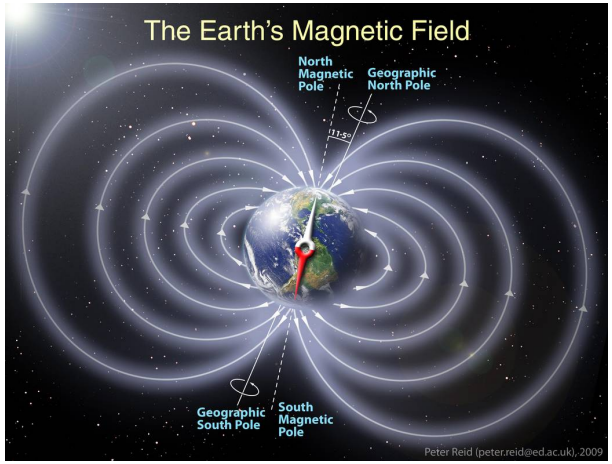
NASA Spotlite Interactive Lesson

Magnets and Metals
Grades 3-5



Teacher Packet

NASA Spotlite Interactive Lesson Guide

Science for students by students

Student-Produced Videos Confronting Science Misconceptions

This NASA eClips™ Spotlite Interactive Lesson supports existing curriculum and should be used as one of many strategies to build students' understandings of science content. The goal of this 5E lesson is to address a science misconception. Through watching a student-produced video (Engage), completing activities (Explore), explaining relevant concepts while applying new vocabulary collectively using a Frayer Model (Explain), and applying new information (Extend/ Elaborate), students will develop an understanding of the science content and how to correct the science misconception.

This PDF document should be downloaded to use the interactive features. The hyperlinks included in this document open PDFs or webpages and may perform differently based on the device being used. Links may have to be cut and pasted into a web browser to open.

Try using Adobe Acrobat Reader and Flash Player for optimal performance of all interactive features included in this guide.

An accompanying student packet is located on the NASA eClips Website.

What are NASA Spotlites?

NASA Spotlites are 90-120 second student-produced video segments that address common science misconceptions as determined by reputable assessment sources such as the National Assessment of Educational Progress (NAEP), National Science Foundation (NSF) Factual Knowledge Questions, and the Misconceptions-Oriented Standards-based Assessment Resources for Teachers (MOSART).

NASA Spotlites are designed to increase scientific literacy in a standards-based classroom. By producing Spotlite videos, students gain production experience, as well as deepen their understanding of science content. Approved NASA Spotlites can be found at the NASA eClips website. https://nasaeclips.arc.nasa.gov/

Animated 5E Instructional Model

NASA eClips™ Guides use the 5E constructivist model developed by Biological Sciences Curriculum Study. Constructivism is an educational philosophy that promotes student-centered learning where, students build their own understanding of new ideas. The 5E instructional model consists of five stages for teaching and learning: Engage, Explore, Explain, Extend (or Elaborate), and Evaluate.

Lesson Information

Science Misconception
All metals are attracted to magnets.

Standards
Next Generation Science Standards
3-PS2-3.Motion and Stability: Forces and Interactions -- Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.
PS2.B: Types of Interactions: Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other.
3-PS2-4. Define a simple design problem that can be solved by applying scientific ideas about magnets.

Objective
In this lesson, students will correct the common misconception that all metals are attracted to magnets. They will learn new vocabulary to develop their understanding of this scientific concept and apply this vocabulary to explain why some metals are repelled and others are attracted to magnets.

Time Frame
Between two and three 45-minute class periods:
Day 1 - Engage and Explore
Day 2 - Explain and Elaborate/Extend
Day 3 – Evaluate

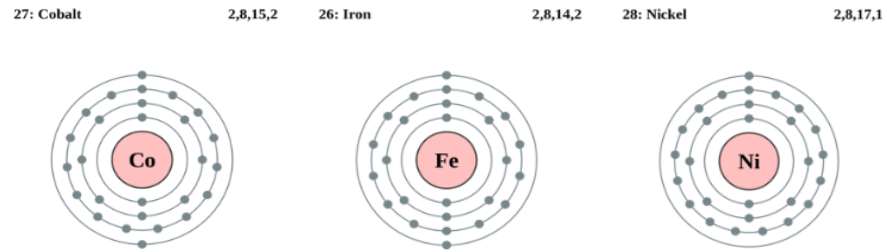
Safety
1. It is recommended to only use magnets created for elementary classroom instruction and have students wear safety goggles. Neodymium Magnets (rare-earth magnets) can be dangerous because of their strength. These magnets can produce sharp fragments when shattered. Magnets should not be left with unsupervised children.
2. Review digital citizenship before students use online resources.

