DAY 15 Compare Particle Models, Part 1

This is the first lesson of chapter 2, *States of Matter*. It includes the chapter start-up activity and the first part of contrasting case activity 2.1.

Big Idea

- All matter is made up of particles that are always moving.
- These particles are attracted to each other, sort of like magnets or static electricity.
- The particles of a solid move slowly, and the attractions pull them so close together that they can only vibrate and wiggle in place.
- The particles of a liquid move faster. The attractions hold them near each other, but they have room to slide past each other and move randomly from place to place.

Materials

Teacher:

1. slides – day15.ppt

Students:

1. solid, liquid, & gas cards (worksheets 6-8)
2. data table – worksheet 9

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
5 minutes – start-up activity – *Vanishing Act* – page 31
30 minutes – cc activity – Compare Particle Models, part 1

Compare Particle Models, part 1

In part 1, students examine two models of solid, liquid, and gas particles, and they complete a table designed to help them focus on key features of the models. In part 2, they use a Venn diagram to depict similarities and differences between the particles of solids, liquids, and gases. The activity ends with a discussion of how the arrangement and motion of particles explains properties of solids, liquids, and gases students observed in the first two cc activities.

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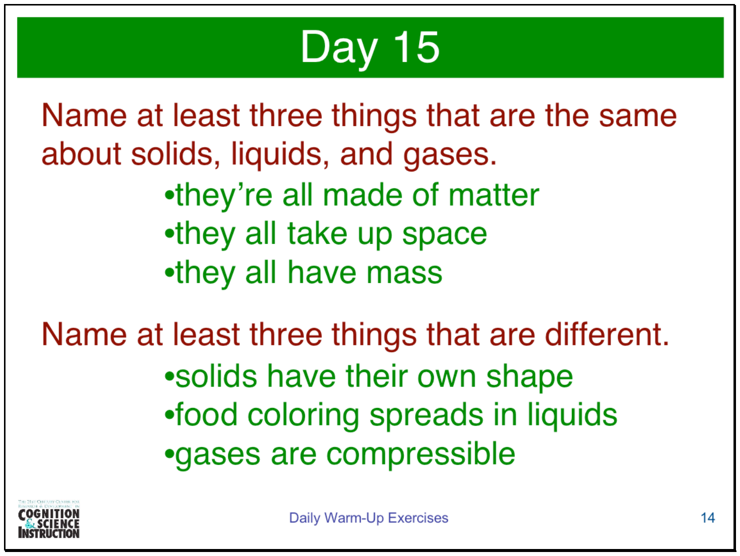
Day 15 – Compare Particle Models, Part 1

Warm-Up Activity

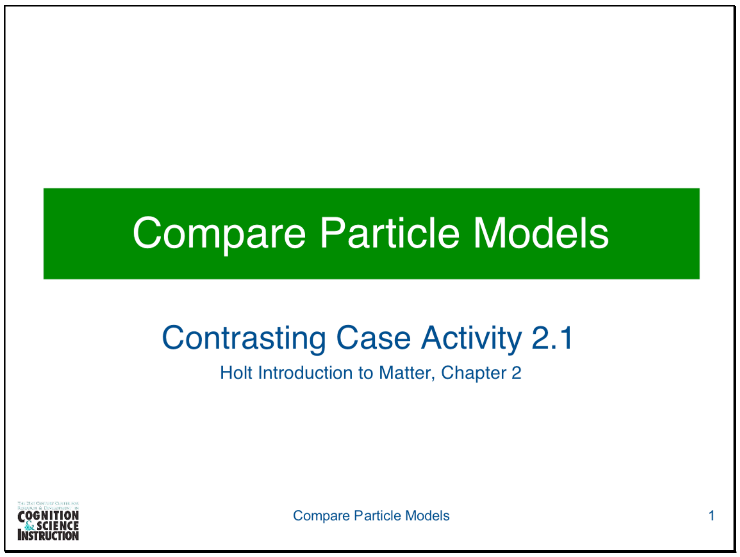


This warm-up sets the stage for today's contrasting case activity. Answers will vary, but the ones that appear on keypress are key ideas that will help students understand that properties of matter result from the arrangement and motion of particles. If students need help coming up with these ideas, use questions to help them remember what they learned from the following activities:

food coloring in solids & liquids
syringe with water & air
ammonia-and-litmus-paper demo

