

**Janice VanCleave's
A+ Projects in Earth Science**

Winning Experiments for Science Fairs and Extra Credit



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DEDICATION

This book is dedicated

to

my husband, Wade, for his love and constant support;

to

my children and grandchildren, Tina and Mike Ryer;

Ginger, Russell, Kimberly, Jennifer, David

and Davin VanCleave; and Ginger, Calvin,

Lauren, and Lacey Russell;

to

friends Jim, Stella, Rachel Anne, Jared Lee, and

Sara Elizabeth Cathey; Whitney Cooper; Sue and

Fred Dunham; Sara, Rachel, James, and Mary Catherine

Blalock; Adam and Lauren Nicole Himsel; David,

Garrett, and Amber Kaiser; Laura, Jim, and Adelaide

Roberts; Sarah, Jared, Jacob, and Jordan Sacchieri;

Weston Ray; and Patrick Walker;

to

my editor, Kate Bradford; my production editors,

Benjamin Hamilton, Joanne Palmer,

and Jude Patterson.

CONTENTS

Introduction	1
Part One	7
Mapping the Earth	
1. Maps and Globes: Terrestrial Guides	9
2. Topography: Highs and Lows of the Earth's Surface	15
Part Two	23
The Earth and Space	
3. Rotation: The Spinning of the Earth on Its Axis	25
4. Heliocentric: The Earth's Solar System	31
5. Night Light: The Structure and Movement of the Earth's Moon	37
6. Mobile Stars: The Apparent Movement of Stars	43
7. Time: Day Lengths and Time Zones	51
8. Early Methods: Ancient Techniques of Determining the Earth's Size and Shape	57
Part Three	65
Physical Composition of the Earth	
9. Elements: The Earth's Building Blocks	67
10. The Earth's Layers: Chemical and Physical Properties of the Earth	73
Part Four	79
The Earth's Lithosphere	
11. Minerals: Distinguishing Physical Characteristics of Minerals	81

- 12. Crystals: Distinguishing Physical Characteristics of Crystals [87](#)
- 13. The Rock Cycle: Processes That Change One Rock Type into Another [91](#)
- 14. Erosion: The Breakdown and Movement of Crustal Material [97](#)

15. Rock Sandwiches: Layering of Regolith Particles	103
16. Soil Texture: Effects of Regolith Size	109
17. Crustal Bending: Deformation of the Earth's Crust	115
18. Faulting: The Earth's Crustal Breaking Point	121
19. Plate Tectonics: Floating Crustal Sections	127
Part Five	133
The Earth's Hydrosphere	
20. Soundings: Mapping a Profile of the Ocean Floor	135
21. Water Waves: Surface Disturbances Due to Energy Transfer	143
22. Percolating Water: The Movement of Water beneath the Earth's Surface	149
23. The Hydrologic Cycle: The Movement of Water from Place to Place	155
Part Six	161
The Earth's Atmosphere	
24. Atmospheric Energy: Unequal Heating by the Earth's Surface	163
25. The Greenhouse Effect: Heat Transfer in the Atmosphere	169
26. Convection: Air in Motion	175
27. Fronts: Moving Air Masses	181
28. Barometric Changes: The Cause and Measurement of Air Pressure	187
29. Hygrometers: Ways to Measure the Atmosphere's Water Content	193
30. Precipitation: Phases of Atmospheric Water	199
Appendix 1	205

Sources of Scientific Supplies

Appendix 2 [207](#)
Temperature Conversion Formulas

Appendix 3 [209](#)
Astronomer's Flashlight

Glossary [211](#)

Index [225](#)

INTRODUCTION

Science is a search for answers to all kinds of interesting questions about our world. Science projects make excellent tools for you to use as you look for the answers to specific problems. This book will give you guidance and provide A+ project ideas. An A+ idea is not a guarantee that you will receive an A+ on your project. You must do your part by planning experiments, finding and recording information related to a problem, and organizing the data to find the answer.

