



SCIENCE

STUDENT BOOK

▶ **8th Grade | Unit 6**

SCIENCE 806

Energy 2

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Energy 2

Introduction

God said, “Let there be lights in the firmament of the heaven to divide the day from the night” (Genesis 1:14). This light is the original source of earth’s energy. Today the growing and active population of the earth is searching for new ways to get energy for the machines of our civilization. Our demand for energy in all its forms has become so great that new sources need to be found for America and the world.

Energy, the capacity to do work, exists in many forms that have been discovered over the years. Static electricity was an interesting toy known to the Greeks in 600 B.C. To Benjamin Franklin it was a stimulant to his curiosity. The scientific study of electricity began with the study of lightning by Franklin. Our understanding of electricity, motors, and generators is based on the concept of magnetism, a naturally occurring property of our planet and of several minerals that make up the earth.

Scientists today are looking at old and new ways to provide energy for the people. In this LIFEPAK® the main topics for study are magnetism, electricity, and energy for the future.

Objectives

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAK. When you have finished this LIFEPAK, you should be able to:

1. Describe the behavior of magnets.
2. Illustrate a magnetic force field.
3. List and apply the laws of electrostatics.
4. Apply Ohm’s law to values in simple circuits.
5. List modern uses of electricity.
6. Associate inventions with their inventors.
7. Describe conventional energy sources.
8. Name some potential energy source of the future.

1. MAGNETISM

In the twelfth century the **lodestone** was used as a compass in navigation, according to the records of the time. In China it was used even earlier. In the first century before Christ, the

Roman, Lucretius, wrote about magnetism. Modern study of magnetism began with the work of William Gilbert.

SECTION OBJECTIVES

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

1. Describe the behavior of magnets.
2. Illustrate a magnetic force field.

VOCABULARY

Study these words to enhance your learning success in this section.

align (u līn´). To form into a line.

declination (dek lu nā´ shun). Deviation of a compass needle from geographic (true) north and south.

domain (dō mān´). A minute region within a magnet.

induce (in dūs´) Cause or produce without direct contact.

lodestone (lōd´ stōn). A rock or mineral that is magnetic.

magnet (mag´ nit). Anything that attracts iron.

repel (ri pel´). Force apart by a natural force.

Note: All vocabulary words in this LIFEPAC appear in **boldface** print the first time they are used. If you are not sure of the meaning when you are reading, study the definitions given.

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

PERMANENT MAGNETS

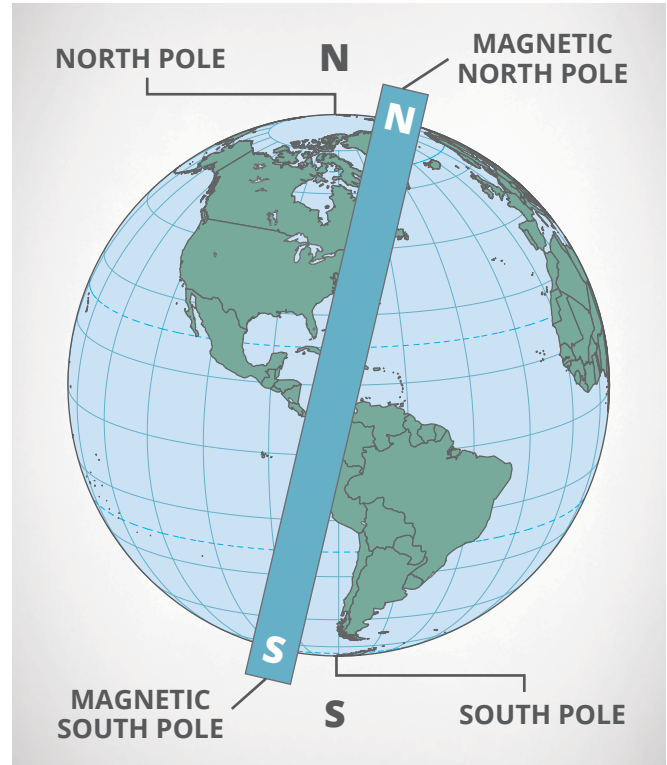
If you have ever used a **magnet** to pick up nails, pins, or other iron particles, you have noticed that some materials could not be picked up. Magnets pick up iron, nickel, and cobalt and some alloys of these materials. **Lodestone**, an iron ore, is a natural form of permanent magnet. In this section you will study the behavior of various types of magnetic materials.

Magnetic materials. In seventeenth-century England, the personal physician of Queen Elizabeth I wrote about magnetism. He was a respected and well-known scientist named William Gilbert. Gilbert explained in his book, *De Magnete*, that the magnetic needle of the compass lines up in a north-south manner because the earth is a giant lodestone. He took a ball of lodestone which he called a *terella* (*little earth*) and placed needles on its surface. They lined up so that the needles all pointed along the same lines and toward the *poles*. Gilbert wrote his book in Latin because that was the language all educated people used then. This book began the scientific study of magnetism.