Day 15 – Compare Particle Models, Part 1

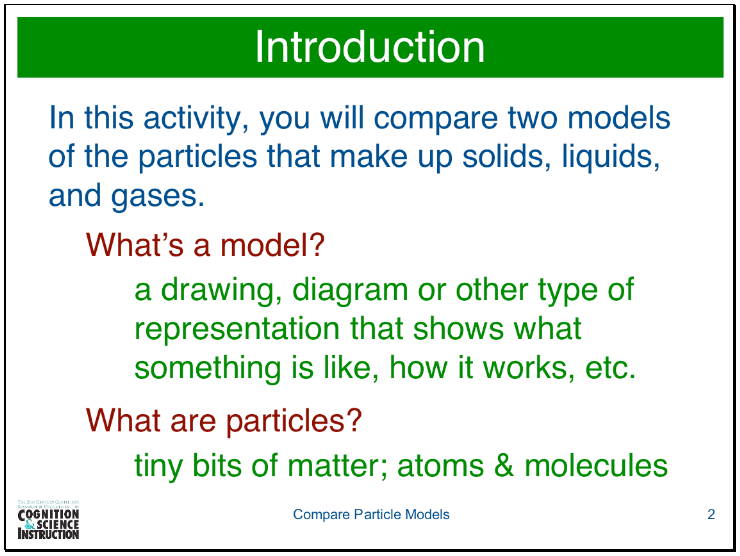
Compare Particle Models, part 1 (cont.)



In this activity, students will compare two models of solid, liquid, and gas particles. The first model consists of a set of drawings that depict the arrangement of particles in each state. Each drawing is accompanied by a paragraph that describes how the particles move. For the second model, students themselves will simulate the arrangement and motion of solid, liquid, and gas particles.

Day 15 – Compare Particle Models, Part 1

Compare Particle Models, part 1 (cont.)



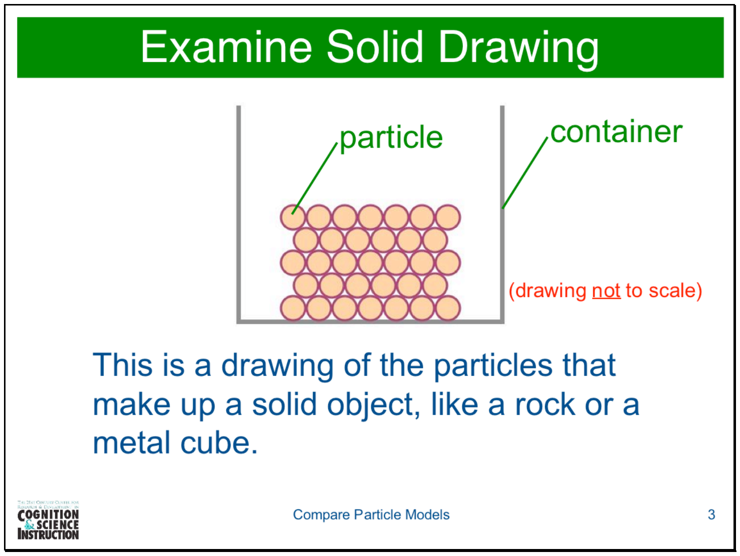
[Questions and answers will appear separately on keypress.]

Before moving to the next slide, tell your students that all matter is made up of particles that are too small to see. These particles are always moving and bumping into each other. They are also attracted to each other, sort of like magnets. When particles are moving slowly, the attractions keep them near each other. But as particles move faster and faster, the attractions are less and less likely to keep them together.

Your students will learn about atoms and molecules in chapter 4. Until then, we will use the word particles to refer to both.

Day 15 – Compare Particle Models, Part 1

Compare Particle Models, part 1 (cont.)



Distribute the cards (worksheets 6-8) and ask students to examine the drawing of a solid. The following questions will help make sure students understand what the model shows. [Added lines and words will appear separately on keypress.]

