DAY 26 Compare Elements & Compounds, Part 1

This lesson is the first half of contrasting case activity 3.1, and it is the first lesson of chapter 3, *Elements, Compounds, and Mixtures*.

Big Idea

- Compounds are made up of elements, but their properties are different from the properties of the elements they contain.

Materials

Teacher:

1. slides – day26.ppt

Students:

1. description cards – worksheets 13-15
2. data table – worksheet 16

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
35 minutes – cc activity – Compare Elements & Compounds, part 1

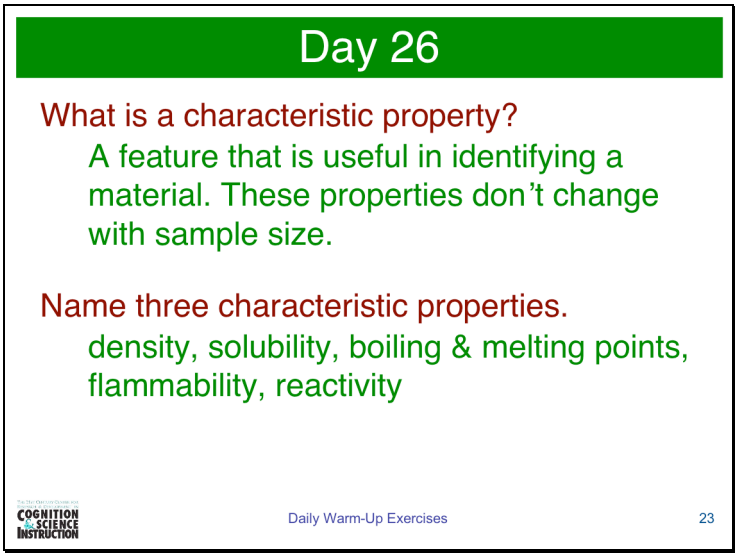
Compare Elements & Compounds, part 1

In part 1, students examine cards that describe elements and compounds, and they complete a table designed to help them focus on key features. In part 2, they use a Venn diagram to depict similarities and differences between elements and compounds. The activity ends with a discussion of some of the properties of the elements and compounds included on the cards.

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 26 – Compare Elements & Compounds 1

Warm-Up Activity

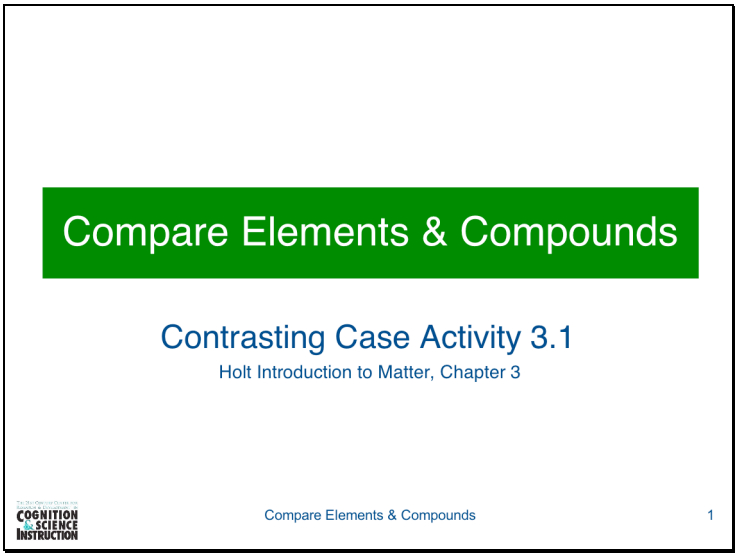


What is a material?
the kind of stuff something is made of

What is density?
the amount of matter in a given amount of space; heaviness-for-size

Day 26 – Compare Elements & Compounds 1

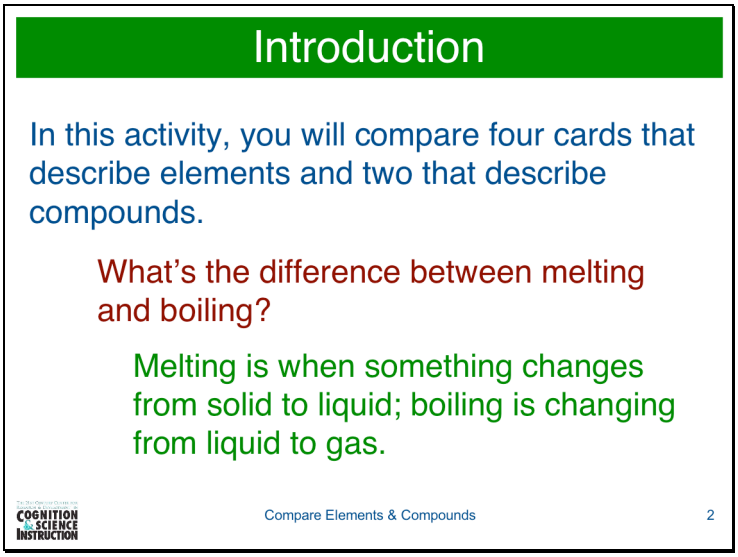
Compare Elements & Compounds, part 1 (cont.)



In this activity, students compare four cards that describe elements and two that describe compounds. The four elements are oxygen, hydrogen, sodium, and chlorine, and the two compounds are water and salt. After identifying similarities among the elements and among the compounds, students complete a Venn diagram to depict similarities and differences. The concluding discussion focuses on comparing the properties of elements with the properties of compounds that contain those elements.

Day 26 – Compare Elements & Compounds 1

Compare Elements & Compounds, part 1 (cont.)



The hydrogen card refers to the Hindenburg disaster. If your students are not familiar with this event, you can use the next slide to tell them about it.

Day 26 – Compare Elements & Compounds 1

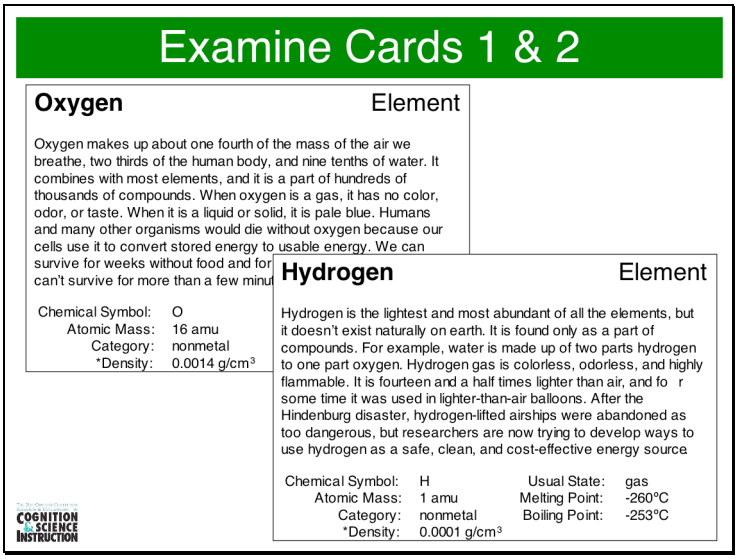
Compare Elements & Compounds, part 1 (cont.)



The Hindenburg was a German airship designed to carry 50 passengers in luxury and comfort. The hydrogen-lifted airship made its first successful crossing of the Atlantic on May 6, 1937. It was scheduled to land at the Lakehurst Naval Air Station in New Jersey. Friends and family gathered to watch the arrival of the lighter-than-air craft, along with reporters and newsreel cameras. As the ship was attempting to dock with its mooring mast, it suddenly burst into flame. The ship was destroyed within one minute, but many on board survived. Of the 36 passengers and 61 crew, only 13 passengers and 22 crew died. Also killed was one member of the ground crew. There are a variety of theories about what started the fire and why it burned so quickly, but the actual cause of the fire remains unknown.

Day 26 – Compare Elements & Compounds 1

Compare Elements & Compounds, part 1 (cont.)

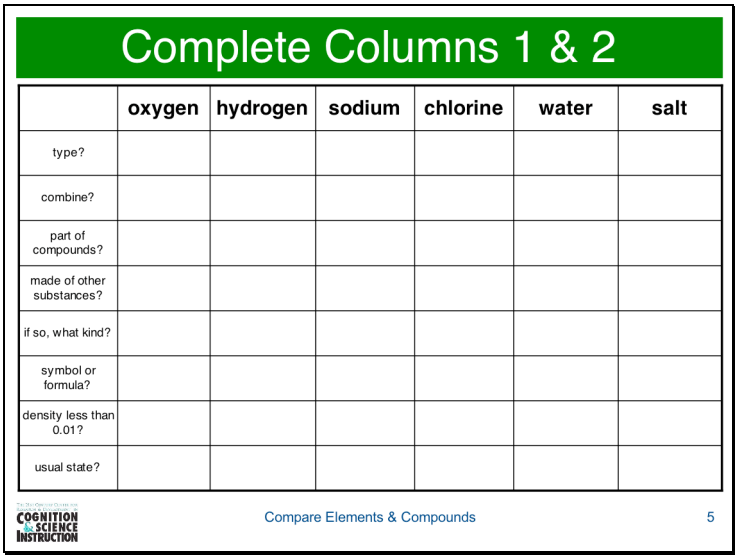


Distribute the description cards (worksheets 13-15) and ask students to examine the first two (Oxygen & Hydrogen). Some of the headings at the bottom of the cards will be unfamiliar. Tell students they will learn about the details later in the unit. For now, we're just looking for patterns and trying to get a general idea about the difference between compounds and elements.

Read through the paragraphs with your students. Encourage them to rephrase key ideas in their own words.

Day 26 – Compare Elements & Compounds 1

Compare Elements & Compounds, part 1 (cont.)

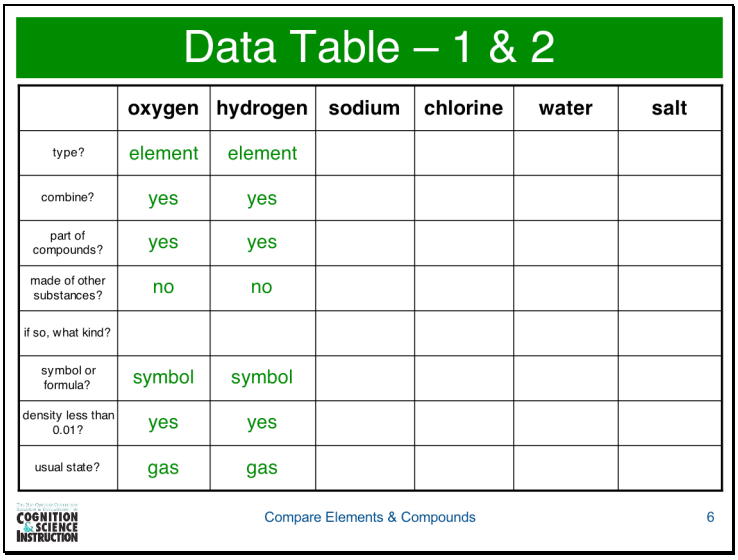


Distribute the data table (worksheet 16) and have students work in pairs to complete the first two columns. [The abridged questions in the first column are for your use when going over the answers with your students. See the student worksheets for the complete questions.]

The next slide shows the completed columns.

Day 26 – Compare Elements & Compounds 1

Compare Elements & Compounds, part 1 (cont.)



Data Table – 1 & 2

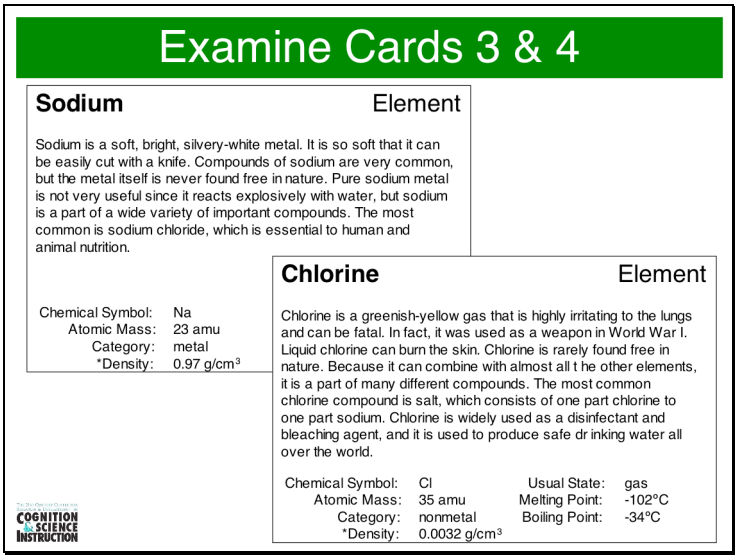
	oxygen	hydrogen	sodium	chlorine	water	salt
type?	element	element				
combine?	yes	yes				
part of compounds?	yes	yes				
made of other substances?	no	no				
if so, what kind?						
symbol or formula?	symbol	symbol				
density less than 0.01?	yes	yes				
usual state?	gas	gas				

Answers appear one-by-one on keypress.

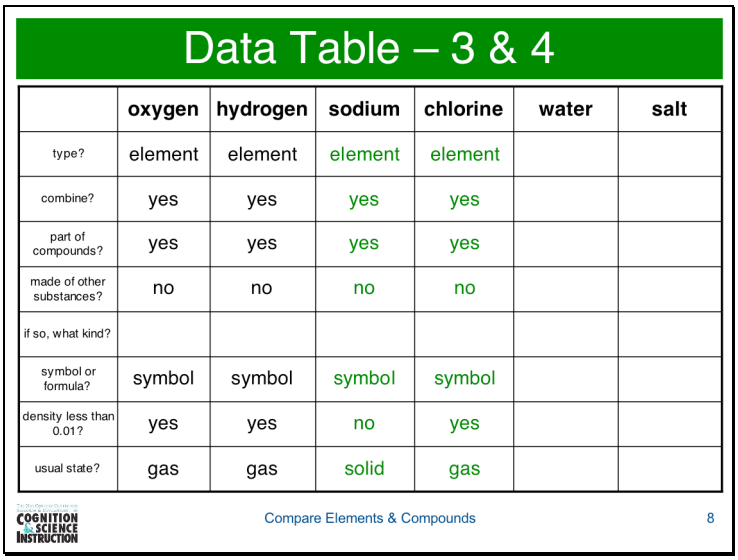
THE 21ST CENTURY CENTER FOR RESEARCH & DEVELOPMENT IN COGNITION & SCIENCE INSTRUCTION

Day 26 – Compare Elements & Compounds 1

Compare Elements & Compounds, part 1 (cont.)



Ask students to examine the next two cards (Sodium & Chlorine). Read through the paragraphs with your students, then have them complete columns 3 & 4 of the data table.



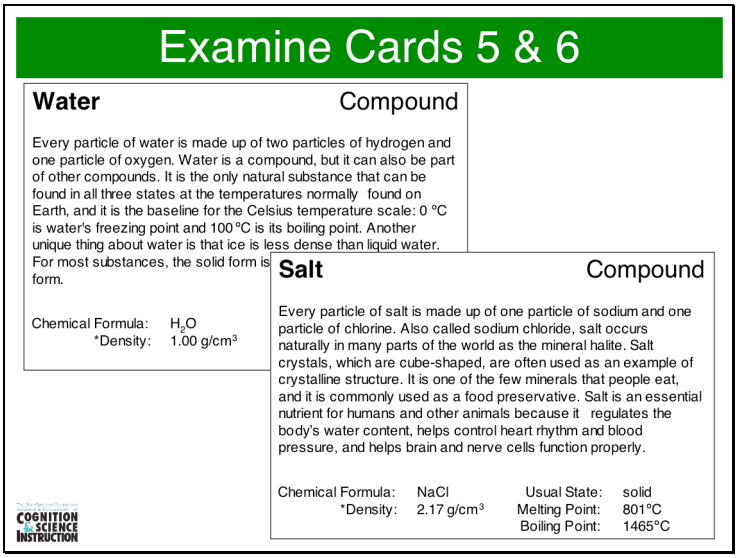
	oxygen	hydrogen	sodium	chlorine	water	salt
type?	element	element	element	element		
combine?	yes	yes	yes	yes		
part of compounds?	yes	yes	yes	yes		
made of other substances?	no	no	no	no		
if so, what kind?						
symbol or formula?	symbol	symbol	symbol	symbol		
density less than 0.01?	yes	yes	no	yes		
usual state?	gas	gas	solid	gas		

Answers appear one-by-one on keypress.

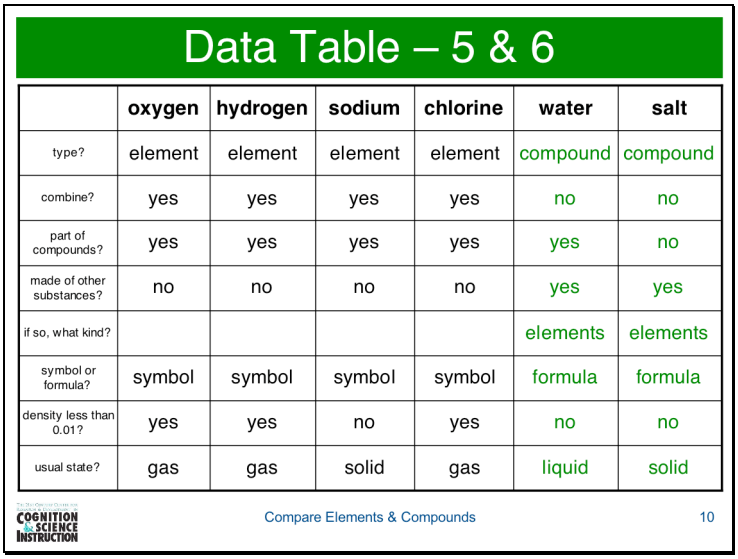
The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 26 – Compare Elements & Compounds 1

Compare Elements & Compounds, part 1 (cont.)



Examine the next two cards with your students, then have them complete columns 5 & 6 of the data table.



	oxygen	hydrogen	sodium	chlorine	water	salt
type?	element	element	element	element	compound	compound
combine?	yes	yes	yes	yes	no	no
part of compounds?	yes	yes	yes	yes	yes	no
made of other substances?	no	no	no	no	yes	yes
if so, what kind?					elements	elements
symbol or formula?	symbol	symbol	symbol	symbol	formula	formula
density less than 0.01?	yes	yes	no	yes	no	no
usual state?	gas	gas	solid	gas	liquid	solid

Answers appear one-by-one on keypress.

