

Lesson 2: Introduction to Metals

Getting Started

Over the next two days, you will learn about the metals. The majority of the elements on the periodic table are classified as metals. These include familiar metals like gold and silver as well as some elements you probably don't think of as metals, like potassium and calcium.

Stuff You Need

- ✓ *Fizz, Bubble, and Flash!* by Anita Brandolini, Ph.D.
- ✓ aluminum strip (kit)
- ✓ colored pencils or markers
- ✓ copper strip (kit)
- ✓ glue
- ✓ hot water
- ✓ iron strips (kit)
- ✓ magazines
- ✓ magnet (kit)
- ✓ materials as needed for your chosen metal demonstration
- ✓ paper
- ✓ periodic table of elements (provided)
- ✓ protective gloves
- ✓ scissors

Ideas to Think About

- How do water, air, energy, and magnets change different elements?
- How do we use changes to classify elements?

Things to Know

- **Luster** describes whether and how much a material shines or reflects light.
- If a material can be shaped or formed, it is described as being **malleable**. The opposite of malleable is **brittle**, meaning the material breaks with pressure rather than stretches.
- There are 6 categories of metals — the familiar transition metals and main-group metals; the less-familiar alkali metals, alkaline earth metals, and lanthanides; and the man-made and short-lived actinides.

Reading and Questions

Read pages 31, 40, 83, 100-102, and 116 of the book, *Fizz, Bubble, and Flash!*, by Anita Brandolini, Ph.D. Answer the following questions:

1. What are some properties of the main-group, transition, and lanthanide metals?

2. Name some main-group metals and transition metals that you can see from where you are sitting.

3. Name 3 familiar metals that belong to the transition metals category.

Activities

Activity 1: What's a Metal?

In your Matter Kit, you have three metal strips — one of copper, one of aluminum, and one of iron. CAUTION: Be sure to wear protective gloves when handling the metal strips since the edges may be sharp.

Use the sheet "Investigating Three Metals" to explore how the three metals are similar to and different from one another. Locate each one on the periodic table and write down what family it is in. (A full-color periodic table of elements has been included with this unit.) Explore the metals closely and make notes on the sheet about the following:

- What color is each metal?
- Is it shiny?
- Be sure you're wearing your protective gloves. Pick up each strip and see how heavy it feels.
- While wearing your protective gloves, carefully dip each strip into hot water to warm it. When you remove the strip from the water, can you bend it or change its shape? (This is called malleability.)

- Hold up the magnet and see if the metal is attracted to it.

Once you have observed and taken notes about each metal, fill in the Venn diagram at the top of the page to show the similarities and differences among the three metals.

Activity 2: A Metal Story

Use the Table of Contents on page 3 to choose a metal from the main-group, transition, or lanthanide metals families to learn more about.

Your Elements

www.movingbeyondthepage.com/link/200/

Go to the website and click on the name of the element you chose to watch a video about. Then read the pages about the element in the book. Think about what type of metal it is, what it looks like, and what it is used for.

For this activity, decide if you would like to create a collage of places where your element is used or compose a letter describing your metal as though it were a brand new discovery you have just made. If you choose a collage, find or draw pictures of products that use your metal and glue them into a collage, listing the element's name at the top of the page.

Activity 3: Prepare for Demonstrations

Talk to your parent to plan for a metal demonstration or experiment from the book.

Your parent will let you know which group of metals to choose from. Read the descriptions of the experiments in the book and choose which metal you would like to perform an experiment with. Let your parent know so you can both start gathering supplies. You will do the experiment for your chosen metal tomorrow.

Option 1

iron (page 85), zirconium (page 92), iridium (page 95), and neodymium (page 108)

Option 2

bismuth (page 37-38), copper (page 89), and lanthanum (page 104)

Activity 4: Demonstrate Your Metal

Find the sheet, "Test Your Metal," and include the information on the experiment or demonstration you chose yesterday.

The options and metals are listed below.

From the book, copy the name of the metal you are working with, what question you hope to answer, what materials you are using, and the procedure you will use.

