SPECTRUM®

Science

GRADE 3

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Current State Standards
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Focused Practice to Support Science Literacy

- Introduction to scientific inquiry
- Natural, earth, life, and applied science lessons
- Research extension activities
- Key word definitions
- Answer key

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Lesson 1.1 Science: Unlocking the World

hypothesis: something that is assumed to be true so that it can be studied and tested

theory: an idea that explains facts or events that occur in the natural world

law: a statement about facts or events in the natural world that is always correct

process: a series of actions that lead to a result

If you see *-ology* at the end of a word, it usually means that the word is describing a type of science.

- **Biology** is the science of life.
- **Zoology** is the science of animals.
- **Psychology** is the science of the mind.
- **Ecology** is the science of the environment.
- **Geology** is the science of Earth.

"Equipped with his five senses, man explores the universe around him and calls the adventure Science."—Edwin Powell Hubble, astronomer

"The scientist is not a person who gives the right answers, he's one who asks the right questions."—Claude Lévi-Strauss, anthropologist

What is science? Read on to see if you know the answer.

Science is a bigger part of your life than you might realize. If you've ever wondered why the sky is blue, or why trees lose their leaves during winter, then you've already started thinking like a scientist. The first step of any kind of science is to start asking questions. Of course, that's just the beginning.

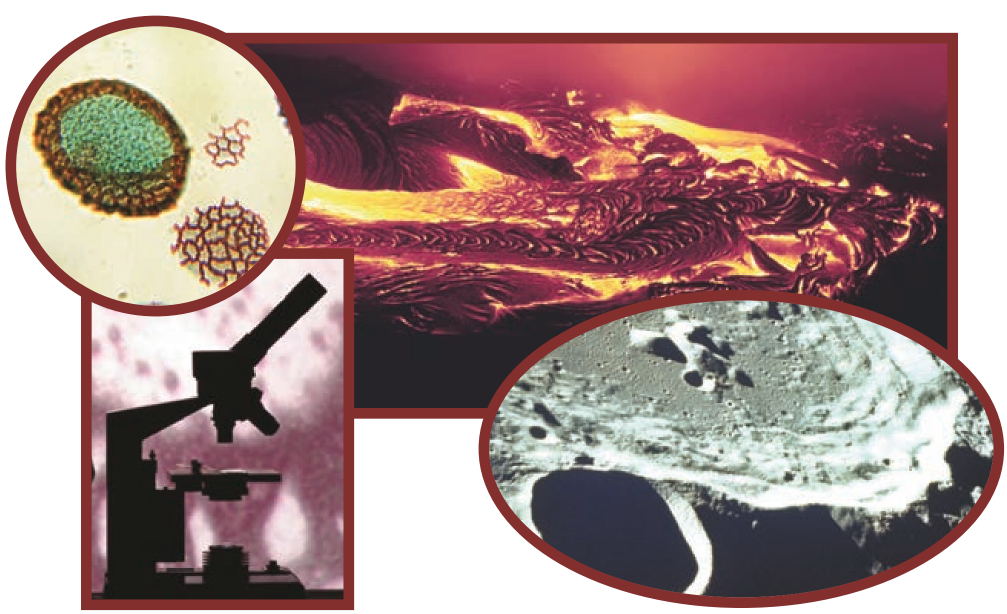
Once a question has been asked, the next step is to simply answer it. This answer is called a **hypothesis**. In science, a hypothesis is an idea that can be tested. Tests, or experiments, are important tools in science. A carefully controlled experiment that is watched closely can provide a lot of information. A good experiment should be able to prove or disprove the hypothesis. If it doesn't, the scientist will need to set up more tests.

Even if a hypothesis is proven wrong, a good scientist won't be too disappointed. It's all part of the process of learning. Besides, it means the right answer is now one step closer!

If a hypothesis is proven to be correct, the scientist will still do more tests. He or she wants to be certain that the answer is right. A **theory** is a hypothesis that has been proven correct many times. If a theory lasts for years and years without ever being proven wrong, it becomes a **law**.

As each question about our world is answered, more questions always come up. Science is an endless **process** of asking, answering, and then asking again. Each scientist builds on what other scientists discovered.