Materials
Assessments
Per student: copy of pretest and posttest

Frayer Model Activity
•Per small group: copy of a digital Frayer Model (alternatively, this can be printed)
•Per classroom: chart paper for posting final vocabulary definitions

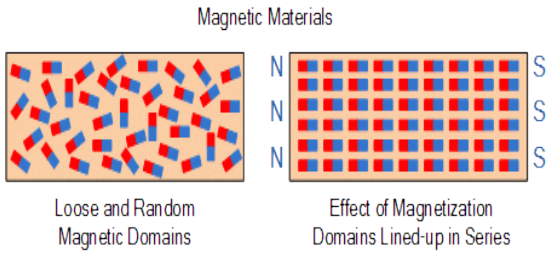
Background Information
A magnet is anything that has an external magnetic field. A magnetic field is an area where an object has magnetic force and can attract or repel other magnetic objects.

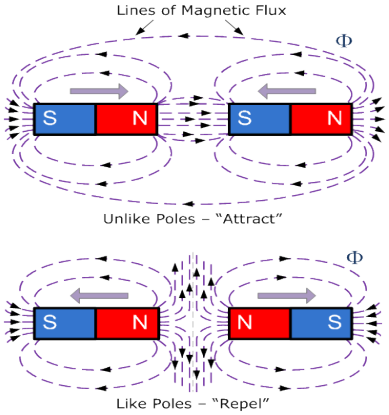
Magnets attract only ferromagnetic materials. Ferromagnetic materials, such as nickel and cobalt, are those materials that are attracted to magnets or can be made magnetic. Ferrous materials are also ferromagnetic and contain iron. One example is steel.



From National Science Teachers Association Electromagnetism Science Object:
There are only three common metals found on the Periodic Table of Elements that are strongly magnetic. These are often called ferromagnetic materials, named for iron, which is the most common magnetic material of all.

Lesson Information

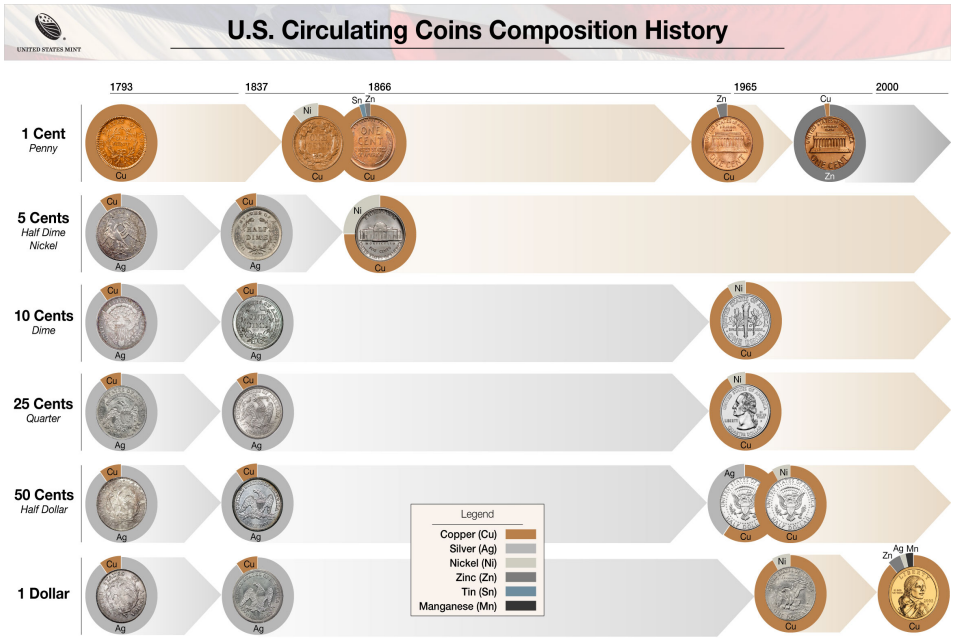




What could cause certain materials to be magnetic?

