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INTRODUCTION

Changes and Problems

Our world continues to change. With changes come problems. To live comfortably in such a world, one has to adapt to change by identifying and creatively solving problems. The activities in this book give students an opportunity to identify interesting problems and a chance to carry out investigations to solve them. While doing their investigative projects, students build self-esteem and self-confidence, they gain knowledge, and they develop science process and critical-thinking skills. These skills and this knowledge will help students to identify and solve daily problems, as well as to become more productive and successful individuals in today's changing world.

Skills and Information

Science Projects provides the necessary skills and information needed to successfully prepare students for enjoyable and rewarding science experiences. It contains many science project ideas and worksheets designed to give students valuable practice in mastering the steps of a problem-solving model. It also has activities to help them plan, complete, and present their science projects with confidence and enthusiasm.

The opening science-investigation model section serves as an excellent guide for teachers, parents, and students. It describes a problem-solving model in detail and provides a completed science project.

Sample Investigations and Inquiry

The final section of this book contains five projects adaptable to an inquiry approach that is more open-ended than some conventional science projects. These projects, while using the traditional scientific method (Question—Hypothesis—Materials—Variables—Controls—Procedure—Data—Results—Conclusion), may also be used solely as enjoyable activities leading to further investigation. These activities may all be used to gather data and make observations and conclusions.

Curiosity and Learning

Curiosity, however, will drive interest in the projects; and scientific habits of observation, multiple trials, data gathering, and drawing conclusions will be developed as valuable learning tools. Thus, the true appeal of science—curiosity about the world—will be harnessed to drive a student's love of learning.

Standards

The activities throughout this book meet science content standards, which are used with permission from McREL. See page 4 for the list of standards.

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STANDARDS AND BENCHMARKS

NATURE OF SCIENCE

STANDARD 11. UNDERSTANDS THE NATURE OF SCIENTIFIC KNOWLEDGE

Level II (Grades 3–5)

1. Knows that although the same scientific investigation may give slightly different results when it is carried out by different persons, or at different times or places, the general evidence collected from the investigation should be replicable by others
2. Knows that good scientific explanations are based on evidence (observations) and scientific knowledge
3. Knows that scientists make the results of their investigations public; they describe the investigations in ways that enable others to repeat the investigations
4. Knows that scientists review and ask questions about the results of other scientists' work

Level III (Grades 6–8)

1. Knows that an experiment must be repeated many times and yield consistent results before the results are accepted as correct
2. Understands the nature of scientific explanations (e.g., use of logically consistent arguments; emphasis on evidence; use of scientific principles, models, and theories; acceptance or displacement of explanations based on new scientific evidence)
3. Knows that all scientific ideas are tentative and subject to change and improvement in principle, but for most core ideas in science, there is much experimental and observational confirmation

STANDARD 12. UNDERSTANDS THE NATURE OF SCIENTIFIC INQUIRY

Level II (Grades 3–5)

1. Knows that scientific investigations involve asking and answering a question and comparing the answer to what scientists already know about the world
2. Knows that scientists use different kinds of investigations (e.g., naturalistic observation of things or events, data collection, controlled experiments), depending on the questions they are trying to answer
3. Plans and conducts simple investigations (e.g., formulates a testable question, makes systematic observations, develops logical conclusions)
4. Uses appropriate tools and simple equipment (e.g., thermometers, magnifiers, microscopes, calculators, graduated cylinders) to gather scientific data and extend the senses
5. Knows that different people may interpret the same set of observations differently

Level III (Grades 6–8)