Day 26 – Compare Elements & Compounds 1

Worksheet 13

Compare Elements & Compounds 13

Oxygen — Element

Oxygen makes up about one fourth of the mass of the air we breathe, two thirds of the human body, and nine tenths of water. It combines with most elements, and it is a part of hundreds of thousands of compounds. When oxygen is a gas, it has no color, odor, or taste. When it is a liquid or solid, it is pale blue. Humans and many other organisms would die without oxygen because our cells use it to convert stored energy to usable energy. We can survive for weeks without food and for days without water, but we can't survive for more than a few minutes without oxygen.

Chemical Symbol:	O	Usual State:	gas
Atomic Mass:	16 amu	Melting Point:	-219°C
Category:	nonmetal	Boiling Point:	-183°C
*Density:	0.0014 g/cm^3		

*at 20°C and 1.0 atm

Hydrogen — Element

Hydrogen is the lightest and most abundant of all the elements, but it doesn't exist naturally on earth. It is found only as a part of compounds. For example, water is made up of two parts hydrogen to one part oxygen. Hydrogen gas is colorless, odorless, and highly flammable. It is fourteen and a half times lighter than air, and for some time it was used in lighter-than-air balloons. After the Hindenburg disaster, hydrogen-lifted airships were abandoned as too dangerous, but researchers are now trying to develop ways to use hydrogen as a safe, clean, and cost-effective energy source.

Chemical Symbol:	H	Usual State:	gas
Atomic Mass:	1 amu	Melting Point:	-260°C
Category:	nonmetal	Boiling Point:	-253°C
*Density:	0.0001 g/cm^3		

*at 20°C and 1.0 atm

Chapter 3 – Elements, Compounds, and Mixtures

Day 26 – Compare Elements & Compounds 1

Worksheet 14

Compare Elements & Compounds 14

Sodium — Element

Sodium is a soft, bright, silvery-white metal. It is so soft that it can be easily cut with a knife. Compounds of sodium are very common, but the metal itself is never found free in nature. Pure sodium metal is not very useful since it reacts explosively with water, but sodium is a part of a wide variety of important compounds. The most common is sodium chloride, which is essential to human and animal nutrition.

Chemical Symbol:	Na	Usual State:	solid
Atomic Mass:	23 amu	Melting Point:	98°C
Category:	metal	Boiling Point:	883°C
*Density:	0.97 g/cm^3		

*at 20ºC and 1.0 atm

Chlorine — Element

Chlorine is a greenish-yellow gas that is highly irritating to the lungs and can be fatal. In fact, it was used as a weapon in World War I. Liquid chlorine can burn the skin. Chlorine is rarely found free in nature. Because it can combine with almost all the other elements, it is a part of many different compounds. The most common chlorine compound is salt, which consists of one part chlorine to one part sodium. Chlorine is widely used as a disinfectant and bleaching agent, and it is used to produce safe drinking water all over the world.

Chemical Symbol:	Cl	Usual State:	gas
Atomic Mass:	35 amu	Melting Point:	-102°C
Category:	nonmetal	Boiling Point:	-34°C
*Density:	0.0032 g/cm^3		

*at 20ºC and 1.0 atm

Chapter 3 – Elements, Compounds, and Mixtures

Day 26 – Compare Elements & Compounds 1

Worksheet 15

Compare Elements & Compounds 15

Water — Compound

Every particle of water is made up of two particles of hydrogen and one particle of oxygen. Water is a compound, but it can also be part of other compounds. It is the only natural substance that can be found in all three states at the temperatures normally found on Earth, and it is the baseline for the Celsius temperature scale: 0ºC is water's freezing point and 100ºC is its boiling point. Another unique thing about water is that ice is less dense than liquid water. For most substances, the solid form is more dense than the liquid form.

Chemical Formula:	H_2O	Usual State:	liquid
*Density:	1.00 g/cm^3	Melting Point:	0°C
		Boiling Point:	100°C

*at 20ºC and 1.0 atm

Salt — Compound

Every particle of salt is made up of one particle of sodium and one particle of chlorine. Also called sodium chloride, salt occurs naturally in many parts of the world as the mineral halite. Salt crystals, which are cube-shaped, are often used as an example of crystalline structure. It is one of the few minerals that people eat, and it is commonly used as a food preservative. Salt is an essential nutrient for humans and other animals because it regulates the body's water content, helps control heart rhythm and blood pressure, and helps brain and nerve cells function properly.

Chemical Formula:	NaCl	Usual State:	solid
*Density:	2.17 g/cm^3	Melting Point:	801°C
		Boiling Point:	1465°C

*at 20ºC and 1.0 atm

Chapter 3 – Elements, Compounds, and Mixtures

Day 26 – Compare Elements & Compounds 1

Worksheet 16

Compare Elements & Compounds – Data Table 16

	oxygen	hydrogen	sodium	chlorine	water	salt
Is it an element or compound?						
Does it combine with elements?						
Is it part of one or more compounds?						
Is it made up of particles of other substances?						
If so, what kind? (elements or compounds)						
What kind of chemical representation does it have? (symbol or formula)						
Is its density less than 0.01 g/cm^3?						
What is its usual state?						

Chapter 3 – Elements, Compounds, and Mixtures

DAY 27 Compare Elements & Compounds, Part 2

This lesson is the second half of contrasting case activity 3.1.

Big Idea

- Compounds are made up of elements, but their properties are different from the properties of the elements they contain.

Materials

Teacher:

1. slides – day27.ppt

Students:

1. description cards – worksheets 13-15
2. data table, Venn diagram & density scale – worksheets 16-18

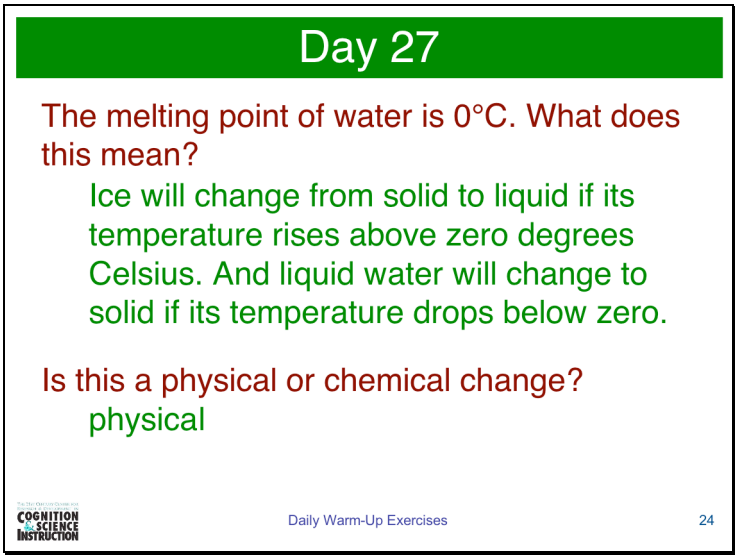
Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
35 minutes – cc activity – Compare Elements & Compounds, part 2

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 27 – Compare Elements & Compounds 2

Warm-Up Activity



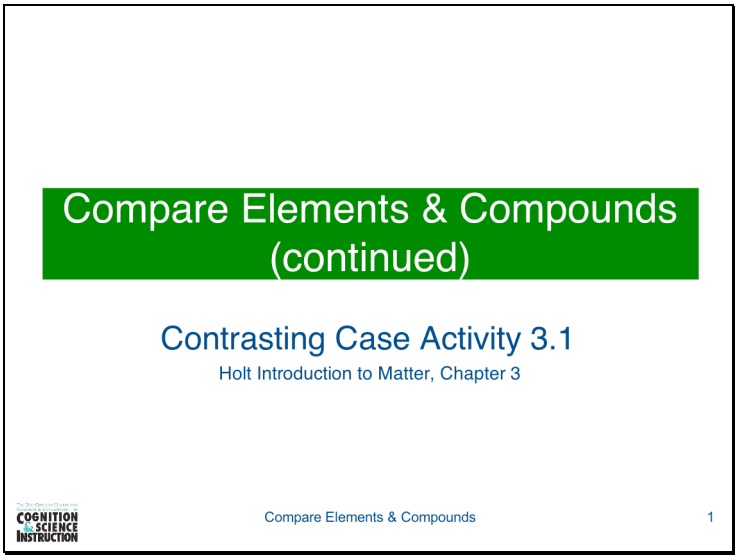
We could also refer to melting point as what?
freezing point

What must happen in order for a substance to change its state?
it must gain or lose energy

When a substance is changing from one state to another, what happens to its temperature?
temperature stays the same

Day 27 – Compare Elements & Compounds 2

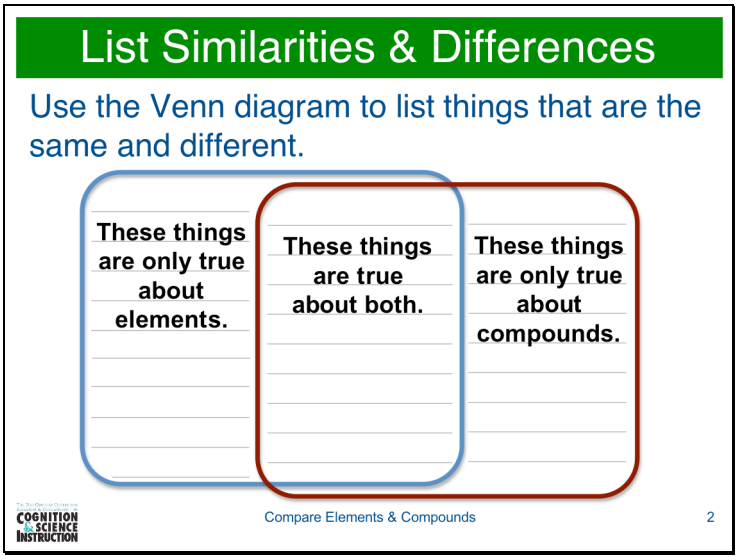
Compare Elements & Compounds, part 2



This is the second half of this contrasting case activity. Students complete a Venn diagram to depict similarities and differences. The concluding discussion focuses on comparing the properties of elements with the properties of compounds that contain those elements.

Day 27 – Compare Elements & Compounds 2

Compare Elements & Compounds, part 2

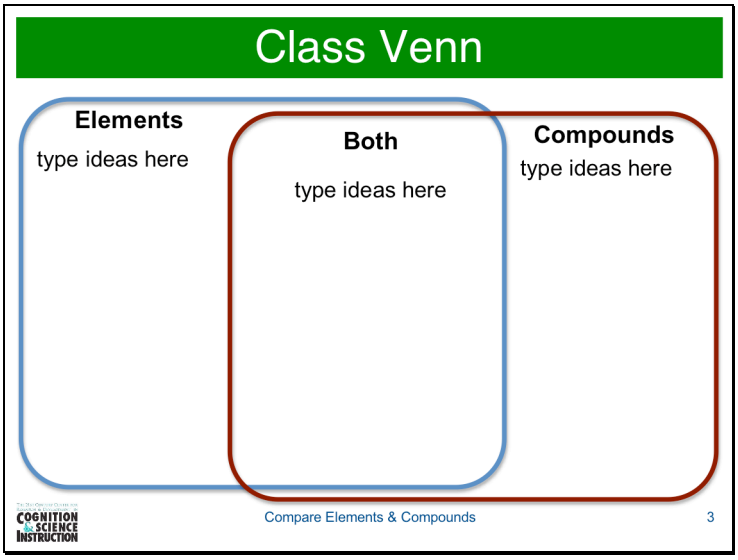


Distribute the Venn diagram (worksheet 17) and have students work in pairs or groups, then share their ideas with the class. The data table (worksheet 16) should make it easy for students to identify differences, but they may need some help to identify similarities. As they work, use questions to help them see that all the cards include information about density, which is heaviness-for-size or mass-per-volume. If all the examples have density, then they all have mass and volume. Since matter is anything that has mass and takes up space, both elements and compounds are kinds of matter. Similarly, all the cards list melting and boiling points, so both elements and compounds can change to a solid, liquid, or gas.

The next slide contains a blank Venn that you can use to display your students' ideas.

Day 27 – Compare Elements & Compounds 2

Compare Elements & Compounds, part 2 (cont.)



(Click Escape to stop the slide show. After typing in their ideas, click the slide show icon at the bottom of the window to display the table.) Some ideas your students may come up with:

Same

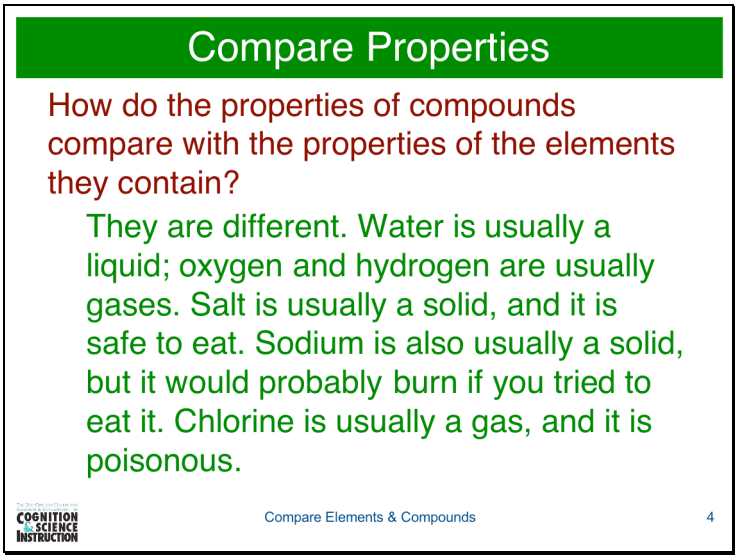
- both are kinds of matter
- both have some kind of chemical representation

Different

- elements can combine to form compounds; compounds are made up of elements or other compounds
- elements are represented by chemical symbols; compounds are represented by chemical formulas

Day 27 – Compare Elements & Compounds 2

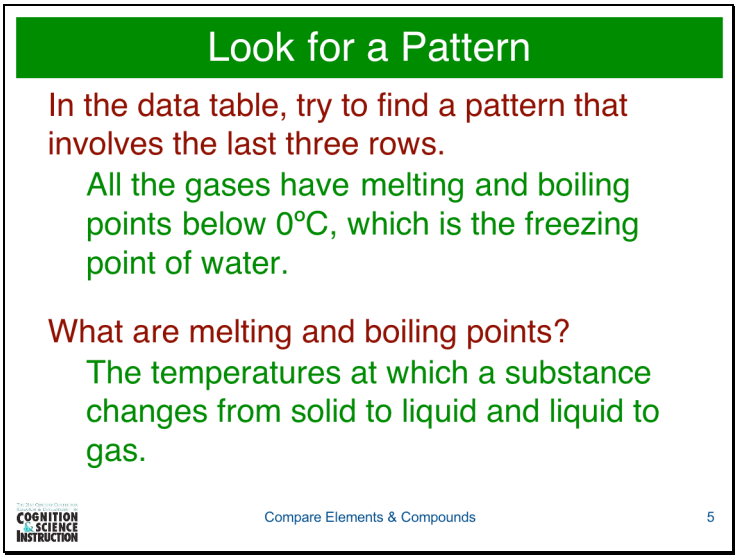
Compare Elements & Compounds, part 2 (cont.)



Your students will probably find many more differences than are included on the slide. The point is that the properties of compounds do not match the properties of the elements they contain.

Day 27 – Compare Elements & Compounds 2

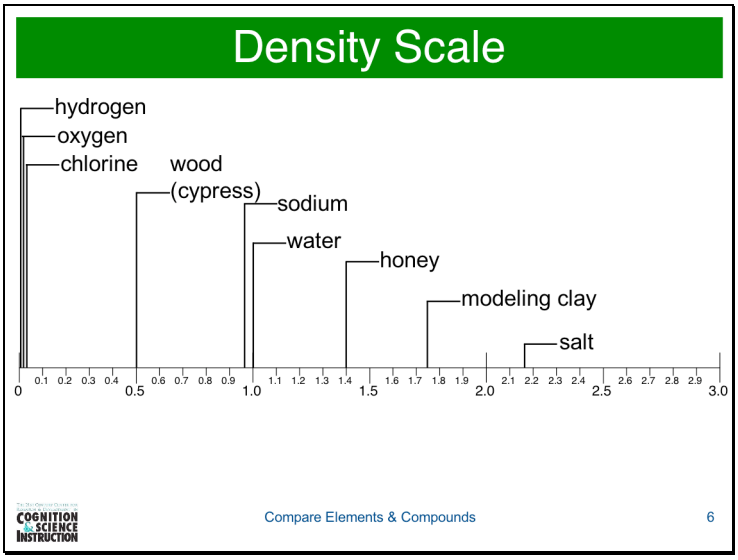
Compare Elements & Compounds, part 2 (cont.)



Remind students that the temperature is the same for the opposite process. In other words, if a gas is cooled to its boiling point, it will change to a liquid. So boiling point could also be called the condensation point. If a liquid is cooled to its melting point, it will change to a solid. So melting point could also be called freezing point.