The answer to this question lies in the structure of the atoms in ferromagnetic materials. Atoms of iron, nickel, and cobalt each have one pair of electrons in their outermost shell. This pair of electrons is farther away from the nuclei than the outer-shell electrons of other metals. These more remote electrons in iron, nickel, and cobalt set up a miniature magnetic field called a magnetic moment. Immense numbers of these atoms cluster together with their magnetic moments aligned in the same direction, with north at one end and south at the other. This large group of ferromagnetic atoms is called a magnetic domain. Yet a domain itself is extremely small, forming the smallest possible permanent magnet. About 6,000 domains could fit on the head of a pin. It requires millions of domains aligned with the same orientation to produce what we see as a bar magnet or a horseshoe magnet.

Source: "Electromagnetism Science Object." SciPacks and Science Objects, National Science Teachers Association, 2019, https://learningcenter.nsta.org



U.S. coin nickels produced after 1866 are 75% copper and are not visibly attracted to magnets.

Target Vocabulary
magnet, magnetic field, attract / attraction, repel / repulsion, iron, steel, nickel, cobalt, poles

Save

Remind students to save responses.
Suggested steps: Under "file" choose "save as."
Type your name in front of the document name.
Choose "save."

This icon identifies the suggested directions and information to read to students.

Engage

Pre-Assessment

Probe for students' prior knowledge using the pre-assessments.

1. Pretest items are located on page 12. Student packets contain a pretest.
2. Essential question.
3. Discussion questions on page 6.

Essential Question

What kind of materials are attracted to magnets?

Today's Lesson

In today's lesson you will learn about magnets. The activities you will do will let you explore and develop an understanding of the objects attracted to magnets. Using interactive Frayer Models, you will learn key vocabulary that will help you explain which materials are attracted to magnets.

What do you already know about magnets?

True or False: All metals are attracted to magnets.

Select the best choice.
This statement is TRUE.
This statement is FALSE.

Spotlite Video

Next, you will watch short videos about magnets and metals. As you watch the videos, see if you can identify a misconception about magnets.

NASA Spotlite: Magnets

NASA eClips™ Website - https://nasaeclips.arc.nasa.gov
NASA eClips™ YouTube - https://youtu.be/4miSpNimwqw

NASA eClips™ Website - https://nasaeclips.arc.nasa.gov
NASA eClips™ YouTube https://youtu.be/_5QlwGKfHRQ

Explore

Class Discussion

Use the questions to lead the class in a discussion.

1. What kinds of materials do magnets attract?
2. Do all magnets attract the same materials?
3. Will magnets work in all settings, such as on the floor, under water or in space?

Explore Activity

Review safe use of all materials with students. Magnets can be harmful if swallowed and can break when dropped.

Explore the following samples to determine if they are attracted to the magnet. Look at the samples and find common characteristics. Can you think of any other samples to test?

1. paper clip Select the best choice.

2. nickel (75% copper) Select the best choice.

3. penny Select the best choice.

4. paper Select the best choice.

5. aluminum foil Select the best choice.

Explore Activity

Students will have the opportunity to explore the attraction and repulsion properties of magnets.

Give each student two magnets. Allow the students time to explore the attracting and repelling properties of magnets. They should be able to demonstrate that a magnet has two ends or poles that will attract or repel from other poles. Have the students observe what happens when two magnets repel each other. The students should find a partner and discuss what they observed and whether their classmate observed the same phenomenon.

Use two magnets to demonstrate that a magnet has two ends or poles that will attract or repel from the poles of another magnet.

What did you discover?

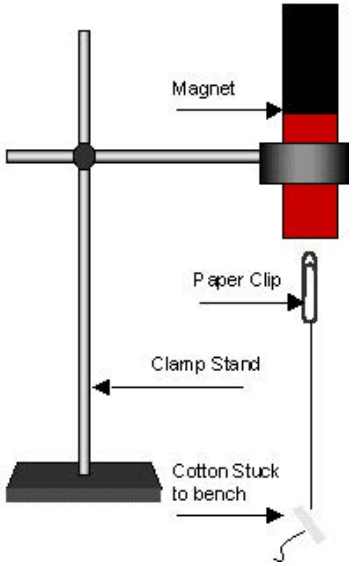
Activity Credit:
https://spacemath.gsfc.nasa.gov/NASADocs/magbook2002.pd f#page=8

Explore

Explore Activity

Model for students how to set up the magnetic force demonstration.