Today we call lodestone *magnetite*. Magnetite is a mineral that is found all over the world. Its usual occurrence is as small crystals in igneous



| A lodestone is nature's magnetic rock. It acts as a magnet



| The earth acts like a giant bar magnet.

rocks. Sometimes large masses are found. Magnetite is an iron oxide. Black particles in sand are commonly magnetite.

William Gilbert discovered that the earth behaves like a giant magnetic iron bar. Today we know that the earth's magnetic forces are not located at the exact north and south poles but are tilted. The difference between true north and magnetic north is called the magnetic **declination**. Sailors call it variation of the compass.

Nickel and cobalt are lesser known natural magnets. These metals can be mixed with iron and some other metals to produce magnets.



Try this investigation.

These supplies are needed:

- world globe showing latitude and longitude
- flexible ruler

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

1. Locate on the globe 76.2° north latitude and 101° west longitude. This location is the magnetic north pole.
2. Locate on the globe 66° south latitude and 139.1° east longitude. This location is a magnetic south pole.
3. Find the scale of miles on the globe. Write in the data table the distance represented by one inch on the globe.
4. Measure the inches from the magnetic north pole to the geographic North Pole. Record this distance in inches.
5. Measure the inches from the magnetic south pole to the geographic South Pole. Record this distance in inches.

| | Measurements |
|--|--------------|
| Miles represented by one inch on globe | |
| Inches from true north to magnetic north | |
| Inches from true south to magnetic south | |



1.1 How far is magnetic north from true, or geographic, north?

1.2 How far is magnetic south from true, or geographic, south?

Magnetic Declination Experiment

Other objects in the universe have magnetic fields. Scientists are studying magnetism of other planets and even the stars. Some magnetic fields extend far into space. A relationship exists between magnetic storms on the sun and poor radio reception on earth.

Magnetic forces. Magnetic forces are the attractions felt by materials close to the magnet. The idea of a *field* is the same as the *sphere of influence* Gilbert described. The field is the space around the magnet in which the magnetic strength can be measured.

The atoms within a magnet line up so that they point in one direction. In nonmagnetic material, atoms point in all directions. In naturally

magnetic metals the atoms are lined up. Sometimes a natural magnet can be used to make other materials magnetic. If a magnet is cut in half, each part will have an N pole and an S pole. A metal bar may be demagnetized by hammering or dropping it. This treatment will throw the atoms into disorder. The atoms will no longer be in orderly rows.

Induced magnetism. Magnetism is **induced** in an iron bar when the bar is stroked with a magnet. The stroking lines up the atoms in the iron bar and makes it magnetic. The tiny N and S poles become aligned through the bar. This kind of magnet will gradually weaken as the atoms lose their **alignment**.



Try this investigation.

These supplies are needed:

- bar magnet
- needle
- glass
- water

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

- 1. Beginning at the point of the needle, stroke the needle gently with the N pole of the bar magnet. Repeat twelve times. Always stroke in the same direction.
- 2. Coat the needle with butter or vegetable oil and gently place the needle on the water. The needle will float if it is placed on the water without breaking the surface.



1.3 Which pole does the eye of the needle seek? _____

1.4 Where did the needle get its magnetism? _____

Compass Experiment



Write the letter of the correct choice.

- 1.5 The lodestone was used for navigation as early as _____ .
 a. 100 B.C. b. 500 c. 1200 d. 1500
- 1.6 The scientific language of the sixteenth century was _____ .
 a. Greek b. French c. English d. Latin

Write true or false.

- 1.7 _____ Lodestone was invented in the twelfth century.
- 1.8 _____ The earth's magnetic poles coincide with its geographic poles.
- 1.9 _____ Magnetite is valuable because it is a rare mineral.
- 1.10 _____ The sun has a magnetic field.

Complete these sentences.

- 1.11 Lucretius, who wrote about magnetism in the first century, B.C., was a citizen of _____ .
- 1.12 The personal physician of Queen Elizabeth I, who wrote *De Magnete*, was _____ .
- 1.13 The name of the mineral that was formerly called lodestone is _____ .
- 1.14 As distance from a magnet increases, the magnetic field (increases, decreases) _____ .
- 1.15 The difference between geographic (true) north and magnetic north is called _____ .
- 1.16 The region, or sphere, of influence around a magnet is called the magnetic _____ .
- 1.17 If an iron bar is stroked with a magnet, magnetism is said to be _____ in the bar.

**Answer these questions.**

- 1.18 What makes magnetic material magnetic? _____

- 1.19 What is the effect on the atoms of an iron bar when the bar is stroked with a magnet?

- 1.20 What is the effect on a magnet of hammering it or dropping it?

- 1.21 What elements in addition to iron, are magnetic?
a. _____ and b. _____

MAGNETIC FIELDS

For the purpose of study, a magnet is thought of as being composed of small segments called **domains**.

The region around a magnet that exerts a force on a small bit of iron is a *magnetic field*. The field is centered on a magnetic pole, and can be illustrated by the pattern of magnetic lines of force. The strength of a magnetic field obeys the inverse square law: Magnetic strength decreases as distance from the pole increases.

Poles. The poles of a magnet are called *north* and *south*. If a bar magnet is hung by a string around its middle, the north, or N, pole of the magnet will point to magnetic north. The south, or S, pole of the magnet will point to magnetic

south. Like poles of bar magnets **repel** each other, and unlike poles attract.

