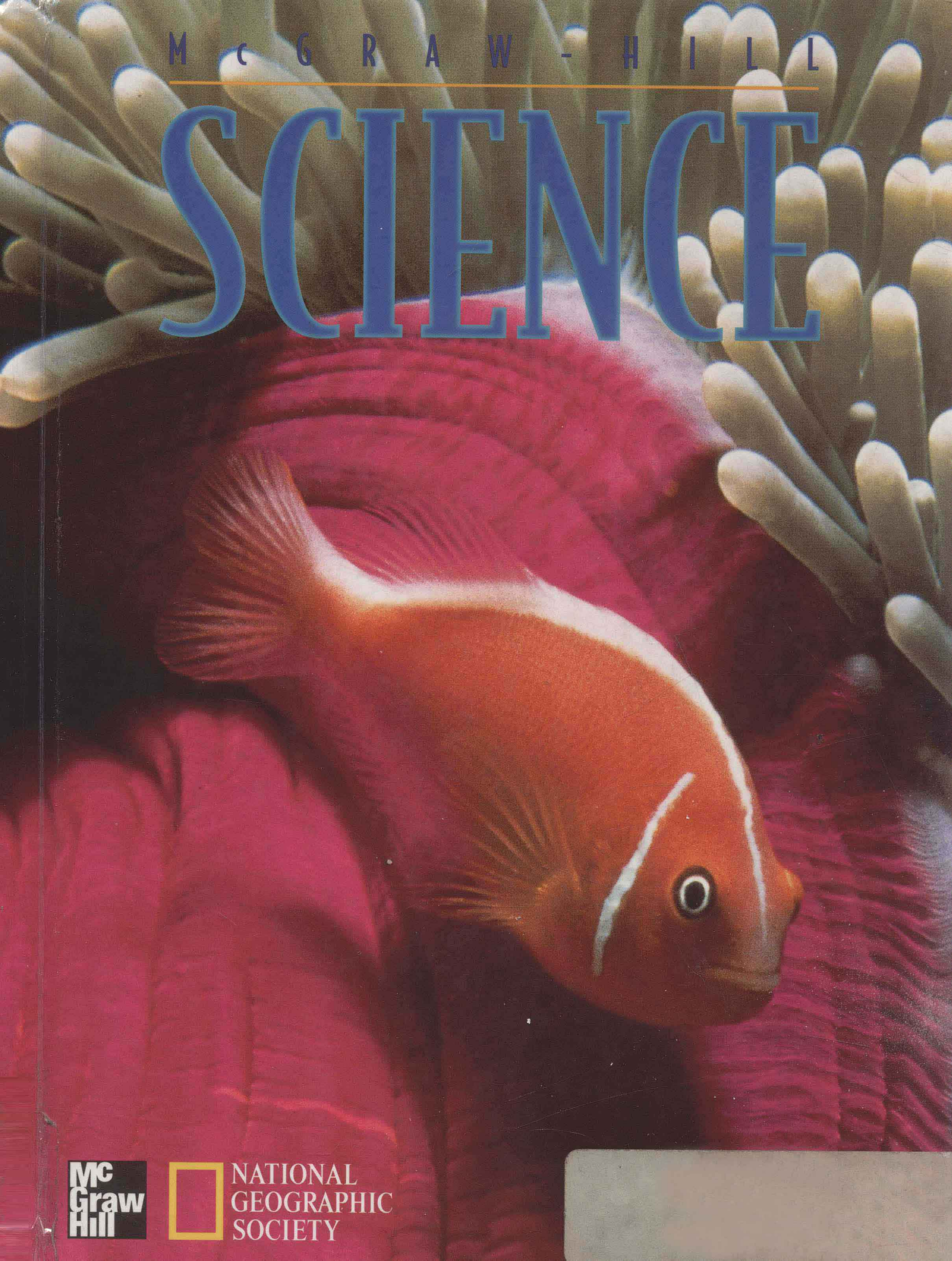


M C G R A W - H I L L

SCIENCE



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NATIONAL
GEOGRAPHIC
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SCIENCE

MACMILLAN/McGRAW-HILL EDITION

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YOUR TEXTBOOK at a Glance

Begin each topic with an **Explore** question. Investigate further by doing an **Explore Activity**.



Topic 4 EARTH SCIENCE

Here Comes the Sun

What difference would it make if the Sun were larger or smaller than it is? Every day you see how the Sun brightens the sky. Even though the Sun is far away, you can see and feel its energy. How does the energy from the Sun affect Earth?

EXPLORE

HYPOTHESIZE Each day Earth receives light and heat from the Sun. How does this affect Earth's temperature? Write a hypothesis in your *Science Journal*.

WORDS

of gases that

of the Sun
area on the

layer of
the Sun

ed to pro-

SCIENCE MAGAZINE

EYES ON MARS

Look up at the sky on a clear night. Even without a telescope, you can spot Mars. It's a bright red point of light. With powerful telescopes, large scientists can see Mars's mountains, large plains, and polar ice caps.

For years people have wondered if there was life on Mars. Space exploration has let us see Mars up close and personal and look for signs of life.

Science, Technology, and Society

In 1964, the U.S. launched the space probe Mariner 4. It was the first to fly by and send back to Earth images of Mars. Since then, space probes have sent back thousands of pictures of the red planet. None showed signs of life, but scientists were surprised to see giant volcanoes and dry canyons. Did the canyons mean that water had once flowed on Mars?

In 1976, the U.S. celebrated its 200th birthday and landed two spacecraft on Mars. Both Viking 1 and 2 took pictures of the rocky plains around the landing sites. Again, there was no evidence of life on Mars.