Tape one end of a piece of string to a desk; tie the other end onto a paper clip. Take a second piece of string and suspend the magnet from a ruler anchored with books. Adjust the level of books so that the distance between the magnet and the paper clip allows the clip to stand up without touching the magnet.



(The students should see that a magnetic force is invisible.) You can place pieces of paper or cloth between the clip and the magnet to show the strength of the magnetic force. (Ask students if they can find materials that block magnetic forces.)
With the string still attached, try to raise the paper clip from the desk with a magnet without letting the magnet and paper clip touch. (The students should see that a magnetic force is invisible. Students should keep a log of the methods and strategies used to accomplish this.)

Activity Credit:
https://spacemath.gsfc.nasa.gov/NASADocs/magbook2002.pd f#page=8

Think-Pair-Share

What kinds of materials are attracted to magnets?

Let's compare your answers!

Most metals are NOT magnetic. Metals made of iron, nickel and cobalt are examples of magnetic materials. Metals are made of tiny particles that normally point in different directions. When a magnet is placed near another magnetic material, the particles line up and point in the same direction.

Explain

Vocabulary Development

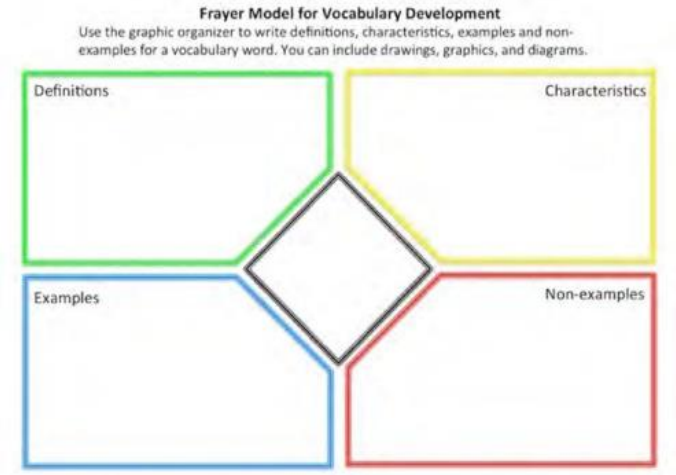
It's almost impossible to learn science concepts without also learning vocabulary words. Those vocabulary words help people discuss science concepts, so they're important. However, knowing vocabulary words is not the same as understanding science concepts. This section is designed to help your students do more than memorize definitions as they connect the vocabulary to the science concepts that they have explored.

1. Place the word "**attract**" in the center of the graphic organizer. (See page 13 for a fillable Frayer Model. Student packets contain a fillable Frayer Model.) Facilitate a discussion with students exploring why this word is key vocabulary to this study.
2. Ask students to brainstorm characteristics of "**attract**" and add responses to the area with the corresponding heading on the graphic organizer.
3. Ask students to continue their exploration as they research the topic using a variety of resources including their textbook and notes.
4. Next, ask students to add examples and non-examples in the Frayer Model. Emphasize the higher-level thinking skill of comparing and contrasting.

How are the examples alike/different than the non- examples?

5. Using the information provided, ask students to develop their own definition of the word **"attract"** that is clear and concise. An example is in the Answer Key section of this document (page 15).
6. After completing the example together, assign a new vocabulary word to each group of students to work on collaboratively.

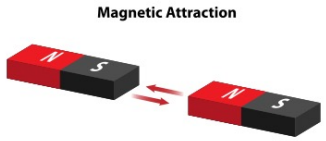
Now complete a new Frayer Model with a partner. Select one word from the key vocabulary list and fill in the graphic organizer. We will share some as a class.

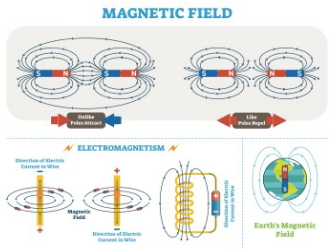


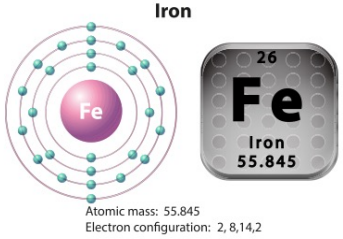
7. Groups will share their Frayer Models and lead discussions to check for understanding of each vocabulary word. Refer to definitions in the Answer Key (page 8).
8. Compile and post final definitions so all students have access for later reference.

