SPECTRUM®

Science

GRADE 6

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Focused Practice to Support Science Literacy

- Lab safety rules
- Natural, earth, life, and applied science lessons
- Research extension activities
- Key word definitions
- Answer key

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Grade 6

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Chapter 1 Science as Inquiry

Lesson 1.1 Rules to Remember

precautions: safety measures taken ahead of time

ingest: to eat or consume

reaction: the result of mixing two or more chemical substances together

Scientists working in extreme conditions need to take special precautions. Antarctica is the coldest, windiest, driest place on Earth. The world's coldest temperature, -129°F, was recorded there. Researchers can't go out when the temperatures dip that low, but they do venture outside in conditions that are quite dangerous. They wear special clothing that can protect them from frostbite and hypothermia. They must also take survival training classes and bring emergency gear—like food, tents, stoves, and radios—with them when they are working in the field. They have to stay in regular contact with their research station, too, so that someone will know if they are in trouble.

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.

NAME ____________________

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?

____

Lesson 1.2 Taking a Good Look at the World

observation: the act of gathering facts or making notes about events

experimentation: the act of conducting experiments

scientific method: a technique used for scientific investigation

hypothesis: a simple statement that can be tested to see if it's true or not

variables: parts of an experiment that can change and cause a change in the results

Here's a quick review of the steps in the scientific method:

- Ask a question about the world.
- Form a hypothesis that answers the question.
- Design an experiment or make observations to prove or disprove the hypothesis.
- If the hypothesis is wrong, form a new hypothesis and design new tests.
- If the hypothesis is correct, test it again to be sure you get the same results.
- Share the results with other scientists so they can test the hypothesis as well.

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.

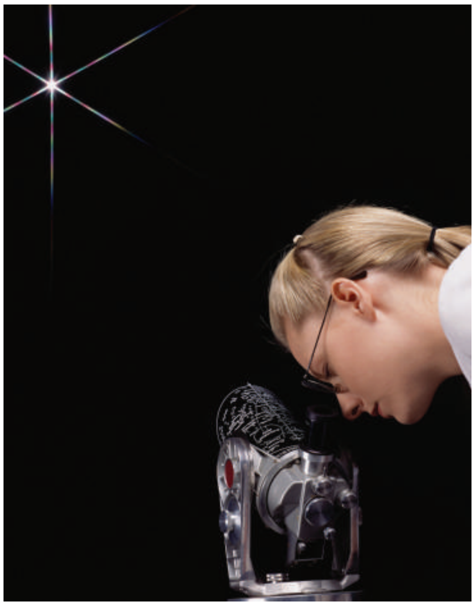
Science always begins with observation. Good scientists are curious, so their observations lead to questions. The scientific method begins when a question has been asked. Then, a hypothesis can be formed. A **hypothesis** is only useful—and scientific—if it can be tested.

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.

NAME ______________________________

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.

Lesson 1.3 On the Rise

dormant: inactive

fermentation: a chemical process in which microorganisms, like yeast or bacteria, break down sugars to form carbon dioxide, water, and alcohol

control: a test group in an experiment in which a variable is not changed; used as a basis for comparison

There are hundreds of species of yeast. Baker's yeast and brewer's yeast are the two types most commonly used in the kitchen. Yeast can be found naturally in soil and on plant leaves and flowers. It can also be found on the skin and in the intestines of warm-blooded animals, including human beings.

A gram of yeast contains about 25 billion cells. Each cell is only approximately 3/100 of an inch in diameter.

The ancient Egyptians first used yeast for baking bread thousands of years ago.

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.

<u>Experiment: Rising to the Challenge</u>

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.

NAME ______________________

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?

____

Lesson 1.4 The Case of the Wet Windows

warped: twisted or bent out of shape

humidity: the amount of moisture in the air

molecules: small, individual pieces of matter that contain two or more atoms

condense: change from a gas into a liquid

Condensation plays an important role in Earth's water cycle. Water molecules evaporate from wet areas on Earth's surface to fill the air with moisture. Warm air near Earth's surface naturally rises through the atmosphere, carrying water molecules with it. As the air rises, it becomes cooler. This drop in temperature causes the water molecules to condense around dust particles in the air, and tiny water droplets are formed. They collect to create clouds. Eventually, the amount of water condensed into a droplet becomes too heavy, and gravity pulls it back to Earth as rain.

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."

NAME ___________________________

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

fossilizing: changing into a fossil

excavating: digging up; unearthing

paleontologists: scientists who study life from past geological periods

microfossils: very small fossils, often identified with a magnifying glass or microscope

Ice Age: a period in Earth's history when temperatures dropped and part of the planet was covered in ice

Pit 91, one area of the tar pits, is still being excavated today. For two months every summer, the public can watch fossils being found. The fossils are then taken to a lab where they are cleaned using tools like dental picks, cotton swabs, and toothbrushes. Then, the fossils are identified, labeled, and cataloged.

To identify specimens, scientists compare the parts they find with fossils already in the collection. They can also compare the fossils to the skeletons of modern animals to look for similarities.

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

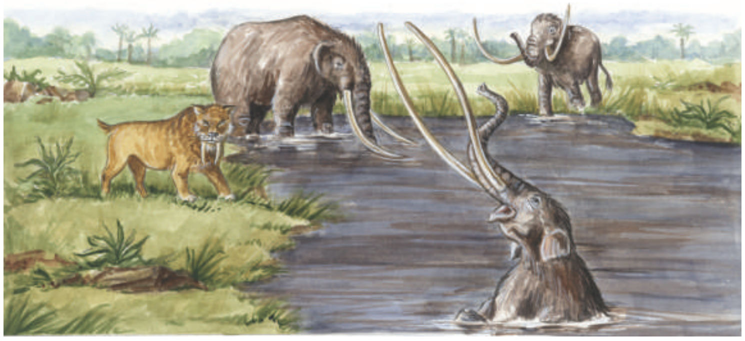
Millions of years ago, before the busy city of Los Angeles existed, the area was covered by the Pacific Ocean. Over time, it turned from sea to land. Oil seeped to the surface through cracks in the ground. It pooled in the low-lying areas, which are known today as the *La Brea Tar Pits*.

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.



NAME ______________________

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?

____

____