Day 27 – Compare Elements & Compounds 2

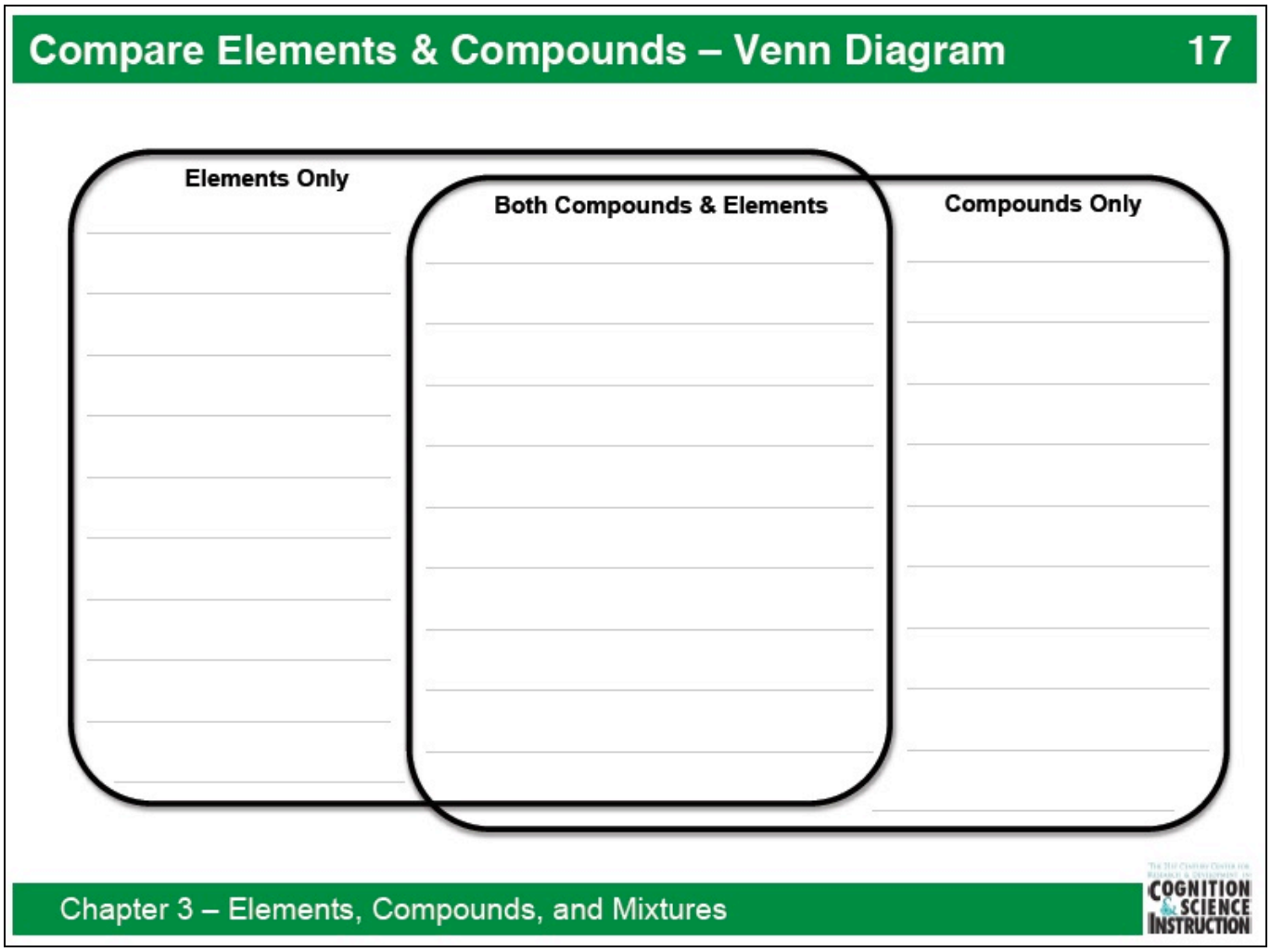
Compare Elements & Compounds, part 2 (cont.)



Use questions to help students notice that the three gases are all clustered at the far left side of the scale. You might also ask students what they learned about floating and sinking in chapter 1 (see page 12). They should recall that materials that are less dense than water will float in water, and materials that are more dense will sink.

Day 27 – Compare Elements & Compounds 2

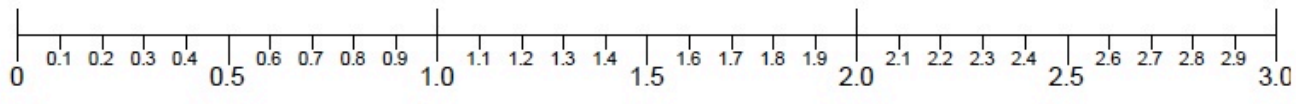
Worksheet 17



Day 27 – Compare Elements & Compounds 2

Worksheet 18

Compare Elements & Compounds – Density Scale 18



Material	Density (g/cm^3)
oxygen	0.0014
hydrogen	0.0001
sodium	0.97
chlorine	0.0032
water	1.00
salt	2.17
modeling clay	1.75
wood (cypress)	0.50
honey	1.40

Chapter 3 – Elements, Compounds, and Mixtures

DAY 28

Elements

This lesson covers section 3.1 (pages 56-59) and includes two visualization exercises and a quick lab.

Big Idea

- An element is a pure substance that cannot be physically or chemically separated into simpler substances.

Materials

Teacher:

1. visualization exercise slides – day28.ppt

Students:

1. bar magnet
2. mixed sample of iron and aluminum nails
3. element cards – worksheets 13-14

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
2 minutes – visualization 3.1a – Labeling
3 minutes – visualization 3.1b – Use of Colors
20 minutes – chapter 3.1 – *Elements*
10 minutes – quick lab – *Separating Elements* – page 57

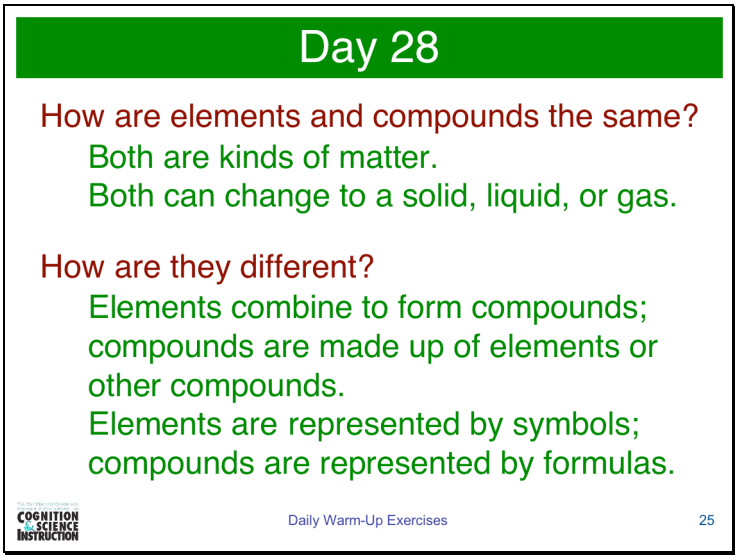
Chapter 3.1 – Elements

Part 3, *Classifying Elements by Their Properties*, introduces three categories of elements: metals, nonmetals, and metalloids. The text points out that, if you know which category an element is in, you can predict some of its properties. Have students look again at the element cards from cc 3.1 and use the information in Figure 4 on page 59 to make predictions based on category. For example, sodium is probably shiny, and hydrogen and chlorine are probably poor conductors of heat and electricity.

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 28 – Elements

Warm-Up Activity



What is matter?
the "stuff" that makes up the physical universe;
anything that has mass and takes up space

Day 28 – Elements

Visualization Exercise 3.1a – Labeling

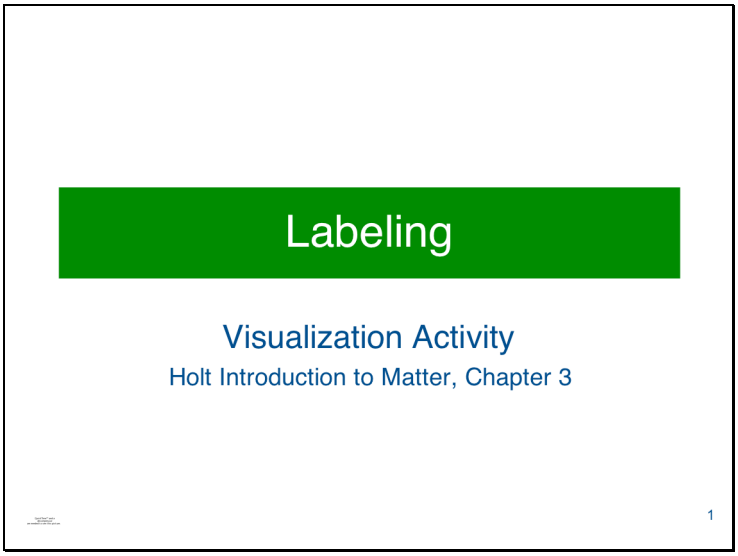


Image comprehension focus: Labeling

Goal: Maintenance on understanding the role of different types of labels and their importance in image comprehension.

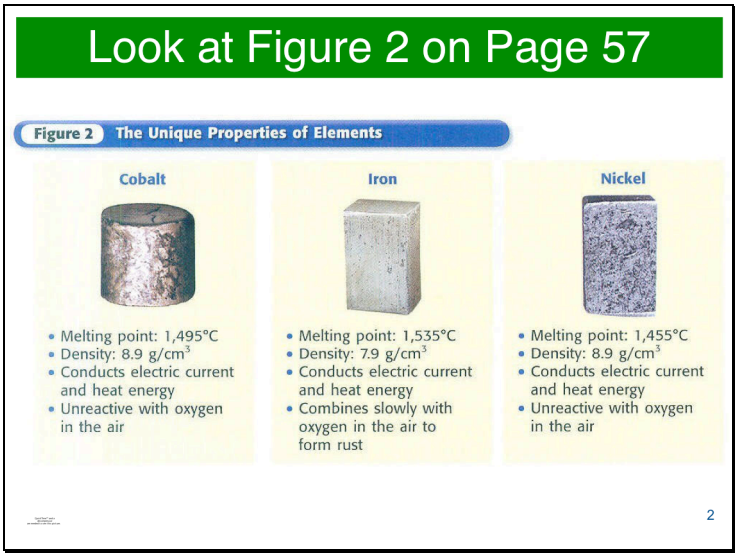
Module Activity: Student Activity

Overview: This activity is designed to provide an additional opportunity for students to practice using labels to interpret a diagram. Periodic opportunities for students to focus on labels and the information that they provide is intended to reinforce the idea that labels are important as well as develop the good habit of reading labels when looking at diagrams. This habit is important when trying to develop strong image comprehension skills.

(Proceed to the next slide)

Day 28 – Elements

Visualization Exercise 3.1a – Labeling (cont.)



Student activity: Teacher has students look at Figure 2 on Page 57 and have them identify the labels (as naming or explanatory labels) as well as describe the function of the naming and explanatory labels.

Teacher should then comment on their answers and give the correct answers: Naming labels ("Cobalt", "Iron", "Nickel") are used to identify diagrams or parts of the diagram; Explanatory labels (the bulleted points under the three images) are used to provide more information about a part of a diagram.

(End of Activity)

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 28 – Elements

Visualization Exercise 3.1b – Use of Colors

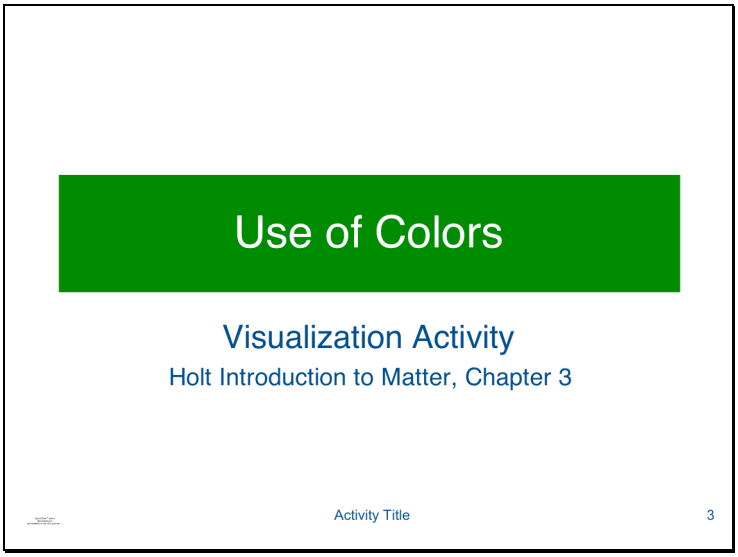


Image comprehension focus: Color

Goal: To understand how colors can be used to indicate similar ideas between different images.

Type of Activity: Teacher guided student activity

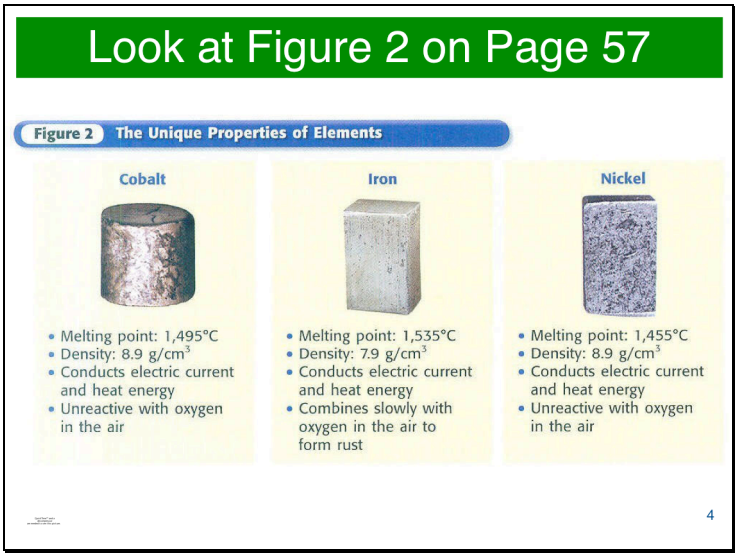
Overview: The purpose of this activity is to make explicit the idea that color is one important element to pay attention to in order to accurately comprehend the meaning of the diagram and that color can be used to connect similar ideas between different images.

(Proceed to the next slide)

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 28 – Elements

Visualization Exercise 3.1b – Use of Colors (cont.)



Student activity: Teacher has students take another look at Figure 2 on page 57, pointing out how each explanatory label under an element corresponds to other explanatory labels under the other elements. For example, each element has an explanatory label for 'Melting point,' one for 'Density,' etc.

Teacher should then ask students what could be done with the labels in order to make this idea clear.

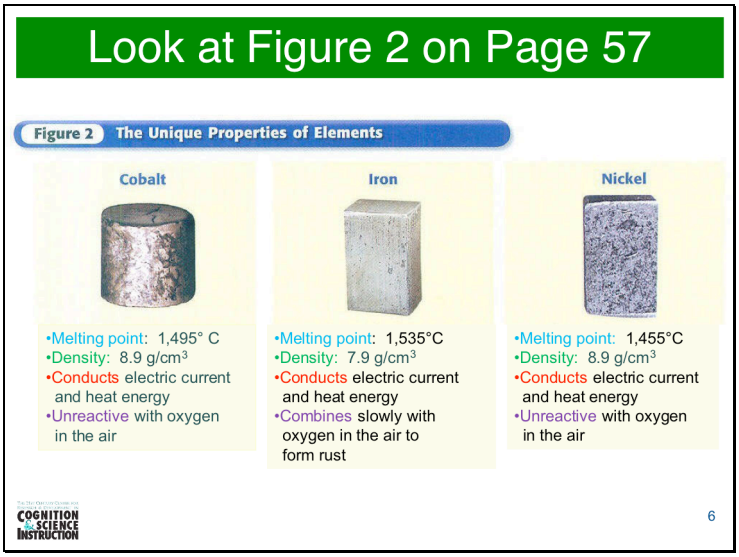
Students may come up with several different ideas. For example, students may suggest the use of different types of bullets, font types, or a numbering system.

(Proceed to the next slide)

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 28 – Elements

Visualization Exercise 3.1b – Use of Colors (cont.)



After students come up with their own ideas, the teacher shows how labels could be color-coded in order to show that labels can point out the same properties for different images.

DAY 29

Comprehensive Review

This lesson provides an opportunity for students to prepare for quiz 5, which is a full-period quiz that will cover everything they've learned so far (chapters 1 and 2 and the first section of chapter 3).

Big Ideas

- See list of big ideas, Days 1-28.

Materials

Teacher:

1. vocabulary list – IM word list.doc
2. list of big ideas – IM big ideas.pdf

Students:

none

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
35 minutes – review chapters 1 & 2 and section 3.1

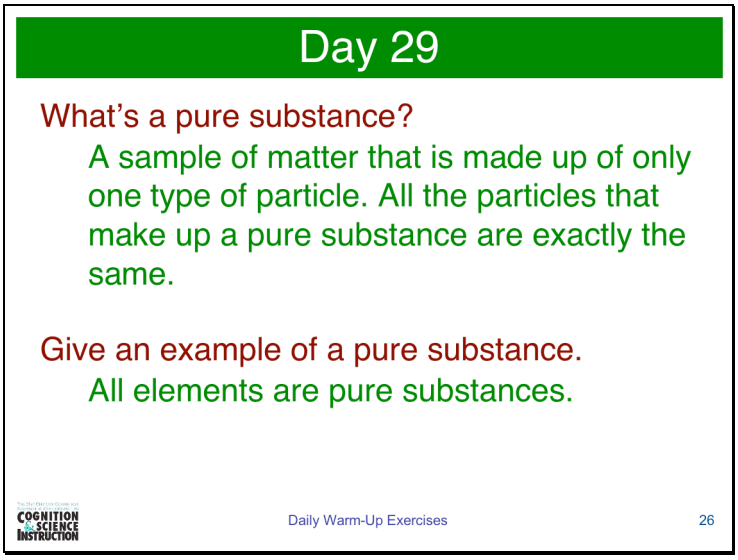
Review Chapters 1 & 2 and Section 3.1

After reviewing the meanings of vocabulary words and the big ideas from days 1-28, use the chapter 1 review on pages 24 and 25, the chapter 2 review on pages 48 and 49, and the section 3.1 review on page 59 to identify areas that need additional attention.

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 29 – Comprehensive Review

Warm-Up Activity



What is an element?

a pure substance that cannot be physically or chemically separated into simpler substances

What are the particles called that make up elements?

atoms

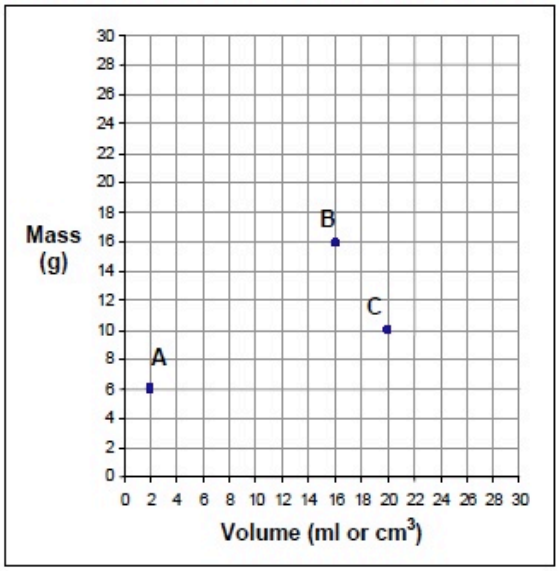
Note: On day 31, students will learn that compounds are also pure substances, made up of particles called molecules.