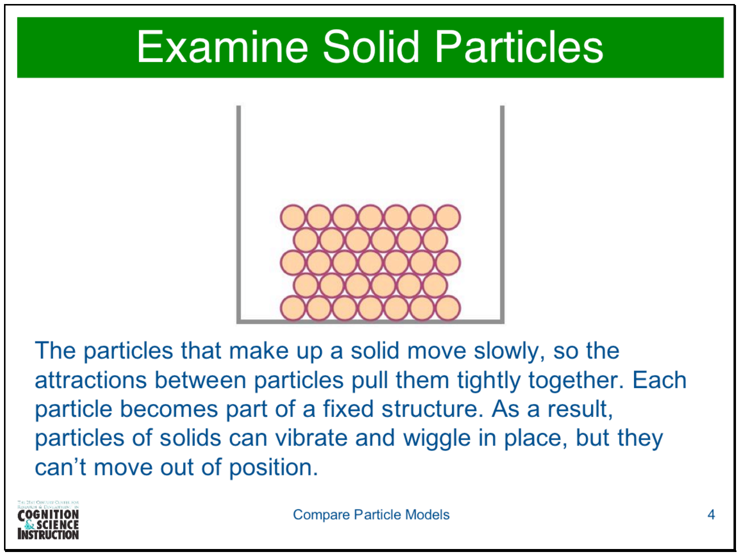
What does each dot represent?
   a particle of matter (an atom or molecule)

What do the gray lines represent?
   a container, like a beaker or a cup

Are particles of matter really this big?
   no, they are too small to see

Day 15 – Compare Particle Models, Part 1

Compare Particle Models, part 1 (cont.)



The following questions will help students connect the model to what you told them about particles of matter.

Earlier, I told you that particles of matter are always moving. How do solid particles move?

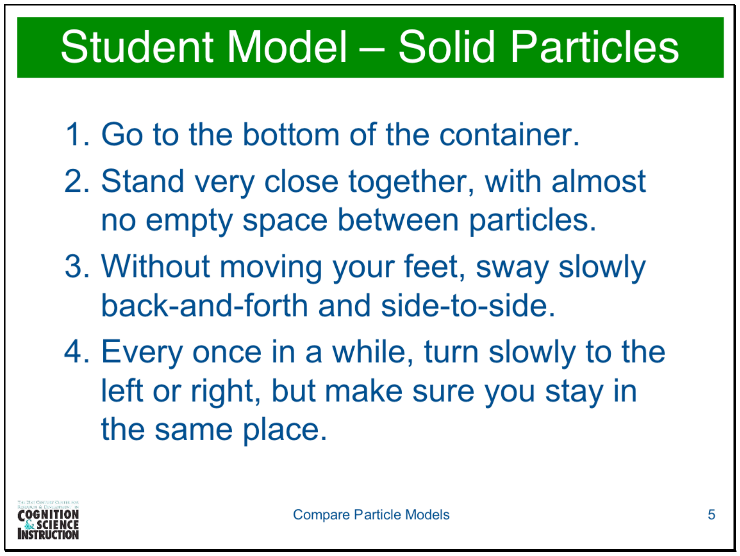
- they move slowly
- they vibrate and wiggle in place

I also said the particles are attracted to each other, sort of like magnets. What can you say about the attractions between solid particles?

- they move slowly, so the attractions pull them close together
- they keep them from moving out of position

Day 15 – Compare Particle Models, Part 1

Compare Particle Models, part 1 (cont.)



Tell students that, for the second set of models, you will need some volunteers. Select 5 to 10 students and have them move to an open area of the classroom and stand in the arrangement described in steps 1 and 2. Tell them to read the directions, but not to do anything else until your signal. When you say go, they should begin moving, and all particles should continue moving until you say stop.

Probably the best way to get the model to work properly is to encourage your observers to critique the modelers' performance.

Day 15 – Compare Particle Models, Part 1

Compare Particle Models, part 1 (cont.)