With your parent, conduct the demonstration or experiment and make notes under the observations section. When you finish, write down the answer to your question.

Read the page after the demonstration in the book. Under "Curious Minds Want to Know," you will usually find an explanation of what should have happened and what the results tells you about that metal.

Option 1

iron (page 85), zirconium (page 92), iridium (page 95), and neodymium (page 108)

Option 2

bismuth (page 37-38), copper (page 89), and lanthanum (page 104)

Reading and Questions

Read pages 12, 21-22, 30, 117, 121 of the book, *Fizz, Bubble, and Flash!*, by Anita Brandolini, Ph.D. Answer the following questions:

1. Why are you unlikely to find alkali metals or alkaline earths on their own in nature c made into objects like spoons?

2. How long do most actinides last?

3. Find the elements aluminum, iron, sodium, and calcium — which are the most common metal elements on Earth — on the periodic table on page 10. Is one family of metals most common?

Activity 5: Characteristics of Metals, Metalloids, and Nonmetals

Find the pages called "Is it a Metal, a Metalloid, or a Nonmetal?" Review each of the questions on the chart and look back at your notes about metals.

Today you will fill out what you know about characteristics that apply to most metals. (Not all metals will share these characteristics.) Fill out as much of the Metals column as you know, and keep this sheet so you can add more information about metals later. You will also fill in the Metalloids and Nonmetals columns in future lessons.

Wrapping Up

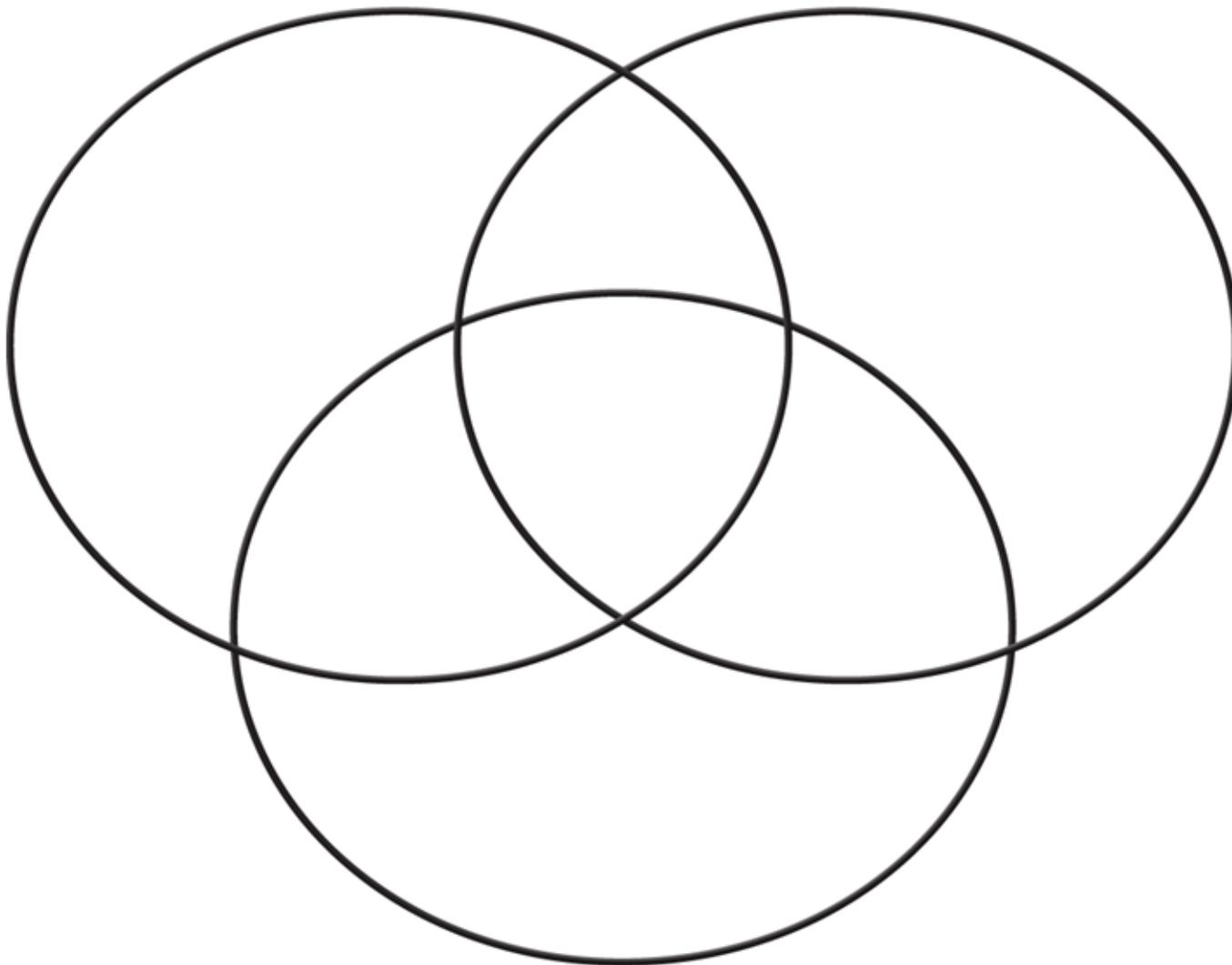
Consider the definition of a metal — metals are lustrous, malleable solids that conduct heat or electricity. Did your work with metals in this lesson match this definition?