The results of science surround us—the clothes you wear, the way this book was printed, the lights in the room, the way your lunch was made. There's hardly anything in the modern world that didn't come from some kind of science.



Circle the letter of the best answer to each question below.

1. During an experiment, a scientist should always be

   a. quiet.

   b. a careful observer.

   c. wearing gloves.

   d. All of the above

2. Which of the following is a field of science?

   a. climate

   b. climbing

   c. climatology

   d. clamber

Number the following scientific steps in the correct order.

3. ________ theory ________ hypothesis ________ question ________ law ________ experiment

Write your answers on the lines below.

4. Hayden wonders which kind of ice cream melts more quickly—chocolate or vanilla? What is a possible hypothesis that he could use to answer this question?

   ____

   ____

5. If an experiment shows that a hypothesis is incorrect, what should a scientist do next?

   ____

   ____

Unifying Concepts and Processes

1. Look around the room. List five things science had a role in creating.

   ____________ ____________ ____________ ____________ ____________

2. Choose one of the items you listed above, and explain what role science had in making it.

   ____

   ____

   ____

Lesson 1.2 The Good Scientist

observe: to closely watch or pay attention to

evidence: facts or signs that help to prove something

solution: an answer to a problem

"What is a scientist after all? It is a curious man looking through a keyhole, the keyhole of nature, trying to know what's going on."—Jacques Cousteau, oceanographer

There are many different kinds of scientists. Here are some you may not be familiar with:

- An **ethologist** studies animal behavior.
- A **seismologist** studies earthquakes.
- A **cytologist** studies cells.
- An **agronomist** studies soil and crops.
- An **entomologist** studies insects.

Do you think you have what it takes to be a successful scientist?

When you picture a scientist, you might think of a person in a white lab coat hunched over a test tube. He or she might be entering numbers into a computer or taking notes about the habits of wild animals. But what makes these people good scientists?

One of the most important qualities of a good scientist is curiosity. Curiosity makes a scientist ask why things happen. It makes him or her eager to learn more or test an idea. Remember the story of Newton and the apple? He might never have discovered gravity if he hadn't asked himself why the apple fell.

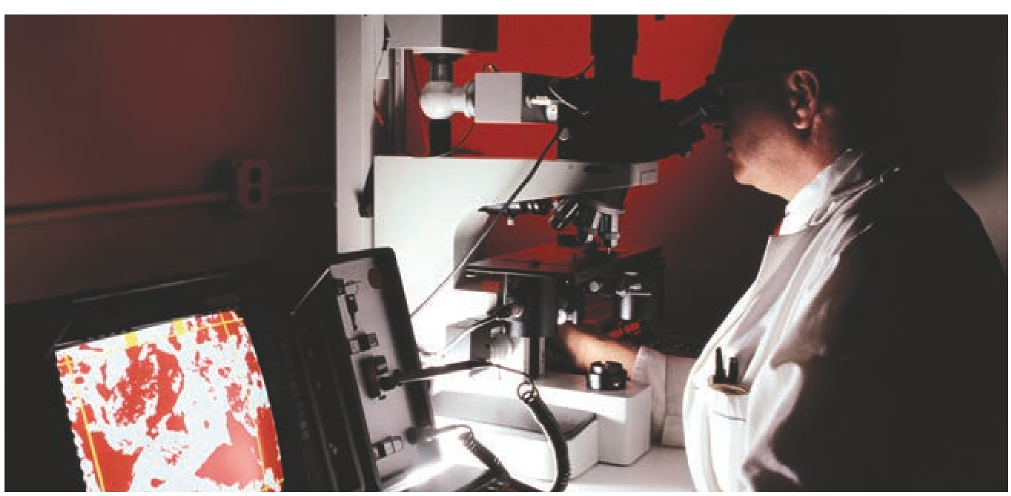
Scientists must be good observers. They must watch the world around them in order to make sense of it. As they **observe**, they must keep an open mind. They must be sure that their opinions don't get in the way of the facts and **evidence** they find.

Creativity is also important to scientists. They have to be able to see **solutions** in unusual places. Some of the greatest inventions might never have been made if scientists didn't have great imaginations. Think of the telephone, the automobile, and TV.

