Focused Practice to Support Science Literacy

- Lab safety rules
- Natural, earth, life, and applied science lessons
- Research extension activities
- Key word definitions
- Answer key
Photo Credit: Page 112. NOAA Photo Library. Mr. Floyd Risvold, USC&GS. California, Long Beach. March 11, 1933.
## Spectrum Science Grade 6

### Table of Contents

#### Chapter 1 Science as Inquiry

- **Lesson 1.1** Rules to Remember ........................................... 6
- **Lesson 1.2** Taking a Good Look at the World .......................... 8
- **Lesson 1.3** On the Rise ......................................................... 10
- **Lesson 1.4** The Case of the Wet Windows ............................... 12
- **Lesson 1.5** A Sticky Lesson ................................................. 14
- **Lesson 1.6** Pangaea, the Supercontinent ................................. 16
- **Lesson 1.7** The Rise and Fall of Planet X ............................... 18
- **Lesson 1.8** Seeing with Electronic Eyes ................................. 20
- **Lesson 1.9** The Man Who Saved the Children ......................... 22
- **Review** Chapter 1 .................................................................. 24

#### Chapter 2 Physical Science

- **Lesson 2.1** Splitting the Atom .............................................. 26
- **Lesson 2.2** Energy on the Move ............................................ 28
- **Lesson 2.3** A Shining Example of Clean Energy ....................... 30
- **Lesson 2.4** On a Roll ............................................................. 32
- **Lesson 2.5** Seeing Sparks ..................................................... 34
- **Lesson 2.6** Taking to the Skies ............................................. 36
- **Lesson 2.7** Swing Time ........................................................ 38
- **Lesson 2.8** Boyle’s Perfect Mixtures ..................................... 40
- **Lesson 2.9** Acid or Base? ...................................................... 42
- **Review** Chapter 2 .................................................................. 44

#### Chapter 3 Life Science

- **Lesson 3.1** Communities of Life .......................................... 46
- **Lesson 3.2** Darwin’s Finches .............................................. 48
- **Lesson 3.3** DNA: A Blueprint for Building Life ....................... 50
- **Lesson 3.4** Blowing in the Wind ............................................ 52
Lesson 3.5 Round and Round It Goes: The Nitrogen Cycle ........................................... 54
Lesson 3.6 Follow That Trail ................................................................. 56
Lesson 3.7 Group Living ................................................................. 58
Lesson 3.8 The Monkey Bread Tree ..................................................... 60
Lesson 3.9 Trouble in Paradise: The Florida Everglades ......................... 62
Review Chapter 3 ........................................................................ 64
Mid-Test Chapters 1–3 .................................................................... 66

Chapter 4 Earth and Space Science
Lesson 4.1 The Restless Continents ...................................................... 68
Lesson 4.2 Carving Out the Grand Canyon ......................................... 70
Lesson 4.3 Set in Stone ..................................................................... 72
Lesson 4.4 A Watery Landscape ......................................................... 74
Lesson 4.5 Layers of the Sky ............................................................... 76
Lesson 4.6 A Sky Full of Lights .......................................................... 78
Lesson 4.7 Soaring Through Space ...................................................... 80
Lesson 4.8 Shrinking Pluto ................................................................. 82
Lesson 4.9 Cosmic Mysteries .............................................................. 84
Review Chapter 4 ........................................................................ 86

Chapter 5 Science and Technology
Lesson 5.1 The Beginning of Human Civilization ................................. 88
Lesson 5.2 From China to the Moon ..................................................... 90
Lesson 5.3 The AC/DC Battle: Tesla Versus Edison ................................ 92
Lesson 5.4 A Picture Is Worth a Thousand Sounds .............................. 94
Lesson 5.5 Bridging the Gap ............................................................... 96
Lesson 5.6 Tunneling Through .......................................................... 98
Lesson 5.7 Up, Up, and Away! ............................................................ 100
Lesson 5.8 At the Bottom of the Ocean ............................................... 102
| Lesson 5.9  | Building the Future Atom by Atom | 104 |
| Review     | Chapter 5                       | 106 |

