

# SCIENCE

Student Book

▶ **4th Grade** | Unit 5

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# SCIENCE 405

## ELECTRICITY AND MAGNETISM

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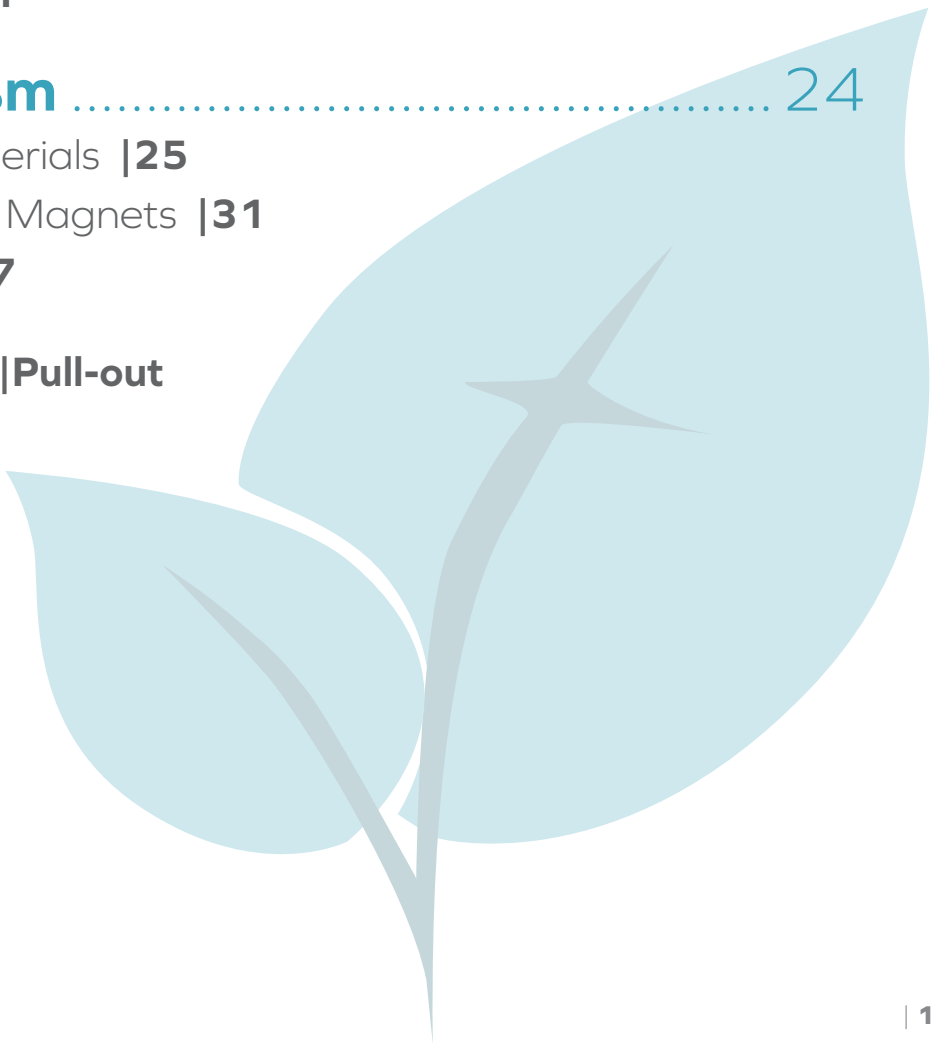
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# ELECTRICITY AND MAGNETISM

Have you ever combed your hair on a cold day and heard the snap of electricity? Your hair may have stood on end! Maybe you discovered that your comb would pick up bits of paper right after you combed your hair. Have you helped your mother take clothes out of the dryer, and seen them cling together? Have you shuffled your feet across a rug, and then taken hold of a doorknob? Did you feel a tingle or a shock? You may have seen a spark. In each case, some things were rubbed together. If an object can attract other objects to itself after it has been rubbed, it is said to be *charged*, or made electric.

In this LIFEPAC® you will study about electricity. You will read about some men and their discoveries. You will also make discoveries of your own. When you have finished the LIFEPAC, you will have learned some amazing things. You will also know how to make use of electrical power.

You use electricity in many ways in your daily life. You are comfortable using it, but you still must respect its power. You know that you must use this gift from God carefully and safely.