DAY 30

Quiz 5

Quiz 5 – Page 1

The graph below shows data about three samples. Two of the samples are solid objects, and the other is water. Use this graph to answer questions 1-3.



1. Which sample has the greatest volume?
   a. A
   b. B
   (c.) C

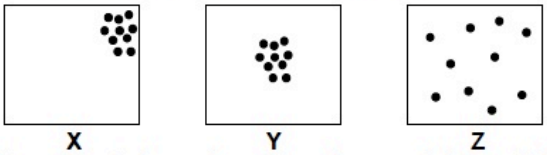
2. Which sample is water?
   a. A
   (b.) B
   c. C

3. Which sample will sink in water?
   (a.) A
   b. B
   c. C

Day 30 – Quiz 5

Quiz 5 – Page 2

4. Imagine you spray perfume in the corner of a room.



Which diagram best shows where the perfume particles would be located immediately after you spray the perfume?

(a.) X
b. Y
c. Z

5. Which diagram best shows where the perfume particles would be located after a few minutes?

a. X
b. Y
(c.) Z

6. Imagine you have a fixed amount of gas in a sealed container with a fixed volume. If you increase the temperature of the gas, what will happen to pressure?

(a.) It will increase.
b. It will decrease.
c. It will stay the same.

7. A wet shirt is hung from a clothesline on a hot summer day. The shirt dries because water particles _____.

a. gain energy, change state, and become air particles
(b.) gain energy, change state, and mix with air particles
c. lose energy, change state, and mix with air particles

8. What could you do to change a liquid to a solid?

a. Bring its temperature above its boiling/condensation point.
(b.) Bring its temperature below its melting/freezing point.
c. Bring its temperature below its boiling/condensation point.

Introduction to Matter

Day 30 – Quiz 5

Quiz 5 – Page 3

9. The table to the right shows the temperature of a substance that changed from a solid to a liquid.

Time (Min)	Temp (°C)
0	20
1	28
2	35
3	39
4	39
5	39
6	39
7	39
8	40
9	44
10	48

Which of the following statements is true?
   a. The solid is completely melted after 3 minutes.
   (b.) The solid is completely melted after 8 minutes.
   c. The solid is still melting after 10 minutes.

10. Which of the following best describes your thinking about question 9?
   a. The temperature of a substance increases during melting.
   b. The temperature of a substance does not change after melting.
   (c.) The temperature of a substance does not change during melting.

11. Which statement is true?
   a. An element is represented by a chemical formula.
   b. A compound is represented by a chemical symbol.
   (c.) An element is represented by a chemical symbol.

12. Which of the following does **NOT** describe an element?
   (a.) can be broken down into simpler substances
   b. has a unique set of properties
   c. can join with other elements to form compounds

13. A substance that contains only one type of particle is called _____.
   (a.) a pure substance
   b. a reactive substance
   c. an atomic substance

Introduction to Matter

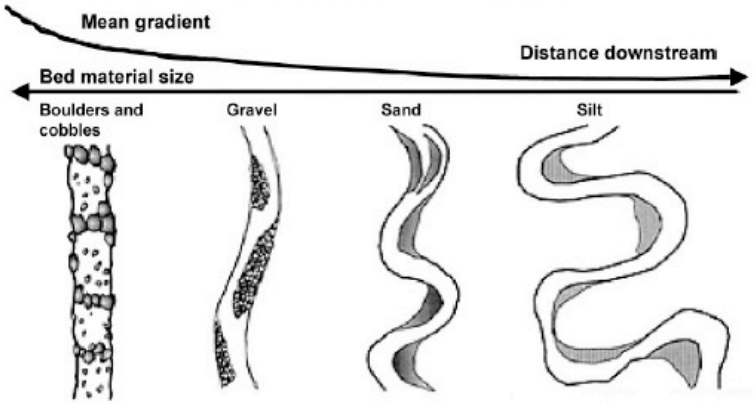
Day 30 – Quiz 5

Quiz 5 – Page 4

14. Which statement is correct?
    a. All elements and most compounds are pure substances.
    b. All compounds and most elements are pure substances.
    (c.) All compounds and all elements are pure substances.

15. If a substance has a density of 0.0027 g/cm^3, it is most likely a _____.
    a. solid
    b. liquid
    (c.) gas

16. **Note to student:** We know you didn't learn this, but we want you to try to answer the question based on the information in the diagram.



Using information from the above diagram, one can tell that _____ has a bed material size that is smaller than sand, while _____ has a bed material size that is larger than gravel.
    a. silt; gravel
    b. silt; sand
    c. gravel; sand
    (d.) silt; boulders and cobbles

Day 30 – Quiz 5

Quiz 5 – Page 5

17. Give at least two examples to show that the properties of a compound are often very different from the properties of the elements it contains.

Answers will vary. Sample: Water is usually a liquid. It is made up of oxygen and hydrogen, which are usually gases. Salt is usually a solid, and it is safe to eat. It contains sodium, which burns in water, and chlorine, which is usually a gas.

Introduction to Matter

DAY 31

Compounds

This lesson covers the first part of section 3.2 (page 60).

Big Ideas

- A compound is a pure substance made up of two or more elements that are chemically combined.

Materials

Teacher:
none

Students:
none

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
35 minutes – chapter 3.2, part 1 – *Compounds: Made of Elements*

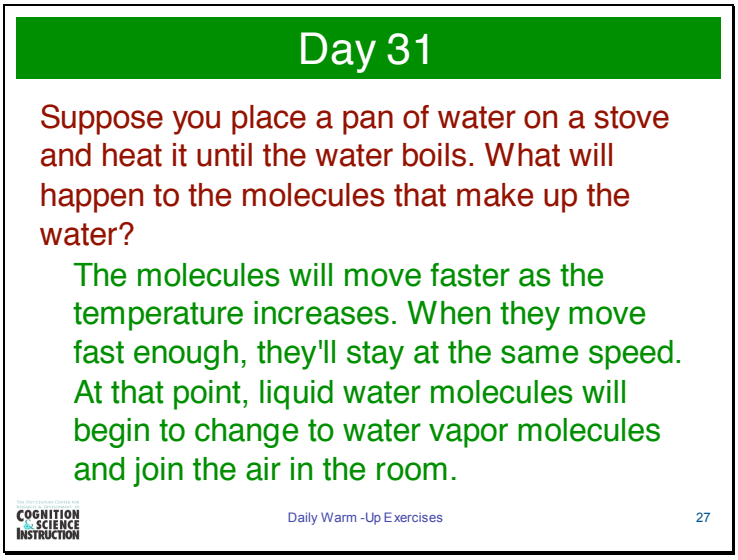
Chapter 3.2, part 1

An important point to get across is that elements always follow the exact same recipe when they combine to make a compound. Water molecules are always made up of two atoms of hydrogen and one atom of oxygen, which is why the chemical formula for water is H_2O. Salt is always one atom of sodium and one atom of chlorine, which is why its chemical formula is NaCl.

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 31 – Compounds

Warm-Up Activity



Is boiling a physical or chemical change?

physical

DAY 32

Properties of Compounds

This lesson covers the rest of section 3.2 (pages 61-63) and includes three visualization exercises.

Big Ideas

- Compounds are made up of elements, but their properties are different from the properties of the elements they contain.
- Compounds can be separated into elements or simpler compounds by chemical changes.

Materials

Teacher:

1. visualization exercise slides – day32.ppt

Students:

none

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
5 minutes – visualization 3.2a – Captions
5 minutes – visualization 3.2b – Captions
5 minutes – visualization 3.2c – Arrows
20 minutes – chapter 3.2, parts 2-4 – *Properties of Compounds*

Chapter 3.2, parts 2-4

Part 2 points out that, like elements, each compound has its own characteristic properties. As students learned from the contrasting case activity, the properties of a compound are different from the properties of the elements it contains. Water is very different from hydrogen and oxygen.

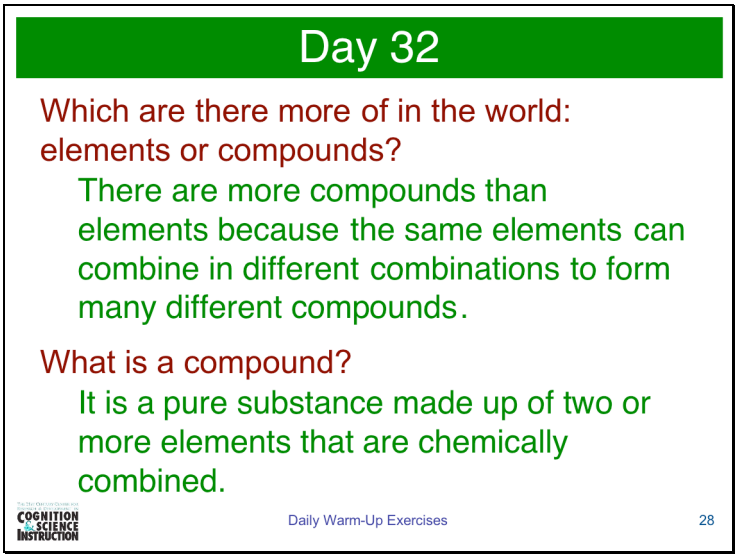
At this point, ask your students to describe the experiment they did with baking soda and vinegar. Encourage them to find vinegar and baking soda in the table on page 60, and tell them that sugar is another compound that is made up of carbon, hydrogen, and oxygen. Use questions to help them identify properties

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 32 – Properties of Compounds

of compounds. For example, can they say anything about the ability to react with another compound? [Baking soda reacts with vinegar.] If baking soda reacts with vinegar, is the liquid that results from the reaction a compound? [Let students debate this for a few minutes, then say we'll come back to this question in the next section.] What properties did the litmus tests reveal? [Vinegar is an acid; the liquid that results from the vinegar-and-baking-soda reaction is a base.]

Warm-Up Activity



What is an element?

a pure substance that cannot be physically or chemically separated into simpler substances

How do the properties of a compound compare with the properties of the elements it contains?

they are different

Day 32 – Properties of Compounds

Visualization Exercise 3.2a – Captions

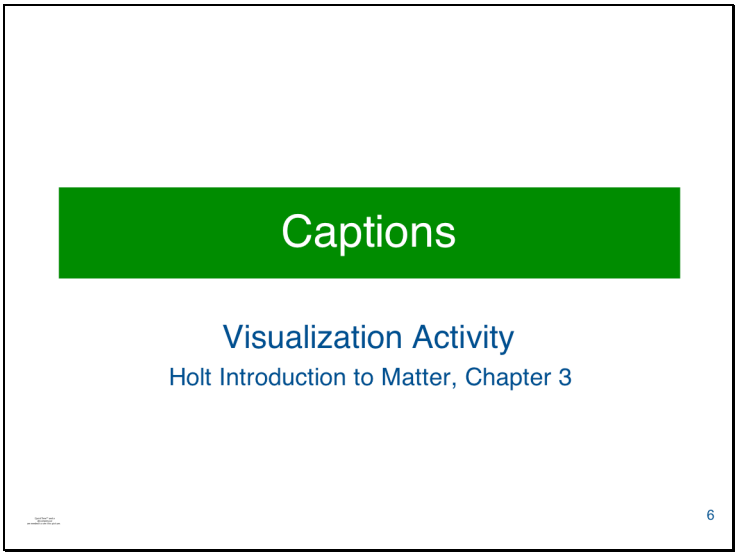


Image comprehension focus: Captions

Goal: To practice with the concept that captions are extremely important to consider when looking at an image since they often provide information that is crucial to understanding the diagram.

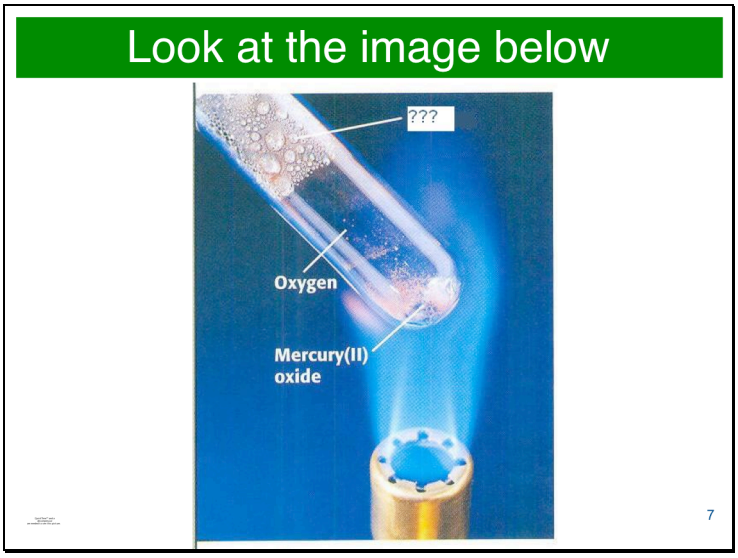
Module Activity: Student Activity

Overview: This activity is designed to further emphasize that captions are critical to read when viewing a diagram or image. The goal is to give the students another experience that reinforces the importance of captions and to encourage them not the skip captions when viewing images.

(Proceed to the next slide, which is a modified version of Figure 3 on page 62)

Day 32 – Properties of Compounds

Visualization Exercise 3.2a – Captions (cont.)



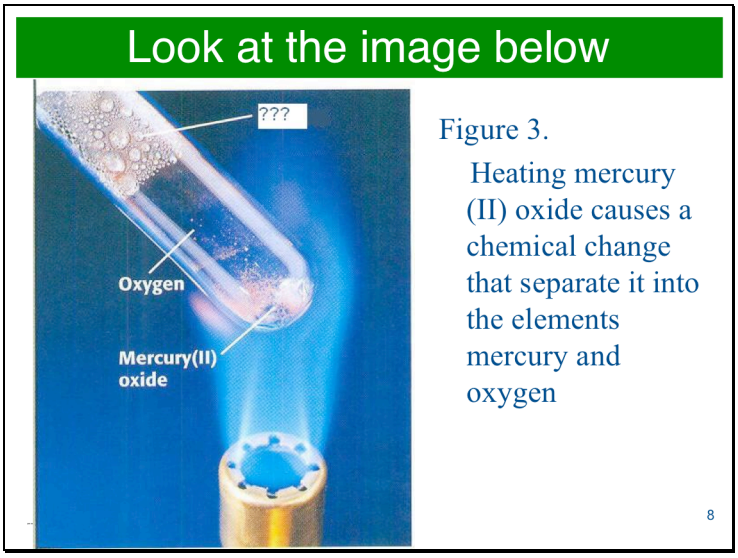
Student Activity: Teacher has students read the modified diagram (missing the label) without the caption, and asks them if they could fill in the blank where originally the label "Mercury" was placed. (Should be difficult to do so)

(Proceed to the next slide)

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 32 – Properties of Compounds

Visualization Exercise 3.2a – Captions (cont.)



Teacher should then show the modified image (missing the label) with the caption, and then have students fill out the block where the originally the label "Mercury" was placed.

Teacher then gives the correct answer as 'Mercury' and comments that it is essential to read the caption in order to understand the meaning of a diagram. In this case, the caption describes the chemical reaction shown in the diagram.

Note: It should be noted that students may see the label of 'oxygen' and assume that this is what oxygen looks like. The teacher should mention that this label could even be thought of as a sort of zoom, and that the author was trying to point out oxygen which cannot actually be seen.

(End of Activity)

Day 32 – Properties of Compounds

Visualization Exercise 3.2b – Captions

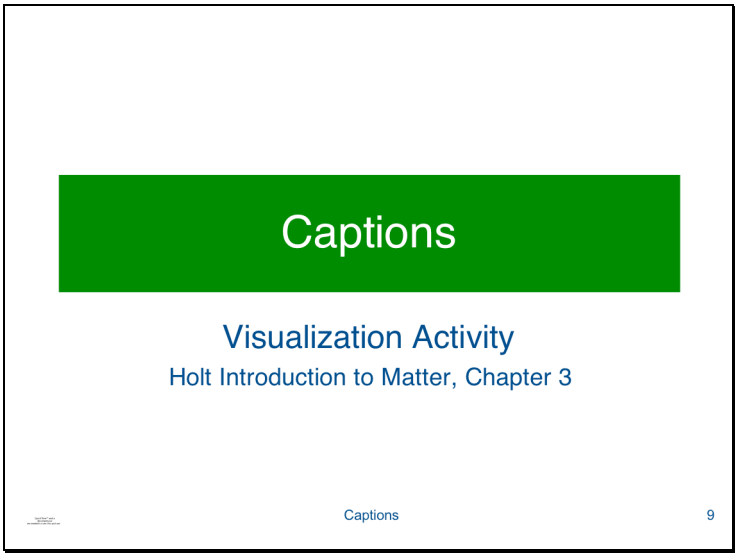


Image comprehension focus: Captions

Goal: To practice with the concept that captions are extremely important to consider when looking at an image since they often provide information that is crucial to understanding the diagram.