### Chapter 6 Science in Personal and Social Perspectives
- **Lesson 6.1** Counting Calories .......................................................... 108
- **Lesson 6.2** Vitamin Health ................................................................. 110
- **Lesson 6.3** Standing Up to Earthquakes .............................................. 112
- **Lesson 6.4** Water: A Resource at Risk ............................................... 114
- **Lesson 6.5** What a Waste! ................................................................. 116
- **Lesson 6.6** Ocean View ................................................................. 118
- **Lesson 6.7** The Age of Information .................................................. 120
- **Lesson 6.8** Healthy Computer Habits ................................................. 122
- **Lesson 6.9** New Technologies = New Careers ..................................... 124
- **Review** Chapter 6 ............................................................................ 126

### Chapter 7 History and Nature of Science
- **Lesson 7.1** Positively Radioactive ...................................................... 128
- **Lesson 7.2** Naming the Stars .............................................................. 130
- **Lesson 7.3** Searching for a Signal ..................................................... 132
- **Lesson 7.4** Flying Through Time ....................................................... 134
- **Lesson 7.5** The Interesting Life of Henry Cavendish ........................ 136
- **Lesson 7.6** The Wizard of Horticulture ............................................. 138
- **Lesson 7.7** The Science of Ancient China .......................................... 140
- **Lesson 7.8** Discovering the West ....................................................... 142
- **Lesson 7.9** For the Love of Chimps ................................................... 144
- **Review** Chapter 7 ............................................................................ 146
- **Final Test** Chapters 1–7 ................................................................... 148
- **Answer Key** ..................................................................................... 152
Do you know which practices are and aren’t safe in a lab?

A science lab is a place where discoveries can unfold. It’s also a place where injuries can occur if the proper precautions aren’t taken. Follow these guidelines, and you’ll stay safe while you’re conducting your investigations.

• Before you begin working, make sure that you understand all parts of the procedure or experiment.

• Do not eat, drink, or chew gum in the lab. Even if you’re careful, you might accidentally ingest something harmful. Before you leave the lab, wash your hands thoroughly with soap and water.

• When you have completed an experiment, check with a teacher or other adult to see how you should dispose of the materials. Chemicals should never be poured down a sink. They could mix and a dangerous reaction could take place. Biological materials, like the remains of a dissected frog, should not be placed in the trashcan.

• Wear appropriate protective gear when you are working in a lab. A smock or apron can protect your clothes and keep you from carrying any chemicals outside the lab. Safety glasses should be worn whenever you are working with heat, glass, or chemicals. Gloves can protect your hands from chemicals and heat.

• Do not wear baggy clothing or dangling jewelry in the lab. If you have long hair, it should be tied back. You should also wear close-toed shoes.

• Your five senses are valuable tools of observation in the lab. Use them carefully, though. Never taste anything and don’t smell anything unless you are instructed to do so. Observing something visually is fine, but keep a distance of about a foot when you’re dealing with chemicals. Also, remember never to look down into a container that is being heated. The substance could splatter and burn you. You could also inhale steam that chemicals produce when they are heated.

• If you are using heated glassware, be sure to keep it away from cool or cold water. The water can cause the hot glass to shatter.

• Conducting experiments can be fun, but you need to make sure that you keep your focus. The lab isn’t a place for playing jokes. Distracting a friend might put both of you in danger.
Read each description below. If safe science practices are being followed, write S on the line. If they are not, write US.

1. _______ Enrique used tongs to remove the glass beaker from the boiling water and set it next to a bowl of cold water beside the sink.

2. _______ A strange smell filled the air, and Olivia leaned closer and sniffed her beaker to see if it was coming from the mixture she had just made.

3. _______ Before Meghan lit the Bunsen burner, she borrowed a rubber band from a friend and put her hair back in a ponytail.

4. _______ Quinn measured quantities of several liquids to use in her experiment while Danny told her about the movie he had seen last weekend.

5. _______ Nico finished examining the contents of the spider's egg sac, so he asked Mr. Hamish how he should dispose of it.