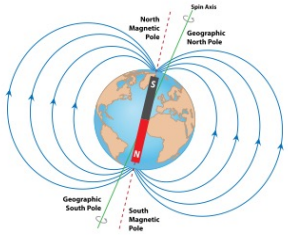
You will review key vocabulary. Pay attention to how your definitions compare to standard definitions.

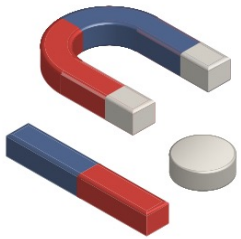
Explain

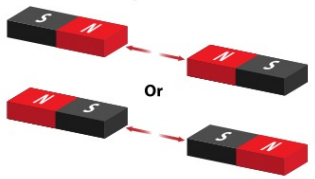
Word	Definition
ATTRACT 	To attract is to pull together.

Word	Definition
MAGNETIC FIELD 	A magnetic field is the region around a magnet where its force attracts or repels materials.

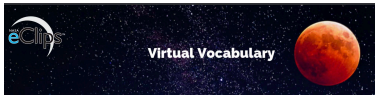
Word	Definition
IRON 	Iron is a malleable, silver-white metallic element with the chemical symbol: Fe.

Word	Definition
POLE 	A pole is one of the two ends of a magnet where the magnetic force is the strongest.

Word	Definition
MAGNET 	A magnet is a metal that has the property of attracting certain substances such as iron.

Word	Definition
REPEL 	Repel means to push away.

Visit the NASA eClips™ Virtual Vocabulary for more definitions.

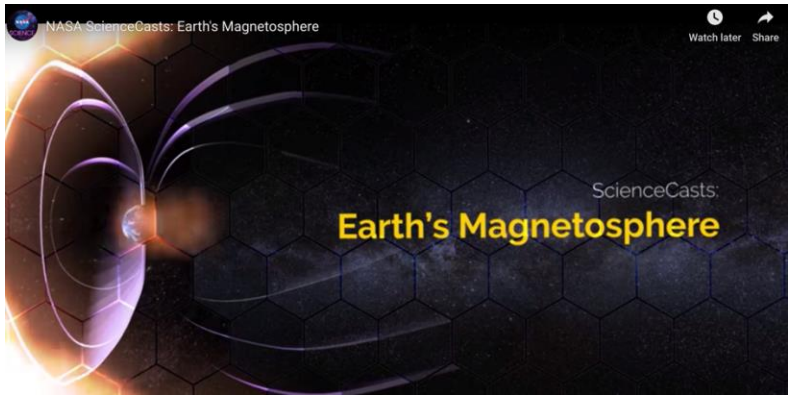


Elaborate/Extend

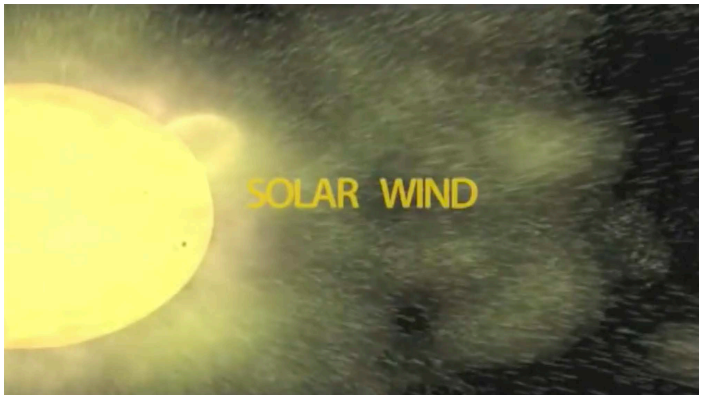
NASA Connection

It is important for the students to explain what's going on by applying what they have learned. It is not unusual for students to have a bit of difficulty with elaborate activities. Student are not used to doing "novel" activities and being asked to apply what they know.

Watch one of these videos to learn more about Earth's magnetic field, called the magnetosphere.



Video Link - **Earth's Magnetosphere**
https://science.nasa.gov/science-news/news-articles/earths-magnetosphere



Video Link – **Our World: The Sun, A Real Star**
https://nasaeclips.arc.nasa.gov/video/ourworld/our-world-the-sun-a-real-star

How does this magnetic field protect Earth?

Evaluate

Post-Assessment

Check students' understanding with these activities.

Identify Misconception

What is a common misconception people have about magnets and metals and how can you correct the misconception?