Lines of force. The lines of force of a magnet can be made visible by sprinkling iron filings around the magnet. The magnetic lines of force show as lines of iron filings in the magnetic field. Concentrated filings indicate a strong field.

Magnetic lines of force travel through paper, glass, plastic, wood, and many other materials. They do not travel through iron and steel. A magnetic compass is not reliable in a steel-framed structure because the metallic walls cause the needle to deflect.



View 806 Magnetism, from the Grade 8 SCIENCE EXPERIMENTS Video

**Try this investigation.****These supplies are needed:**

- two bar magnets
- iron filings
- one horseshoe magnet
- sheet of glass or plastic

Follow these directions and complete the activities. Put a check in the box when each step is completed.

- 1. Place a bar magnet on a table.
- 2. Put a sheet of glass or plastic over the magnet.
- 3. Sprinkle the iron filings over the sheet evenly.
- 4. Sketch the magnet in the following space and show the lines made by the iron filings.
- 5. Return the filings to their container.

Bar Magnet

- 6. Place a horseshoe magnet on the table.
- 7. Put a sheet of glass or plastic over the magnet.
- 8. Sprinkle the iron filings over the sheet.
- 9. Sketch the magnet in the following space and show the lines made by the iron filings.
- 10. Return the filings to their container.

Horseshoe Magnet



Magnetism Experiment

- 11. Place two bar magnets N pole to N pole with an inch between them.
- 12. Put a piece of glass or plastic over the magnets.
- 13. Sprinkle the iron filings over the glass or plastic.
- 14. Sketch the magnets in the following space and show the lines made by the iron filings.
- 15. Return the filings to their container.

N Pole to N Pole

- 16. Turn one of the bar magnets around so they are N pole to S pole with an inch between them.
- 17. Sprinkle the iron filings over the glass or plastic.
- 18. Sketch the magnets in the following space and show the lines made by the iron filings.

N Pole to S Pole

- 19. Put all the materials away.

Sample images for the sketches can be found on the back pages of this unit.



Magnetism Experiment

1.22 State the rule of magnetism that is illustrated by the lines of the iron filings in Step 14.

1.23 State the rule of magnetism that is illustrated by the lines of the iron filings in Step 18.

1.24 Why was the glass or plastic used to separate the filings from the magnets in the experiment? _____



1.25 Did the glass or plastic stop the passage of the magnetic lines of force? _____

1.26 Do the iron filings bridge the open end of the horseshoe magnet?

Magnetism Experiment

SELF TEST 1

Match these items (each answer, 2 points).

- | | | | | |
|-------|-------|-----------------|----|---|
| 1.01 | _____ | William Gilbert | a. | temporary magnetism |
| 1.02 | _____ | magnetite | b. | man-made permanent magnet |
| 1.03 | _____ | electromagnet | c. | iron oxide |
| 1.04 | _____ | inverse square | d. | lines representing the strength and direction of magnetic force |
| 1.05 | _____ | lines of force | e. | <i>De Magnete</i> |
| 1.06 | _____ | alnico | f. | very cold |
| 1.07 | _____ | demagnetize | g. | strength decreases as the square of the distance |
| 1.08 | _____ | domain | h. | current-carrying wire has a magnetic field |
| 1.09 | _____ | Oersted | i. | small region within a magnet |
| 1.010 | _____ | supermagnet | j. | drop or hammer |
| | | | k. | king of Sweden |

Complete these activities (each answer, 5 points).

- 1.011 Draw the lines of force around a single bar magnet.



- 1.012 Draw the lines of force around two bar magnets, N pole to S pole.



Complete these activities (each answer, 2 points).

List three factors that determine the strength of an electromagnet.

1.013 _____

1.014 _____

1.015 _____

Give two ways in which a permanent magnet can be weakened.

1.016 _____

1.017 _____

Answer these questions (each answer, 3 points).

1.018 What was William Gilbert's big discovery? _____

1.019 How is an electromagnet made? _____

1.020 Why is a magnetic compass not useful for navigating a submarine?

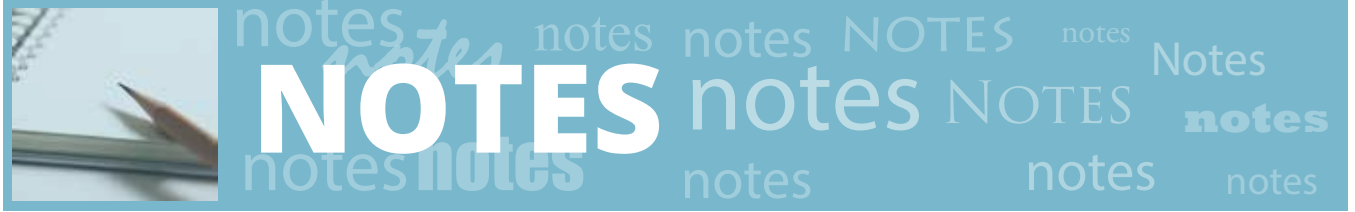
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