SPECTRUM®

Science

GRADE 5

Focused Practice to Support Science Literacy

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

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NAME _____

Use the chart on page 6 to answer the following questions.

1. Which day was coldest? _____
2. Which day was warmest? _____
3. Which day was the windiest? _____
4. Which days were the least windy? _____
5. What was the total amount of rainfall during this three-week period? _____

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

6. _____ The windiest days always occurred when it was raining.
7. _____ The barometric pressure seldom changed.
8. _____ The lowest temperatures usually came on cloudy days.
9. _____ The barometric pressure was at its highest on clear days.

Write your answers on the lines below.

10. Can this chart be used to predict the weather for the next month? Why or why not?

_____

_____

11. Did the information gathered by the students prove or disprove their hypothesis? Explain your answer.

_____

_____

What's Next?

For one week, watch the weather report on the evening news each day. What information does the meteorologist include in his or her report? Do you see similar patterns in how the weather changes in your area compared to what the students in this selection observed?

Lesson 1.2 The Father of Genetics

characteristics: the qualities that make something different from others; traits

offspring: the young of an organism

pollinated: fertilized; transferred grains of pollen from the male to the female parts of plants

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

traits: the qualities that make something different from others; characteristics

crossbreeding: breeding two different types of plants with one another

genes: the parts of a plant or animal that determine what traits will be passed on to the offspring

Mendel had hoped to become a high school teacher. He took the exam several times and failed it, so he continued his work as a monk and did experiments in his spare time.

Mendel experimented with about 30,000 pea plants in order to discover the laws of heredity, or how traits are passed along.

How did the study of pea plants lead to the discovery of how traits are passed from one generation to the next?

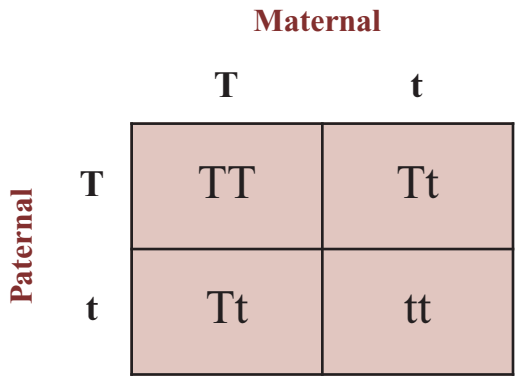
Gregor Mendel was an Austrian monk who was very interested in plants. He spent much of his time in the monastery's garden. Mendel was curious about the **characteristics** of different plants and their **offspring**, so in 1857, he decided to breed peas. He chose to study seven characteristics of the pea plants, such as the length of the stem and the color of the ripe seeds. First, he made sure that the plants he was studying were purebred. This meant that they always had offspring with the same characteristics. If a plant had wrinkled seeds, its offspring would have wrinkled seeds, too.

He also used a greenhouse because he didn't want his plants to be **pollinated** by insects. This would have introduced too many **variables**. For the purposes of the experiment, Mendel had to control the pollination himself.

The first results didn't surprise Mendel. It made sense that a young plant would have the same **traits**, or characteristics, as its parents. Next, Mendel tried **crossbreeding** pea plants that had different traits. For example, he bred a plant that had a long stem with one that had a short stem. What kind of plants do you think he got? Ones that had a medium-length stem? Mendel was surprised to see that all the offspring had long stems. It seemed as though the shortness characteristic had disappeared. When he tried breeding these new plants with one another, he found that some of their offspring were tall and some were short. What was going on?

Mendel kept experimenting and discovered that pairs of **genes** determine each characteristic—one gene from each parent. Some traits are stronger than others. He called these *dominant traits* and called the weaker ones *recessive traits*. Mendel used a capital letter as a symbol for a dominant trait, and a lowercase letter as a symbol for a recessive trait. Two dominant genes (TT) or one recessive and one dominant gene (Tt) would result in offspring having the dominant trait. Only when the offspring received two recessive genes (tt) would it have the recessive trait.

Mendel was right, but it took almost 40 years for others to believe him. He tried to share the results of his work, but no one took him seriously. He was only an amateur scientist, not a professional. Today, Mendel is known as the "father of genetics."



NAME _____

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

1. Which of the following is a human trait?

   a. eye color

   b. height

   c. hair texture

   d. All of the above

2. A hypothesis is a statement that is assumed to be true so that it can be tested. Which of the following might have been one of Mendel's hypotheses?

   a. Two purebred plants will have offspring that have the same traits as they do.

   b. Plants with long stems produce more peas.

   c. Pea plants with short stems cannot have offspring.

   d. Why are some traits stronger than others?