Life Application

If it is possible to visit a jewelry-making shop or other metal-working facility, tour it and find out what metals they use. Ask a metal worker how hot his or her tools have to be to work with that metal.

Investigating Three Metals

DIRECTIONS: LOCATE EACH OF YOUR METALS ON THE PERIODIC TABLE AND WRITE DOWN ITS FAMILY NAME IN THE CORRECT OVAL. EXPLORE THE METALS CLOSELY, ANSWER THE QUESTIONS AT THE BOTTOM OF THE PAGE, AND THEN FILL IN THE DIAGRAM TO SHOW THE SIMILARITIES AND DIFFERENCES AMONG THE THREE METALS.



OBSERVATIONS:

WHAT COLOR IS EACH METAL? _____

IS IT SHINY? _____

HOW HEAVY DOES IT FEEL? _____

IF YOU PUT EACH STRIP INTO HOT WATER TO WARM IT, AND THEN REMOVE IT WEARING GLOVES, CAN YOU BEND IT OR CHANGE ITS SHAPE? THIS PROPERTY IS CALLED MALLEABILITY. IS IT MALLEABLE? _____

HOLD UP THE MAGNET AND SEE IF THE METAL IS ATTRACTED TO IT.



TEST YOUR METAL

Directions: Fill in the information about the demonstration you're going to do about the metal you have chosen.

QUESTION

MATERIALS

- *Fizz, Bubble, and Flash!* by Anita Brandolini, Ph.D



-
-
-
-

PROCEDURE

1.
2.
3.
4.
5.
6.
7.

OBSERVATIONS

When you have finished your observations, read the section "Curious Minds Want to Know" about your metal.

Is it a Metal, a Metalloid, or a Nonmetal?

METAL	METALLOID	NONMETAL
Common on Earth? IN HUMANS IN OCEANS IN EARTH'S ATMOSPHERE IN EARTH'S CRUST (circle all that apply)	Common on Earth? IN HUMANS IN OCEANS IN EARTH'S ATMOSPHERE IN EARTH'S CRUST (circle all that apply)	Common on Earth? IN HUMANS IN OCEANS IN EARTH'S ATMOSPHERE IN EARTH'S CRUST (circle all that apply)
Luster Description:	Luster Description:	Luster Description:
Common Colors:	Common Colors:	Common Colors:
Common States of Matter at Room Temperature:	Common States of Matter at Room Temperature:	Common States of Matter at Room Temperature:
Malleability: (very malleable to very brittle)	Malleability: (very malleable to very brittle)	Malleability: (very malleable to very brittle)
Dissolves in Water: YES / NO	Dissolves in Water: YES / NO	Dissolves in Water: YES / NO
Floats in Water: YES / NO	Floats in Water: YES / NO	Floats in Water: YES / NO

Is it a Metal, a Metalloid, or a Nonmetal?