On July 4, 1997, the U.S. spacecraft Pathfinder landed on Mars. Aboard was Sojourner, a robot on wheels that could travel to rocks and report what they were made of. Scientists there were made of. Scientists there could choose a rock and send Sojourner

to make a close-up examination. The Pathfinder mission showed that Mars once had the water that could have made life possible!

The U.S. plans a Mars mission every two years. Will they find life? Stay tuned!

DISCUSSION STARTER

1. Why would finding water on Mars prove that there is or was life on the planet?
2. How was Pathfinder different from other space missions?

To learn more about Mars, visit www.nasa.gov/mars and enter the keyword ONMARS.

INTERNET CONNECTION

▶ Discuss an exciting **Science Magazine** after each topic. **National Geographic World of Science** is the first magazine in each unit.

DID YOU KNOW?

In a single tree in a rain forest in Peru, scientists found 43 different kinds of ants. That's more types of ants than are found in the United States.

Do you think forest supports lots of ants in the United States?



NATIONAL GEOGRAPHIC FUNtastic Facts

The world's tallest tree is a coast redwood, a kind of conifer found in California. It is 111 meters (364 feet) high. It is also one of the world's oldest trees. How long do you think it took to grow this tall?



◀ Flex your brain with questions about real-world facts.

Brain Power

Astronauts visiting the Moon left footprints. How long do you think these footprints will last? Explain.

EXPLORE ACTIVITY

Investigate How the Sun's Energy Affects Earth

Use a model to explore how the Sun's energy affects Earth's temperature.

PROCEDURES

- 1. MAKE A MODEL** Cover the can with black paper. The can represents Earth. Place the thermometer in the can, and set the can on a table 20 cm from the lamp. The lamp represents the Sun.
- 2. COLLECT DATA** Read the temperature inside the can. Record the number in your *Science Journal*.
- 3. COLLECT DATA** Turn on the lamp. Record the temperature of the can every two minutes for 10 minutes.

CONCLUDE AND APPLY

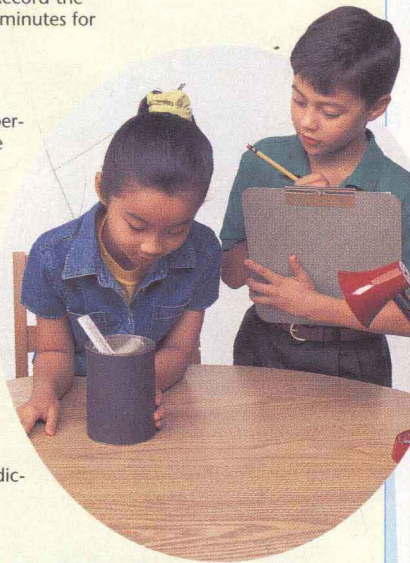
- 1. IDENTIFY** What was your first temperature measurement? What was the temperature after 10 minutes?
- 2. EXPLAIN** Was the temperature of the can still increasing after 10 minutes? How do you know?
- 3. INFER** Why did the temperature of the can stop increasing? Where do you think the energy from the lamp is going?

GOING FURTHER: Problem Solving

- 4. EXPERIMENT** Suppose the can were twice as far from the lamp. How warm do you think it would get in 10 minutes? Write your prediction. Test it.

MATERIALS

- lamp with light bulb, 60 watt
- aluminum can
- thermometer
- black paper
- meter stick
- tape
- *Science Journal*



Reading Graphs, Diagrams, Maps, and Charts help you learn by using what you see.

PARTICLES IN DIFFERENT FORMS OF MATTER

Solid

Liquid

Gas

READING CHARTS

- 1. DISCUSS** Compare the particles in a solid to the particles in a gas.
- 2. WRITE** In your own words, describe the particles in a liquid.

EXPLORE ACTIVITY

Design Your Own Experiment

WHAT IS THE VOLUME OF JUPITER?

PROCEDURES

- 1. IF EARTH HAD THE VOLUME OF A BEAN, JUPITER WOULD HAVE THE VOLUME OF THE BOWL.**
- 2. MAKE A MODEL.** How can you estimate how much larger the volume of the bowl is than the volume of the bean?
- 3. COMMUNICATE.** Write your plan in your *Science Journal*. Share your plan with your teacher.
- 4. EXPERIMENT.** Try your plan.

CONCLUDE AND APPLY

- 1. USE NUMBERS.** How much greater is the volume of the bowl than the volume of the bean?
- 2. DRAW CONCLUSIONS.** How much

MATERIALS

- 2 in. soy bean
- plastic bowl
- small cup
- *Science Journal*

UNIT REVIEW

USING IDEAS AND SKILLS

- 16. PREDICT** Two seeds are planted in some soil. Only one of the seeds is watered. Which seed is more likely to grow into a plant?
- 17.** List three things a kitten needs to live and grow.
- 18.** Describe the pupa of a butterfly. What happens inside the pupa?
- 19. CLASSIFY** Many animals move by using their legs, fins, or wings. Think of two examples for each type of movement. Make a table like the one below. Write the names of the animals in the table.

LEGS	WINGS	FINS

20. Make a drawing of a cell. Label the cell membrane, the nucleus, and the cytoplasm.

WRITING IN YOUR JOURNAL

SCIENCE IN YOUR LIFE
Give some examples of the special needs of puppies, kittens, or babies. Tell how these needs are taken care of.

PREDICT AND
Some ads on TV try to make you hungry so that you respond by eating the foods shown. Describe an ad like this that you have seen and tell if it made you respond.

HOW SCIENTISTS WORK
Tell why scientists work experiments instead of just guessing or making up stories about how things work.