Write your answers on the lines below.

3. In a certain type of plant, the gene for red flowers is dominant and the gene for yellow flowers is recessive. If a purebred plant with red flowers was crossed with a purebred plant with yellow flowers, what color flowers would the offspring have?

   _____

4. If **F** is the dominant red flower gene and **f** is the recessive yellow flower gene, what color is each of the flowers listed below?

   FF: _____ ff: _____ Ff: _____

5. Why do you think Mendel needed to be in charge of the pollination of his pea plants?

   _____

6. Why didn't other scientists take Mendel's work seriously?

   _____

7. What would have happened if other scientists had tried performing Mendel's experiments themselves?

   _____

Lesson 1.3 Break It Down

process: series of events that lead to a certain result

erosion: the movement of rock and soil by natural means, such as wind and rain

mechanical weathering: the breaking apart of rock into smaller pieces by physical forces

chemical weathering: the breaking apart of rock into smaller pieces by chemical forces

The Mississippi River carries an average of 230 million tons of eroded material into the Gulf of Mexico each year.

The roots of plants and trees help hold soil in place. They also offer the soil some protection from wind. As human beings have used more land for agriculture and building, they have cut down trees. This causes the land to erode more quickly than it might have otherwise.

What processes cause changes in Earth's surface to take place?

The surface of Earth is constantly changing. This might surprise you. After all, hills, valleys, and rivers don't appear to change much at all from day to day or even year to year. That's because most changes to Earth's surface happen slowly. They are part of a **process** called **erosion**. Erosion is the natural movement of rocks and soil over time. Agents of erosion—the forces that move the material—are water, wind, and ice.

Wind can't move an enormous boulder, though. Water can't wash away an entire mountain. Before the forces of nature can move anything, weathering must take place. Weathering is a process in which rock is broken down into smaller pieces. Weathering and erosion are both natural processes, or series of events that lead to the changing of the landscape.

When physical forces act on rock, **mechanical weathering** is taking place. Water is a common cause of mechanical weathering. Water can cause rocks to break apart, through rain or ocean waves. Water also seeps into tiny holes in rocks. When it freezes, it expands and puts pressure on the rock, which causes it to crack and break apart.

Glaciers—huge masses of ice, snow, and rock—move very slowly. As they do, they grind and scrape away at layers of rock. Even trees and animals can be sources of weathering. An animal that uses its claws to burrow underground can break rocks into smaller pieces. The roots of trees can do the same thing over time.

Chemical weathering causes a change to the minerals that are found in rocks. It breaks down the bonds that hold rocks together. For example, rain absorbs carbon dioxide as it falls through the air. It forms an acid that eats away at certain types of rocks.

Once material has been weathered, it is carried away, often by water. The water can be in the form of rain that beats against a cliff or ocean waves that pound on a coastline. It can be a stream whose movement pulls pebbles and silt from its banks and carries them along. Wind can also pick up soil, tiny bits of rock, and sand and transport them from one place to another.

The changes brought about by weathering and erosion are usually slow. A big storm, like a hurricane can speed them along. Otherwise, you must be patient and observant to see the landscape change.

NAME _____

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

1. Which of the following is an agent of erosion?

   a. thunder

   b. ocean waves

   c. glaciers

   d. Both b and c

2. What is the result of the processes of weathering and erosion?

   a. changes to the landscape

   b. the formation of larger mountains

   c. more flooding during times of heavy rains

   d. overflowing rivers and streams

Write your answers on the lines below.

3. Explain how weathering and erosion are different from one another.

_____

_____

4. How is the freezing and thawing of water a part of the weathering process?

_____

_____

5. What is one effect that human beings have had on erosion?

_____

6. How would a storm like a hurricane or a tornado speed up the process of erosion?

_____

7. How is a glacier a source of both weathering and erosion?

_____

What's Next?

Arizona's Grand Canyon, which is more than 5,000 feet deep, was formed by erosion. See if you can find out what forces created this spectacular beauty. How long did it take?

Lesson 1.4 Taking Heat

thermal energy: the amount of heat energy stored inside a substance

scales: ways of taking measurements using a series or sequence of equal units

properties: special qualities of a substance or substances

absolute zero: 0 K, or the temperature at which no heat energy is present; it exists only in theory and has never been reached; it is equal to -459.67°F

The coldest temperature ever found in nature is 1 K, or about -457°F. It was measured in the Boomerang Nebula, about 5,000 light-years from Earth.