6. _______ Darius had something in his eye, so he put down the test tube he was holding, took out his contact lens, and then replaced it.

Now, explain how each unsafe activity could be done more safely.

7. ____________________________

8. ____________________________

9. ____________________________

10. ____________________________

Write your answers on the lines below.

11. Why is it important to avoid eating or drinking in the lab?

__________________________________________

12. Why isn’t it a good idea to wear baggy clothing or dangling jewelry in the lab?

__________________________________________

13. How are precautions that researchers in the Antarctic take similar to those that students follow in a lab?

__________________________________________

Spectrum Science
Grade 6
Why are experiments such an important scientific tool?

Scientists are like detectives trying to solve the mysteries of the universe. They use their skills to investigate what, when, where, why, and how things happen. Probably the two most important tools a scientist has at his or her disposal are observation and experimentation. They’re both parts of the scientific method, but they definitely aren’t the same thing.

Science always begins with observation. Good scientists are curious, so their observations lead to questions. The scientific method begins when a question has been asked. Then, a hypothesis can be formed. A hypothesis is only useful—and scientific—if it can be tested.

The best way to test a hypothesis is to design an experiment. Experiments are one of science’s greatest inventions because they allow the scientist to be in control. Each experiment is carefully designed to answer just one question— is the hypothesis true or false? In nature, there are often too many variables to know for sure why something happened. In an experiment, the scientist can limit the number of variables. An experiment allows a scientist to see why he or she got one result instead of another.

As important as experiments are to science, they aren’t always practical. For example, how does an astronomer test a star that’s thousands of light-years from Earth? Observation, however, is almost always possible. Observational science uses scientific facts that are already known to answer questions about what the scientist sees.

An astronomer can’t travel across space, but with observation, he or she can still discover a lot about the stars. For example, experiments on Earth have shown that when elements are burned, each one emits a very specific wavelength of color. By observing the colors of stars, astronomers can tell which chemical elements the star contains—without ever leaving our planet.

Certain types of science use observation much more than experimentation. Archeology, paleontology, and astronomy rely heavily on observing the world, and then drawing conclusions based on the evidence.

Observation is always a part of experimenting. How else would you know what happened in an experiment if you didn’t observe the results? But observational science is the method you use when experimenting can’t be done.
Circle the letter of the best answer to each question below.

1. Observing and experimenting are both
   a. parts of the scientific method.
   b. ways of investigating the world.
   c. examples of hypotheses.
   d. Both a and b

2. A hypothesis is
   a. a scientific question that can be answered easily.
   b. a statement that can be proven true or false.
   c. a type of experiment used in the scientific process.
   d. the end result of an experiment.

Write your answers on the lines below.

Maddie is testing different kinds of soil to see which one is the best for growing plants. She fills one cup with a mixture of soil and sand, a second cup with soil and gravel, and a third cup with soil and shredded bark. Then, she plants radish seeds in all three cups.

3. Write a possible hypothesis for Maddie’s experiment.

4. What is the variable in this experiment?

5. How will observation be a part of Maddie’s experiment?

Read the examples of scientific activities listed below. Write O on the line if the scientist is using observation. Write E on the line if the scientist is conducting an experiment.

6. _______ A paleontologist decides that a dinosaur is a meat-eater because it has sharp teeth.

7. _______ A physicist tests three types of gases to see which one is densest.

8. _______ A chemist mixes water and sodium to prove that an explosion will occur.

9. _______ An archaeologist digs up an arrowhead and concludes that the ancient people who used it were hunters.
How can you inflate a balloon without blowing into it?

Have you ever baked bread before or watched someone else make it? If you have, you probably know that most types of bread contain yeast. Yeast looks similar to other powdery baking ingredients, but it's actually alive. Yeast, a type of fungus, is a microscopic organism. When it is dry, it is dormant, but when it becomes moist and warm, it comes to life.