Sharing your findings by presenting your project at science fairs will be a rewarding experience if you have properly prepared the exhibit. Trying to assemble a project overnight usually results in frustration, and you cheat yourself out of the fun of being a science detective. Solving a scientific mystery, like solving a detective mystery, requires that you plan well and carefully collect facts.

Start your project with curiosity and a desire to learn something new. Then, proceed with purpose and a determination to solve the problem. It is likely that your scientific quest will end with some interesting answers.

Select a Topic

The 30 topics in this book suggest many possible problems to solve. Each topic has one "cookbook" experiment—follow the recipe, and the result is guaranteed. Read all of these easy experiments before choosing the topic you like best and want to know more about. Regardless of the problem you choose to solve, your discoveries will make you more knowledgeable about earth science.

Each of the 30 sample projects begins with a brief summary of topics to be studied and objectives to be determined. Information relevant to the project is also included in the opening summary. Terms are defined when first used in the project discussion, but definitions are not repeated throughout the text. Check the Glossary or Index to find explanations about any terms that are unfamiliar to you.

Try New Approaches

Following each of the 30 introductory experiments is a section titled "Try New Approaches" that provides additional questions about the problem presented. By making small changes to some part of the

sample experiment, you achieve new results. Think about why these new results might have happened.

Design Your Own Experiment

In each chapter, the section titled "Design Your Own Experiment" allows you to create experiments to solve questions related to the sample experiment. Your own experiment should follow the sample experiment's format and include a single purpose or statement; a list of necessary materials; a detailed step-by-step procedure; written results with diagrams, graphs, and charts, if they seem helpful; and a conclusion explaining why you got the results you did and answering the question you posed to yourself. To clarify your answer, include any information you found through research. When you design your own experiment, make sure to get adult approval if supplies or procedures other than those given in this book are used.

Get the Facts

Read about your topic in many books and magazines. You are more likely to have a successful project if you are well informed about the topic. For each topic in this book, the section titled "Get the Facts" provides some tips to guide you to specific sources of information. Keep a journal to record all the information you find from each source, including the author's name, the title of the book or article, the page numbers, the publisher's name, the city of publication, and the year of publication.

Keep a Journal

Purchase a bound notebook to serve as your journal. Write in it everything relating to the project. It should contain your original ideas as well as ideas you get from books or from people like teachers and scientists. It should also include descriptions of your experiments as well as diagrams, photographs, and written observations of all your results.

Every entry should be as neat as possible and dated. A neat, orderly journal provides a complete and accurate record of your project from start to finish and can be used to write your project report. It is also proof of the time you spent sleuthing out the answers to the scientific mystery you undertook to solve, and you will want to display the journal with your completed project.

Use the Scientific Method

Each project idea in this book will provide foundation material to guide you in planning what could be a prize-winning project. With your topic in mind and some background information, you are ready to demonstrate a scientific principle or to solve a scientific problem via the **scientific method**. This method of scientifically finding answers involves the following steps: research, purpose, hypothesis, experimentation, and conclusion.

Research:

The process of collecting information about the topic being studied. It is listed as a first step because some research must be done first to formulate the purpose and hypothesis and then to explain experimental results.

Purpose:

A statement that expresses the problem or question for which you are seeking resolution. You must have some knowledge about a topic before you can formulate a question that can lead to problem-solving experimentation. Thus, some research is necessary before you state a purpose, and you can find much of the information about each topic in this book.

Hypothesis:

A guess about the answer to the problem based on prior knowledge and on research you have done before beginning the project. It is most important to write down your hypothesis before beginning the project and not to change it even if experimentation proves you wrong.

Experimentation:

The process of testing your hypothesis. Safety is of utmost importance. The projects in this book are designed to encourage you to learn more about an earth science phenomenon by altering a known procedure, but you should explore untested procedures only with adult supervision.

Conclusion:

A summary of the experimental results and a statement that addresses how the results relate to the purpose of the experiment. Reasons for experimental results that are contrary to the hypothesis are included.