DESIGN YOUR OWN EXPERIMENT
How does an ant move? Write a hypothesis. Design an experiment that lets you see the parts of an ant and how it moves. Think safety! First, review your experiment with your teacher before you try it.

Internet CONNECTION
For help in reviewing this unit, visit www.ck12.org/science

Use a Telescope

It makes faraway objects, like the Moon, look just your eyes.

the night sky let you see as you can. and the the eyepiece the Moon. Moon. you see your two the sky. stars. the

How do the acorns in the ground to store them for winter. Most of the acorns get eaten by the squirrels, but a few of them are forgotten. They stay buried in the new trees. They will grow into

QUICK LAB

Traveling Seeds

HYPOTHESIS Animals with fur often help plants spread their seeds. How might they do this? Write a hypothesis in your *Science Journal*.

PROCEDURES

- 1. PREDICT** What will happen when you toss the seeds onto the fur? Record your prediction in your *Science Journal*.
- 2. EXPERIMENT** Test your prediction. Have your partner hold up the fur. Toss different seeds at it. Record the results.

CONCLUDE AND APPLY

- 1. HYPOTHESIS** Which of the seeds stuck to the fur?
- 2. INFER** How might animals with fur help plants spread their seeds?

MATERIALS

- seeds
- fur
- *Science Journal*

Design Your Own Experiments, do Quick Labs, use Internet Connections, and try Writing in Your Journal. Use the Handbook for help.

SKILL BUILDER

Skill: Experimenting

HOW A SOY BUG RESPONDS
If you lift up a large rock or log in a damp place you may find soy bugs. In this activity you will experiment to find out how a soy bug responds to changes in its environment.

SAFETY: Wash hands after handling soy bugs.

PROCEDURES

- 1. OBSERVE.** Place the soy bug on the paper. Take turns observing it with the hand lens. How does the soy bug move? Very gently, touch it with a toothpick. Record your observations in your *Science Journal*.
- 2. PLAN.** To test how the soy bug responds, plan several ways to change its environment. Be sure the changes will not harm the soy bug. Record your plans on a table like the one shown. Use it, then, to make statements that can be tested for each change.
- 3. EXPERIMENT.** Test the statement in the table. Record your results.
- 4. COLLECT DATA.** Test your own statements. Record the results in your table.

CONCLUDE AND APPLY

COMMUNICATE Write a paragraph that describes how the soy bug responds to changes in its environment.

Statement	How the soy bug responds	Results
1. If I touch the soy bug with a toothpick, it will move.	It moved.	Yes
2. If I touch the soy bug with a hand lens, it will stop moving.	It did not stop moving.	No

UNIT REVIEW

PROBLEMS and PUZZLES

Plant
Did the stem of the plant grow in the light?

Bean Experiments
Plant a few pinto beans. Water them and place them in a sunny spot. Check the beans every few days. Record your observations in your *Science Journal*.

OBSERVE
Note how many days it takes for the seedlings to appear. How could you measure their growth? Record your measurements for one week. Then graph your results on a bar graph.

EXPERIMENT
What conditions affect the growth of your seedlings? Design an experiment to find out. What conditions make the plants grow faster and stronger? What conditions were not good for the plants?

Build your skills with Skill Builders and Problems and Puzzles. xiii

www.ertongbook.com

READ ALOUD

**INVITATION TO
SCIENCE**



Even as a young boy, Ballard loved the sea!

Aboard a research ship, Ballard and his crew study images taken by an underwater camera.

Robert Ballard

Robert Ballard's love for the sea began when he was a boy in southern California. Other Californians liked to surf the waves, but Ballard was more interested in what lay beneath the ocean's surface.

To explore that world safely, he knew he had to learn as much as possible. He says, "I needed to learn a lot about geography, navigation, meteorology, geology, biology, and many other things."

His hard work has paid off! Now Ballard leads expeditions to explore the bottom of the sea. He and his crew travel in underwater vehicles called submersibles.

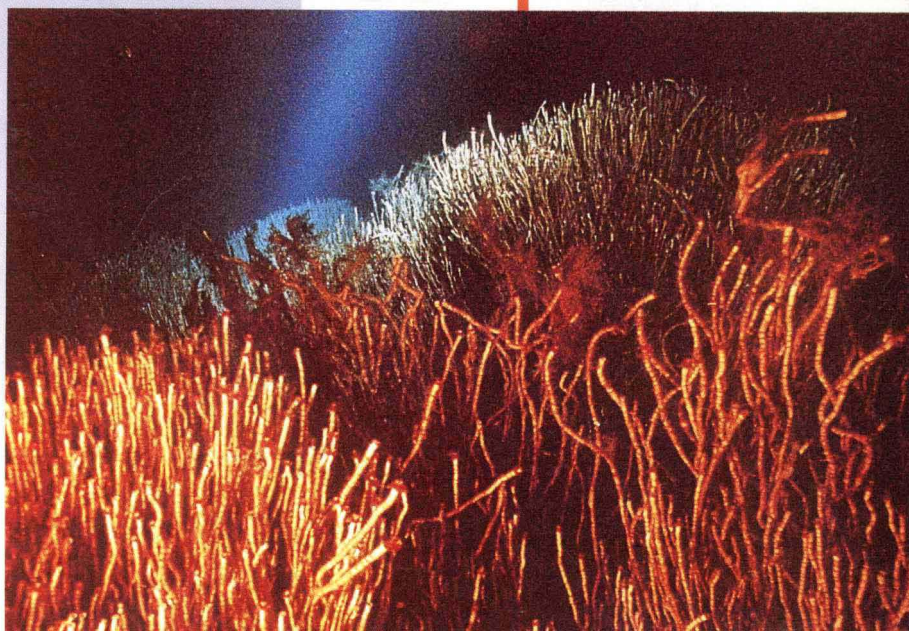
He is most proud of discovering unusual volcanoes on the sea floor. Hot water and minerals flow from the volcanoes, supporting many strange kinds of animals. "Most of the creatures my colleagues and I found," he says, "were completely new to science."