To change a temperature from Celsius to Fahrenheit, multiply the Celsius temperature by 1.8 (°C x 1.8) and then add 32.

To change a temperature from Fahrenheit to Celsius, subtract 32 from the Fahrenheit temperature (°F - 32) and then multiply the result by 0.56.

What does a thermometer really measure?

A rock on the ground doesn't seem like a very energetic thing. If you could see its atoms and molecules, though, you'd know differently. All those tiny particles are bouncing around, giving the rock plenty of energy. Pick up a rock that's been warmed by the sun, and you'll feel some of this energy.

Heat causes atoms and molecules to move more quickly. The heat you feel coming from the rock is actually energy causing the atoms and molecules in your hand to pick up speed. Heat is energy moving from one place to another.

Everything contains atoms and molecules in motion, so everything has energy. How hot or cold something is—the amount of energy it has—depends on how quickly or slowly its particles move. This means that when you measure temperature, you are really measuring moving molecules. You're measuring how much energy something has.

Thermometers are the scientific tools used to measure temperature. They can use mercury, electricity, or electromagnetic waves to see how much **thermal energy** something has. Several different **scales** have been developed for thermometers.

You are probably most familiar with temperatures given in the Fahrenheit scale. The German physicist Daniel Fahrenheit invented this method in 1724. No one knows for sure what he based his scale on. One guess is that he set 0ºF as the lowest temperature he recorded during winter, and 100ºF as the temperature of his body. On the Fahrenheit scale, water freezes at 32ºF and boils at 212ºF. Today, the United States is the only country that still regularly uses Fahrenheit temperatures.

The rest of the world—and most scientists—use the Celsius scale, named after Swedish astronomer Anders Celsius. The Celsius scale is based on **properties** of water. On Earth, water is the only substance that exists naturally in three states of matter—solid, liquid, and gas. The Celsius scale is based on this characteristic of water. Water freezes at 0ºC and boils at 100ºC.

Another temperature scale that some scientists use is the Kelvin scale. Each Kelvin is equal to one degree Celsius, but the Kelvin scale starts at a much lower temperature—**absolute zero**. At absolute zero, atoms and molecules stop moving completely because they have no thermal energy. This is only an idea, though. Atoms and molecules never really stop moving.

NAME _____

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

1. All matter has _____ because everything contains atoms and molecules in motion.

a. energy

b. frequency

c. kelvins

d. properties

2. Heat is

a. not found in cold things.

b. another word for atoms and molecules.

c. a way to measure temperature.

d. energy on the move.

3. What does a thermometer measure?

a. water

b. thermal energy

c. temperature

d. Both b and c

Write your answers on the lines below.

4. Why are 0º and 100º important in the Celsius scale?

_____

5. How is the Kelvin scale different from the Celsius scale? How are they similar?

_____

_____

6. What is absolute zero?

_____

7. If it's 58ºF outside, what is the temperature in degrees Celsius? Use a calculator if you need help.

_____

Lesson 1.5 Flying into History

What does it take to become a famous inventor?

In the late 1800s, Wilbur and Orville Wright owned a bicycle shop in Dayton, Ohio. The men even designed their own brand of bicycle. With the money they made, the brothers began working on something they loved even more than bicycles—flying machines.

The Wright Brothers had been closely following the work of other inventors and **engineers**. They had read about Otto Lilienthal's successful—and dangerous—glider flights in Germany. They were excited by Samuel Langley's flying, steam-powered models. They had heard reports about Octave Chanute's glider experiments over the sand dunes of Lake Michigan. All of this had happened in a single year—1896. A real race was on to invent the perfect flying machine. The Wright Brothers wanted to join in.

The brothers soon realized that getting human beings into the air wasn't the problem. Machines could already do that. They could even fly around for a while. The problem was that they were impossible to control. This point was made tragically clear when Lilienthal was killed in a glider crash that same year. The Wright Brothers knew that the key to inventing a **practical** flying machine was finding a good way to steer it.

For the next five years, the men designed and tested hundreds of different wing shapes and steering **mechanisms**. They tested their gliders in the steady winds blowing across the flat beaches at Kitty Hawk, North Carolina.

In 1901, the brothers thought they had a glider that would work perfectly. They tested it dozens of times, only to discover that it still wasn't right. Disappointed, they headed back to Ohio to keep trying.