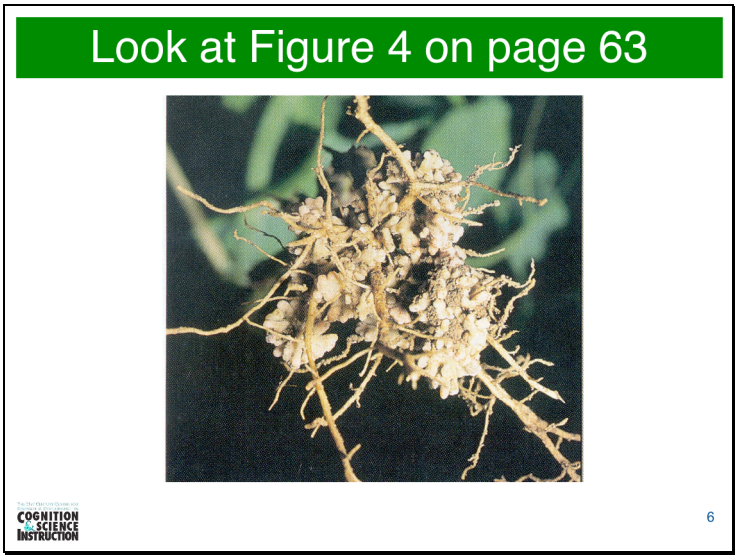
Module Activity: Student Activity

Overview: This activity is designed to further emphasize that captions are critical to read when viewing a diagram or image, as the image alone may not necessarily give the reader a comprehensive understanding of the text or idea being presented.

(Proceed to the next slide)

Day 32 – Properties of Compounds

Visualization Exercise 3.2b – Captions (cont.)

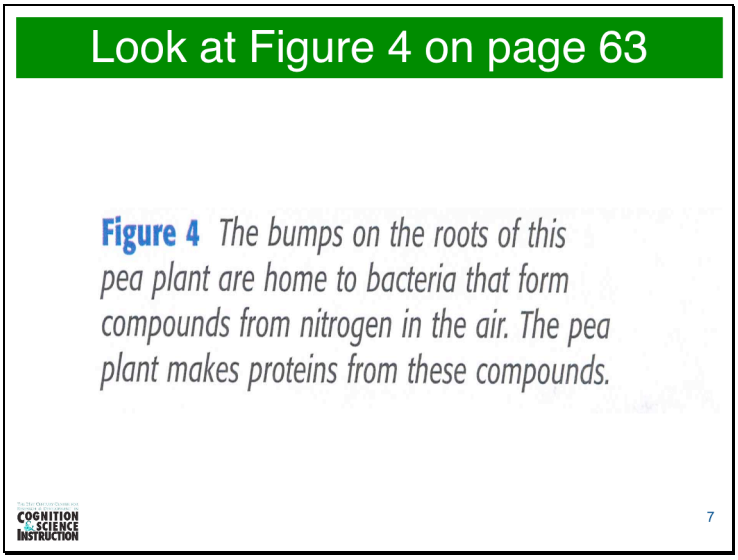


Teacher Guided Student Activity: Teacher has students look at Figure 4 on page 63, (shown above for the teacher to project if desired), as well as read the text that accompanies the diagram at the top of page 63 ('Compounds in Nature'). The teacher then asks the students to take a look at the image that is shown above without the caption, and asks students if they would be able to understand the picture without the caption (this should be difficult to do).

(Proceed to the next slide)

Day 32 – Properties of Compounds

Visualization Exercise 3.2b – Captions (cont.)

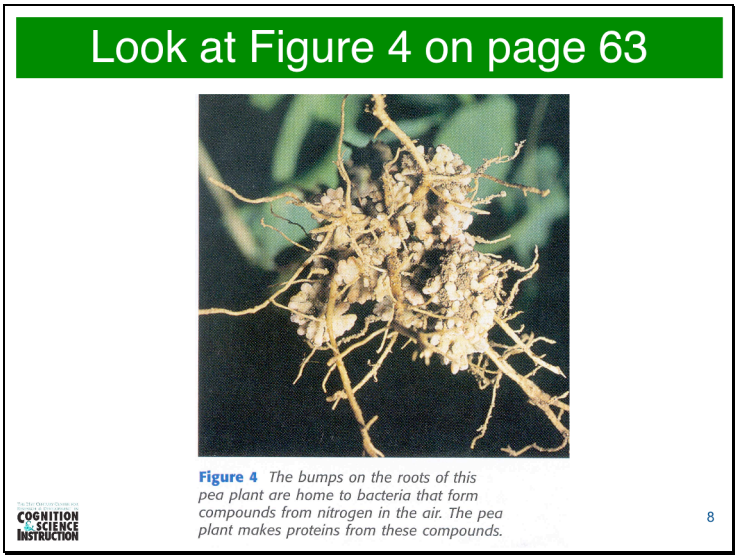


Teacher Guided Student Activity: The teacher then has students read the caption from the slide above (or can ask students to cover the picture so that only the caption can be seen). The teacher asks the students if they need the picture in order to understand the caption. (Students should not need this picture in order to understand the information being conveyed by the caption.)

(Proceed to the next slide)

Day 32 – Properties of Compounds

Visualization Exercise 3.2b – Captions (cont.)



The teacher explains the importance of reading captions, as sometimes the image shown may not give the relevant information needed in order to understand a particular concept or idea. In this case, the picture does not show the process of bacteria forming compounds from nitrogen in the air, nor does it show the idea that proteins are made from these compounds.

Note: Students may be unfamiliar with nitrogen. The teacher should advise students that nitrogen is an element, if this is an element that has not been mentioned previously.

Additional Student Activity: The teacher may ask students, if they were the author of the textbook, what type of image would they select so that the reader would be able to obtain information relevant to the text even without the caption. Note: In assisting students with this activity, teacher should encourage the use of as many different diagram conventions as possible (labels, arrows, color, etc.).

(End of Activity)

Day 32 – Properties of Compounds

Visualization Exercise 3.2c – Arrows

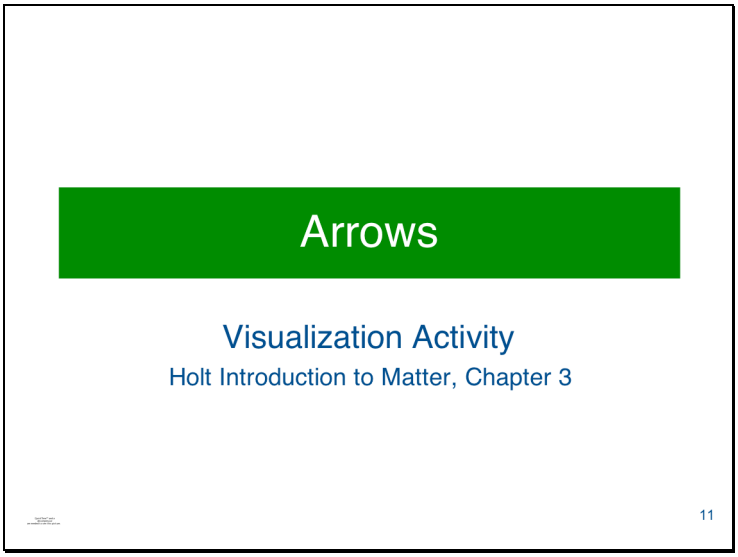


Image comprehension focus: Arrows

Goal: Expand understanding of how arrows can indicate a reaction and the product of a reaction

Activity: Teacher Comment

Overview: This activity is intended to extend students' understanding of the use of arrows in diagrams to include indicating a reaction and product of a reaction.

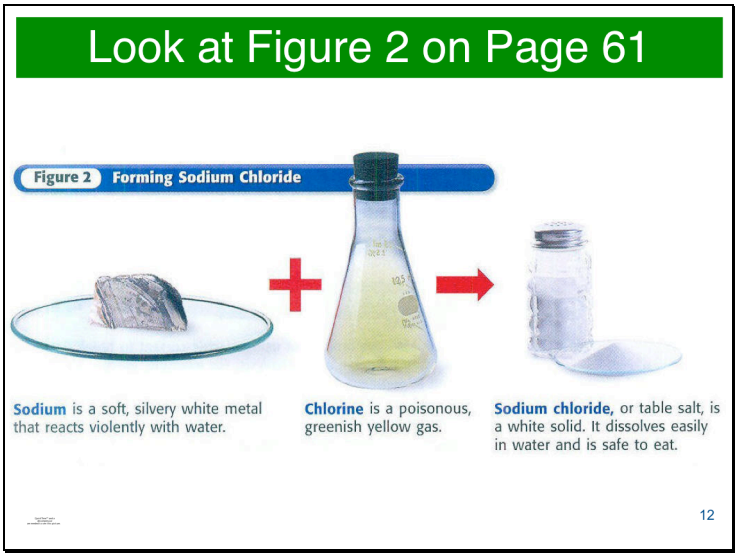
Procedure: The teacher should remind the students that they have already seen how arrows can measure/indicate length and how they can indicate change of positions and states. He/she should explain that now we are going to investigate an additional role for arrows, showing reaction and the product of reaction.

(Proceed to the next slide)

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 32 – Properties of Compounds

Visualization Exercise 3.2c – Arrows (cont.)



Teacher Comment: In addition to their role in indicating magnification or zoom-in, length, and change of position or state, arrows can also be used to indicate that substances (connected with a "+" symbol if there are more than one) react and form a compound (the product of the reaction). The teacher can explain that the "+" indicates that the sodium and the chlorine are combined together and the arrow indicates that the two form a different substance, sodium chlorine, which is a compound. Teacher could also comment that using plus symbols and arrows in this way is often seen in chemistry and biology.

(End of Activity)

The 21st Century Center for Research & Development in Cognition & Science Instruction

DAY 33 Compare Compounds & Mixtures, Part 1

This lesson is the first half of contrasting case activity 3.3.

Big Ideas

- Compounds are made up of elements, but their properties are different from the properties of the elements they contain.
- Compounds always have the same composition.
- Mixtures can be made up of elements, compounds, or both, and their composition can vary.

Materials

Teacher:

1. slides – day33.ppt

Students:

1. description cards – worksheets 19-21
2. data table – worksheet 22

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
35 minutes – cc activity – Compare Compounds & Mixtures, part 1

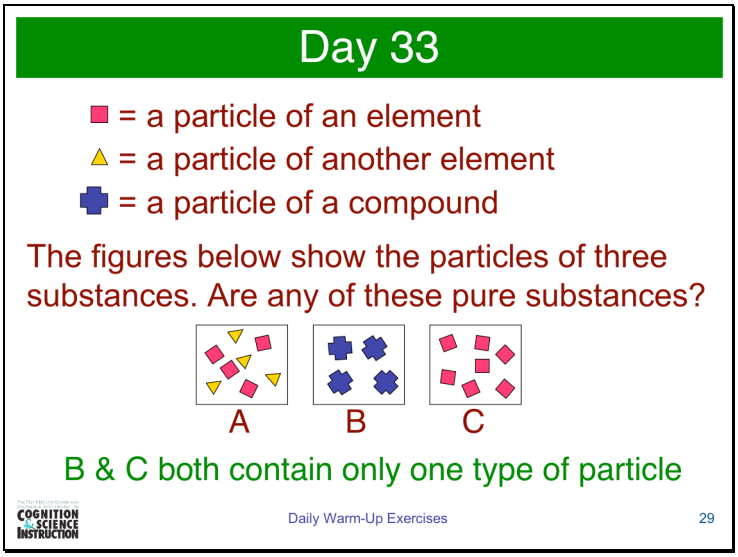
Compare Compounds & Mixtures, part 1

This activity is very similar to cc 3.1. In part 1, students examine cards that describe compounds and mixtures, and they complete a table designed to help them focus on key features. In part 2, they use a Venn diagram to depict similarities and differences. The concluding discussion focuses on key differences, including the idea that a chemical formula depicts the "recipe" for a given compound, which is always the same.

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 33 – Compare Compounds & Mixtures, 1

Warm-Up Activity



Why is A not a pure substance?

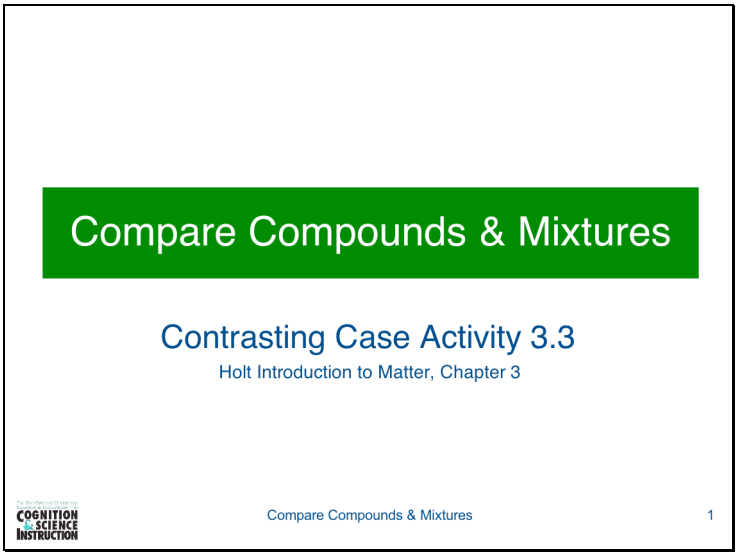
Pure substances contain only one type of particle. A contains two different types.

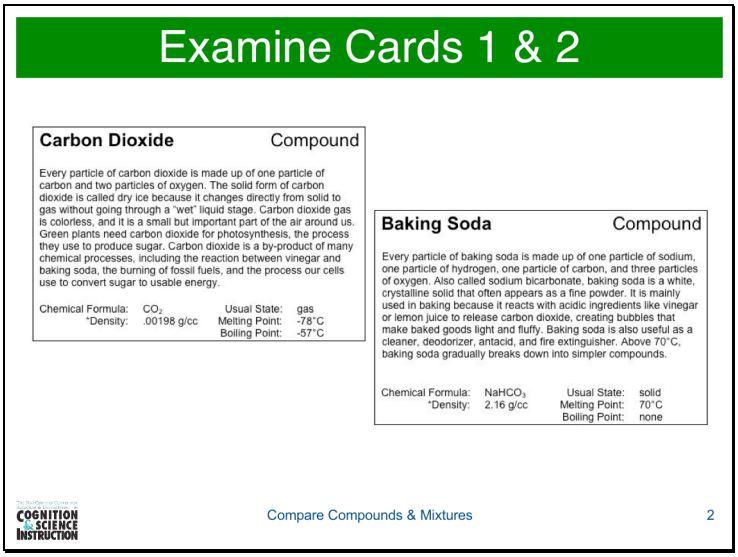
How can compounds be separated into elements or simpler compounds?

by chemical changes

Day 33 – Compare Compounds & Mixtures, 1

Compare Compounds & Mixtures, part 1 (cont.)



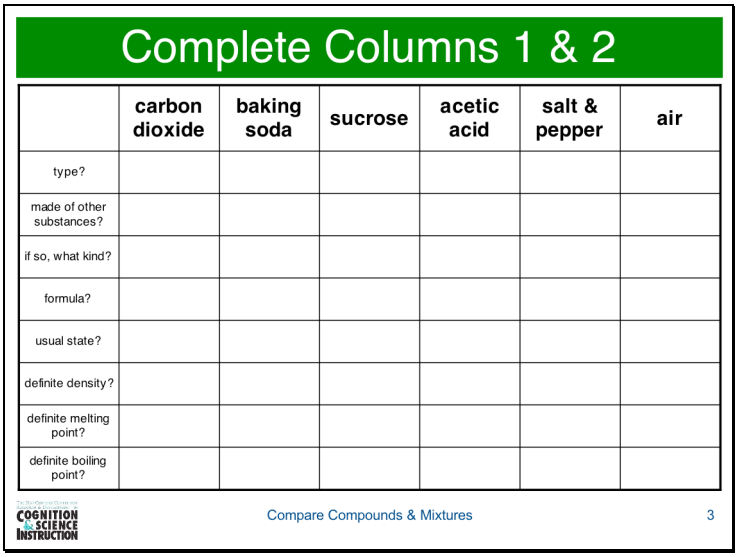


Distribute the description cards (worksheets 19-21) and ask students to examine the first two (carbon dioxide & baking soda). Read through the paragraphs with your students. Encourage them to rephrase key ideas in their own words.

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 33 – Compare Compounds & Mixtures, 1

Compare Compounds & Mixtures, part 1 (cont.)



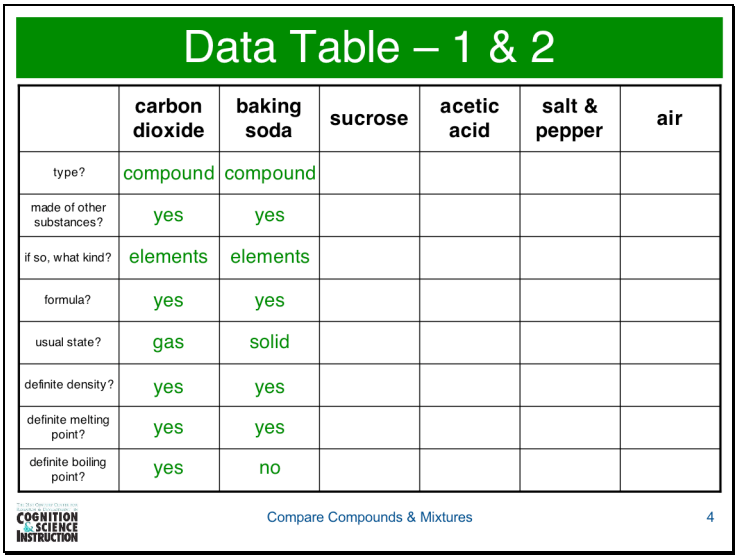
Distribute the data table (worksheet 22) and have students work in pairs to complete the first two columns.

Students may need help with the third question, about the kind of substances that make up each compound or mixture. Have them use the Periodic Table (pages 154-155) to identify the elements they're not yet familiar with (e.g., carbon, nitrogen).

The next slide shows the answers for the first two columns.

Day 33 – Compare Compounds & Mixtures, 1

Compare Compounds & Mixtures, part 1 (cont.)