## Objectives

**Read these objectives.** The objectives tell you what you will be able to do when you have successfully completed this LIFEPAAC. Each section will list according to the numbers below what objectives will be met in that section. When you have finished this LIFEPAAC, you should be able to:

1. Explain how objects, atoms, electrons, and electricity relate to each other.
2. Tell what an electrical conductor does.
3. Tell what an insulator does.
4. List three ways in which electricity can be used.
5. List two ways electricity is made safe to use.
6. Tell what a magnet will do.
7. Name two magnetic materials.
8. Describe the way a magnet is made electric.
9. Tell two ways electromagnets are important in our world.



# 1. ELECTRICITY

Electricity is no longer a thing of mystery. Scientists have learned that electricity has several forms and many uses. They know how to handle it so that it can be useful and will not be dangerous. Scientists realize, however, that they still do not know everything about electricity. For example, scientists know *how* electricity acts, but they do not always know *why* it acts that way. As you study this section, you will learn some important things about electricity.

## Objectives

**Review these objectives.** When you have completed this section, you should be able to:

1. Explain how objects, atoms, electrons, and electricity relate to each other.
2. Tell what an electrical conductor does.
3. Tell what an insulator does.
4. List three ways in which electricity can be used.
5. List two ways electricity is made safe to use.

## Vocabulary

**Study these new words.** Learning the meanings of these words is a good study habit and will improve your understanding of this LIFEPAK.

**acid** (as' id): Liquid with a sour taste like that of vinegar.

**atom** (at' um): The smallest part of any object.

**attract** (u trakt'): To draw toward oneself.

**circuit** (sér' kit): The track on which electric current flows.

**conductor** (kun duk' tur): Any material through which electricity will flow.

**connect** (ku nekt'): To join one thing to another.

**current electricity** (kèr' unt i lek tris' u tē): Electricity that flows without stopping.

**electrical** (i lek' tru kul): Having to do with electricity

**electron** (i lek' tron): A particle in an atom that can travel out of the atom.

**fuse** (fyüz): A safeguard to prevent an overload of electricity in a circuit.

**galvanometer** (gal vu nom' u tur): A machine that will find and measure small amounts of electricity.

**insulator** (in' su lā tur): Any material through which electricity cannot flow.

**negative** (neg' u tiv): The kind of electricity that is in an object with an extra amount of electrons.

**neutral** (nü' trul): Having neither a positive nor a negative electrical charge.

**neutron** (nü' tron): One of three kinds of particles found in atoms.

**particle** (pär' tu kul): A very tiny bit.

**positive** (poz' u tiv): Electricity that is made when electrons travel out of an object.

**proton** (prō' ton): A particle in an atom that does not travel out of the atom.

**Note:** All vocabulary words in this LIFEPAC appear in **boldface** print the first time they are used. If you are unsure of the meaning when you are reading, study the definitions given.

**Pronunciation Key:** hat, āge, cāre, fār; let, ēqual, tērm; it, īce; hot, ōpen, ôrder; oil; out; cup, pūt, rüle; child; long; thin; /TH/ for then; /zh/ for measure; /u/ or /ə/ represents /a/ in about, /e/ in taken, /i/ in pencil, /o/ in lemon, and /u/ in circus.

## From Electrons to Electric Current

**Atoms, electrons**, and electricity are all related to each other. Many hundreds of years were needed for man to understand how they are related. One of the keys to understanding this relationship was learning to understand lightning. Another key was learning about the atom.

**Lightning.** When you look at the sky and see the clouds piling up in heaps, what do you expect to happen? You know that it will probably rain. If the clouds are really dark and heavy, you may expect thunder and lightning.

Lightning is one of God's wonders of nature. Lightning has both frightened and puzzled men from the very beginning of time. In the book of Job, lightning is mentioned at least six times. Job always described lightning with great respect. He knew it came from God, but he did not understand it.

Many times, Bible writers used the example of lightning to describe the power of God. God used thunder and lightning with hail as one of the troubles He sent to Egypt. You can read that story in Exodus, chapter 9.

Men have tried for thousands of years to discover the secret of the power of lightning. Within the storm clouds are stored strong **electrical** charges. When some of these electrical charges move from cloud to cloud or from a cloud to the ground, we see a spark. We call the spark lightning.