METAL	METALLOID	NONMETAL
<p>Conducts Heat?</p> <p>WELL</p> <p>SLIGHTLY</p> <p>NOT AT ALL</p> <p>(circle one)</p>	<p>Conducts Heat?</p> <p>WELL</p> <p>SLIGHTLY</p> <p>NOT AT ALL</p> <p>(circle one)</p>	<p>Conducts Heat?</p> <p>WELL</p> <p>SLIGHTLY</p> <p>NOT AT ALL</p> <p>(circle one)</p>
<p>Conducts Electricity?</p> <p>WELL</p> <p>SLIGHTLY</p> <p>NOT AT ALL</p> <p>(circle one)</p>	<p>Conducts Electricity?</p> <p>WELL</p> <p>SLIGHTLY</p> <p>NOT AT ALL</p> <p>(circle one)</p>	<p>Conducts Electricity?</p> <p>WELL</p> <p>SLIGHTLY</p> <p>NOT AT ALL</p> <p>(circle one)</p>
<p>Magnetic?</p> <p>FERROMAGNETIC (very)</p> <p>PARAMAGNETIC (not)</p> <p>DIAMAGNETIC (repels)</p> <p>(circle one)</p>	<p>Magnetic?</p> <p>FERROMAGNETIC (very)</p> <p>PARAMAGNETIC (not)</p> <p>DIAMAGNETIC (repels)</p> <p>(circle one)</p>	<p>Magnetic?</p> <p>FERROMAGNETIC (very)</p> <p>PARAMAGNETIC (not)</p> <p>DIAMAGNETIC (repels)</p> <p>(circle one)</p>
<p>Additional Notes:</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>Additional Notes:</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>Additional Notes:</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>

Parent Overview

Lesson 2: Introduction to Metals

Getting Started

? Big Ideas

- How do water, air, energy, and magnets change different elements?
- How do we use changes to classify elements?



Facts and Definitions

- **Luster** describes whether and how much a material shines or reflects light.
- If a material can be shaped or formed, it is described as being **malleable**. The opposite of malleable is **brittle**, meaning the material breaks with pressure rather than stretches.
- There are 6 categories of metals — the familiar transition metals and main-group metals; the less-familiar alkali metals, alkaline earth metals, and lanthanides; and the man-made and short-lived actinides.

⦿ Skills

- Know the differences between elements and compounds. It is important that students learn the differences between elements and compounds based on observation, description of physical properties, and chemical reactions. Elements are represented by chemical symbols, while compounds are represented by chemical formulas. (S)
- Classify matter based on physical properties including mass. (S)
- Understand that elements are classified as metals, nonmetals, and metalloids based on their physical properties. The elements are divided into three groups on the periodic table. (S)

Introducing the Lesson

Ask your child what he already knows about metals. Ask him if any of the elements on the periodic table during Lesson 1 sounded familiar and talk about why.