Communication is a must for scientists. Science is built on the work of earlier scientists. If someone doesn't share what he or she has found, it loses importance. Louis Pasteur found that disease is caused by organisms too tiny to be seen by the human eye. What if he had never shared his discovery?

Scientists must be persistent. They have to be willing to try again and again if they don't succeed the first time. The Wright Brothers had to try many times before their plane finally flew. People worked for years to find a vaccine for measles before they had any success. If they had given up too soon, the world might be a different place.

Now that you know some of the qualities of good scientists, how do you measure up?



NAME ______________________

Circle the letter of the best answer to each question below.

1. Jane Goodall spent many years learning about chimps in the wild. ____________________ played an important role in the information she collected.

   a. Evidence

   b. Communication

   c. Invention

   d. Observation

2. Which is an example of finding a solution in an unusual place?

   a. Galileo tried to measure the speed of light, but found he didn't have the tools to do it.

   b. Eli Whitney invented the cotton gin to make it easier to harvest cotton.

   c. Alexander Fleming discovered penicillin by accident when mold grew in a dish in his lab.

   d. Sally Ride helped design a robot arm for the space shuttle.

Write **true** or **false** next to each statement below.

3. ____________________ Imagination is an important part of being a good scientist.

4. ____________________ If a good scientist does not succeed the first time, he or she will give up.

5. ____________________ A scientist's opinions are more important than the evidence he or she finds.

6. ____________________ Sharing information is important in the world of science.

Write your answers on the lines below.

7. One of the reasons that Newton discovered gravity is that he was ____________________.

8. Mr. Okani finally completed a study he had been doing on the West Nile virus. He published his results in *The World of Science* magazine. Which quality from the selection is this an example of?

   ____

9. In your opinion, what is another quality that good scientists need? Why would they need this quality?

   ____

   ____

Lesson 1.3 The Scientific Toolbox

How do scientists see bacteria? How do they measure the distance to the moon?

To build a house, a carpenter needs a hammer and a saw. To fix a car, a mechanic needs a wrench and a screwdriver. Having the right tool for the right job makes work easier. Like any other worker, a scientist needs tools as well. The exact tool he or she uses depends on what needs to be known.

Measuring is one of the most common scientific tasks. Whether it's time, weight, temperature, or length, every measurement needs to be **accurate**. If a measurement hasn't been made carefully, the result can't be trusted, and neither can the experiment.

Scientists use the metric system for their measurements. Rulers, used to check length, have marks on them showing centimeters and millimeters. Measurements longer than a meter are often made using a measuring tape. The tape is several meters long. Because it is thin and flexible, it can be rolled up and stored in a small case.

The longest measurements are made using **lasers**. The amount of time the laser beam needs to hit an object and reflect back shows the distance.

Thermometers help scientists find temperature—the amount of heat something has. Scientific thermometers use the Celsius scale. For many years, thermometers were filled with mercury. It rose or fell inside them based on the amount of heat. Today, most thermometers are electronic. Mercury is a poison, and electricity is safer. It is also much more accurate.

Often what a scientist needs to study is too small or far away to be seen without help. Microscopes and telescopes are tools that **magnify** things. For both devices, lenses are placed inside tubes. Looking through the tubes makes objects easier to see.

Microscopes let scientists peer into the tiny worlds of bacteria and viruses. Telescopes allow them to watch what is happening in space billions and billions of miles from Earth.

accurate: close to exact

lasers: a narrow beam of light made from the vibrations of atoms and molecules; laser stands for "**l**ight **a**mplification by **s**timulated **e**mission of **r**adiation"

magnify: to make something appear larger

How Far to the Moon?

When astronauts visited the moon during the 1969 and 1970 *Apollo* missions, they left behind mirrors. These mirrors have been used to find the exact distance from Earth to the moon. Scientists on Earth's surface bounce laser beams off these mirrors and measure how long it takes for the beam to return. They have been able to measure the distance very precisely. In fact, scientists now know that the moon is slowly drifting away from Earth. Each year, the distance to the moon increases by about 3.8 centimeters (1.5 inches).