Benjamin Franklin did a famous experiment with lightning. He attached a key to the end of a kite string and succeeded in getting his kite to fly in the rain. The kite soon became charged with electricity. An electrical charge moved down the string to the key. When Franklin held his finger near the key, a spark jumped from the key to his finger.

Do not try Franklin's experiment. It was very dangerous. He was fortunate that he was not killed. If you have ever seen a tree that has been struck by lightning you can imagine what could have happened to Benjamin Franklin.

You must be sure that lightning will go into the ground instead of damaging people or objects.



| Ben Franklin with kite and key.



**Do this activity.**

- 1.1** Thomas Alva Edison did many things with electricity. Find out all you can about him and the things he invented. Pretend that you are a newspaper or television reporter, and write a news story about him. Write your story on other paper, but put it in your LIFEPAK when you are finished.

**Teacher check:**

Initials \_\_\_\_\_ Date \_\_\_\_\_

**Protons and electrons.** All objects are made of atoms. Each atom has three kinds of **particles**. The particles are called **protons**, electrons, and **neutrons**.

Protons are found in the center of the atom. In chemical reactions the protons never move out of the center of the atom.

Only electrons can travel out of the object. What happens when some of the electrons are moved from object to object? When electrons are either removed from or added to an object, that object becomes electrically charged.

If one object loses electrons, that object has more protons than electrons. The object is positively charged. The object that received the electrons is negatively charged.

When an object has an equal number of **positive** and **negative** particles, the object is **neutral**.

As you learn about positive and negative charges remember, charges that are alike push each other away. Unlike charges **attract** each other.

**Answer true or false.**

- 1.2 \_\_\_\_\_ Atoms are made of objects.
- 1.3 \_\_\_\_\_ In chemical reactions, protons do not move out of the center of the atom.
- 1.4 \_\_\_\_\_ Only electrons can travel out of an object.
- 1.5 \_\_\_\_\_ When an object has more protons than neutrons, the object is neutral.
- 1.6 \_\_\_\_\_ Charges that are alike push each other away.

**Answer these questions.**

- 1.7 What happens when an object becomes charged? \_\_\_\_\_  
\_\_\_\_\_
- 1.8 When an atom has an equal number of negative and positive particles, it is \_\_\_\_\_.
- 1.9 What happens between two objects with like electrical charges when they are brought close together? \_\_\_\_\_
- 1.10 What happens between two objects with unlike electrical charges when they are brought close together? \_\_\_\_\_

**Match these items.**

- |                              |  |
|------------------------------|--|
| 1.11 _____ Benjamin Franklin | a. made electric                         |
| 1.12 _____ Job               | b. book of Bible that mentions lightning |
| 1.13 _____ lightning         | c. kite experiment                       |
| 1.14 _____ charged           | d. do not leave center of the atom       |
| 1.15 _____ protons           | e. one of God's wonders                  |
| 1.16 _____ electrons         | f. travel out of an atom                 |
|                              | g. volts                                 |

# CHARGE SOME OBJECTS

## These supplies are needed:

- string
- two balloons
- a woolen sweater or piece of woolen cloth
- a rubber comb or a hard rubber rod

**Follow these directions and answer the questions.** Put a check mark in the box when each step is completed.

- 1. Blow up both balloons and tie them shut.
- 2. Tie a string to each balloon.
- 3. Rub the balloons with the wool.
- 4. Hold both strings in one hand so that the balloons are hanging side by side.  
The balloons have now collected electrons and are negatively charged.

**1.17** What happens? \_\_\_\_\_

**1.18** Why? \_\_\_\_\_

- 5. Rub the rubber comb or hard rubber rod with wool.
- 6. Turn on the faucet gently so that a very thin stream of water is flowing.
- 7. Hold the charged comb or rod close to the stream of water.
- 8. Move the comb or rod slowly away.  
The water is neutral so it is attracted by the charged object.

**1.19** What happens to the water? \_\_\_\_\_



### Teacher check:

Initials \_\_\_\_\_ Date \_\_\_\_\_

## From Current to Circuit

We know that lightning is a form of electricity. We still do not know how to make use of lightning. Lightning comes and goes in a split second. To be useful, electricity must flow, not come and go. Electricity that flows without stopping is **current electricity**.

**Electric cells.** In the late eighteenth century, an Italian scientist named Alessandro Volta made a discovery. Volta discovered that when two different metals were placed in certain liquids, an electric charge would flow. The charge would flow through a wire **connecting** the metals.

