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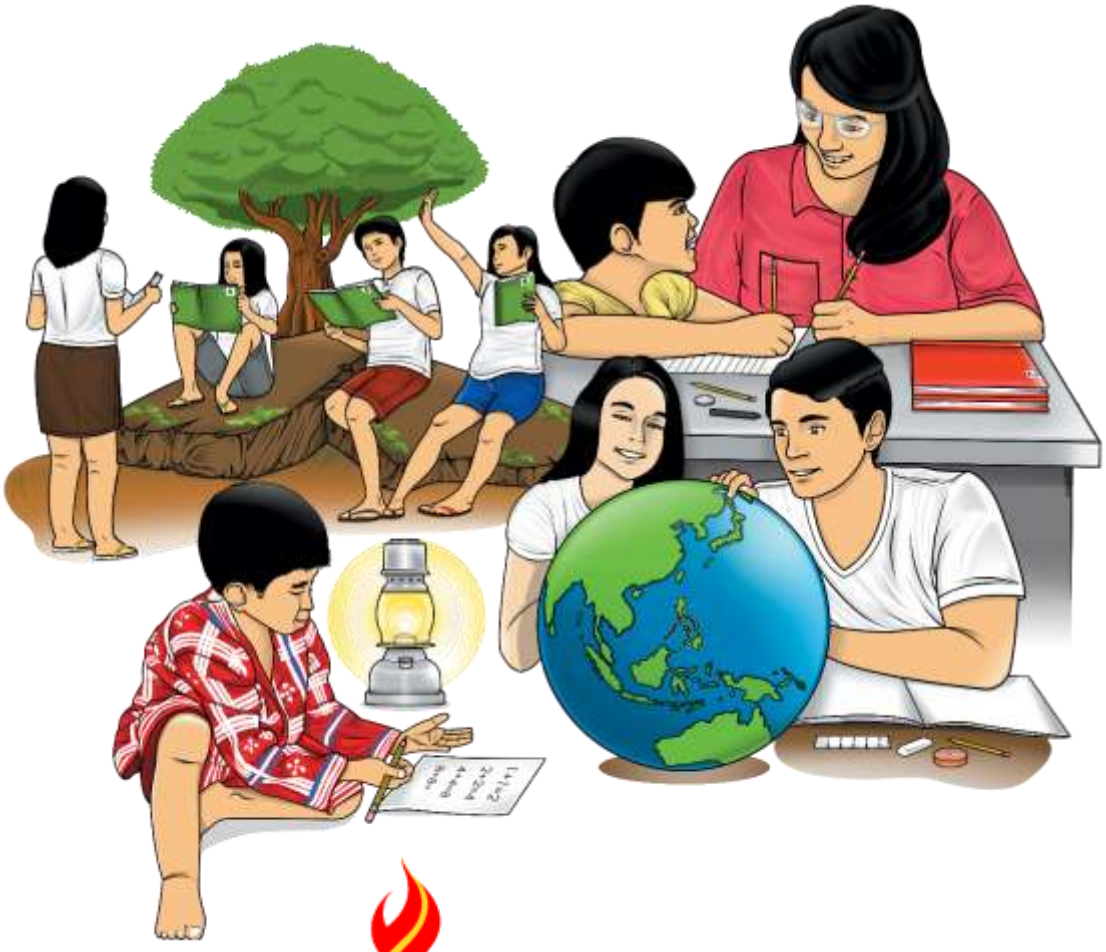
Science

Quarter 3 – Module 6:
Factors Affecting the Strength of an Electromagnet



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Science

Quarter 3 – Module 6:
Factors Affecting the Strength of an Electromagnet

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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

What I Need to Know

This module was designed and written to help you learn the factors affecting the strength of an electromagnet. The scope of this module permits it to be used in many different learning situations. The language used recognizes the diverse vocabulary level of students. The lessons are arranged to follow the standard sequence of the course. But the order in which you read them can be changed to correspond with the textbook you are now using.

Specifically, this module will help you describe an electromagnet and its properties and design, an experiment to determine the factors affecting its strength. As you go through this module, you are expected to:

1. describe what an electromagnet is;
2. construct a simple electromagnet and identify its parts;
3. enumerate the factors affecting the strength of an electromagnet; and
4. identify some uses of electromagnets.