Yeast is a plantlike organism, but it can't make its own food the way plants do. Instead, it feeds on sugar. As yeast breaks down the sugar to make energy, a chemical reaction called fermentation takes place. In the process, it creates alcohol and carbon dioxide as waste. The carbon dioxide appears as little bubbles of gas. These bubbles are what cause bread dough to rise and baked bread to have its light, spongy texture.

Experiment: Rising to the Challenge

Materials: two packets of yeast, two plastic bottles, two balloons, warm water, granulated sugar, a tablespoon, a funnel

- Pour a cup of very warm (but not hot) water into each bottle. Place a funnel over the mouth of bottle 1 and add two tablespoons of sugar. Place the cap on the bottle and shake it until the sugar dissolves.

- Open the bottle and put the funnel over the mouth again. Add the yeast and replace the cap. Swirl the mixture around in the bottle until the yeast dissolves. The water will be cloudy and have turned a light brown color. Follow the same procedure to add yeast—but not sugar—to bottle 2, the control bottle.

- Open each bottle and slide the end of a balloon over the bottle's mouth. Make sure that the balloons create a tight seal. If the seals aren't tight enough, use some string, a rubber band, or packing tape to create a better seal.

- Put the bottles someplace warm, like on a sunny windowsill. In about 20 minutes or so, you will notice that the balloon on top of bottle 1 has inflated. It trapped the carbon dioxide that the yeast produced during fermentation. Balloon 2 will not have inflated because yeast does not ferment and produce carbon dioxide without sugars to feed on.
In each scenario below, a variable in the experiment has been changed. On the line that follows each scenario, write a hypothesis that contains your prediction for the outcome of the experiment. Remember, a hypothesis is written in the form of a statement.

1. Boiling hot water is used in place of the warm water in the bottles.

2. Ice-cold water is used in place of the warm water in the bottles.

3. Instead of adding sugar to the bottles, a sweet liquid, such as grape juice, is added to the warm water.

4. Instead of adding sugar to the water, two tablespoons of salt are added.

5. Now, give examples of two more ways in which you could change the variables in this experiment.

Write your answers on the lines below.

6. Why is it important to have a tight seal between the balloon and the neck of the bottle?

7. What is the purpose of using a funnel in this experiment?

8. How is dry yeast different from yeast that has been combined with warm water and flour to make bread?

9. What does yeast produce during fermentation?
How were Julio's posters ruined?

It was late October in Springtown. The days were warm, but at night, the temperatures dropped into the low 40s and high 30s. The jacket Julio had worn to school that morning lay on the floor. It was late afternoon, and the sunlight streaming through the hallway windows was making him hot.

Julio was hard at work taping posters onto the glass. He and his sister had spent the previous weekend painting them. In big letters, the posters asked students to “Vote for Julio!” Julio stood back to admire their work and then grabbed his jacket and headed home.

When Julio walked into school the next morning, sunlight poured into the hallway again, but this time from the windows on the opposite side. He quickly made a shocking discovery. Someone had gotten his posters wet! The paper was warped, and the letters had smeared. The posters were ruined.

Julio stomped angrily to his homeroom to inform Ms. Wilson. She asked Julio to calm down and take his seat. Then, she went to investigate.

“Good morning,” Ms. Wilson said, as she reentered the room. “We’re going to discuss atoms this morning, but first, let me get a drink of water.”

Ms. Wilson left again and soon returned carrying a glass of ice water. She set it on her desk and began teaching. About half an hour later, she picked up the glass and showed it to the class. A wet ring had formed on the desk, and the sides of the glass were dripping with water.

“Let’s have a short discussion about humidity,” Ms. Wilson suggested. “Along with nitrogen and oxygen atoms, the air around you contains water molecules. Whenever the temperature drops, water molecules condense onto surfaces. The dew you find on grass in the mornings is a result of water molecules condensing when the temperatures cooled down overnight.

“This ice water made the surface of the glass very cold,” Ms. Wilson continued. “Any air coming close to the glass was cooled as well. The water molecules in the cooled air condensed onto the nearest surface, which was the glass itself. Moisture from the air collected onto the cool glass surface, and soon there was enough water to begin dripping down the sides. Julio, do you understand what I’m saying?”