Finally, they had a breakthrough. By adding a **rudder** to the glider's tail, it could be steered using both the wings and the tail. When they tested this new glider design in 1902, it steered safely over the sand dunes.

The next year they focused on designing an engine for their glider. By the time they headed back to Kitty Hawk, their flying machine had an engine and a **propeller**.

For weeks they tried unsuccessfully to get their plane into the air. The propeller kept breaking, and they had engine troubles. Finally, on December 17, 1903, the Wright Brothers made history. Their machine flew straight into the wind for hundreds of feet. Human beings have been flying ever since.

engineers: people who design and build things

practical: useful; not just experimental

mechanisms: the parts that allow a machine to work

rudder: a flat, movable piece of wood or metal used for steering a ship or airplane

propeller: blades attached to a central point that spins; used to propel boats or airplanes

To this day, almost all airplanes are still steered using the design invented by the Wright Brothers.

For several years, most people doubted that the Wright Brothers' flight really happened. Only a few witnesses were at the beach that day. A few months later, the brothers tried to fly again in Ohio. This time, with plenty of reporters watching, the Wright Brothers' machine could barely get off the ground.

"Genius is one percent inspiration and ninety-nine percent perspiration."—Thomas Edison, inventor

NAME _____

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

1. The Wright Brothers' mechanical skills were _____

   a. learned in the army.

   b. first used for constructing bicycles.

   c. not good enough to build a working airplane.

   d. used to build steam engines.

2. What key problem did the Wright Brothers concentrate on solving?

   a. controlling the flying machine when it was in the air

   b. getting the flying machine off the ground with a person inside

   c. finding a good fuel for the flying machine's engine

   d. finding the best place to test their flying machines

Write your answers on the lines below.

3. Why was Kitty Hawk a good place to test flying machines?

   _____

4. Do you think the Wright Brothers invented every mechanism in their flying machine? Why or why not?

   _____

   _____

   _____

5. Were the Wright Brothers good scientists? Give at least two reasons that support your answer.

   _____

   _____

Unifying Concepts and Processes

How do you think the invention of automobiles was similar to the invention of airplanes? How was it different?

_____

_____

Lesson 1.6 Safety First

precautions: safety measures

contaminated: made impure or unusable

dispose: to throw out or get rid of

Professional scientists often need special protection when they are working. For example, astronauts wear spacesuits that have more than 10 layers of material. The suits keep astronauts safe from the harsh conditions of space.

Marie Curie was a scientist best known for her work with radiation. At the time, no one yet knew about the dangers of radioactive materials, so Curie did not take proper safety precautions. She was even known to carry test tubes of these harmful materials in her pockets. Marie Curie died of leukemia at the age of 66 from her exposure to radiation.

How can you keep yourself and your environment safe when you are performing scientific investigations?

Performing experiments and doing scientific research can be exciting and interesting. There can be risks, though, so it's important that you take **precautions**—whether you're at home or at school.

- Some science projects are safe to work on alone. For others, you should have an adult's supervision. Before you start any experiment or project, check with an adult.
- Reading directions carefully is a must. Read the entire instructions thoroughly before you begin, and make sure you understand them as well as any possible dangers.
- Protect yourself. If you'll be using chemicals, you should wear safety glasses and gloves. The safety glasses can also protect your eyes if there's a chance something might explode or shatter. An apron can protect your clothing and body. If you have long hair, be sure to keep it tied back. Also, remember not to wear sandals or open-toed shoes in the lab, especially when you're working with chemicals, materials that become hot, or heavy objects. If you're wearing loose clothing or dangling jewelry, make sure that it is secured before you begin working.
- Don't bring food or anything to drink into a lab. There's always the risk that it could become **contaminated**. You could end up consuming something that is harmful.
- Don't experiment with chemicals if you're not sure what reaction might take place. Many chemicals become dangerous when combined. For example, bleach and ammonia form a poisonous gas.
- If you are collecting specimens in nature, such as plants or leaves, be sure to clean your hands and nails thoroughly afterward. Some species are poisonous or can cause allergic reactions.
- Water conducts electricity. If you are working with electrical equipment, make sure your hands and your workspace are dry.
- Be careful of how you **dispose** of materials. Chemicals, plant or animal materials, and samples of bacteria should not be placed in a household or school trash can. Check with a teacher or parent to find out how to safely get rid of these materials.
- If you use a hot plate or a Bunsen burner, double-check that it is turned off when you have finished with it.