What I Know

Directions: Read and understand the sentences well. Write **True** if the sentence is correct and **False** if it is not. Write your answers in your Science notebook/ answer sheets.

1. In magnets, similar poles attract.
2. Electromagnets can't lift heavy objects.
3. The strength of an electromagnet is permanent.
4. A magnet is a material that pulls/attracts metallic objects.
5. An electromagnet is a temporary magnet.
6. Magnetism is the property of the magnet to attract metallic objects.
7. The more coil the iron nail or core has, the lesser the magnetism or attraction.
8. When the electricity stops flowing in an electromagnet, magnetism continues to flow.
9. Electromagnetism is the ability of the wire to carry electricity to produce a magnetic current.
10. The iron nail or core is the part of the electromagnet where magnetic flux made by the current is concentrated.

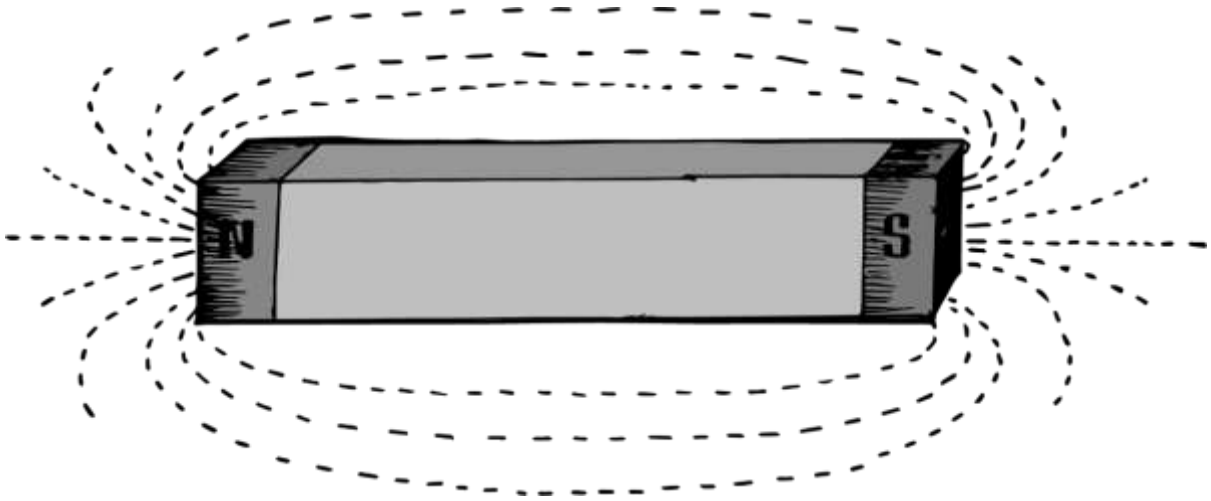
Lesson 1 Factors Affecting the Strength of an Electromagnet

What's In

A **magnet** is a material that can attract metallic objects such as steel, nickel, cobalt, and most especially, iron. This property of magnets can be described as magnetism. This attraction happens because magnets have two ends that have opposite characteristics – the **North** and **South poles**. Hence, magnets follow the fundamental law that *opposites attract and like poles repel*.

Microscopically, the molecules in magnets are arranged in a certain order. When the polarities of the molecules are aligned, that all the north poles point in one direction, that piece of material is said to be magnetized. The effect of the magnetized piece is that its magnetic fields make a kind of circuit that enters at one end and exits at the other. This idea is graphically shown in Figure 1 below.

Below shows how the said orientation of molecules creates a magnet:



Illustrated by Ryan A. Machate and Jose Marie E. Baculi

Figure 1. Simple illustration of a magnet

However, not all materials or metals are magnetic. Sometimes, they have to be combined with other materials to create a magnetic effect. The simple device that can show how this effect is done is called an **electromagnet**.