Data Table – 1 & 2

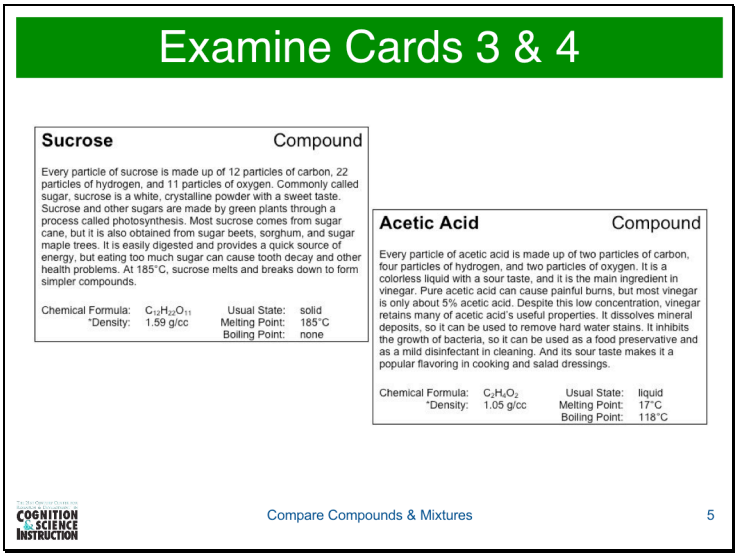
	carbon dioxide	baking soda	sucrose	acetic acid	salt & pepper	air
type?	compound	compound				
made of other substances?	yes	yes				
if so, what kind?	elements	elements				
formula?	yes	yes				
usual state?	gas	solid				
definite density?	yes	yes				
definite melting point?	yes	yes				
definite boiling point?	yes	no				

Answers will appear on keypress. [The abridged questions in the first column are for your use when going over the answers with your students. See the student worksheets for the complete questions.]

THE 21ST CENTURY CENTER FOR RESEARCH & DEVELOPMENT IN COGNITION & SCIENCE INSTRUCTION

Day 33 – Compare Compounds & Mixtures, 1

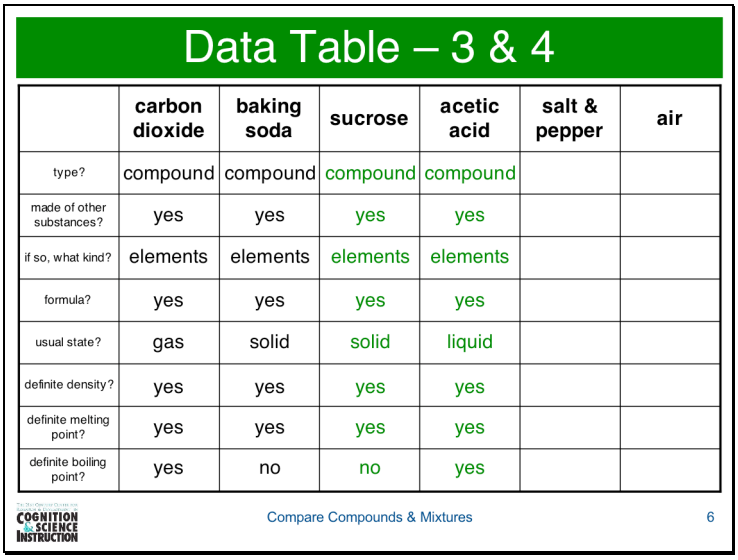
Compare Compounds & Mixtures, part 1 (cont.)



Ask students to examine the next two cards (sucrose & acetic acid, worksheet 20). Read through the paragraphs with your students, then have them complete columns 3 & 4 of the data table.

Day 33 – Compare Compounds & Mixtures, 1

Compare Compounds & Mixtures, part 1 (cont.)



Data Table – 3 & 4

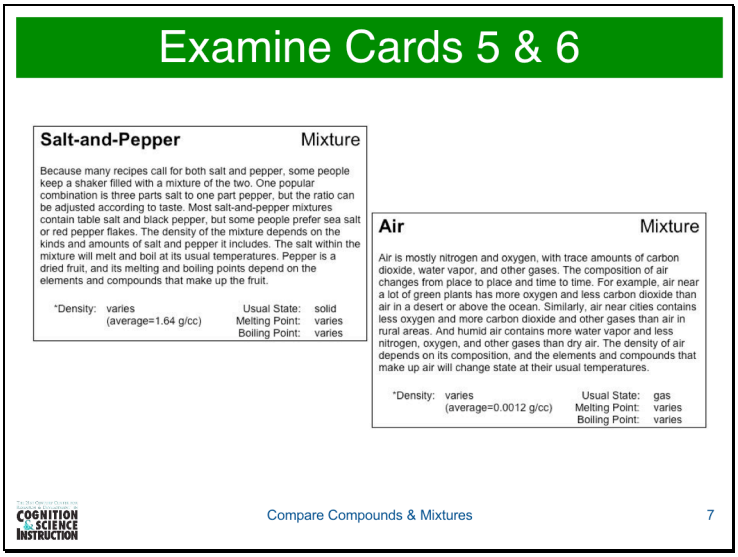
	carbon dioxide	baking soda	sucrose	acetic acid	salt & pepper	air
type?	compound	compound	compound	compound		
made of other substances?	yes	yes	yes	yes		
if so, what kind?	elements	elements	elements	elements		
formula?	yes	yes	yes	yes		
usual state?	gas	solid	solid	liquid		
definite density?	yes	yes	yes	yes		
definite melting point?	yes	yes	yes	yes		
definite boiling point?	yes	no	no	yes		

Answers will appear on keypress.

THE 21ST CENTURY CENTER FOR RESEARCH & DEVELOPMENT IN COGNITION & SCIENCE INSTRUCTION

Day 33 – Compare Compounds & Mixtures, 1

Compare Compounds & Mixtures, part 1 (cont.)

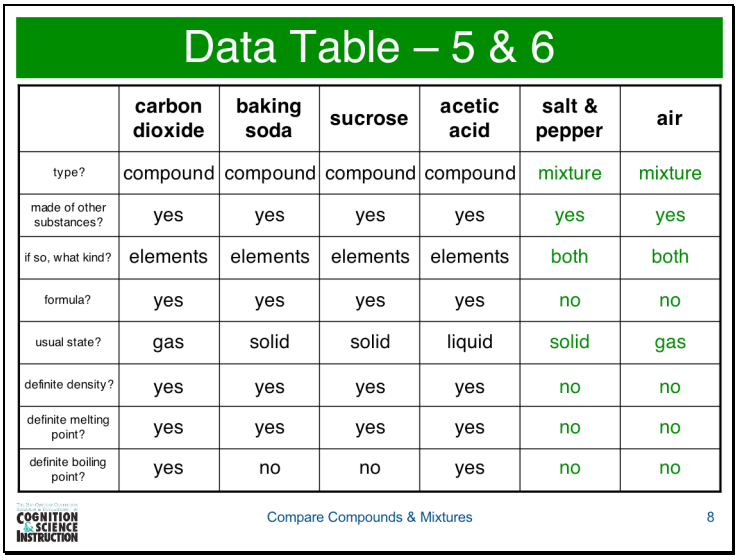


Ask students to examine the last two cards (salt-and-pepper & air, worksheet 21). Read through the paragraphs with your students, then have them complete columns 5 & 6 of the data table.

THE 21ST CENTURY CENTER FOR RESEARCH & DEVELOPMENT IN COGNITION & SCIENCE INSTRUCTION

Day 33 – Compare Compounds & Mixtures, 1

Compare Compounds & Mixtures, part 1 (cont.)



Data Table – 5 & 6

	carbon dioxide	baking soda	sucrose	acetic acid	salt & pepper	air
type?	compound	compound	compound	compound	mixture	mixture
made of other substances?	yes	yes	yes	yes	yes	yes
if so, what kind?	elements	elements	elements	elements	both	both
formula?	yes	yes	yes	yes	no	no
usual state?	gas	solid	solid	liquid	solid	gas
definite density?	yes	yes	yes	yes	no	no
definite melting point?	yes	yes	yes	yes	no	no
definite boiling point?	yes	no	no	yes	no	no

Answers will appear on keypress.

THE 21ST CENTURY CENTER FOR RESEARCH & DEVELOPMENT IN COGNITION & SCIENCE INSTRUCTION

Day 33 – Compare Compounds & Mixtures, 1

Worksheet 19

Compare Compounds & Mixtures 19

Carbon Dioxide — Compound

Every particle of carbon dioxide is made up of one particle of carbon and two particles of oxygen. The solid form of carbon dioxide is called dry ice because it changes directly from solid to gas without going through a "wet" liquid stage. Carbon dioxide gas is colorless, and it is a small but important part of the air around us. Green plants need carbon dioxide for photosynthesis, the process they use to produce sugar. Carbon dioxide is a by-product of many chemical processes, including the reaction between vinegar and baking soda, the burning of fossil fuels, and the process our cells use to convert sugar to usable energy.

Chemical Formula:	CO_2	Usual State:	gas
*Density:	.0020 g/cc	Melting Point:	-78°C
		Boiling Point:	-57°C

*at 20°C and 1.0 atm

Baking Soda — Compound

Every particle of baking soda is made up of one particle of sodium, one particle of hydrogen, one particle of carbon, and three particles of oxygen. Also called sodium bicarbonate, baking soda is a white, crystalline solid that often appears as a fine powder. It is mainly used in baking because it reacts with acidic ingredients like vinegar or lemon juice to release carbon dioxide, creating bubbles that make baked goods light and fluffy. Baking soda is also useful as a cleaner, deodorizer, antacid, and fire extinguisher. Above 70°C, baking soda gradually breaks down into simpler compounds.

Chemical Formula:	$NaHCO_3$	Usual State:	solid
*Density:	2.16 g/cc	Melting Point:	70°C
		Boiling Point:	none

*at 20°C and 1.0 atm

Chapter 3 – Elements, Compounds, and Mixtures

Day 33 – Compare Compounds & Mixtures, 1

Worksheet 20

Compare Compounds & Mixtures 20

Sucrose — Compound

Every particle of sucrose is made up of 12 particles of carbon, 22 particles of hydrogen, and 11 particles of oxygen. Commonly called sugar, sucrose is a white, crystalline powder with a sweet taste. Sucrose and other sugars are made by green plants through a process called photosynthesis. Most sucrose comes from sugar cane, but it is also obtained from sugar beets, sorghum, and sugar maple trees. It is easily digested and provides a quick source of energy, but eating too much sugar can cause tooth decay and other health problems. At 185°C, sucrose melts and breaks down to form simpler compounds.

Chemical Formula:	$C_{12}H_{22}O_{11}$	Usual State:	solid
*Density:	1.59 g/cc	Melting Point:	185°C
		Boiling Point:	none

*at 20°C and 1.0 atm

Acetic Acid — Compound

Every particle of acetic acid is made up of two particles of carbon, four particles of hydrogen, and two particles of oxygen. It is a colorless liquid with a sour taste, and it is the main ingredient in vinegar. Pure acetic acid can cause painful burns, but most vinegar is only about 5% acetic acid. Despite this low concentration, vinegar retains many of acetic acid's useful properties. It dissolves mineral deposits, so it can be used to remove hard water stains. It inhibits the growth of bacteria, so it can be used as a food preservative and as a mild disinfectant in cleaning. And its sour taste makes it a popular flavoring in cooking and salad dressings.

Chemical Formula:	$C_2H_4O_2$	Usual State:	liquid
*Density:	1.05 g/cc	Melting Point:	17°C
		Boiling Point:	118°C

*at 20°C and 1.0 atm

Chapter 3 – Elements, Compounds, and Mixtures

Day 33 – Compare Compounds & Mixtures, 1

Worksheet 21

Compare Compounds & Mixtures 21

Salt-and-Pepper — Mixture

Because many recipes call for both salt and pepper, some people keep a shaker filled with a mixture of the two. One popular combination is three parts salt to one part pepper, but the ratio can be adjusted according to taste. Most salt-and-pepper mixtures contain table salt and black pepper, but some people prefer sea salt or red pepper flakes. The density of the mixture depends on the kinds and amounts of salt and pepper it includes. The salt within the mixture will melt and boil at its usual temperatures. Pepper is a dried fruit, and its melting and boiling points depend on the elements and compounds that make up the fruit.

*Density:	varies (average=1.64 g/cc)	Usual State:	solid
		Melting Point:	varies
		Boiling Point:	varies

*at 20ºC and 1.0 atm

Air — Mixture

Air is mostly nitrogen and oxygen, with trace amounts of carbon dioxide, water vapor, and other gases. The composition of air changes from place to place and time to time. For example, air near a lot of green plants has more oxygen and less carbon dioxide than air in a desert or above the ocean. Similarly, air near cities contains less oxygen and more carbon dioxide and other gases than air in rural areas. And humid air contains more water vapor and less nitrogen, oxygen, and other gases than dry air. The density of air depends on its composition, and the elements and compounds that make up air will change state at their usual temperatures.

*Density:	varies (average=0.0012 g/cc)	Usual State:	gas
		Melting Point:	varies
		Boiling Point:	varies

*at 20ºC and 1.0 atm

Chapter 3 – Elements, Compounds, and Mixtures

Day 33 – Compare Compounds & Mixtures, 1

Worksheet 22

Compare Compounds & Mixtures – Data Table 22

	carbon dioxide	baking soda	sucrose	acetic acid	salt & pepper	air
Is it a compound or mixture?						
Is it made up of particles of other substances?						
If so, what kind? (elements, compounds, both)						
Does it have a chemical formula?						
What is its usual state?						
Does it have a definite density?						
Does it have a definite melting point?						
Does it have a definite boiling point?						

Chapter 3 – Elements, Compounds, and Mixtures

DAY 34

Compare Compounds & Mixtures, Part 2

This lesson is the second half of contrasting case activity 3.3.

Big Ideas

- Compounds are made up of elements, but their properties are different from the properties of the elements they contain.
- Compounds always have the same composition.
- Mixtures can be made up of elements, compounds, or both, and their composition can vary.

Materials

Teacher:

1. slides – day34.ppt

Students:

1. description cards – worksheets 19-21
2. data table & Venn diagram – worksheets 22-23

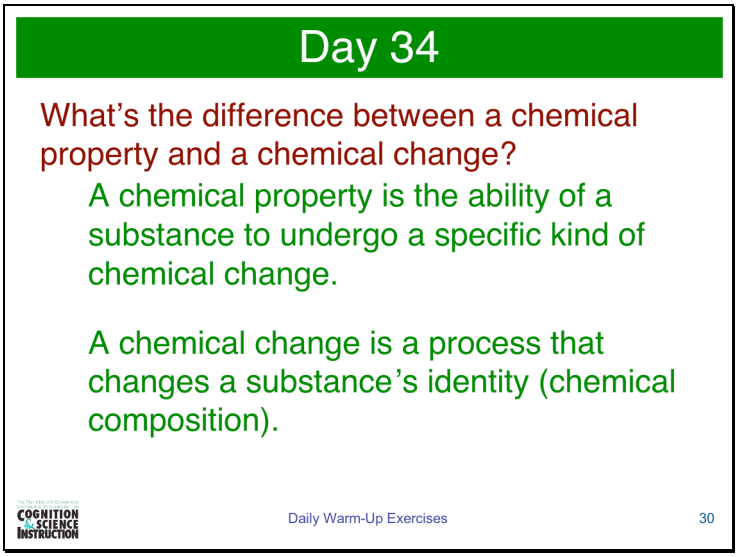
Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
35 minutes – cc activity – Compare Compounds & Mixtures, part 2

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 34 – Compare Compounds & Mixtures, 2

Warm-Up Activity



Can you give an example of each?

flammability is a chemical property; burning is a chemical change

What's a physical property?

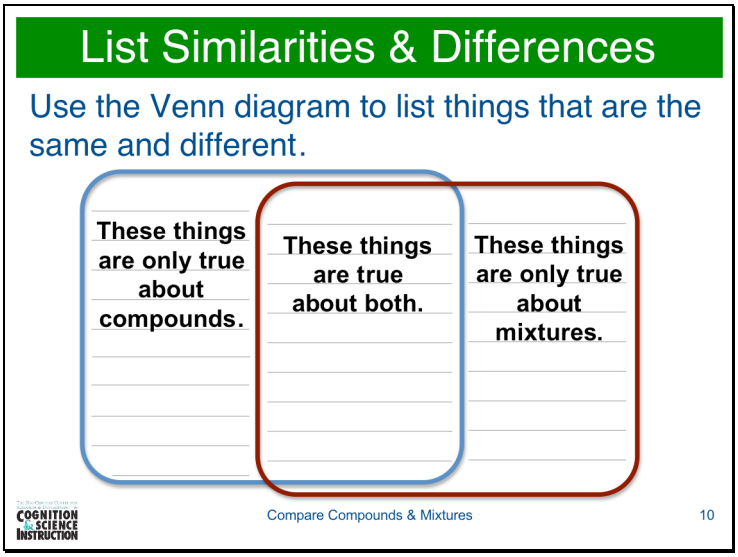
a feature that can be observed or measured without changing a substance's identity

What's a physical change?

a change in one or more physical properties; does not change a substance's identity

Day 34 – Compare Compounds & Mixtures, 2

Compare Compounds & Mixtures, part 2

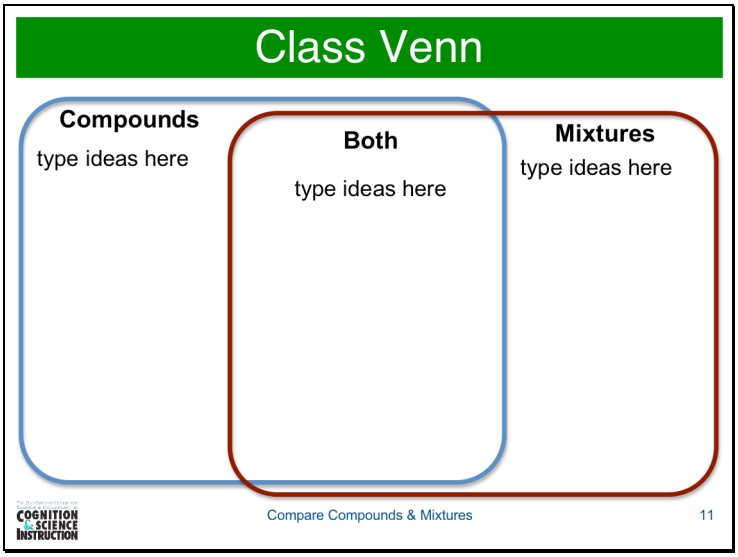


Distribute the Venn diagram (worksheet 23) and have students work in pairs or groups, then share their ideas with the class. As with cc 3.1, students may need some help to identify similarities. As they work, use questions to help them see that if all the examples have density, then they all have mass and volume. Since matter is anything that has mass and takes up space, both are kinds of matter. Although they don't all have definite melting and boiling points, they can all change to at least one different state.