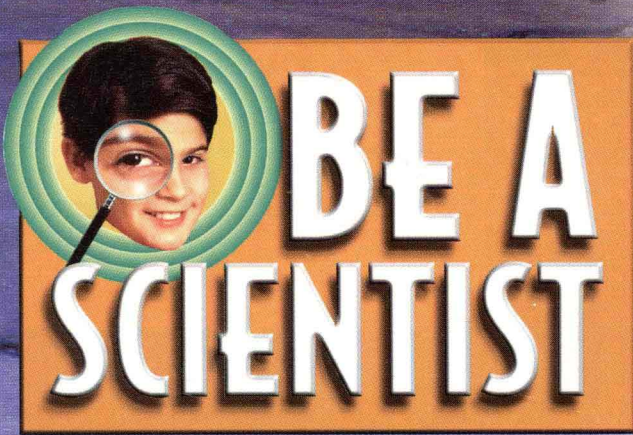
To help other people enjoy the thrill of discovery, Ballard started the JASON project. It uses satellite broadcasts and Internet connections to let students take part in real scientific expeditions!



The submersible *Alvin* can carry scientists deep underwater.

Ballard discovered strange forms of life on the ocean floor.





BE A SCIENTIST

Have you ever looked at the Moon through a telescope? The light places you see are mountains and hills. The dark places are flat lands. Can you see parts that look like rings or holes? These are called **craters** (krā'tərz). A crater is a hollow area in the ground. A crater has a flat floor with walls rising around it. Craters are found in different sizes. Some can be smaller than a dime. Others can be miles across. How did they get there?

EXPLORE



Why are craters different sizes? Write a possible explanation in your *Science Journal*. How might you test your explanation?



Investigate Why Craters Are Different Sizes

How does the size of a falling marble affect the size of the crater it forms? How does the height of a falling marble affect its crater size? Think of a sentence about craters that you can test. Example: A large marble will make a larger crater than a small marble.

MATERIALS

- flour
- aluminum pie tin
- marbles of different sizes
- newspaper
- meterstick
- ruler
- safety goggles
- *Science Journal*

PROCEDURES

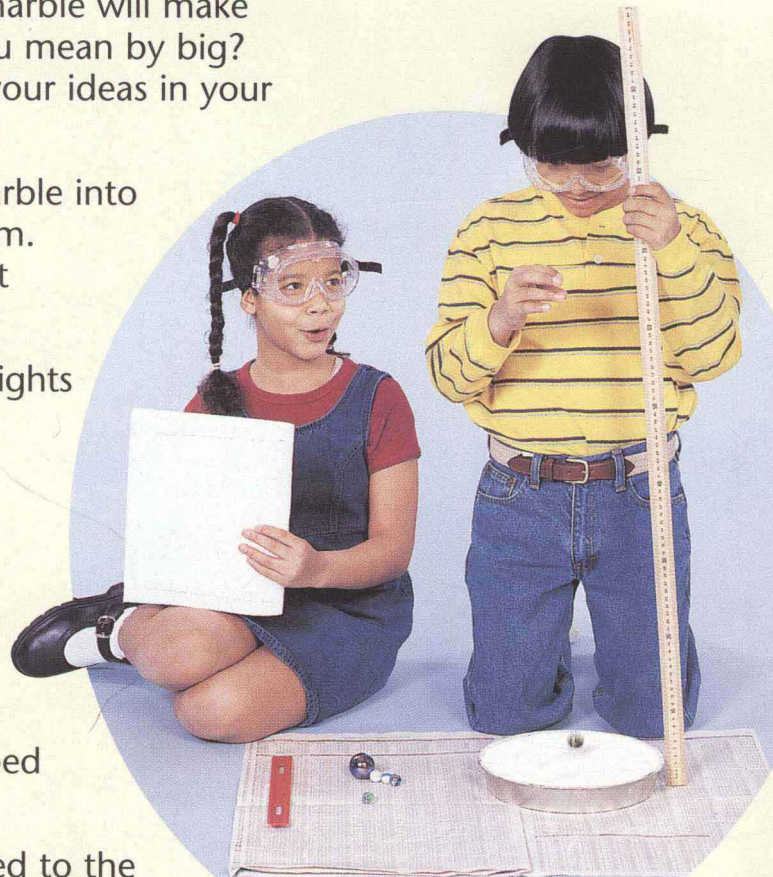


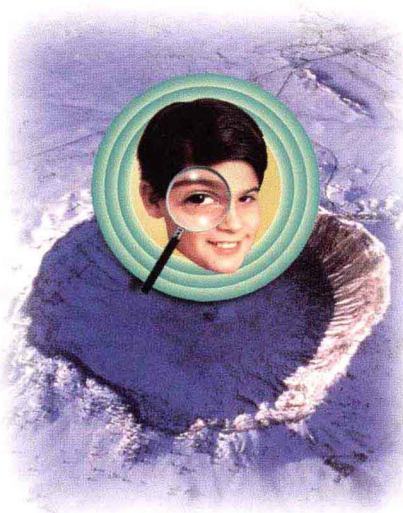
SAFETY: Wear goggles.