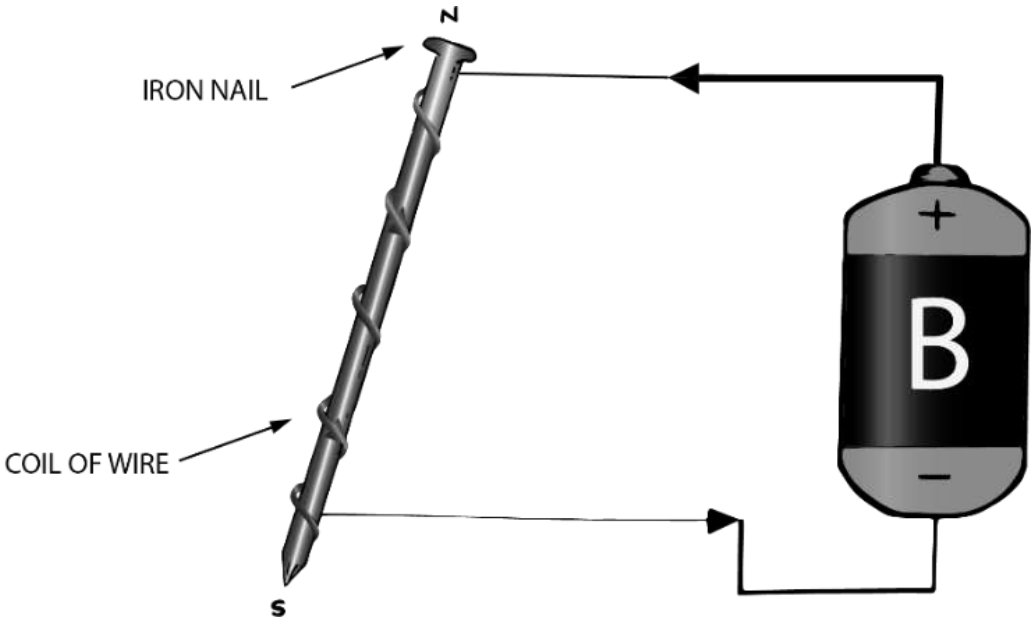
What's New

CONSTRUCTING A SIMPLE ELECTROMAGNET

You will Need:

Dry cell
3-inch iron nail
Thin electrical wire
Thumbtacks/ safety pins/ metal paper clips

(**Suggestion**: Decide on one common metal object (e.g. thumbtacks) throughout the activity for more accurate results.)



Illustrated by Ryan A. Machate and Jose Marie E. Baculi

What to Do:

(Note: Make sure that the iron nail does not have any rust. Be careful in handling materials. If possible, do the activity with the presence of an elder.)

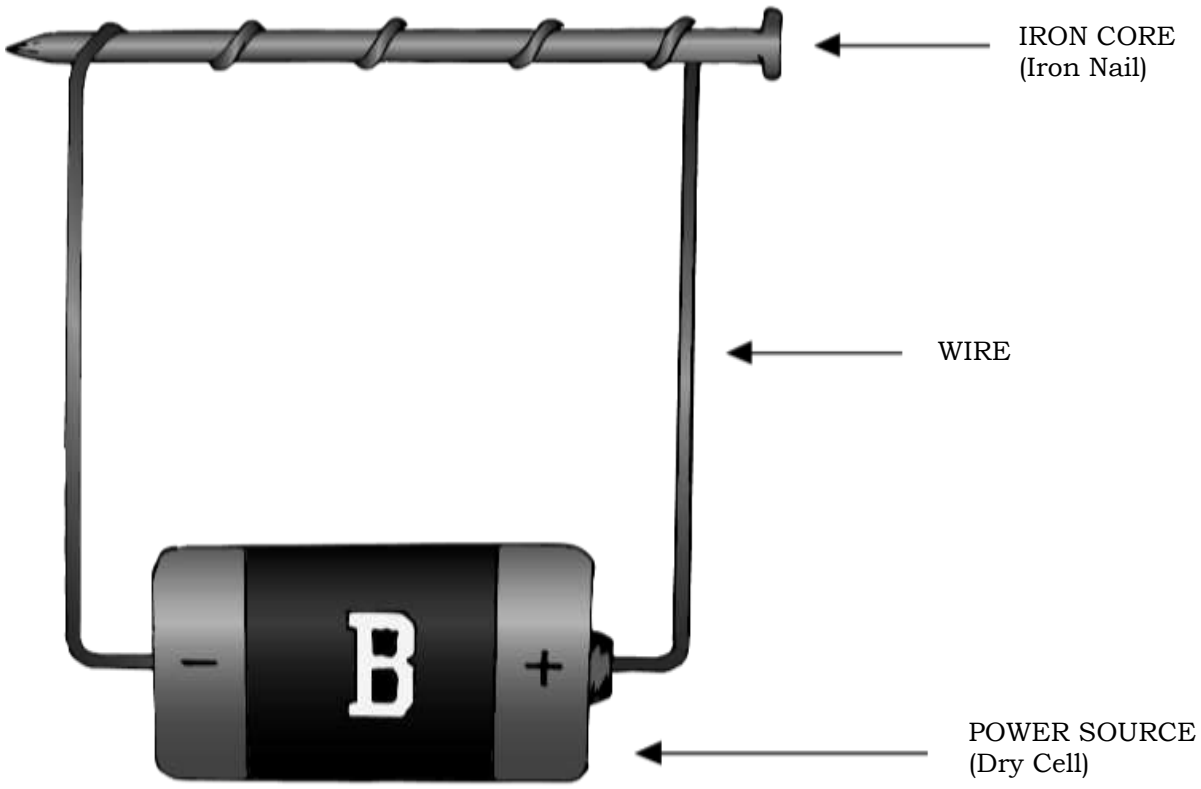
1. Make an electromagnet by winding the electrical wire five times around the nail.
2. Connect both ends of the wire of the electromagnet to the dry cell.
3. Test the electromagnet by placing some thumbtacks near the nail. Did the nail attract the thumbtacks? How many thumbtacks did the electromagnet attract?