Discussion Questions

1. What kinds of materials do magnets attract?
2. Do all magnets attract the same materials?
3. Will magnets work in all settings, such as on the floor, under water or in space?

Carefully rewatch the NASA Spotlite videos to assess your understanding about which materials are attracted to magnets.

NASA Spotlite: Magnets and Metals

NASA eClips™ Website - https://nasaeclips.arc.nasa.gov
NASA eClips™ YouTube - https://youtu.be/4miSpNimwqw

NASA eClips™ Website - https://nasaeclips.arc.nasa.gov
NASA eClips™ YouTube https://youtu.be/_5QlwGKfHRQ

Vocabulary Review

Most asteroids are composed mainly of rocky material, along with some clays and metals. Others are made mostly of the metals iron, nickel and cobalt, and may even contain platinum and gold. How could magnetic properties be used to sort the asteroids?

Resources

Magnets and Metals Grades 3-5 Pretest / Posttest
NASA Spotlite Interactive Lesson

Read each question and select the best choice.

1. A material with a magnetic field that can attract or repel other magnetic materials is

Select the best answer.
A. an aluminum can
B. a magnet
C. a battery
D. an object made of gold

2. The region around a magnet where a magnetic force can be found is called

Select the best answer.
A. a magnetic field
B. work
C. friction
D. magnetic poles

3. Magnets attract

Select the best answer.
A. all types of metal
B. all types of plastic
C. metals containing aluminum
D. metals containing iron, cobalt or steel

4. Which of the following materials would be attracted to a magnet?

Select the best answer.
A. iron and aluminum
B. gold and silver
C. iron and steel
D. paper and plastics

5. Sarah was testing the following items to see if they could be picked up by her horseshoe magnet. Which item was she able to pick up?