1. **MAKE A MODEL** Place newspaper on a flat surface. Fill a pie tin with flour. Smooth the flour's surface.
2. **OBSERVE** Compare the sizes of the marbles. Discuss with a partner which marble will make the biggest crater. What do you mean by big? Deep or wide, or both? Write your ideas in your *Science Journal*.
3. **MEASURE** Drop the smallest marble into the flour from a height of 25 cm. Measure the size of the crater it creates. Record your results.
4. **MEASURE** Repeat step 3 from heights of 50 cm, 75 cm, and 100 cm.
5. **REPEAT** Try the activity again with a large marble.

CONCLUDE AND APPLY

1. **INTERPRET DATA** What happened to the size of the crater as the marble was dropped from greater heights? Why?
2. **INTERPRET DATA** What happened to the size of the crater as the size of the marble increased? Why?
3. **INFER** Why are craters on the Moon different sizes?





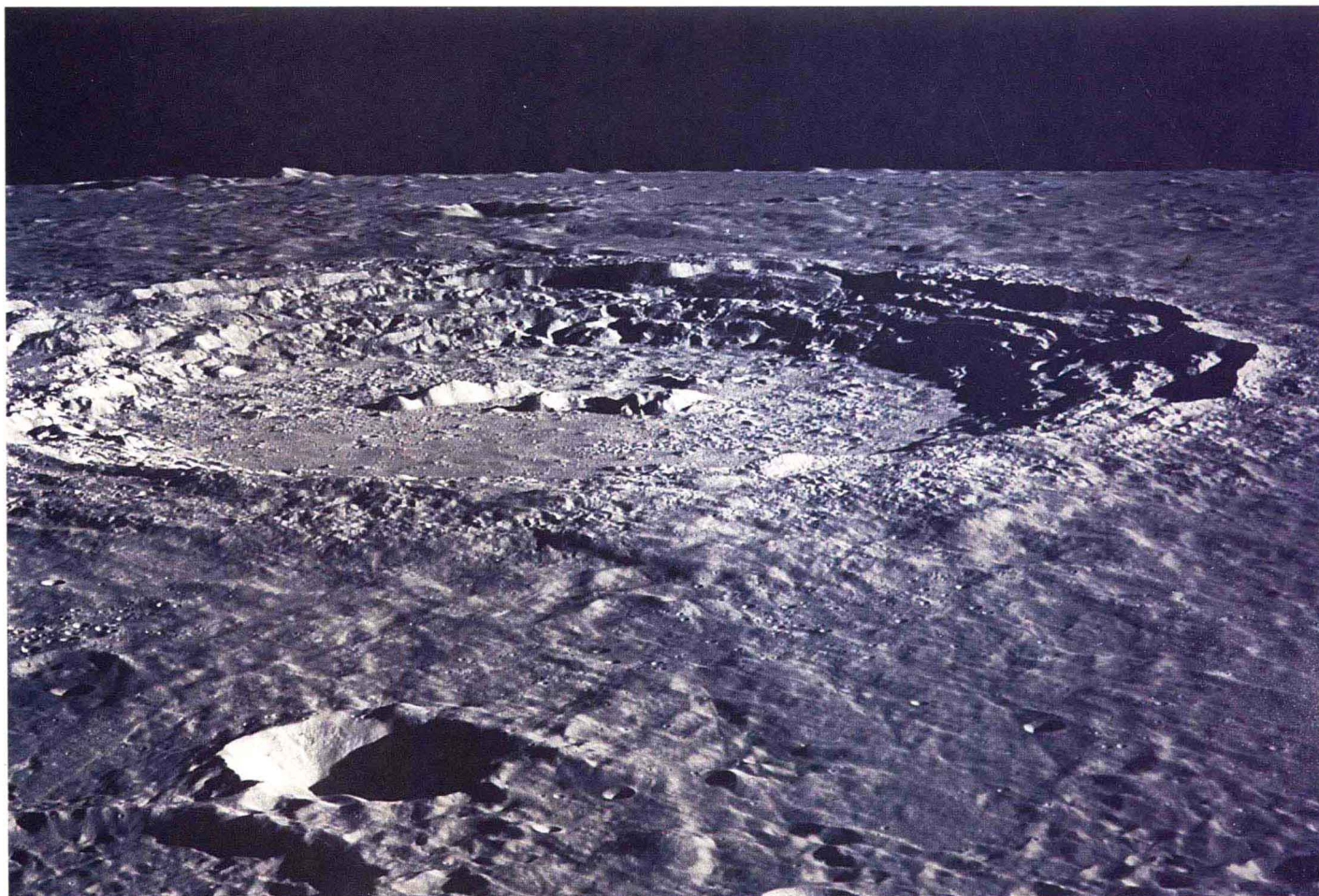
Why Are Craters Different Sizes?

The Explore Activity shows that craters form when an object hits a surface. Scientists call this event an impact. That is why they often call craters *impact craters*.

The Explore Activity also shows that the width of the crater depends on the size of the object hitting the surface. How deep the crater is changes depending on how fast the object is traveling when it hits. The greater the height the marble was dropped from, the greater its speed. Greater speed results in deeper craters.

Did the craters you made in the tin of flour remind you of any other craters you have seen? Could the craters on the Moon be caused by impacts from objects traveling in space?

A large crater on the Moon

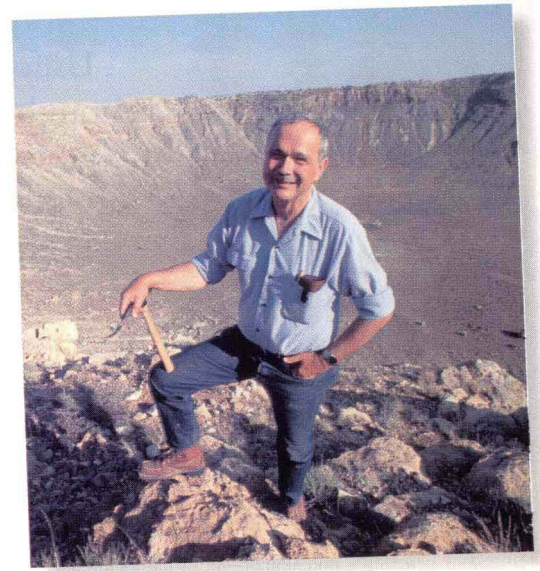


How Do Scientists Work?