What is It

What is an Electromagnet?

An **electromagnet** is a type of magnet in which an electric current produces the magnetic field. Electromagnets usually consist of wire wounds into a coil. Professor Hans Christian Oersted coined the term **electromagnetism** in 1820. It refers to the ability of a wire to carry electric current to produce a magnetic current.

The illustration below shows a simple electromagnet with its parts. What are the three main parts of the electromagnet? What does each part do?



Illustrated by Ryan A. Machate and Jose Marie E. Baculi

An electromagnet is temporary and is called an artificial magnet. It is a magnet that is only magnetic when an electric current is flowing through it. If the flow of the current is cut off, the property of magnetism stops.

The Parts of an Electromagnet

A basic electromagnet has three main parts: an iron core, insulated wire and a power source.

1. Iron core. Its purpose is to concentrate the magnetic flux produced by the current in the area outside the wires.

2. Wire/ Insulated wire. The wire serves as the passage of the electric current creating a magnetic field. The number of turns of wire represents the power of the electromagnet. The cable and wires need to be insulated as it prevents the current from coming into contact with other conductors. It preserves the wire material against environmental threats and resists electrical leakage.

3. Power source. It serves as the source of electricity that flows to the wire to create a magnetic field. The amount of current also affects the strength of the electromagnet.

How to Make an Electromagnet Stronger

An electromagnet can be made stronger in three ways:

a. by having more coils of wire on the iron nail or core;
b. by increasing the amount of current supplied; and
c. by using soft iron as the core.

The more coils the iron nail or core has, the stronger the electromagnet. Similarly, when soft iron is used as the core, the electromagnet is stronger than when other materials are used. Furthermore, the greater the number of dry cells, the more electrons flow in the electromagnet, resulting in stronger magnetism.

This is the advantage of an electromagnet from a permanent magnet. When there is a need to strengthen it, all the factors mentioned can be manipulated. An electromagnet operates only when there is a flow of electricity in the coil of wire. Its magnetism can be turned on and off.

Illustrated by Ryan A. Machate and Jose Marie E. Baculi

Figure 2. A simple electromagnet

Uses of Electromagnets

Using electromagnets, you can create all sorts of things, including motors, solenoids, hard disks and tape drives, speakers, and many others.

Electromagnets have many uses.

1. It is used to transmit signals, as in the telegraph, telephone, radio, and television.
2. It is also used for industrial purposes, such as in motors, generators, and transformers.
3. The electromagnet in a crane is used to lift heavy objects like metals, steel bars, scrap iron, and cars.
4. Electromagnets are used in bells, buzzers, chimes, circuit breakers, and other electrical appliances in our homes.
5. Electromagnets run electric toys.