Data Table – Solids

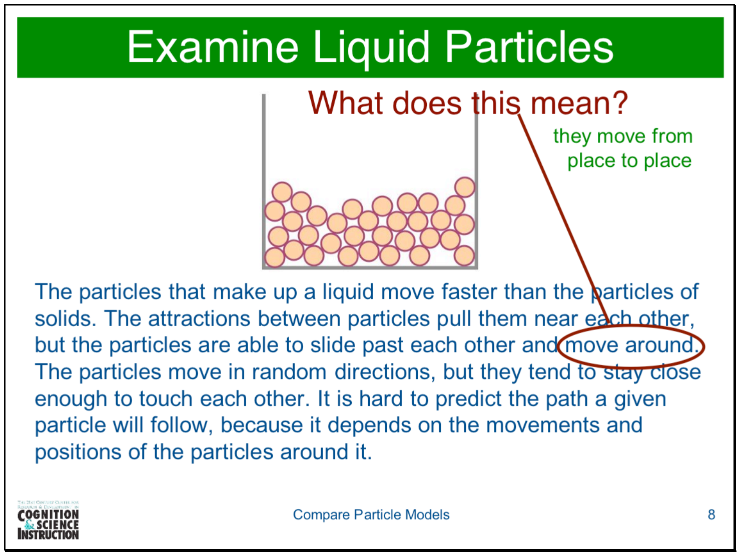
	Solids	Liquids	Gases
Is it made up of particles?	yes		
Are the particles moving?	yes		
If so, how fast do they move?	slowly		
Do they move from place to place or move in one place?	move in one place		
If they move from place to place, is it random or does it follow a pattern?	--		
Do they attract each other?	yes		
If so, what effect do the attractions have?	pull them tightly together		

Compare Particle Models 6

Distribute the data table (worksheet 9) and have students work in groups to complete the solids column, then share their answers with the class. [Entries will appear separately on keypress.]

Day 15 – Compare Particle Models, Part 1

Compare Particle Models, part 1 (cont.)



How do particles of a liquid move?

- faster than particles of solids
- they slide past each other and move around, but they tend to stay close enough to touch each other
- their movements are random; hard to predict

What can you say about the attractions between liquid particles?

- the attractions pull them near each other, but they have room to slide past each other

The paragraph says "move around," but solid particles vibrate and wiggle, and you could call that moving around. What's the difference?

- solid particles move but stay in one place
- liquid particles move from place to place

Teacher Note: On day 23, students will learn that temperature is a measure of particle speed and that temperature remains constant during phase change. At that point, you will tell them that, although liquid particles usually move faster than solid particles, they all move at the same speed during phase change. The same is true for particles changing from liquid to gas or vice versa.

Compare Particle Models, part 1 (cont.)

Student Model – Liquid Particles

1. Go to the bottom of the container.
2. Stand close enough to touch each other, but leave a few empty spaces here and there.
3. Moving at a moderate pace, slide past each other but stay close enough to touch most of the particles around you.
4. Continue moving. Try to maintain a steady, moderate pace.

Compare Particle Models 8

Select a different group of students to model liquid particles. Have them stand in the arrangement described and wait for your signal.

Data Table – Liquids

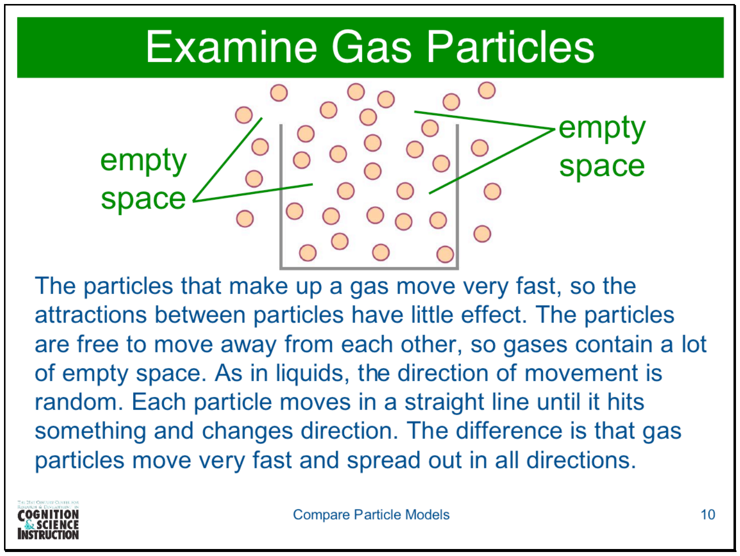
	Solids	Liquids	Gases
Is it made up of particles?	yes	yes	
Are the particles moving?	yes	yes	
If so, how fast do they move?	slowly	faster	
Do they move from place to place or move in one place?	move in one place	move from place to place	
If they move from place to place, is it random or does it follow a pattern?	--	random	
Do they attract each other?	yes	yes	
If so, what effect do the attractions have?	pull them tightly together	pull them near each other	

Compare Particle Models 9

Have students work in groups to complete the liquids column, then share their answers with the class.