A. mixed metal nickel (75% copper)

B. aluminum foil ball

C. iron screw

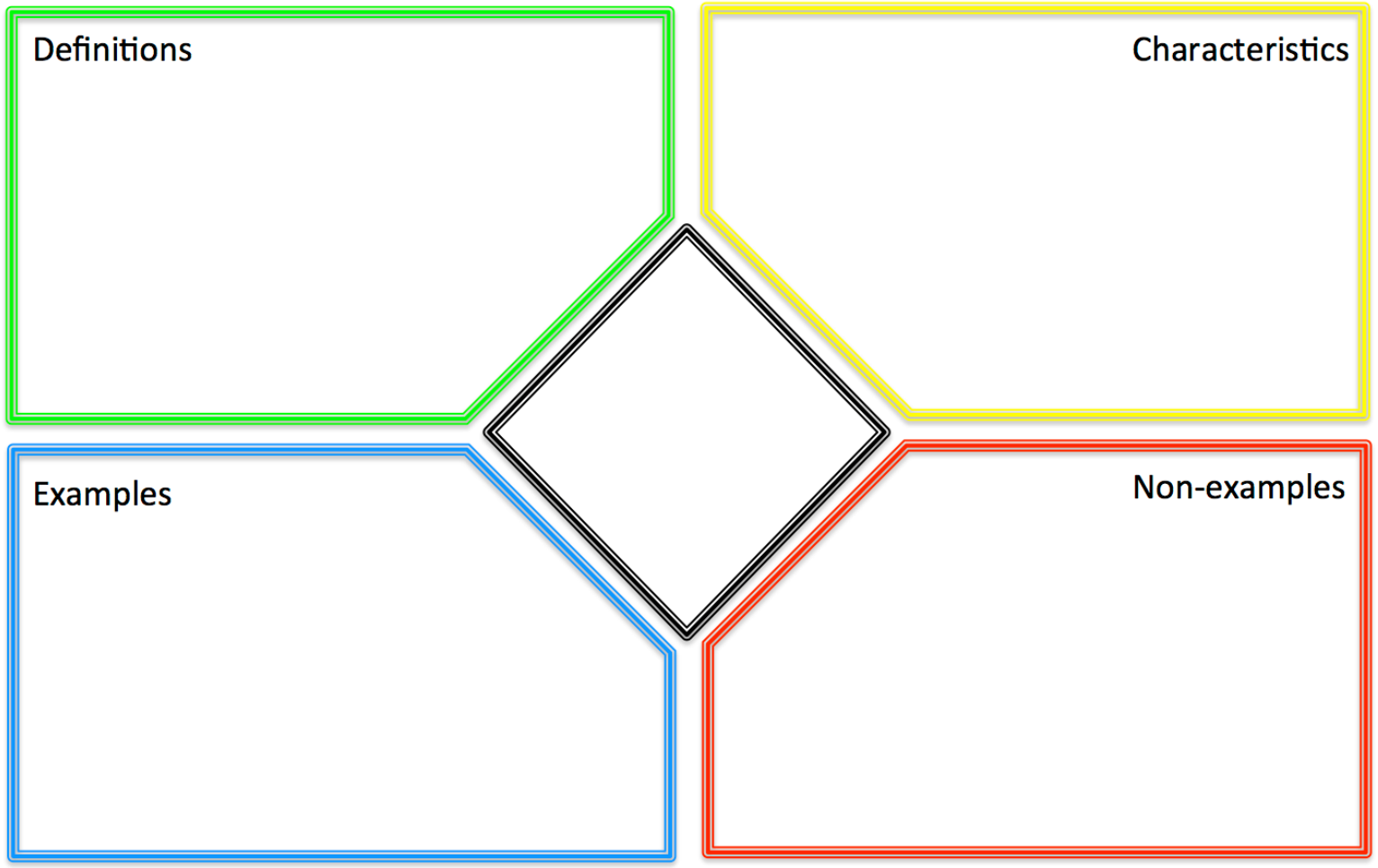
D. aluminum can

Select the best answer.
A. mixed metal nickel
B. aluminum foil ball
C. iron screw
D. aluminum can

Resources

Frayer Model for Vocabulary Development

Use the graphic organizer to write definitions, characteristics, examples and non-examples for a vocabulary word. You can include drawings, graphics, and diagrams.



Answer Key

Magnets and Metals Grades 3-5 Pretest / Posttest
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Read each question and select the best choice.

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A. an aluminum can
B. a magnet **
C. a battery
D. an object made of gold

2. The region around a magnet where a magnetic force can be found is called
A. a magnetic field **
B. work
C. friction
D. magnetic poles

3. Magnets attract
A. all types of metal.
B. all types of plastic.
C. metals containing aluminum.
D. **metals containing iron, cobalt or steel** **

4. Which of the following materials would be attracted to a magnet?
A. iron and aluminum
B. gold and silver
C. iron and steel **
D. paper and plastics

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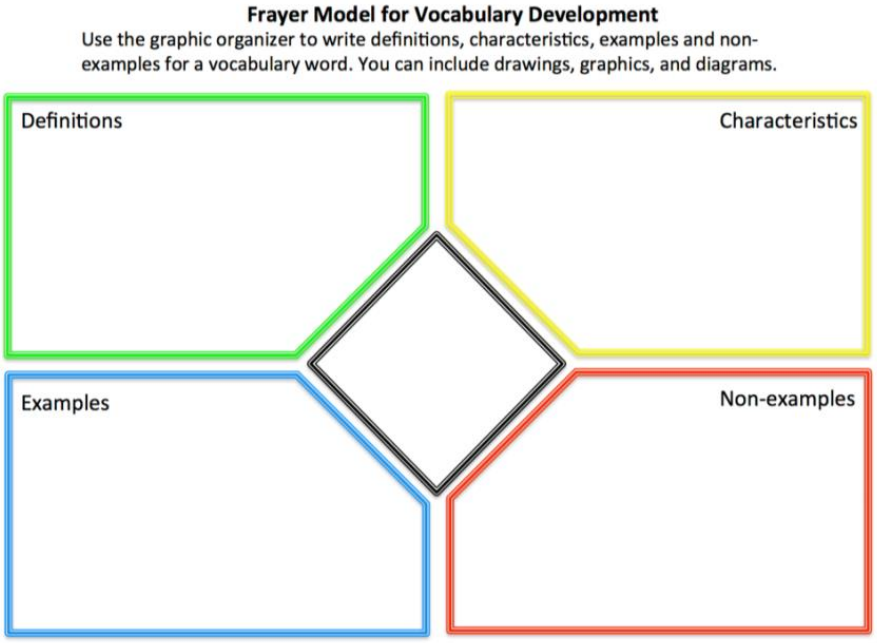
Answer Key



Vocabulary Word
Attract

Characteristics
pull together, move closer, stick, force

Examples
opposites attract, positive and negative, magnet and iron

Non-examples
repel, negative pole and negative pole

Definition
Attract means to draw together by a physical force; adhere, or unite; pull.

Product Information

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