Circle the letter of the best answer to each question below.

1. Scientists use ____________________ to measure distance.

   a. rulers

   b. lasers

   c. the metric system

   d. All of the above

2. What do microscopes and telescopes have in common?

   a. They both use lasers.

   b. They are both used to see tiny objects.

   c. They both contain lenses.

   d. Both b and c

3. The Celsius scale is used for measuring

   a. temperature.

   b. distance.

   c. weight.

   d. the size of bacteria.

Write your answers on the lines below.

4. Why are electric thermometers used more often now than mercury thermometers?

   ____

   ____

5. Even though a measuring tape might be long enough to measure the height of a tree, why might a scientist use a laser instead?

   ____

   ____

Unifying Concepts and Processes

Why is it important for a scientist to take precise measurements? What are some problems that a scientist could have if he or she tried to use sloppy measurements?

____

____

Lesson 1.4 The Metric System

fraction: part of a whole, like 1/2 or 2/3

conversion: changing something from one form into another equal form

volume: the measurement of how much space something fills

cubic centimeter: a cube that measures one centimeter on all edges

The Celsius temperature scale is also a metric system based on water and the number ten. Water freezes at 0°C and boils 100°C.

The metric system is used by every country on Earth except three: Liberia, Myanmar, and the United States.

Why has the metric system become the scientific standard for measurement?

If someone asks how tall you are, you'll probably answer in feet and inches. If you were a scientist, though, you'd most likely answer in meters.

The metric system was created in France during the 1700s. Scientists wanted a simpler way to compare things. The old way was complicated. For example, one gallon of water weighs 8.33 pounds. If you want to know the weight of 14 gallons of water, the math is not simple.

French King Louis XIV asked his scientists to invent an easier system. Their answer was the metric system. All of its measurements are based on the number ten and a length called the *meter*.

The oldest measurements began as body parts. This is where the term *foot* comes from. The French scientists wanted their new system to be based on something more precise. They decided the meter would be a small **fraction** of the distance between Earth's two poles.

For many years, an official meter stick was kept in France. All other meters were based on it. Soon, scientists tired of having to rely on this one meter. They wanted to be able to find the exact length without having to travel to France. Today, one meter is defined as the distance light travels in 1/299,792,458 of a second. Now, that's accurate!

A meter is divided into one hundred centimeters. One thousand meters makes one kilometer. **Conversion** is much simpler when a system is based on tens—you just need to move the decimal point. For example, something that is 350 meters long is also 0.35 kilometers long or 35,000 centimeters long.

Different types of measurements are linked with each other as well. Metric length, weight, and volume are related based on water. If you could form water into a box shape that was one centimeter on each side (length), it would be one **cubic centimeter**. One cubic centimeter of water equals one milliliter of water (volume), which weighs about one gram (weight).

Because these conversions are so simple, most scientists and nations use the metric system.

NAME ______________________

Circle the letter of the best answer to each question below.

1. In which country was the metric system invented?
   a. England
   b. the United States
   c. France
   d. Sweden

2. The metric system is based on
   a. the number ten.
   b. the meter.
   c. the weight of water.
   d. Both a and b

Use the diagram below to answer the questions that follow.

length	volume	weight
1,000 millimeters (mm)	1,000 milliliters (ml)	1,000 milligrams (mg)
100.0 centimeters (cm)	100.0 centiliters (cl)	100.0 centigrams (cg)
1.000 meter (m)	1.000 liter (L)	1.000 gram (g)
0.001 kilometers (km)	0.001 kiloliters (kl)	0.001 kilograms (kg)

3. A rock that weighs 3.5 kg can also be said to weigh
   a. 3,500 g.
   b. 350 kl.
   c. 35 cm.
   d. 3.5 km.

4. 1 L of water weighs 1 kg, so 15.7 kg of water has what volume?
   a. 157 ml
   b. 1.57 g
   c. 15.7 L
   d. Not enough information

Write your answer on the line below.

5. Why do you think it is important to study and learn the metric system?

____

What's Next?

Although the United States hasn't officially changed over to the metric system, metric measurements are all around you. Next time you are at the grocery store, see how many products you can find that use metric measurements.