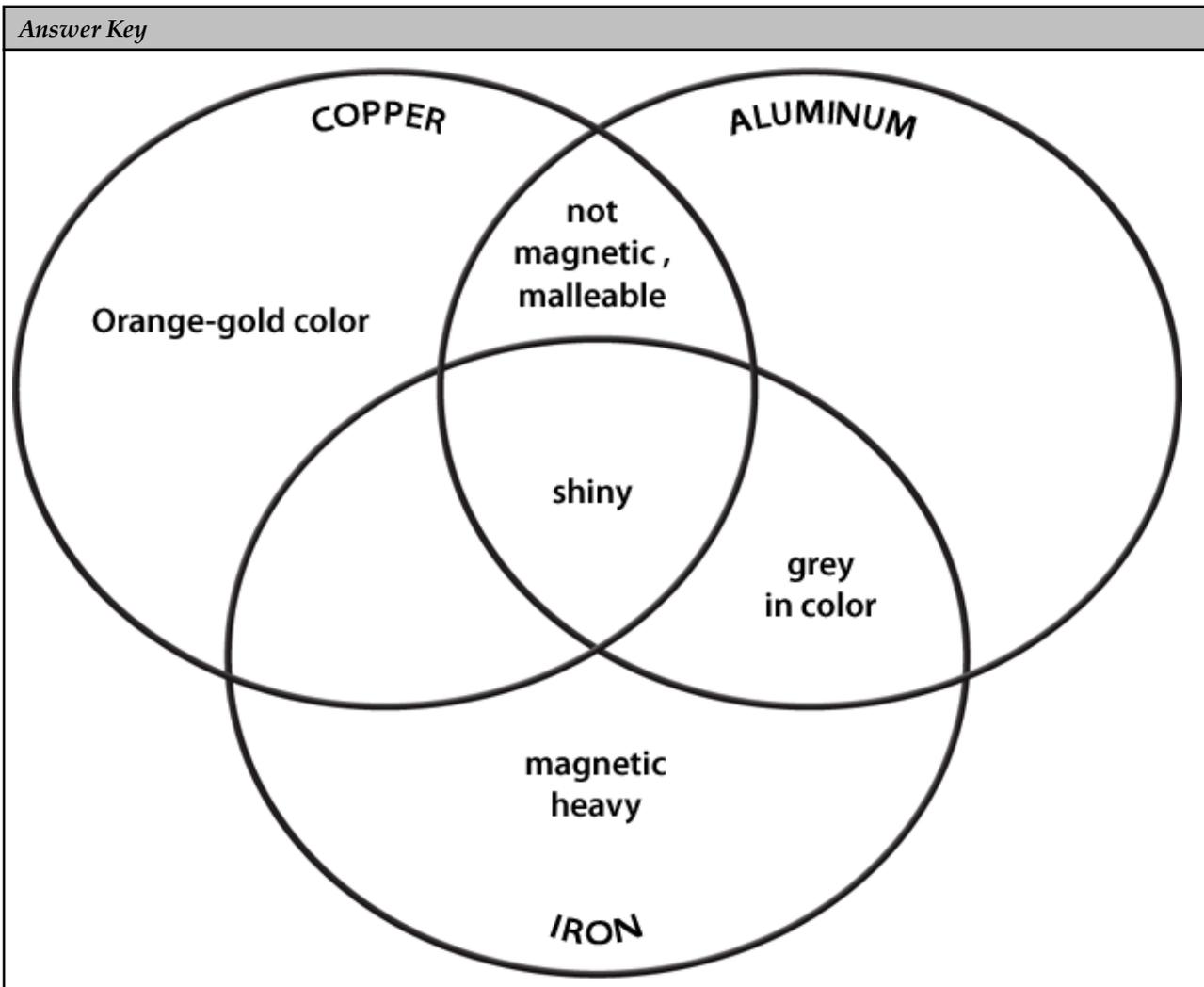
Reading and Questions (Answers)

1. What are some properties of the main-group, transition, and lanthanide metals?
 - Shiny, conduct heat and electricity, strong, heavy, solid.
2. Name some main-group metals and transition metals that you can see from where you are sitting.
 - Answers will vary.
3. Name 3 familiar metals that belong to the transition metals category.
 - Answers will vary but may include silver, copper, zinc, gold, iron, nickel, platinum, or mercury.

Outline of Activities and Answer Keys

Activity 1: What's a Metal?

Your child will explore metal strips made of aluminum, copper, and iron. CAUTION: Be sure that your child wears protective gloves when handling the metal strips since the edges may be sharp. For this activity, he will need to put on gloves, dip each strip into a glass of hot water, and then try to bend each strip. Make sure that he is careful with the metal strips and the hot water. Observe and assist him as needed. Then he will complete a diagram comparing the 3 metals.