Julio smiled. “I get it.”
Circle the letter of the best answer to each question below.

1. Humidity refers to
   a. evaporation.
   b. the amount of moisture in the air.
   c. water that condenses onto surfaces.
   d. All of the above

2. Dew, which is the moisture found on grass in the morning,
   a. comes from inside each blade of grass.
   b. falls from the sky as small, almost invisible raindrops.
   c. is water molecules from the air that condensed.
   d. is drawn up out of the ground by changing temperatures.

3. Clouds form when
   a. wind pushes rain up into the sky.
   b. water molecules get big enough to be seen.
   c. a water molecule condenses onto a dust particle.
   d. water droplets in the atmosphere collect in large groups.

Write your answers on the lines below.

4. Explain why water condensed on the outside of Ms. Wilson’s glass.

5. Explain what ruined Julio’s posters.

**Unifying Concepts and Processes**

Do you think the temperature of Ms. Wilson’s glass rose or fell as water molecules condensed onto it? Explain your answer.
Lesson 1.5

**A Sticky Lesson**

*A Sticky Lesson*

Why are the La Brea Tar Pits so important in learning about Earth's history?

Millions of years ago, before the busy city of Los Angeles existed, the area was covered by the Pacific Ocean. Over time, it turned from sea to land. Oil seeped to the surface through cracks in the ground. It pooled in the low-lying areas, which are known today as the La Brea Tar Pits.

During warm periods, the oil that oozed from the ground became sticky. The surface of the pools would become covered with leaves, dust, and even water. When animals came to drink, they became trapped. Predators that preyed on the trapped animals often became trapped themselves. The sticky asphalt was perfect for fossilizing and preserving the remains of these animals.

Today, the La Brea Tar Pits, which are actually asphalt pits, are one of the best sites for excavating fossils. More than three million fossils have been found there since the early 1900s. The larger fossils, which came from animals like mammoths, saber-toothed tigers, and short-faced bears, are the most dramatic findings. But fossils of plants, insects, and smaller animals are also valuable to the paleontologists who work in the pits.

These microfossils help scientists form a complete picture of what life was like in the area around Los Angeles nearly 40,000 years ago. For example, by examining plant life and even fossilized pollen, they learned that the climate was moister and cooler, but not very different than it is today. This was an important finding because an Ice Age was taking place at the time. The fossils gave scientists a better idea about the range in types of weather during an Ice Age.

So how do the experts know how old the fossil remains are? They use a process called radiometric dating. Living things contain the element carbon. A small portion of the carbon on Earth is an unstable isotope called carbon-14. Carbon-14 changes to a stable atom, but this change happens very slowly. It takes 5,730 years for half the carbon-14 to become stable. Then, it takes the same amount of time for half of the remaining carbon to become stable, and so on. Measuring the amount of unstable carbon-14 remaining in a fossil allows scientists to accurately date it. By using carbon dating on the fossils in the tar pits, they found that most were between 8,000 and 38,000 years old. This might seem ancient, but keep in mind that dinosaurs lived about 65 million years ago.
Circle the letter of the best answer to each question below.

1. Why would a scientist measure the amount of carbon-14 a fossil contains?
   a. to find out whether the fossil is authentic
   b. to find out where the fossil was found
   c. to find out what the fossil is made of
   d. to find out how old the fossil is

2. By examining the types of plant life found in the tar pits, scientists learned that during the last Ice Age, the climate in Los Angeles was
   a. very different than it is today.
   b. exactly the same as it is today.
   c. cooler and moister than it is today.
   d. hotter and drier than it is today.

Write your answers on the lines below.

3. Explain how animals became trapped in the La Brea Tar Pits.

4. Why is it helpful for scientists to study a wide variety of fossils, including microfossils?

5. What are two common tools that scientists use when cleaning fossils?

6. What sorts of comparisons do scientists make when they are trying to identify new fossils?

7. Why do you think it is important for scientists to identify, label, and catalog the specimens they find?