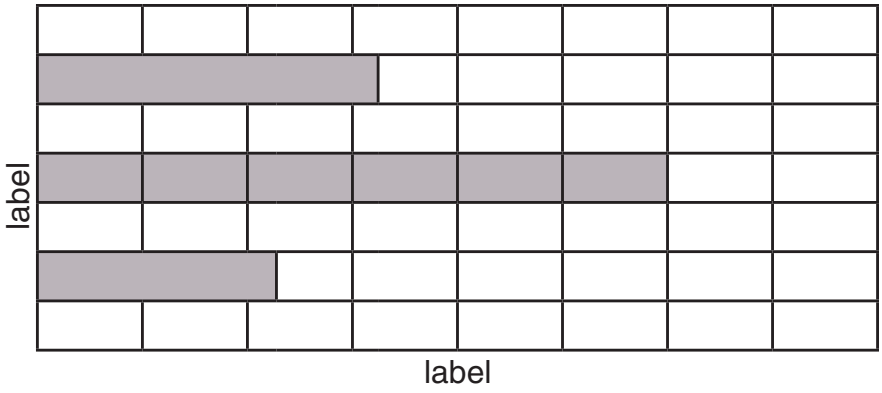
1. Knows that there is no fixed procedure called "the scientific method," but that investigations involve systematic observations, carefully collected, relevant evidence, logical reasoning, and some imagination in developing hypotheses and explanations
2. Understands that questioning, response to criticism, and open communication are integral to the process of science (e.g., scientists often differ with one another about the interpretation of evidence or theory in areas where there is not a great deal of understanding; scientists acknowledge conflicting interpretations and work towards finding evidence that will resolve the disagreement)
3. Designs and conducts a scientific investigation (e.g., formulates hypotheses, designs and executes investigations, interprets data, synthesizes evidence into explanations, proposes alternative explanations for observations, critiques explanations and procedures)
4. Knows that observations can be affected by bias (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results)
5. Uses appropriate tools (including computer hardware and software) and techniques to gather, analyze, and interpret scientific data

DISPLAYING DATA: RESULTS

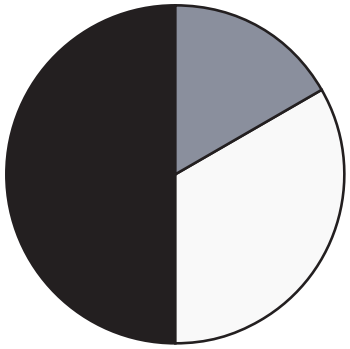
After data has been collected and organized in a table, it can be displayed in graphs. Since graphs are like pictures, they make it easy for people to see the results of science investigations. Line graphs, bar graphs, and circle graphs are the most-commonly-used types of graphs. Everyone should be able to read and make each type.

Below are some typical views of the basic graphs. Explanations and sample graphs with data are provided on pages 69–77. Try drawing each type on the board and discuss all of them in class. (Some graphs contain individual data values, while others contain averaged data values.)

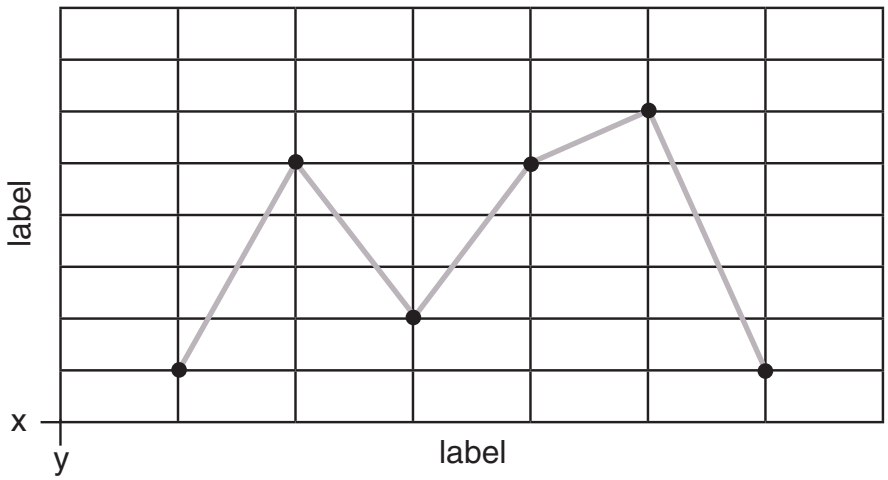
Typical Bar Graph (two views)



Typical Circle Graph
(sometimes called a "pie chart")



Typical Line Graph



TESTING TOWELS

(Science Investigation: Osmosis and Capillary Action)

Rapid Rising

Problem: Which brand of paper towel (A, B, C, or D) will absorb (soak up) water the fastest?