The two pieces of metal were called electrodes. The liquid was called an electrolyte. Volta had made an electric cell. He used copper and zinc as the electrodes for the electric cell. He used an electrolyte of salt water. Volta's cell was called a wet cell. Today a dry cell is used.

Electric cells are used to make current electricity. Current electricity is made in very large amounts to supply our lights, toasters, washing machines, and other everyday equipment. Current electricity is also used to run factories of many kinds.



| A dry cell.



**Complete the following sentence.**

- 1.20** The three parts of an electric cell are one a. \_\_\_\_\_  
and two b. \_\_\_\_\_.

# WET CELLS

View 405  
Electric Current:  
Grade 4 Science  
experiments video

Try your hand at making each of the wet cells described here. You will need a simple instrument called a **galvanometer**, which will show you when electric current is flowing. Plans for making a simple galvanometer from a compass and some insulated wire can be found online. Your teacher may decide to discuss this experiment with you rather than have you perform it. Check before you proceed.

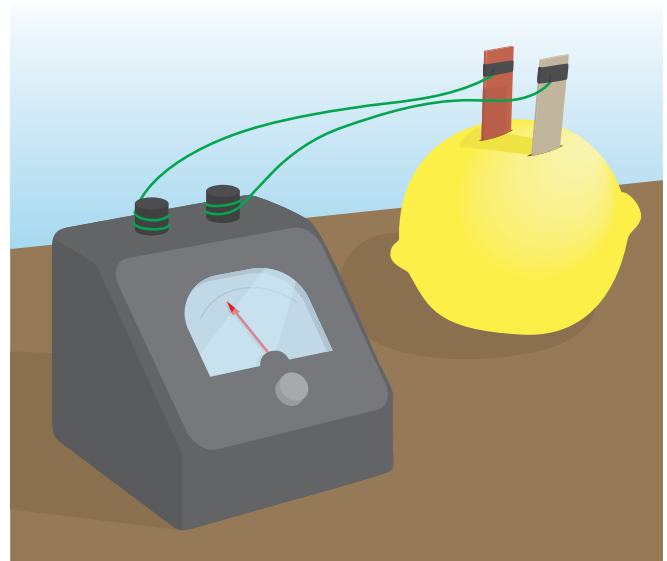


### Teacher check:

Initials \_\_\_\_\_ Date \_\_\_\_\_

### These supplies are needed:

three strips each of copper and zinc (15 x 3 cm)  
four lengths of covered copper wire, each about 50 cm long.  
a glass of vinegar  
a galvanometer  
a juicy lemon  
a sharp knife



**Follow these directions.** Check the boxes as you do each step. Answer the questions.

- 1. Roll the lemon firmly on a hard surface to make it soft and juicy.
  - 2. Cut two slits in the lemon about 3 cm apart.
  - 3. In one slit put a strip of copper, and in the other slit put a strip of zinc.
  - 4. Attach a length of covered copper wire to the top of each strip.
  - 5. Attach the other ends of the wires to the posts of the galvanometer. (Have your teacher show you how to strip the covering off the end of the wire before you try to attach it to the galvanometer.)
- 1.21 How much current is flowing in this cell? \_\_\_\_\_ .
- 1.22 What is the electrolyte? \_\_\_\_\_ .
- 1.23 What are the electrodes? a. \_\_\_\_\_ and b. \_\_\_\_\_ strips.
- 6. In the glass of vinegar, insert zinc and copper strips with copper wire attached.
  - 7. Connect the loose ends of wire to the galvanometer.
- 1.24 Measure the flow of the current. \_\_\_\_\_ .
- 8. In the glass of vinegar, put two strips of copper.
- 1.25 Is there any flow of electric current? \_\_\_\_\_ .
- 1.26 Why? \_\_\_\_\_
- 9. In the glass of vinegar, put two strips of zinc together.
- 1.27 Is there any flow of electric current? \_\_\_\_\_ .
- 1.28 Why? \_\_\_\_\_

**Conductors and insulators.** Now that you have electric current, you must find a way to control it. You will provide a track for it to travel on by using some covered wire.

The wire is a **conductor**. Conductors are materials that can carry electricity from place to place. Most metals are good conductors, but some are better than others. Copper is an especially good conductor. Probably many of the electric wires in your home are made of copper. Aluminum wires are often used for heavy electric lines.