Lesson 1.5 Hot Colors

bar graph: a visual way of comparing numbers using bars, or rectangles

data: facts or information about something

conclusion: a decision that has been reached by careful thought

absorbed: took in or swallowed up

White light contains all colors. When it shines on something colored, though, only that color of light reaches your eye. For example, an apple is red because only red light bounces off it. Every other color—blue, green, yellow, purple, etc.—is **absorbed** by the apple.

Why should you wear white in the desert?

For almost two weeks, Hayden struggled to come up with a good idea for his science project. The due date was now a week away, and he was getting worried. Hayden sat at the desk in his bedroom trying to come up with ideas, but his mind remained blank. What was he going to do?

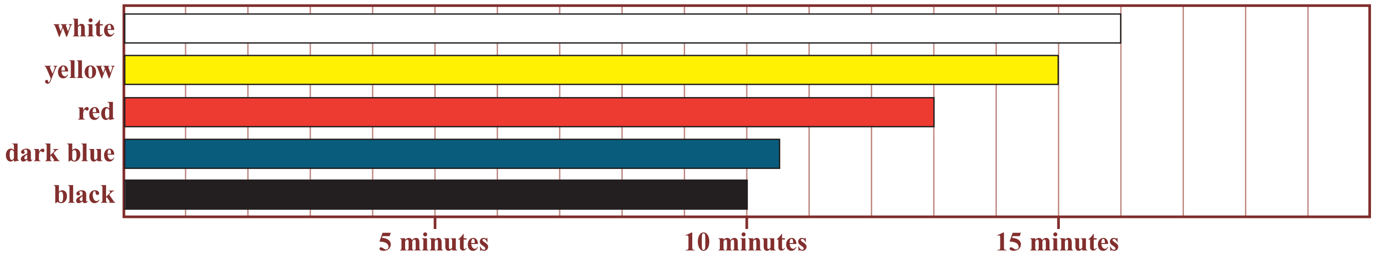
Frustrated, Hayden stood and walked over to a photograph hanging on his bedroom wall. It showed his great-grandfather standing in the desert with some other men. They all wore the traditional white robes of his Arabic heritage. For a moment, Hayden stopped thinking about his science project. Instead, he wondered why all the robes were white. Suddenly, Hayden knew what his project would be.

A week later, Hayden presented his project to the class. He had made a large **bar graph** on poster board that he placed at the front of the room. Across the top of the board were five blocks of color—one each of white, yellow, red, dark blue, and black. Down the left side of the graph were numbers. The numbers were labeled *minutes*.

Hayden explained his experiment to the class. He had put an ice cube inside an open shoebox. Next, he had covered the box with a colored cloth. Then, he had placed the box directly underneath a lamp. Hayden used a stopwatch to time how long it took for the ice cube to melt.

He repeated these steps with five different colors of cloth and recorded each result. Then, Hayden put the **data** into a graph. The last step of the project was to draw a **conclusion**.

As Hayden finished, he turned to his teacher. She smiled and thanked him for his good work. Hayden took his poster board and headed back to his seat. Now, he knew why you should wear white on a very hot day—or when you're in the desert.



Answer the following questions based on Hayden's bar graph.

1. According to Hayden's results, which color melted the ice cube most quickly? ______________
2. Which color melted the ice cube most slowly? ______________
3. Which color absorbed the most heat? Explain your answer.

____

____

____

Write your answers on the following lines.

4. The ice cube took almost the same amount of time to melt under the dark blue cloth as it did under the black cloth. The times for white and yellow were also close. What does this information tell you?

____

____

____

5. When Hayden first tried his experiment, he had a 75-watt bulb in the lamp. After melting three ice cubes, the bulb burned out. He could only find a 100-watt bulb as a replacement. Hayden threw away his results and began his experiment again. Why?

____

____

____

____

Circle the letter of the best answer to the question below.

6. Which is the best hypothesis for Hayden's experiment.

   a. White absorbs less heat than other colors.

   b. An ice cube will melt when placed under a light bulb.

   c. Why do people wear white clothing in the desert?

   d. White light contains all colors of light.