The next slide contains a blank Venn you can use to record ideas your students all agree on.

Day 34 – Compare Compounds & Mixtures, 2

Compare Compounds & Mixtures, part 2 (cont.)



(Click Escape to stop the slide show. After typing in their ideas, click the slide show icon at the bottom of the window to display the Venn.)

Some ideas your students may come up with:

Same

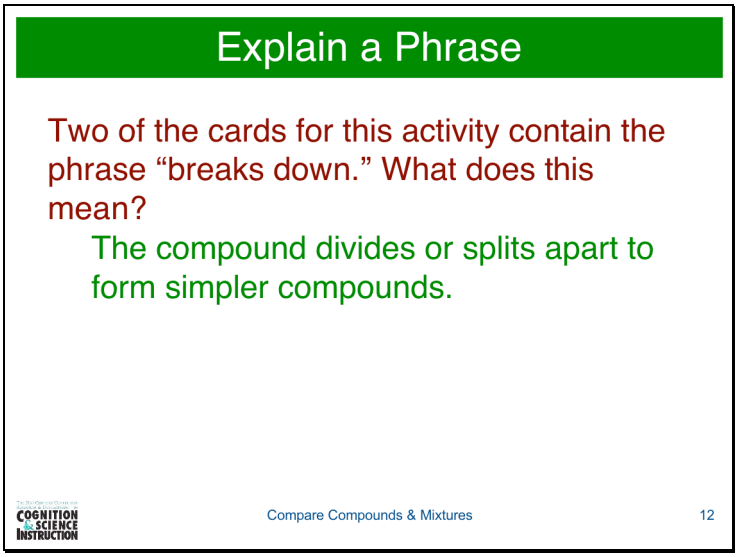
- both are kinds of matter
- both have mass, volume, and density
- both are made up of two or more substances

Different

- a compound always contains the same combination of elements; mixtures can contain different combinations of substances
- compounds are represented by chemical formulas; mixtures aren't
- compounds have definite densities, melting, & boiling points; mixtures don't

Day 34 – Compare Compounds & Mixtures, 2

Compare Compounds & Mixtures, part 2 (cont.)



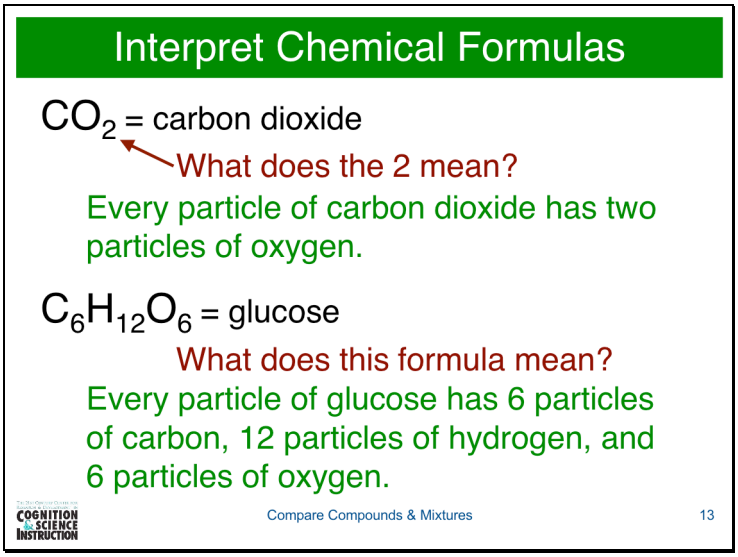
This slide will enable students to figure out why baking soda and sucrose don't have boiling points. Use questions like the following to guide their thinking:

What causes these two compounds to break down?
they reach a certain temperature (above 70ºC for baking soda; 185ºC for sucrose)

Why don't these two compounds have boiling point?
because they both break down before the particles can move fast enough to change to a gas.

Day 34 – Compare Compounds & Mixtures, 2

Compare Compounds & Mixtures, part 2 (cont.)

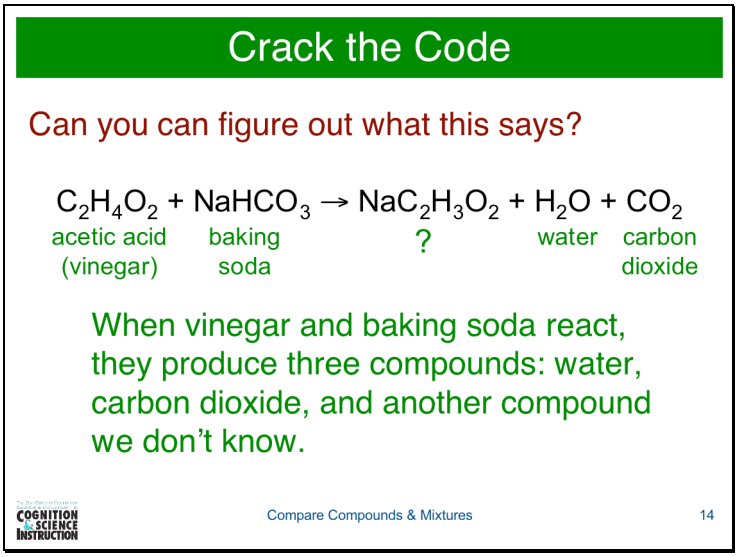


Explain that a compound's chemical formula shows its "recipe" or composition. It tells which elements it contains and how much there is of each element. Another way of interpreting the formula is to say that glucose is 6 parts carbon, 12 parts hydrogen, and six parts oxygen.

Use questions to help your students notice that the formula for glucose is very similar to sucrose, and that both compounds end in -ose. Tell them that, if a compound ends in -ose, it is a kind of sugar. Glucose is the form of sugar our cells use for fuel. When we eat sucrose or other sugars or starches, our bodies convert them to glucose, which is then transported to cells or stored for future use.

Day 34 – Compare Compounds & Mixtures, 2

Compare Compounds & Mixtures, part 2 (cont.)



The equation will not appear until you press a key. You might warn your students that the coded message is going to look really complicated at first. Encourage them to look for parts they understand and use those parts to figure out the rest. Use questions like the following to guide their thinking: [answers will appear on keypress]

What is H^2O?

water

What is CO^2?

carbon dioxide

The first formula is on one of your cards. What is it?

acetic acid

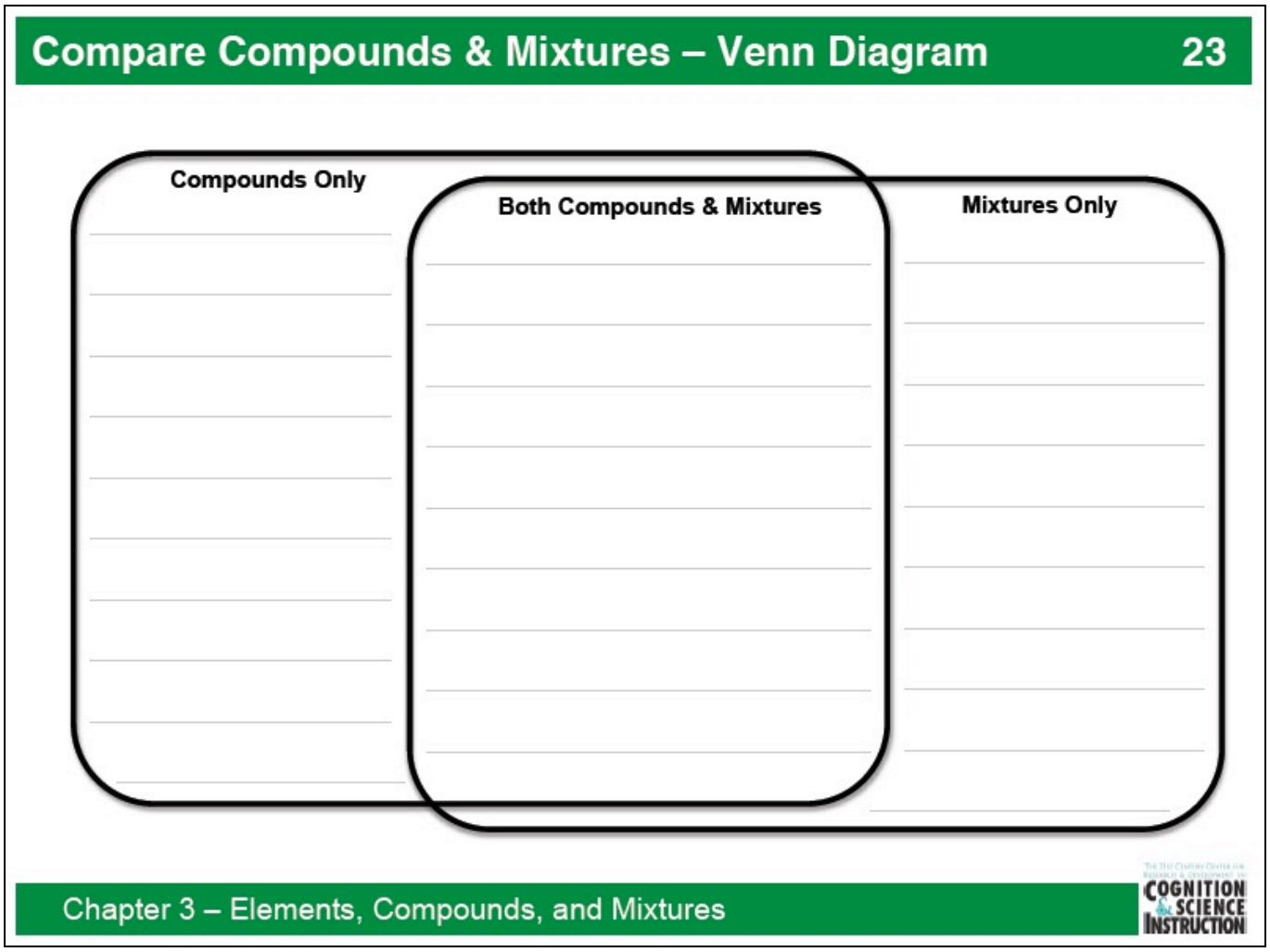
The second formula is on another card. What is it?

baking soda

At this point, most students will guess that the coded message is about the chemical reaction they observed when they added baking soda to vinegar. The compounds on the left side of the arrow are the reactants, and the compounds on the right side are the products. [The unfamiliar compound is called sodium acetate. If some of your students are interested in substances with unusual properties, encourage them to look up sodium acetate on the web.]

Day 34 – Compare Compounds & Mixtures, 2

Worksheet 23



DAY 35

Quiz 6/Reteach/Review

This lesson provides an opportunity for you to address areas that need attention and for students to review what they've learned about matter to this point.

Big Ideas
See list of big ideas, Days 1-34.

Materials

Teacher:

1. vocabulary list – IM word list.doc
2. list of big ideas – IM big ideas.pdf

Students:

1. Quiz 6

Activities & Allotted Time (40 minutes total)

10 minutes – quiz
10 minutes – go over quiz
20 minutes – reteach/review chapter 3.2

Reteach/Review Chapter 3.2
After going over the quiz and reviewing the meanings of vocabulary words and the big ideas from days 1-34, use the section review questions on page 63 to identify areas that need additional attention.

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 35 – Quiz 6/Reteach/Review

Quiz 6 – Page 1

1. When elements combine to form compounds _____.
   a. their properties remain the same
   (b) their properties change
   c. some properties change and some remain the same

2. What kind of changes can separate compounds into elements or simpler compounds?
   a. physical changes only
   (b) chemical changes only
   c. either physical or chemical changes

3. Which statement about compounds is true?
   (a) Compounds always have the same composition.
   b. The elements that make up a compound are physically combined.
   c. The properties of a compound are the same as the properties of the elements it contains.

4. Which of the following are pure substances?
   a. elements only
   b. compounds only
   (c) both elements and compounds

5. The composition of _____ can vary.
   a. compounds
   (b) mixtures
   c. compounds and mixtures

6. An element can be separated into simpler substances by _____.
   a. physical changes
   b. chemical changes
   (c) neither of the above

Introduction to Matter

Day 35 – Quiz 6/Reteach/Review

Quiz 6 – Page 2

7. **Note to student:** We know you didn't learn this, but we want you to try to answer the question based on the information in the diagram.



In the diagram above, what does this shade of gray stand for? ☐

a. Canada
b. land
c. islands
(d.) water

Introduction to Matter

Day 35 – Quiz 6/Reteach/Review

Quiz 6 – Page 3

8. How are elements and compounds different?

Elements can combine to form compounds. Compounds are made up of elements. Elements are represented by symbols. Compounds are represented by formulas that show their composition, which is always the same. Compounds can be separated into elements or simpler compounds by chemical changes. Elements can't be separated into simpler substances.

Introduction to Matter

DAY 36

Properties of Mixtures

This lesson covers part 1 of section 3.3 (pages 64-66) and includes a hands-on activity and a teacher demo.

Big Idea

- A mixture is a combination of two or more substances that are not chemically combined.
- Mixtures can be separated by physical changes.

Materials

Teacher:

1. sodium chloride
2. sulfur
3. beaker
4. stirring rod
5. filter paper
6. funnel
7. hot plate

Students:

1. beakers with water
2. coffee grounds
3. filter paper
4. funnel
5. stirring rod
6. sugar

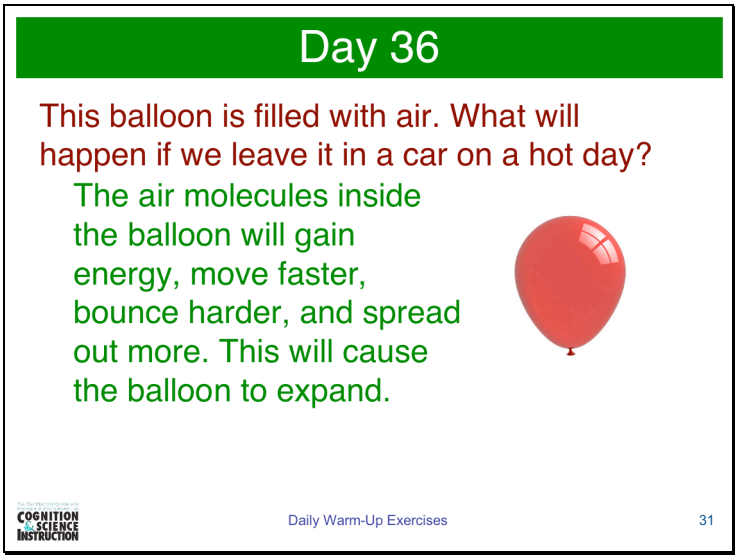
Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
15 minutes – chapter 3.3, part 1 – *Properties of Mixtures*
10 minutes – activity – filtering coffee & sugar – page 65
10 minutes – demo – *Filtering a Mixture* – page 65

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 36 – Properties of Mixtures

Warm-Up Activity



What will happen when the balloon can no longer expand?

If the air continues to gain energy and move faster, the air pressure inside the balloon will increase, and the balloon may pop.

What is pressure?

a force or set of forces that is spread out over a surface

What is a force?

a push, pull, or similar action

Chapter 3.3, part 1

The book uses a pizza as an example of a mixture, but that example doesn't help students understand that substances in mixtures retain their properties. A clearer example would be the iron and aluminum nails students worked with in the *Separating Elements* quick lab on Day 28. Mixing the nails together didn't change their identities, so the iron nails were still magnetic and the aluminum nails were still not magnetic. Similarly, when salt and pepper are combined, the salt will still dissolve in water and the pepper still won't. And when sugar is mixed with vinegar, the litmus test will show that the vinegar is still an acid.

Day 36 – Properties of Mixtures

Chapter 3.3, part 1 (cont.)
Since the substances in a mixture are not chemically combined, they can be separated by physical changes. As you go over the different ways to separate mixtures, use questions to help your students understand that these techniques take advantage of the fact that substances retain their characteristic properties. Examples:

- distillation – boil one substance & collect the gas as it evaporates (see Figure 2 on page 65); the other remains [uses boiling point, a characteristic property]
- magnet – magnetic substance sticks to the magnet; the other remains [uses magnetism, a characteristic property]
- centrifuge – substances separate according to heaviness [uses density, a characteristic property]
- dissolving & filtration – substance that dissolves goes through the filter; the other remains [uses solubility, a characteristic property]
- evaporation – substance that evaporates goes into the surrounding air; substance that doesn't evaporate remains [uses boiling point, a characteristic property]

The 21st Century Center for Research & Development in Cognition & Science Instruction

DAY 37

Solutions

This lesson covers part 2 of section 3.3 (pages 66-67).

Big Idea

- A solution is a mixture in which one substance dissolves in another substance.

Materials

Teacher:

1. slides – day37.ppt

Students:

1. acetic acid card – worksheet 20

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
35 minutes – chapter 3.3, part 2 – *Solutions*

Chapter 3.3, part 2

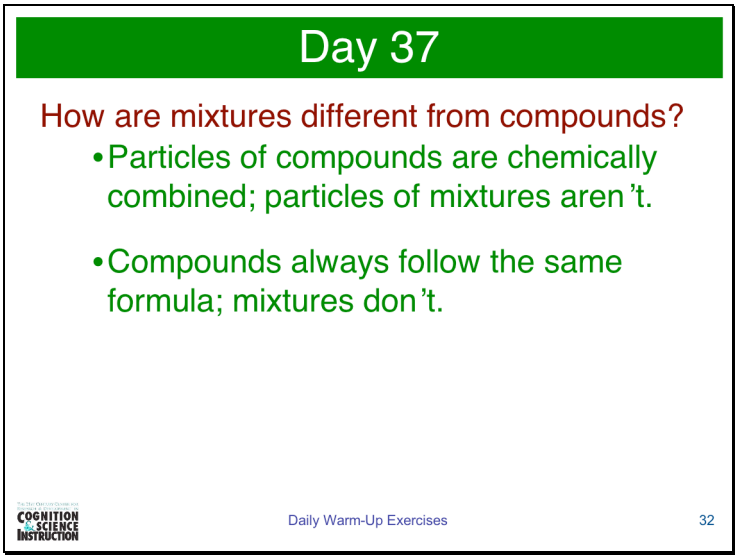
The text explains that solutions form when one substance dissolves in another substance. People often use the word "melt" to describe this process, as in, "Sugar melts in water." If you hear students say something like this, encourage them to use "dissolve" for this process and "melt" to refer to the change of state. Not because "melt" is incorrect, but just to avoid confusion.