The covering on the wire prevents the electric current from flowing out of the wire into

## SELF TEST 1

**Match these items** (each answer, 3 points).

- |              |                                       |  |
|--------------|---------------------------------------|--|
| <b>1.01</b>  | _____ to charge                       | a. current electricity                           |
| <b>1.02</b>  | _____ protons, electrons,<br>neutrons | b. good conductor                                |
| <b>1.03</b>  | _____ electricity that flows          | c. track for current                             |
| <b>1.04</b>  | _____ conductors                      | d. make electric                                 |
| <b>1.05</b>  | _____ insulators                      | e. one of God's wonders                          |
| <b>1.06</b>  | _____ fuse                            | f. will carry electricity from place to<br>place |
| <b>1.07</b>  | _____ circuit                         | g. safeguard                                     |
| <b>1.08</b>  | _____ lightning                       | h. machine to find and measure<br>electricity    |
| <b>1.09</b>  | _____ water                           | i. Volta   |
| <b>1.010</b> | _____ galvanometer                    | j. particles of an atom                          |
|              |                                       | k. will not carry electricity                    |

**Write the letter for the correct answer in each blank** (each answer, 3 points).

- 1.011** When an object is electrically charged, \_\_\_\_\_ have been added to or removed from the object.  
a. protons                      b. electrons                      c. neutrons
- 1.012** If you hold a charged object near a stream of water, the water will \_\_\_\_\_.  
a. bend toward the object                      b. move away from the object
- 1.013** An electric cell must have \_\_\_\_\_.  
a. only an electrolyte  
b. 3 electrodes  
c. 2 electrodes and 1 electrolyte
- 1.014** An instrument used to find and measure small electric currents is called a \_\_\_\_\_.  
a. galvanometer                      b. electron                      c. proton

- 1.015** A switch is a \_\_\_\_\_.  
a. fuse                                      b. circuit breaker                      c. insulator
- 1.016** Benjamin Franklin experimented with lightning when he used a \_\_\_\_\_.  
a. lightning rod                      b. fuse                                      c. kite and key
- 1.017** Electric cells are used to make \_\_\_\_\_.  
a. lightning                              b. current electricity                      c. toasters
- 1.018** A good conductor of electricity is \_\_\_\_\_.  
a. water                                      b. rubber                                      c. glass
- 1.019** The track along which electricity flows is called \_\_\_\_\_.  
a. the round trip                      b. the circuit                              c. the railroad

**Answer true or false** (each answer, 2 points).

- 1.020** \_\_\_\_\_ Benjamin Franklin made the electric cell.
- 1.021** \_\_\_\_\_ Protons do not move out of the center of the atom.
- 1.022** \_\_\_\_\_ Charges that are alike push each other away.
- 1.023** \_\_\_\_\_ Job is a book in the Bible.
- 1.024** \_\_\_\_\_ Electricity that flows without stopping is current electricity.
- 1.025** \_\_\_\_\_ A galvanometer shows when electric current is flowing.
- 1.026** \_\_\_\_\_ Electricity will not flow through a conductor.
- 1.027** \_\_\_\_\_ Metals and liquids with salt and acid in them are poor conductors.
- 1.028** \_\_\_\_\_ Electricity is important to our world.

**Answer these questions** (each answer, 5 points).

**1.029** How does a fuse work to protect wires in a house from becoming too hot?

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---



**1.030** How would your ways of eating change if electricity were to suddenly disappear?

---



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**1.031** What should be done about broken or worn-out electrical cords?

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**Choose the right prefix to make each sentence correct. Use only the prefixes *un-*, *re-*, *ex-*, and *in-* (each answer, 2 points).**

**1.032** You must have an \_\_\_\_\_ broken circuit for electric current to flow through.

**1.033** A weak battery may be \_\_\_\_\_ charged.

**1.034** Each paragraph should be \_\_\_\_\_ dented.

**1.035** The teacher \_\_\_\_\_ pressed her wish that the students work hard.

**1.036** Come \_\_\_\_\_ side the school building.

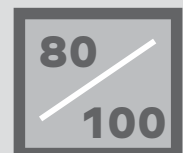


**Teacher check:**

Score \_\_\_\_\_

Initials \_\_\_\_\_

Date \_\_\_\_\_





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