One scientist who asked these same questions was **geologist** (jē ol'ə jist) Eugene Shoemaker. A geologist is a scientist who studies the characteristics of rocks to tell how the rocks may have formed. He investigated craters on Earth, and it made him wonder about the craters on the Moon.

Dr. Shoemaker's interest in craters started when he was in school. He saw a crater in Arizona called Meteor Crater and wondered how it formed. He wanted to learn everything he could about it. He studied the crater's shape, and he chipped away at the rock inside it to see what he could learn from it.

The more Dr. Shoemaker studied Meteor Crater, the more he became interested in the craters on the Moon. He was so interested he decided to become an astronaut. He wanted to "bang on the Moon" with his own hammer!



Dr. Eugene Shoemaker was a geologist.

Meteor Crater in Arizona is over one kilometer wide!





Unfortunately, Dr. Shoemaker's health was not good enough for him to be an astronaut. He didn't get a chance to go to the Moon, but he did train astronauts who went into outer space.

He also traveled to craters on every part of Earth. Thanks to his work, scientists now think Meteor Crater was made by a chunk of rock from outer space that hit Earth. The rock was as big as a house! Rocks from outer space enter Earth's **atmosphere** (at'məs fîr'). The atmosphere is the layer of gases that surround the planet. The rocks that enter Earth's atmosphere are called **meteors** (mē'tē ərz). When they hit an object like Earth or the Moon, they are called **meteorites** (mē'tē ə rīts').

Dr. Shoemaker investigated more questions he had about craters. Were all craters the "footprints" of meteorites? Were craters on the Moon formed the same way as craters on Earth? Dr. Shoemaker and other scientists studied many other craters. They found **evidence** (ev'i dəns) of more than 100 large craters on Earth. Evidence is a word for clues used to solve a problem.

Meteorites are made up of mostly stone and iron.



How Do Scientists Use the Work of Other Scientists?

Dr. Shoemaker compared his ideas with what other scientists had discovered. He learned that meteorite craters had several features in common:

- They are all shaped like circles.
- The floor of the crater is lower than the land around it.
- The rim of the crater is higher than the land around it.
- The rim is made of rock material thrown out of the crater.
- The rocks thrown out of the crater are like those just below Earth's surface around the crater.
- Rock layers under the crater floor have many cracks.
- Pieces of the rock from space may be found buried in the floor of the crater. They also may be found in the ground around the crater. These rocks are different from rocks on Earth.



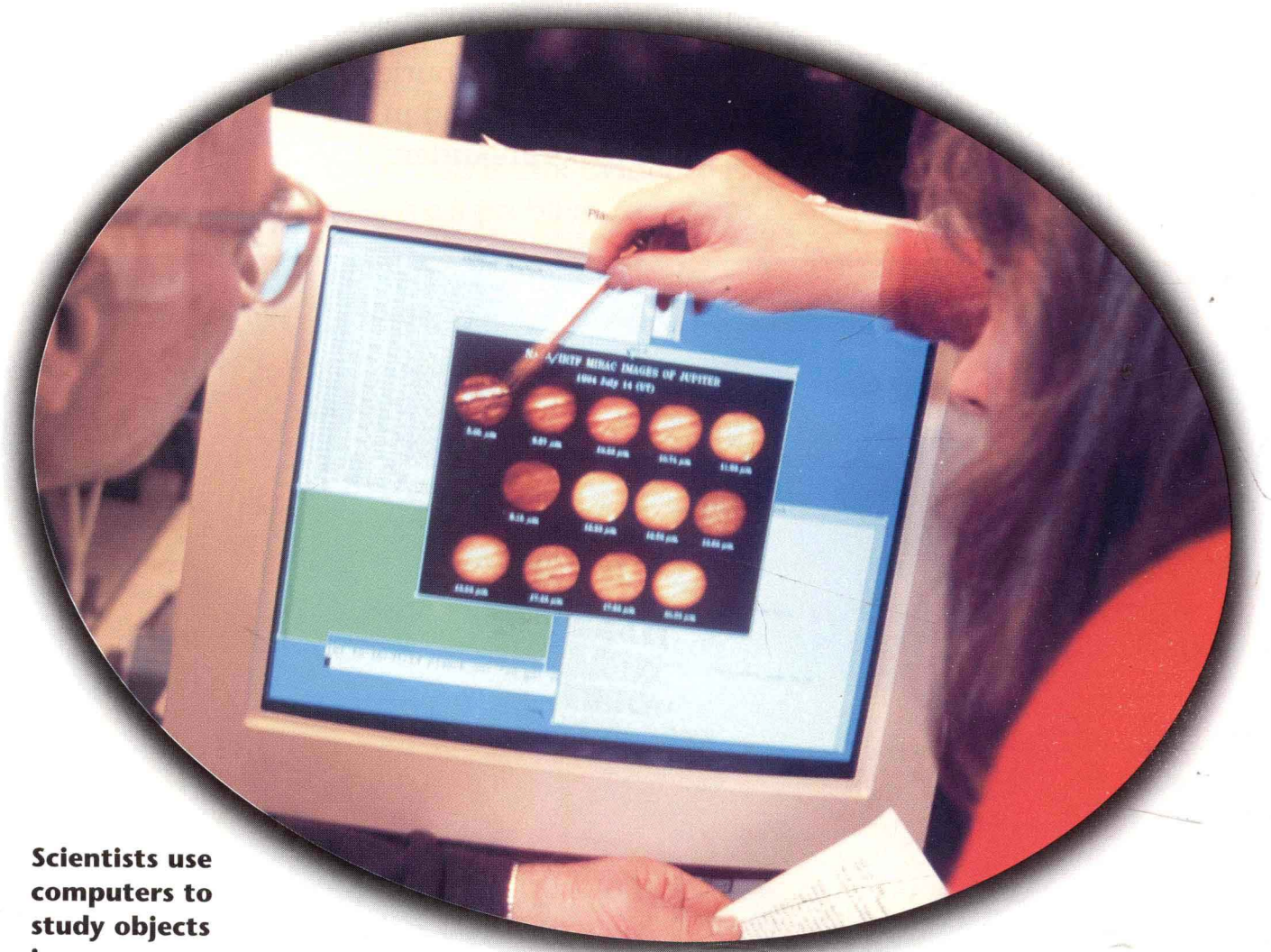
Henbury Crater is a meteorite crater found in Australia.