Assemble the Display

Keep in mind that while your display represents all that you have done, it must tell the story of the project in such a way that it

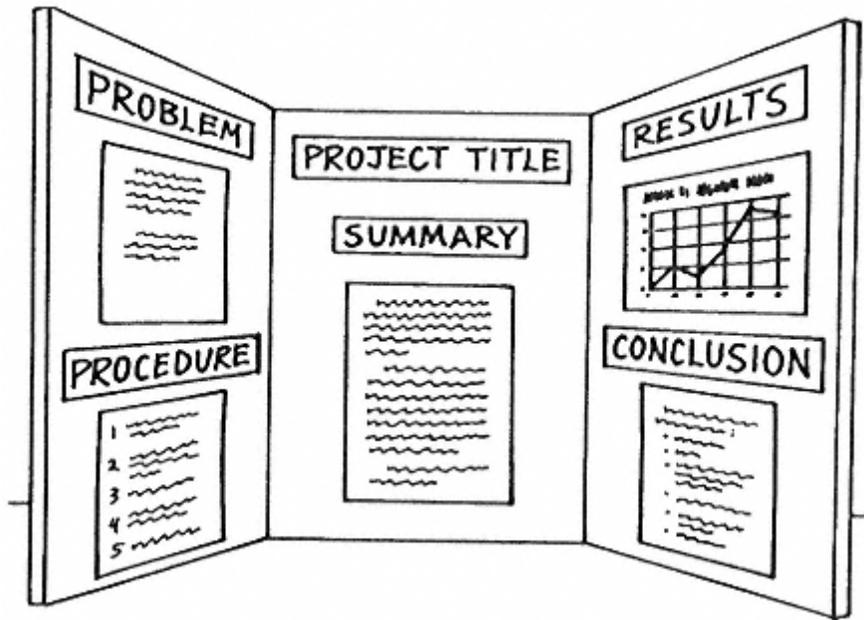


Figure I.1

attracts and holds the viewer's interest. So keep it simple. Try not to cram all your information into one place. To conserve space on the display and still exhibit all your work, keep some of the charts, graphs, pictures, and other materials in your journal instead of on the display board itself.

The actual size and shape of displays vary according to local science fair official rules, so remember to check them out for your particular fair. Most exhibits are allowed to be 48 inches (122 cm) wide, 30 inches (76 cm) deep, and 108 inches (274 cm) high. Your display may be smaller than these maximum measurements. A three-sided backboard (see Figure I.1) is usually the best way to display your work. Wooden panels can be hinged together, or you can use sturdy cardboard pieces taped together to form a very inexpensive, but presentable, exhibit.

A good title of about eight words or less should be placed at the top of the center panel. The title should capture the theme of the project but not be the same as the problem statement. For example, suppose the problem under question is, What is the best type of soil for plant growth? An effective title might be "Effects of Soil Porosity

and Permeability on Plant Growth." The title and other headings should be neat and also large enough to be readable from a distance of about 3 feet (1 m). You can glue letters onto the backboard (buy precut letters or cut some out of construction paper), or use a computer to create them for all the titles. A short summary paragraph of about 100 words to explain the scientific principles involved is useful and can be printed under the title. Someone who has no knowledge of the topic should be able to easily understand the basic idea of the project just by reading the summary.

There are no set rules about the position of the information on the display. However, it all needs to be well organized, with the title and summary paragraph as the focal point at the top of the center panel and the remaining material placed neatly from left to right under specific headings. The headings you display will depend on how you wish to organize the information. Separate headings of "Problem," "Procedure," "Results," and "Conclusion" may be used.

Discuss the Project

The judges give points for how clearly you are able to discuss the project and explain its purpose, procedure, results, and conclusion. While the display should be organized so that it explains everything, your ability to discuss your project and answer the questions of the judges convinces them that you did the work and understand what you have done. Practice a speech in front of friends, and invite them to ask you questions. If you do not know the answer to a question, never guess or make up an answer or just say, "I do not know." Instead, say that you did not discover that answer during your research, and then offer other information that you found of interest about the project. Be proud of the project, and approach the judges with enthusiasm about your work.