What's More

Activity 1: More Coil

You Will Need:

2 pieces of 2-inch iron nail

½ meter copper wire

1 piece of big dry cell

Safety pins or thumbtacks

What to Do:

1. Coil the wire around the nail five (5) times.
2. Attach the ends of the wire to the opposite ends of one (1) dry cell.
3. Test the electromagnet by placing the nail near the safety pins/ thumbtacks.
4. Observe what happens. How many safety pins/ thumb tacks did the magnet attract?
5. Add another five (5) coils around the nails. Repeat procedure numbers 2 and 3.
6. Observe what happens. Record the number of safety pins/ thumb tacks attracted to the magnet.
7. Increase the coils to fifteen (15). Repeat procedures 2 and 3. Record the number of safety pins/ thumbtacks that are attached to the magnet.
8. This time wind the wire five times more around the nail. Again, connect the ends of the wire to the dry cell.
   a. How many thumbtacks did the electromagnet attract?

b. Was there an increase in the number of thumbtacks attracted by the electromagnet?

9. What factor made the electromagnet stronger?

Guide Questions 1

Directions: Based on the activity conducted, complete the table below. Write your answers in your Science notebook/answer sheet.

Number of Coils	Number of Safety Pins attracted
5	
10	
15	
20	

1. How did the increase in the number of coils affect the strength of the electromagnet? Explain your answer briefly.
2. How did the increase in the number of coils change the strength of an electromagnet?

Activity 2: More Power

You will need:

1 piece of a 3- inch iron nail

1-meter copper wire

3 pieces of big dry cells

Safety pins or thumbtacks

What to Do:

1. Coil the wire around the nail ten (10) times.
2. Attach the ends of the wire to the opposite ends of one (1) dry cell.
3. Test the electromagnet by placing the nail near the safety pins/ thumbtacks.
4. Observe what happens. How many safety pins/ thumbtacks did the magnet attract?
5. Disconnect the wires. Connect/ add another dry cell to the first dry cell. Repeat procedure numbers 2 and 3.
6. Observe what happens. Record the number of safety pins/ thumbtacks attracted to the magnet.
7. Again, disconnect the wires before adding another dry cell to the setup. Repeat procedures 2 and 3. Record the number of safety pins/ thumbtacks that are attached to the magnet.

8. Was there an increase in the electric current as more dry cells were added? Why?
9. What factor made the electromagnet stronger?

Guide Questions 2

Directions: Based on the activity conducted, complete the table below. Write your answers in your Science notebook/answer sheet.

Number of Dry Cells	Number of Thumbtacks Attracted to the Magnet
1 dry cell	
2 dry cells	
3 dry cells	

1. As the number of dry cells increases, how did it affect the strength of the electromagnet? Explain your answer briefly.
2. As the number of dry cells increases, how did it change the strength of an electromagnet?

What I Have Learned

Directions: Read and understand the paragraph below. Choose your answers from the box by filling in the blanks. Write your chosen answers in your Science notebook/answer sheet.

attracted	iron	magnet
magnetism	magnetic field	nail
switch	wire	

An electromagnet is a device made temporarily magnetic by electricity. It is produced by making electricity flow through a coil of 1. _____. The wire is winded around a piece of 2. _____. It serves as a core which is usually made of 3. _____. When electric current flows through the wire, the wire and the iron became a 4. _____. Both produce a 5. _____. Any magnetic substance that is located within the field is 6. _____ to it. Without electricity, it loses its 7. _____.

What I Can Do

Directions: Read and understand the given situation below. Choose the appropriate actions that correspond to the situation by putting a check (✓) mark and a cross mark (**x**) if not. Write your answer in your Science notebook/ answer sheet.

One afternoon your Science class had just finished the experiment on electromagnets when your classmate accidentally bumped the table with instructional materials causing the box of thumbtacks to spill its contents into the sandbox. How are you going to gather all the thumbtacks using what you learned from the lesson?

1. Ask everyone to help gather the thumbtacks.
2. Pick the thumbtacks one by one.
3. Construct an electromagnet.
4. Use an electromagnet to gather the thumbtacks.
5. Make the electromagnet stronger so that many thumbtacks will be magnetized.