Day 15 – Compare Particle Models, Part 1

Compare Particle Models, part 1 (cont.)



How do particles of a gas move?

- very fast
- their movements are random
- they spread out in all directions

What can you say about the attractions between gas particles?

- they move very fast, so the attractions have little effect
- they are free to move away from each other

In the drawing, there are a lot of spaces between the gas particles. What is in those spaces?

- nothing – the spaces are empty

Compare Particle Models, part 1 (cont.)

Student Model – Gas Particles

1. Stand far apart, with as much empty space as possible between particles.
2. Moving at a fast pace, walk directly forward until you bump into another particle or an object.
3. Stop and rotate so you're facing a different direction.
4. Repeat steps 2 and 3. Try to maintain a fast but steady pace.

Compare Particle Models 11

Once the model is running smoothly, tell the particles to stop moving but stay in position. Ask your observers what is in the spaces between particles. If they say air, remind them that these are gas particles. Suppose it's a model of air. Each student in the model is an air particle. What is in the spaces between the air particles? [nothing; the spaces are empty]

Data Table – Gases

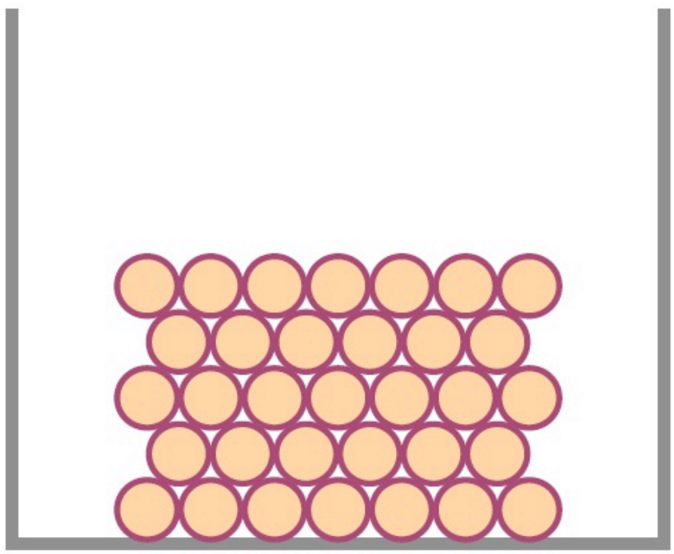
	Solids	Liquids	Gases
Is it made up of particles?	yes	yes	yes
Are the particles moving?	yes	yes	yes
If so, how fast do they move?	slowly	faster	very fast
Do they move from place to place or move in one place?	move in one place	move from place to place	move from place to place
If they move from place to place, is it random or does it follow a pattern?	--	random	random
Do they attract each other?	yes	yes	yes
If so, what effect do the attractions have?	pull them tightly together	pull them near each other	little effect

Compare Particle Models 12

Day 15 – Compare Particle Models, Part 1

Worksheet 6

Compare Particle Models – Solid 6



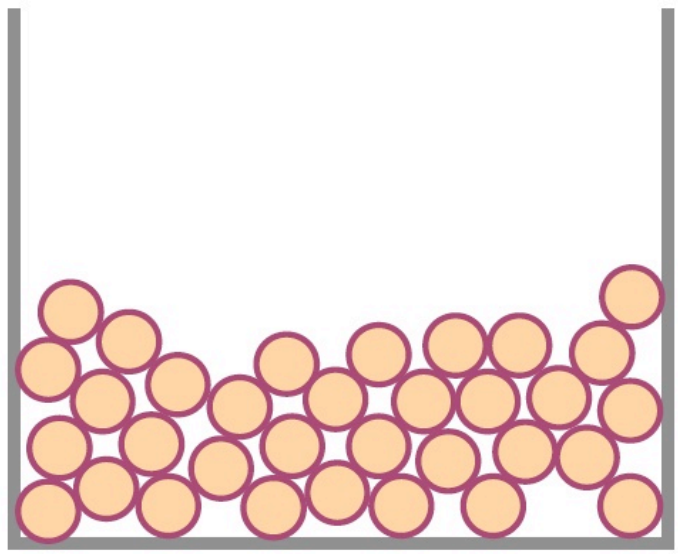
The particles that make up a solid move slowly, so the attractions between particles pull them tightly together. Each particle becomes part of a fixed structure. As a result, particles of solids can vibrate and wiggle in place, but they can't move out of position.