After going over the information on pages 66-67, have your students look again at the acetic acid card (worksheet 20, slide 1). How much acetic acid does vinegar contain? [only about 5%] Tell them the concentration of distilled vinegar, which is the kind they mixed with baking soda, can range from 5 to 20%. Does this make distilled vinegar a compound or a mixture? [It's a mixture, because its formula can vary. The ratio of acetic acid to water isn't always the same.]

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 37 – Solutions

Warm-Up Activity



A formula is like a recipe. Compounds always follow the exact same recipe when they form. A molecule of water always has two hydrogen atoms and one oxygen atom. Because of this, what else do compounds have that mixtures don't have?

definite densities & melting/boiling points

How can mixtures be separated?

by physical changes

Chapter 3.3 – part 2 (cont.)

Tell your students that room temperature is about 20°C, then ask: What would acetic acid's state be at room temperature? [liquid, because the temperature is above its melting point]. At what point will acetic acid freeze? [at its melting point, 17°C] Tell them 17°C is 63°F, which is not far below room temperature. Acetic acid would freeze if you put it in the refrigerator, but vinegar doesn't. Most vinegar freezes at about -2°C, which is just below water's freezing point. This shows that, contrary to what it says in Table 1 on page 66, the substances that make up a mixture don't always retain all of their properties.

Day 37 – Solutions

Chapter 3.3 – part 2 (cont.)
Return to slide 14, which shows the equation for the reaction between vinegar and baking soda. The products of this reaction are sodium acetate, water, and carbon dioxide. What happens to the carbon dioxide? [It escapes into the surrounding air.] Once the bubbling stops, all that remains is a liquid. What does this liquid contain? [sodium acetate & water] Is the liquid an element, compound, or mixture? [It couldn't be an element, because it contains two different substances.] Allow your students to share ideas for a few minutes.

Tell your students that, at room temperature, sodium acetate is an odorless white powder that is soluble in water and has a density of 1.58 g/cc. Based on this description, your students should conclude that the liquid is a mixture. If sodium acetate is soluble in water, it will dissolve and form a solution. Solutions are mixtures, not compounds. In other words, even though a chemical reaction occurs and three compounds are formed, the liquid that remains is a mixture containing two compounds, sodium acetate and water.

The 21st Century Center for Research & Development in Cognition & Science Instruction

DAY 38

Sugar Cube Race

This lesson is the skills practice lab called *Sugar Cube Race* (page 136).

Big Idea

- Different factors can affect the rate at which sugar dissolves.

Materials

Teacher:

none

Students:

1. beakers
2. water
3. sugar cubes
4. graduated cylinders
5. stopwatches

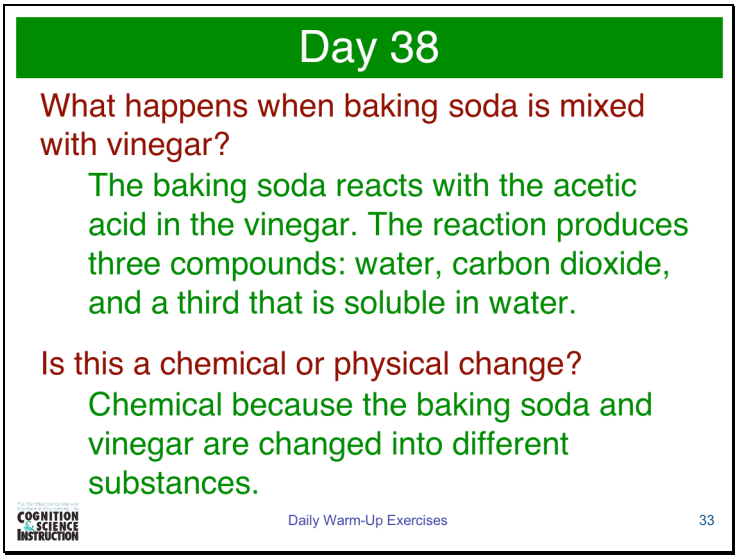
Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
35 minutes – student lab – *Sugar Cube Race* – page 136

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 38 – Sugar Cube Race

Warm-Up Activity



Do you remember the name of the third compound?
sodium acetate

Do water and sodium acetate form a mixture or a compound?
mixture -- sodium acetate dissolves & forms a solution

DAY 39

Concentration

This lesson covers the rest of section 3.3 (pages 68-69) and includes a brief hands-on activity.

Big Idea

- Concentration is the amount of solute dissolved in a solvent, often measured in grams of solute per milliliter of solvent (g/ml).

Materials

Teacher:

none

Students:

1. beakers
2. water
3. food coloring
4. white paper

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
25 minutes – chapter 3.3, parts 3-5
10 minutes – activity – *Comparing Solutions* – page 68

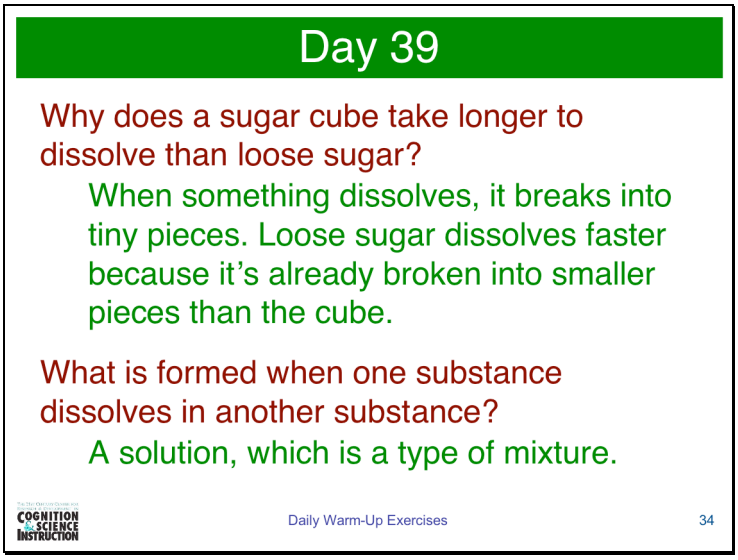
Chapter 3.3, parts 3-5

After introducing the concept of concentration, ask your students to compare concentration to density. They should recognize that both are measured in grams per milliliter. Density is heaviness-for-size: the mass of an object or sample compared to its own volume. Concentration is a different kind of heaviness-for-size: the mass of a solute compared to the volume of the solvent it's dissolved in. Density is a characteristic property of matter. Concentration is a property of an individual solution. [The concentration of a given solution of saltwater doesn't change with sample size, but other saltwater solutions could have different concentrations.]

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 39 – Concentration

Warm-Up Activity



What is a mixture?
a combination of two or more substances that are not chemically combined

Why don't mixtures have chemical formulas?
because the composition of mixtures can vary

Chapter 3.3, parts 3-5 (cont.)

In chapter 1, students learned that solubility is a physical property that indicates whether or not a substance can dissolve in another substance. In this section, the text defines solubility as the ability of a substance to dissolve in another substance at a given temperature and pressure. The idea here is that solubility is not just a "yes or no" property. It's a property that varies with temperature and pressure. Salt dissolves in water, but more salt will dissolve in hot water than in cold water. Solubility, then, is not a measure of whether a substance will dissolve, but of how much of the substance will dissolve. Like concentration, solubility is usually measured in grams of solute per milliliter of solvent (g/ml). The book points out that most solids become more soluble as temperature increases, but most gases become less soluble.

DAY 40

Flame Tests

This lesson is the skills practice lab called *Flame Tests* (pages 72-73). It involves working with an open flame and hydrochloric acid, so you might want to do this as a teacher demonstration.

Big Idea

- Flame color is a property that can be used to identify specific elements within compounds.

Materials

Teacher:

none (see note above)

Students:

1. Bunsen burner
2. chloride test solutions
3. beaker with dilute hydrochloric acid
4. spark igniter
5. masking tape
6. 4 small test tubes in rack
7. beaker with distilled water
8. wire with wooden handle
9. safety glasses

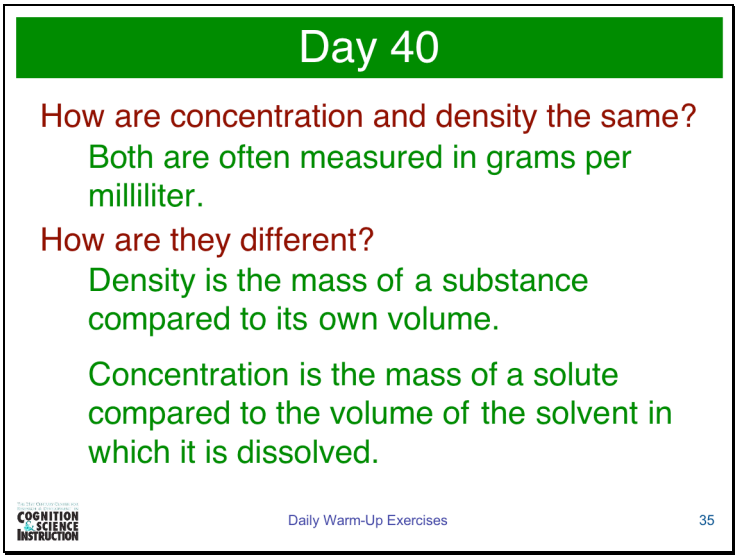
Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
35 minutes – student lab – *Flame Tests* – pages 72-73

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 40 – Flame Tests

Warm-Up Activity



Help your students understand that density involves one substance, and concentration involves two substances mixed together.

The following sites provide additional activities or diagrams to help students better understand concentration and solubility:
•www.inquiryinaction.org/classroomactivities/activity.php?id=9
•phet.colorado.edu/en/simulation/concentration
•www.middleschoolchemistry.com/lessonplans/chapter5/lesson3
•www.chem4kids.com/files/matter_solution.html
•www.bbc.co.uk/schools/scienceclips/ages/10_11/rev_irrev_changes.shtml
•www.all-science-fair-projects.com/project1272_38_1.html
•ice.chem.wisc.edu/KitComponents/Samples/CompanionSample.pdf

DAY 41

Comprehensive Review

This lesson provides an opportunity for students to prepare for Quiz 7, which is a full-period quiz that will cover everything they've learned from the first three chapters.

Big Ideas

- See list of big ideas, Days 1-40.

Materials

Teacher:

1. vocabulary list – IM word list.doc
2. list of big ideas – IM big ideas.pdf

Students:

none

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
35 minutes – review chapters 1-3

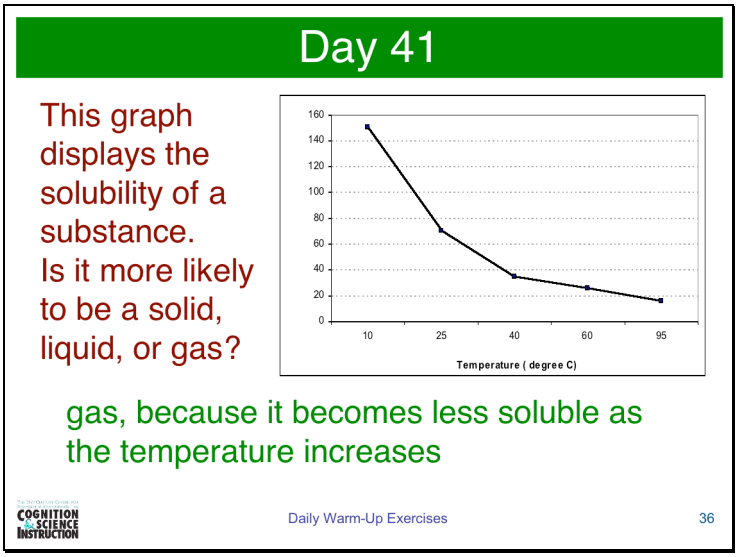
Review Chapters 1-3

After reviewing the meanings of vocabulary words and the big ideas from days 1-40, use the section 3.3 review questions on page 71 and the chapter reviews from all three chapters (74-75; 48-49; 24-25) to identify areas that need additional attention.

The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 41 – Comprehensive Review

Warm-Up Activity



Why do gases tend to become less soluble when they get warm?

When temperature increases, gas particles move faster and faster. More and more particles escape from the liquid, so fewer remain dissolved.

DAY 42

Quiz 7

Quiz 7 is a comprehensive assessment that covers chapters 1 through 3.

Big Ideas
See list of big ideas, Days 1-40.

Materials

Teacher:
none

Students:
1. Quiz 7

Activities & Allotted Time (40 minutes total)

40 minutes – quiz

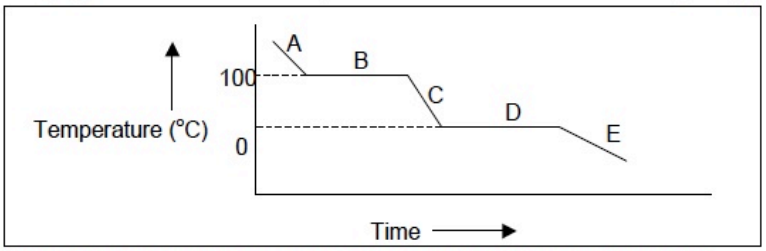
The 21st Century Center for Research & Development in Cognition & Science Instruction

Day 42 – Quiz 7

Quiz 7 – Page 1

1. Which statement about particles of matter is true?
   a. Particles of liquids and gases move, but particles of solids do not move.
   (b) Particles of matter attract each other, sort of like magnets or static electricity.
   c. Because particles of liquids move randomly from place to place, liquids have no definite volume or shape.

2. The graph below shows the temperature of a substance that is losing energy.



Which letter shows when the substance is changing from liquid to solid?
   a. A
   b. B
   c. C
   (d) D
   e. E

3. The physical forms that matter can take are called _____.
   a. pure substances
   (b) states of matter
   c. physical properties

4. Why do solids, liquids, and gases have different physical properties?
   (a) because of the arrangement and movements of their particles
   b. because they are made of different materials
   c. because liquids are very dense and gases have no mass

Introduction to Matter

Day 42 – Quiz 7

Quiz 7 – Page 2

5. Which statement is true?
   a. All matter can change from one state to another.
   b. Change of state is a chemical change.
   c. The temperature of a substance decreases when the substance is changing from one state to another.

6. When air **IS NOT** in a container with a fixed volume, what will happen if the temperature of the air decreases?
   a. The air will take up more space.
   b. The air will take up less space.
   c. The air will take up the same amount of space.

7. When air **IS** in a container with a fixed volume, what will happen if the temperature of the air decreases?
   a. The air pressure will increase.
   b. The air pressure will decrease.
   c. The air pressure will stay the same.

8. What does a chemical formula show?
   a. the composition of a compound
   b. the density of a pure substance
   c. the concentration of a solution

9. Chemical symbols are used to represent _____.
   a. elements
   b. compounds
   c. mixtures

10. Which statement is true?
    a. Compounds do not have a definite density.
    b. The elements that make up compounds are chemically combined.
    c. The composition of a compound can vary.

Introduction to Matter

Day 42 – Quiz 7

Quiz 7 – Page 3

11. Liquids form layers based on _____.
    a. mass
    b. weight
    (c.) density

12. A solution is a type of _____.
    a. element
    b. compound
    (c.) mixture

13. Which statement is true?
    a. The particles that make up mixtures are chemically combined.
    (b.) Mixtures can be separated by physical changes.
    c. Mixtures can be identified by characteristic properties like density.

14. Imagine you add salt to water and stir until all the salt dissolves. The solution after stirring is shown in Figure 1.

    You heat the solution and let it boil for 20 minutes. The solution after boiling is shown in Figure 2.

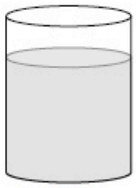


Figure 1

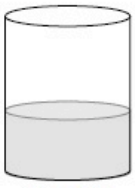


Figure 2

    How does the concentration of salt compare in the two figures?
    a. The concentration is greater in Figure 1 than in Figure 2.
    (b.) The concentration is greater in Figure 2 than in Figure 1.
    c. The concentration is the same in the two figures.

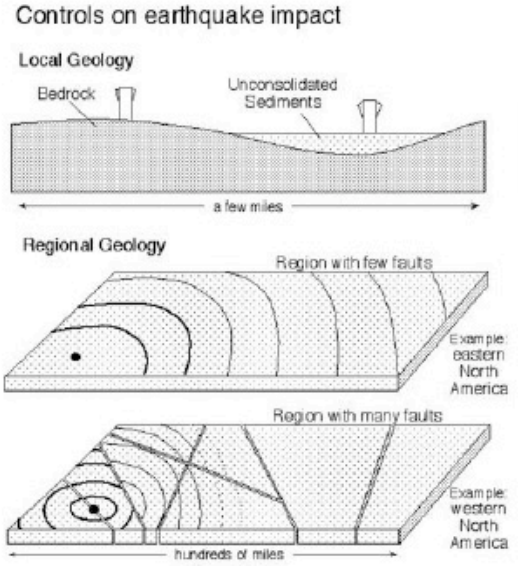
15. Which of the following best describes your thinking about question 14?
    a. Dissolved salt evaporates faster than water.
    b. Evaporation does not change the concentration of a solution.
    (c.) Evaporation results in less water but the same amount of salt.

Introduction to Matter

Day 42 – Quiz 7

Quiz 7 – Page 4

16. **Note to student:** We know you didn't learn this, but we want you to try to answer the question based on the information in the diagram.



According to the above diagram, regional geology _____, while local geology _____.

a. always has many faults; may include bedrock
b. always has few faults; always has many fault
c. covers hundreds of miles; covers a few miles
d. covers a few miles; covers hundreds of miles

Introduction to Matter

Day 42 – Quiz 7

Quiz 7 – Page 5

17. Why do compounds have chemical formulas?

Compounds are made up of elements, and the elements always follow the exact same recipe when they combine. The formula shows how many atoms of each element make up each molecule of the compound. For example, the formula for salt is NaCl. This shows that each molecule of salt has one atom of sodium and one atom of chlorine.

Introduction to Matter