How Can a Computer Help Scientists?

Dr. Shoemaker collected evidence about his ideas. He compared craters on Earth to craters on the Moon. He concluded that they were alike. When you **draw conclusions**, you put together in a statement all the facts you have learned.

Dr. Shoemaker used a computer to help answer some of his questions. He made a computer **model** (mod'əl) that showed what it's like when a meteorite hits Earth. A model is something that represents an object or event. In the computer model, the rocks at the center of the spot where the meteorite hit were thrown the farthest away. Rocks around the edges of where the meteorite hit moved only slightly. The rocks now formed the rim of the crater.



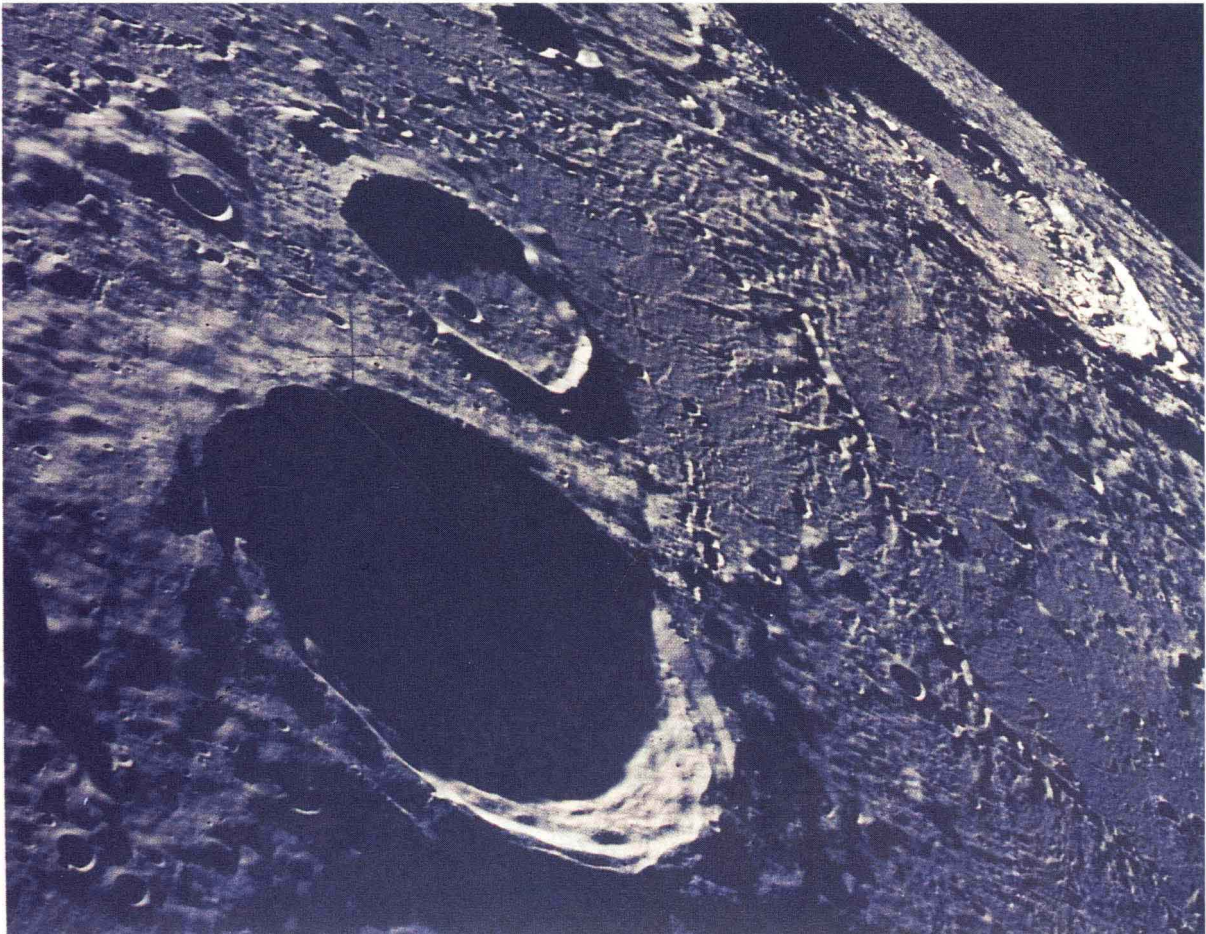
Scientists use computers to study objects in space.

