conduct experiments to test ideas. They will learn how to control and manipulate variables as they test and retest their ideas. A variable is something that can be changed. Each change to a variable can affect an experiment's outcome. Observations can be recorded in tables and plotted on a graph to show relationships between variables.

During Reading

Investigation	Science Concepts
pp. 10–12: As children complete the Discover Activity, ask questions such as: *Why did it help to begin with a prediction? How can you record your data?*	A prediction is usually based on accepted information. When experimental results support a prediction, they also support the accepted information. When results do not support a prediction, they often bring about questions as to the validity of the accepted information.
pp. 13–14: Ask: *Why is it important to change just one variable at a time?*	Changing one variable at a time allows results to be tested against a standard.
pp. 15–18: Encourage children to think about their hypothesis each time they add more marbles. Ask: *At each step, does it look like your hypothesis is going to be supported by the end of the experiment?*	Scientists always keep their hypothesis in mind as they work toward testing it.
p. 19: Encourage children to share ideas and collaborate on the trials.	A hypothesis should be tested more than once to determine the accuracy of the results and whether they can be replicated.
p. 20: Quiz children to be sure they can distinguish between dependent and independent variables.	To ensure reliable results, only one independent variable is changed at a time in a well-designed experiment.

During Reading (continued)

Investigation	Science Concepts
pp. 22–23: Have children make a cause-and-effect chart to record the variables Edison changed when trying to make a practical light bulb and how each change affected the bulb. For example: Cause: Carbonized cotton was used for filament; Effect: Light burned longer.	A change in an independent variable (the cause) brings about an observable reaction in the dependent variable (the effect).
pp. 24–27: Make sure children record the variable they change each time. Be sure they also record and check their predictions. After children finish the experiment, ask: *Were the results surprising? What could you do to be sure the results are accurate?*	Sometimes a change in an independent variable has no effect on the dependent variable.
p. 28: Ask: *What do you think would be a good way to record results? Can you think of any way that would show the pattern you discovered?*	Data can be recorded on a graph to give a visual representation of the relationship between two variables.
p. 29: Engineers are not just for designing and creating things on a large scale. Challenge children to find things in your classroom that were likely designed by an engineer.	Science, technology, and engineering affect many aspects of our everyday lives. We are surrounded by engineered devices and objects.
p. 30: Be sure children can relate why controlling all other variables while changing one is crucial to the reliability of results.	To reliably link an effect back to a single cause, there must be only one variable that could account for the effect. Therefore, only one variable can be manipulated at a time.
pp. 31–34: Ask: *Why would you want to make a controlled variable the independent variable, and make the independent variable the controlled variable?*	Scientists not only repeat experiments many times to ensure accurate results, but also sometimes conduct several different experiments to find the best answer to their initial question. They often investigate many possible causes for a single observable effect.
p. 36: If time allows, have children use craft sticks and glue to make frame structures in different shapes. After they have had time to "play" with the frames for a while, ask: *How does a truss work?*	A truss supports a load across a greater area than a straight beam would.
pp. 38–42: Make sure children understand how to plot data on graphs. If necessary, draw some blank graphs on the board and give children practice plotting ordered pairs. Be sure also that children can read and interpret the information in a graph. Explain that the purpose of using a graph to record data is to show any relationship that might exist between variables in an experiment. A relationship may show up on the graph as a pattern.	Each point plotted on a graph represents an experimental observation. Relationships between variables can be linear or show a more complex pattern.

During Reading (continued)

Investigation	Science Concepts
p. 43: Revisit the list of ideas children brainstormed on page 9. Have children use those ideas and what they have learned to design and build a bridge to get the grapefruit across the water in a basin.	Scientists often apply old knowledge to new situations.
p. 44: Have children follow the instructions in the second paragraph to build a different bridge. They can work alone or in groups. Then have them share their successes and failures with other groups. What can they learn from each other?	Scientists collaborate, and they share their experiments and results with other scientists. They learn from each other's successes and failures, and they build on each other's research.

After Reading

Restate the key ideas in this book. Scientists conduct experiments to test hypotheses. In setting up an experiment, scientists first identify the variable they want to study. Then they determine the variables they will control in the experiment and the one variable they will manipulate. They run the experiment, keeping careful records of their methods and their results. They may organize data in tables. Then they run the experiment more times to be sure they can repeat the results. To identify any pattern in the results, they may plot the data on a graph. Then they may choose to manipulate a different independent variable in the same experimental setup to see how the dependent variable is affected.

Investigation	Understanding Science
Hand out graphs that show different patterns and challenge children to identify the relationships represented by the graphs.	Relationships between variables in an experiment are often much easier to identify when the data are graphed than when they are simply presented in a table.