Hypothesis: Brand _____ will absorb water the fastest.

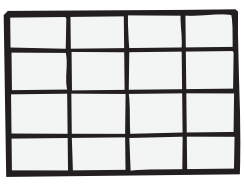
Materials: four different brands of paper towels, water, clear plastic cups, food coloring, spoon, device that can record time in seconds

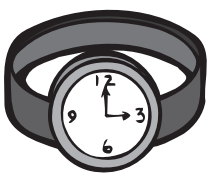
Variables: The variables are the four different brands of paper towels.

Controls: The controls in this experiment are the amount of water, food coloring, and starting time.

Procedure

1. Fill a clear plastic cup almost full of water. Place a few drops of food coloring in the water and stir.
2. Carefully tear four paper towels from four different brands of paper towel along the perforated lines.
3. Roll each towel into a long, thin tube about equal in length to each other.
4. Mark the name of each towel on one end of the tube.
5. Write down the exact time. Place all four tubes in the cup at the same time.
6. Observe how the colored water climbs up the paper towel tubes.
7. Keep track of which towel the water climbs fastest, reaching the end of the tube, and which is second, third, and fourth.
8. Keep track of the elapsed times for each.
9. Using fresh towels (of the same brands) each time, do two more trials to confirm your results.





TESTING TOWELS (cont.)

Rapid Rising *(cont.)*

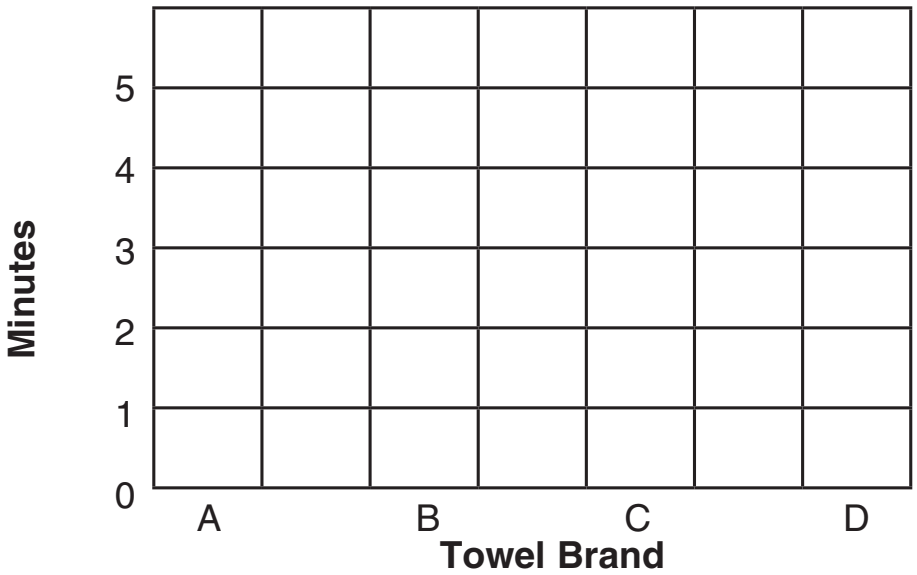
Data: Make a data chart recording your results. Make a bar graph using the average times from three trials to illustrate your data chart.

Data Chart: Towel Speed of Absorption

Brand	Time			
	Trial 1	Trial 2	Trial 3	Average
A				
B				
C				
D				

Results: _____

Bar Graph: Towel Speed of Absorption



Conclusion: (Was your hypothesis supported or not supported?)

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