**PART ONE—
MAPPING THE EARTH**

1—

Maps and Globes: Terrestrial Guides

A map is a representation of all or part of a region of the Earth's surface. Maps can be spherical like the Earth or flat. They all have crisscrossing lines that are used to indicate the coordinates of any specific location. These reference lines are called meridians (or lines of longitude) and parallels (or lines of latitude).

In this project, you will study and model the meridians and parallels. You will learn a technique for measuring latitude and determine the latitude where you live. Planar projection, a method of preparing flat maps, will also be demonstrated.

Getting Started

Purpose:

To model meridians (lines of longitude) on a globe.

Materials

lemon-size ball of modeling clay
pencil
dental floss

Procedure

1. Shape the clay into a sphere.
2. Use the pencil to draw a circle around the center of the clay sphere.
3. Draw a second circle perpendicular to the first one.
4. Hold the sphere so the lines cross at its top and bottom ends.
5. Observe the position of the lines and the distance between them at (1) the ends of the sphere where the lines cross, and (2) the center of the sphere, midway between the ends.
6. Wrap the ends of the dental floss around your index fingers, then use your thumbs to press the floss into one of the circles. Press the floss through the clay sphere, cutting the sphere in half (see Figure 1.1).

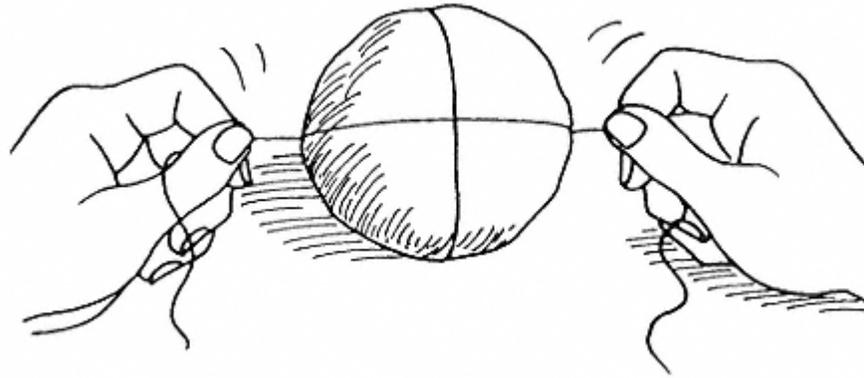


Figure 1.1

Results

The lines you drew with the pencil are not parallel. They approach and cross each other at opposite ends of the sphere and are farthest apart around the center of the sphere. Cutting through the clay creates a plane that passes through the center of the sphere.

Why?

The circles around the clay sphere are called **great circles** (circles on a sphere, with the center of the circle and the center of the sphere being the same). A **meridian** is defined as a great circle, or half of a great circle passing through the Earth's **North** and **South Poles** (northernmost and southernmost points on the Earth). In this book, meridian will refer to half of a great circle. Thus, the clay model has four meridians from pole to pole. While there is no limit to the number of meridians that may be on a globe, a common number of meridians is 24.

Meridians are also called **lines of longitude** because they measure longitude. **Longitude** is the distance in degrees east and west of the meridian running through Greenwich, England, called the **prime meridian**. The prime meridian is located at 0° longitude. Longitudes 0° and 180° divide a globe into the Eastern and Western Hemispheres, as demonstrated by cutting the clay model in half. (The word **hemisphere** means half a sphere.) In the **Eastern Hemisphere** the longitudes are 0° to 180° and are labeled with an E, such as 90° E. The **Western Hemisphere** longitudes making up the other half of the sphere also start at 0° and end at 180° they are labeled with a W, such as 90° W. Note that 90° E and 90° W are on

opposite sides of the sphere from each other and that 0° E and 0° W are the same meridian, as are 180° E and 180° W.