Dr. Shoemaker repeated his **experiment** on the computer using **variables** (vâr'ē ə bəlz). Variables are things in an experiment that can be changed or controlled. Each time he repeated the experiment, Dr. Shoemaker changed the size of the meteorite. The larger the meteorite he used, the larger the crater formed. All of the information he gathered supported his explanation. Earth's craters were formed by meteorites that hit its surface.

Studying Things That Are Far Away

Dr. Shoemaker wanted to learn more about the craters on the Moon. Most scientists agreed that most of the Moon's craters were also formed by meteorites. How could Dr. Shoemaker find out more about how these craters formed? How could he study the Moon's craters without going to the Moon?

Craters cover most of the Moon's surface.



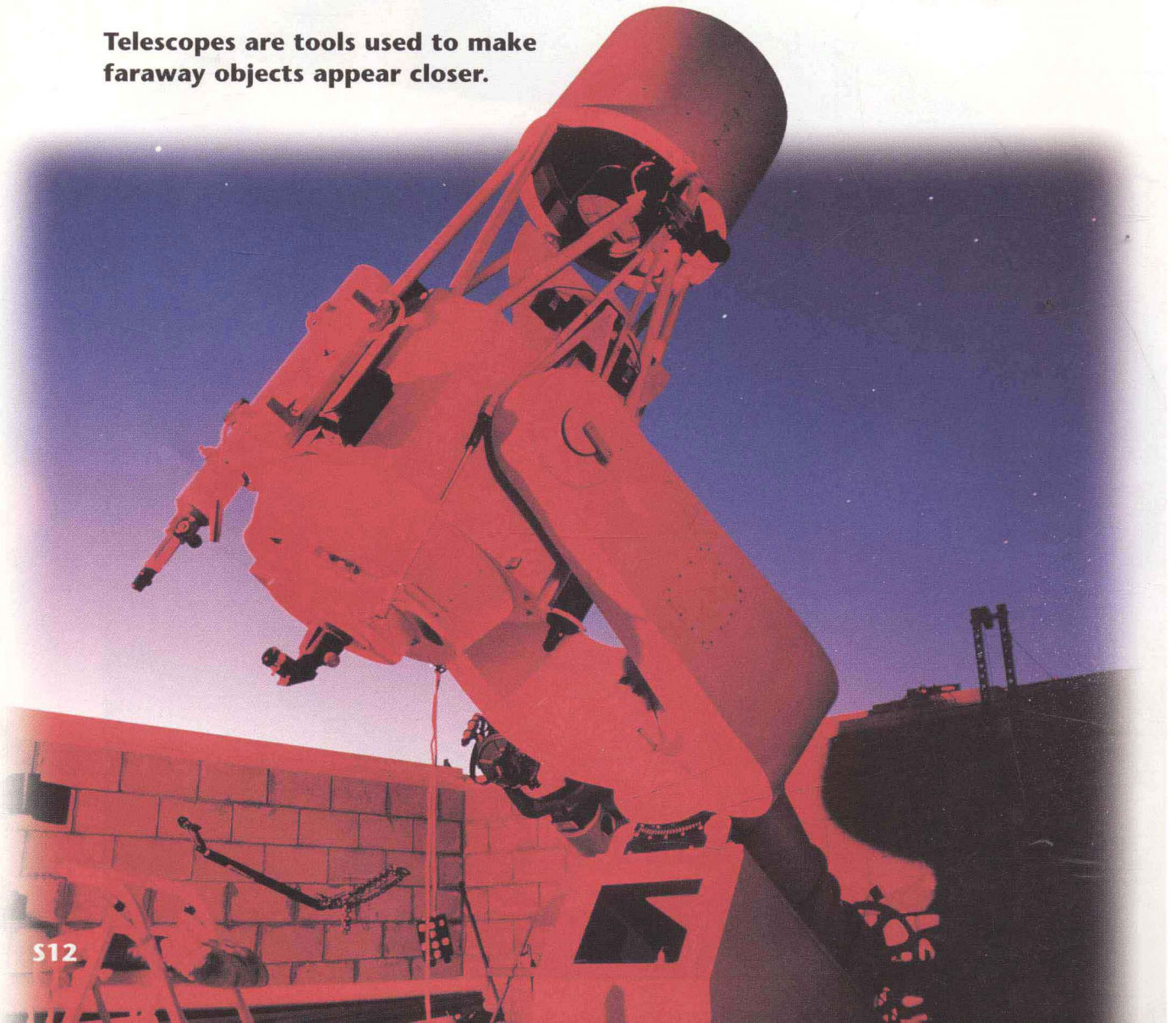


How Can a Scientist Prove His or Her Ideas?

Dr. Shoemaker and other scientists studied photographs of the craters. The pictures were taken through large telescopes. The pictures could be enlarged, making the images much bigger and easier to see. Guess what they found out?

- The Moon's craters are shaped like circles.
- The floors of the Moon's craters are lower than the land around them.
- The rims of the Moon's craters are higher than the land around them.
- The rim around the Moon's Copernicus Crater is much like Meteor Crater's rim in Arizona.

Telescopes are tools used to make faraway objects appear closer.



Based on the evidence, the scientists concluded that Copernicus Crater was made when a large meteorite hit the Moon.

What would it take to make this explanation more certain? Astronauts would have to visit Copernicus Crater and bring back rock samples from it.

The explanation seems correct. Most scientists agree with it. It can be defended using the evidence from photos. The photos can be compared with the evidence collected at Meteor Crater in Arizona.

In the future you may be able to find new evidence as an astronaut or scientist. Maybe you will think of new questions about the Moon's craters. Maybe you will investigate to find the answers.



**Copernicus Crater
on the Moon**

Astronauts have brought rocks from the Moon back to Earth.