Activity 2: A Metal Story

Your child will create a collage or a letter about a metal after he learns about it from the book and from videos online. If he needs help locating the video, he can search "University of Nottingham" and the name of his element (e.g. bismuth) to locate it.

Activity 3: Prepare for Demonstrations

Your child will complete one of the demonstrations or experiments in the book about a metal. You should let your child know which elements he can choose from.

Option 1

The demonstrations for the metals iron, zirconium, iridium, and neodymium are easier.

Option 2

The demonstrations for the metals bismuth, copper, and lanthanum are more challenging.

Activity 4: Demonstrate Your Metal

Today your child will conduct the demonstration from the book for the metal he chose. Provide support and guidance as needed.

Option 1

iron (page 85), zirconium (page 92), iridium (page 95), and neodymium (page 108)

NOTE: For the iron demonstration, your child will need to crush the cereal as finely as possible (ideally to almost a powder) and use only a small amount spread very thinly on the paper. If he doesn't see anything move, encourage him to mix up the crushed cereal and try again with a new spoonful.

Option 2

bismuth (page 37-38), copper (page 89), and lanthanum (page 104)

Today your child will conduct the demonstration from the book for the metal he chose. Provide support and guidance as needed.

Reading and Questions (Answers)

1. Why are you unlikely to find alkali metals or alkaline earths on their own in nature or made into objects like spoons?
 - Because they react with oxygen in air or water and don't exist long on Earth outside of compounds.
2. How long do most actinides last?
 - Seconds or less. Most are created by scientists in laboratories.
3. Find the elements aluminum, iron, sodium, and calcium — which are the most common metal elements on Earth — on the periodic table on page 10. Is one family of metals most common?
 - No, there is one element from each of four metal families: alkali metals, alkaline earth metals, transition metals, and main-group metals. There are no common elements on Earth from the lanthanide or actinide metals group however.

Activity 5: Characteristics of Metals, Metalloids, and Nonmetals

Your child will fill out what he has learned about metals so far on the chart "Is it a Metal, a Metalloid, or a Nonmetal?" Note that he will indicate characteristics that apply to most metals. (Not all metals will share these characteristics.) Remind him to keep this sheet to add more information on future days.

Answer Key

METAL	
Common on Earth? <input checked="" type="checkbox"/> IN HUMANS <input type="checkbox"/> IN OCEANS <input type="checkbox"/> IN EARTH'S ATMOSPHERE <input checked="" type="checkbox"/> IN EARTH'S CRUST (circle all that apply)	Conducts Heat? <input checked="" type="checkbox"/> WELL <input type="checkbox"/> SLIGHTLY <input type="checkbox"/> NOT AT ALL (circle one)
Luster Description: <i>shiny</i>	Conducts Electricity? <input checked="" type="checkbox"/> WELL <input type="checkbox"/> SLIGHTLY <input type="checkbox"/> NOT AT ALL (circle one)
Common Colors: <i>grey</i>	Magnetic? <input checked="" type="checkbox"/> FERROMAGNETIC (very) <input type="checkbox"/> PARAMAGNETIC (not) <input type="checkbox"/> DIAMAGNETIC (repels) (circle one)
Common States of Matter at Room Temperature: <i>solid</i>	Malleability: <i>very malleable</i> (very malleable to very brittle)
Dissolves in Water: YES / <input checked="" type="checkbox"/> NO	Floats in Water: YES / <input checked="" type="checkbox"/> NO

Wrapping Up

Questions to Discuss

- What characteristics did all the metals you tried have in common?
- What metals do you see around us as compounds and elements?

Things to Review

Review the definitions of *luster*, *brittle*, and *malleable* as well as the six categories of metals that your child has learned about – transition metals, main-group metals, alkali metals, alkaline earths, lanthanides, and actinides.

Special Notes

If it is possible to take your child to visit a jewelry-making shop or other metal-working facility, go and tour it and find out what metals they use. Have your child ask a metal worker questions about his or her work with metals.