The lines on the clay sphere, like the meridians on a globe, are not parallel. The distance between the meridians is greatest at the middle of the globe and decreases toward the poles (ends). One degree (1°) of longitude is about 69 miles (110 km) wide at the equator and gradually narrows to 0 miles (0 km) wide at the North and South Poles.

Try New Approaches

Circles around a globe that run parallel to each other and perpendicular to the meridians are called **parallels**. The parallel that runs around the center of the globe, equidistant to the Poles and the only one that is a great circle, is called the **equator**. Parallels are also called **lines of latitude** because they measure latitude. **Latitude** is the distance in degrees north or south of the equator, which is located at 0° latitude. The equator divides the globe into the **Northern** and **Southern Hemispheres**. The latitudes in each hemisphere range from 0° to 90° . Latitudes are labeled N in the Northern Hemisphere and S in the Southern Hemisphere.

Prepare a model showing lines of longitude and lines of latitude. Repeat steps 1 through 4 from the original experiment, then draw a circle around the middle of the sphere, halfway between the poles and perpendicular to the lines of longitude. This line represents the equator. Draw two more circles on either side of the equator, parallel to it, each centered between the equator and a pole. These two circles represent lines of latitude at 45° north and south of the equator.

Design Your Own Experiment

1. In the Northern Hemisphere, you can determine your latitude by measuring the height of the North Star (Polaris) above the horizon. To do this, you can use an **astrolabe**, an instrument used to measure the altitude of a **celestial body** (a natural object in the sky, such as a star, sun, moon, or planet). Make an astrolabe by tying one end of a 12-inch (30-cm) string through the center hole in the base of a protractor. Attach the free end of the string to a washer. Tape a drinking straw along the straight edge of the protractor. Without covering the lines, place pieces of masking tape on the protractor and write 0 to 90 on the pieces of tape, as shown in Figure 1.2.

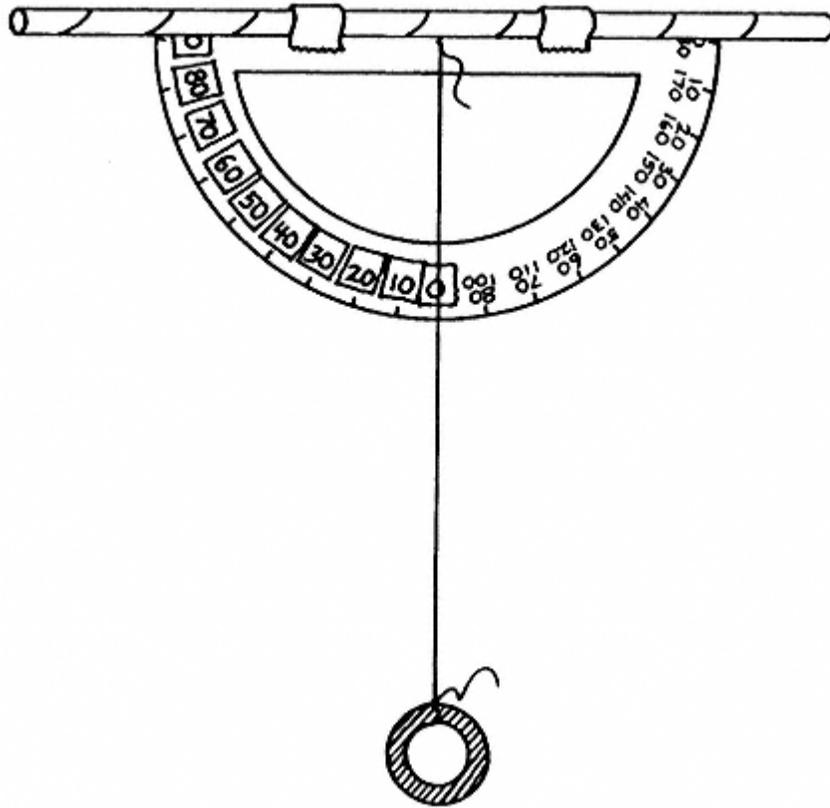


Figure 1.2

Stand outdoors on a dark, clear night and find the North Star by lining up the two outermost stars in the bowl of the Big Dipper. The North Star, a relatively faint star, is directly ahead of these two stars. Close one eye and use the other eye to look through the viewing end of the straw. Sight the North Star through the straw. Ask a helper to use an astronomer's flashlight (see Appendix 3) to read the angle where the string crosses the protractor. This angle is equal to the latitude of the area where you are.