Assessment

Directions: Read and understand the sentences below. Fill in the blanks with the correct word to complete the idea of the sentence. Write your answers in your Science notebook/answer sheet.

opposite poles	iron nail	magnetic field	strength	magnets
electromagnet	dry cell	magnetism	increasing	transmits

1. Magnets has a property that attracts objects called _____.
2. In the field of communication, electromagnet _____ signals.
3. The _____ of electromagnets can be increased or decreased.
4. In a simple electromagnet setting, the _____ serves as the core.
5. The _____ of electromagnets exist only when electricity is flowing.
6. The source of electric current in the simple electromagnet set-up is the _____.
7. Magnets follow the fundamental law that _____ attract similar poles repel.
8. An _____ is a magnet whose magnetic properties are produced by electricity.
9. Metallic objects such as steel, nickel, cobalt, and iron are attracted to _____.
10. One way of making electromagnets stronger is by _____ the number of coils around an iron nail or core.

Additional Activities

Directions: List down at least five practical uses of the electromagnet.

1.
2.
3.
4.
5.

Answer Key

What I Know

1. False
2. False
3. False
4. True
5. True
6. True
7. False
8. False
9. True
10. True

Lesson 1
What's New

For Item No. 3.
Did the nail attract the thumbtacks?

- Yes. The nail attracted the thumbtacks.
- No. The nail did not attract the thumbtacks.

How many thumbtacks did the electromagnet attract?

- The number of thumbtacks may vary depending on the strength of the electromagnet.

Lesson 1
What's More
Activity 1. More Coil

4. (Write the **number**) thumbtacks were attracted to the electromagnet.
6. (Write the **number**) thumbtacks were attracted to the electromagnet.
7. (Write the **number**) thumbtacks attached to the electromagnet.
8. a. (Write the **number**) thumbtacks attached to the electromagnet.
   b. Yes. There was an increase in the number of thumbtacks that were attracted to the electromagnet.
9. The increase in the number of coils on the iron nail or core made the electromagnet stronger.

Lesson 1
Guide Question 1.

Number of Coils	Number of Safety Pins/ Thumbtacks attracted
5	The number/ answer may vary.
10	The number/ answer may vary.
15	The number/ answer may vary.
20	The number/ answer may vary.

1. The increase in the number of coils increases the strength of the electromagnet because the number of safety pins/ thumbtacks also increased every time that the number of coils were increased.
2. As the number of coils increases, the strength of the electromagnet also increases

Activity 2. More Power

4. (Indicate the number of safety pins/ thumbtacks) safety pins/ thumbtacks were attracted to the electromagnet.
6. (Indicate the number of safety pins/ thumbtacks) safety pins/ thumbtacks were attracted to the electromagnet.
7. (Indicate the number of safety pins/ thumbtacks) safety pins/ thumbtacks were attracted to the electromagnet.
8. Yes, there was an increase in the electric current as more dry cells were added because there was an increase in the number of safety pins/ thumbtacks that were attracted to the electromagnet.
9. Power or number of batteries used

Lesson 1

Additional Activities

(Answers may vary/ can be interchanged)

Electromagnets have many uses.

1. They are used to transmit signals, as in the telegraph, telephone, radio, and television.
2. They are also used for industrial purposes such as in motors, generators, and transformers.
3. The electromagnet in a crane is used to lift heavy objects like metals, steel bars, scrap iron, and cars.
4. In our homes. Electromagnets are used in bells, buzzers, chimes, circuit breakers, and other electrical appliances.
5. Electric toys are run by electromagnets

Lesson 1
What I Have Learned

1. wire
2. nail
3. Iron
4. magnet
5. magnetic field
6. attracted to it
7. Magnetism

Lesson 1
What I Can Do

Uses of Electromagnet:

1. x
2. x
3. ✓
4. ✓
5. ✓

Lesson 1
Assessment

1. magnetism
2. transmits
3. strength
4. iron nail/ core
5. magnetic fields
6. dry cell/ batteries
7. opposite poles
8. electromagnet
9. magnets
10. increasing

Lesson 1

Guide Questions 2

Number of Dry Cells	Number of Thumbtacks Attracted to the Magnet
1 dry cell	The number/ answer may vary.
2 dry cells	The number/ answer may vary.
3 dry cells	The number/ answer may vary.

1. The more dry cells were added, the strength of the electromagnet increases because the number of safety pins/ thumbtacks that were attracted to the electromagnet also increased.
2. As the number of the dry cells in an electromagnet increases, its strength also increases.

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