2. While globes most accurately represent the Earth, they are not 100% accurate. Flat maps are less accurate than globes, but flat maps are less expensive and easier to carry around. All methods

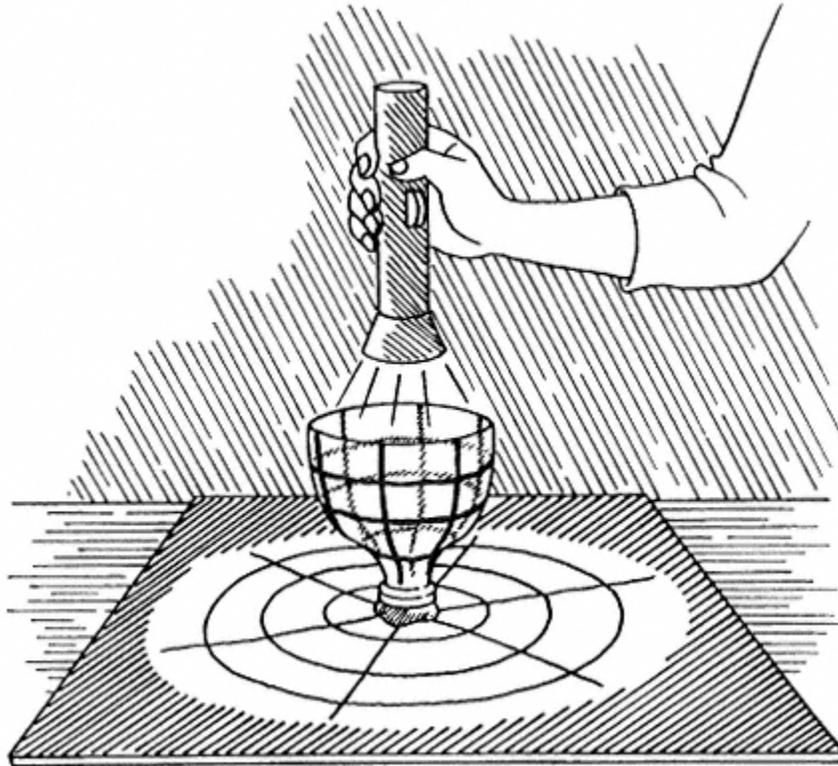


Figure 1.3

of making a flat map of the curved Earth involve some inaccuracies. Map projection is one method of producing a flat map. A **planar projection** is a circular map that shows only one hemisphere of the Earth.

Demonstrate how to make a planar projection by cutting off the top 5 inches (12.5 cm) of a 2-liter plastic soda bottle. Use the top section of the bottle to model a hemisphere. Using a rubber band as a guide, draw three or four latitude lines around the outside of the bottle with a black permanent marker. Draw six or eight longitude lines. In the center of a piece of white poster board, stand the bottle in a walnut-size piece of clay so that the cut end of the bottle points upward. In a darkened room, hold a flashlight above the center of the model (see Figure 1.3). Ask a helper to trace the projection on the poster board.

Get the Facts

1. Mercator projection is the most commonly used type of projection for a world map. Find out more about map projections. What are the advantages of Mercator projections? What are cylindrical projections? Conical projections? For information about map projections, see *Janice VanCleave's Geography for Every Kid* (New York: Wiley, 1993), pp. 43–51.
2. A *chronometer* is a clock that keeps very accurate time. Discover how John Harrison (1693–1776) built the first chronometer capable of keeping accurate time at sea, making possible the determination of longitude. See Dava Sobel, *Longitude* (New York: Walker, 1995).