Chapter 2 – States of Matter

Day 15 – Compare Particle Models, Part 1

Worksheet 7

Compare Particle Models – Liquid 7



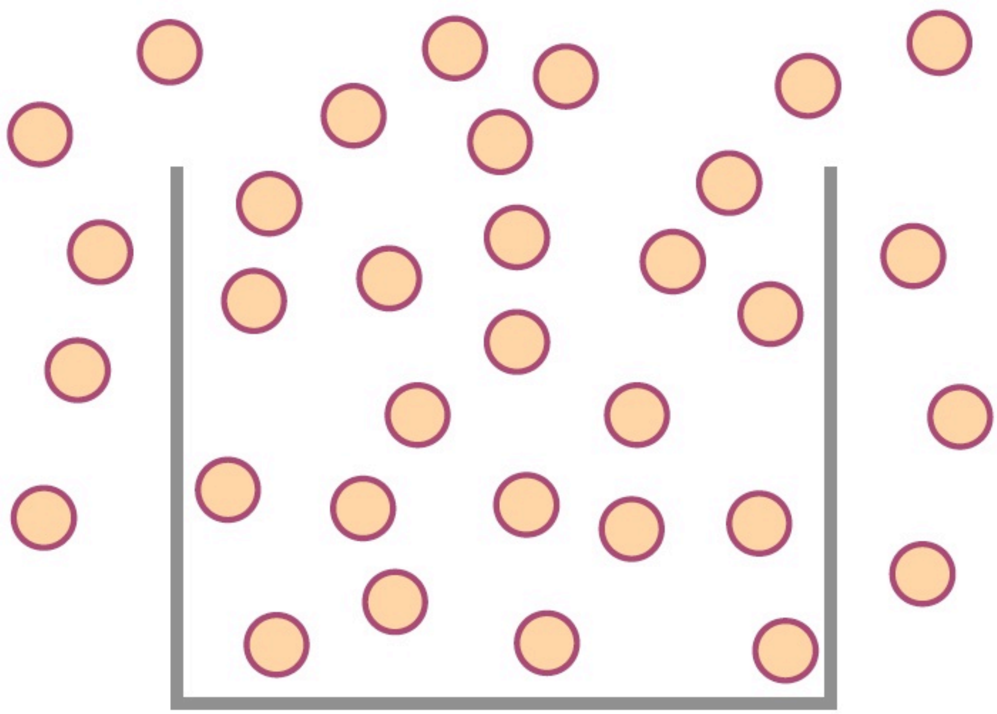
The particles that make up a liquid move faster than the particles of solids. The attractions between particles pull them near each other, but the particles are able to slide past each other and move around. The particles move in random directions, but they tend to stay close enough to touch each other. It is hard to predict the path a given particle will follow, because it depends on the movements and positions of the particles around it.

Chapter 2 – States of Matter

Day 15 – Compare Particle Models, Part 1

Worksheet 8

Compare Particle Models – Gas 8



The particles that make up a gas move very fast, so the attractions between particles have little effect. The particles are free to move away from each other, so gases contain a lot of empty space. As in liquids, the direction of movement is random. Each particle moves in a straight line until it hits something and changes direction. The difference is that gas particles move very fast and spread out in all directions.

Chapter 2 – States of Matter

Day 15 – Compare Particle Models, Part 1

Worksheet 9

Compare Particle Models 9

Data Table

	solid	liquid	gas
Is it made up of particles?			
Are the particles moving?			
If so, how fast do they move?			
Do the particles move from place to place or do they move in one place?			
If they move from place to place, is the movement random or does it follow a pattern?			
Do the particles attract each other?			
If so, what effect do the attractions have on the particles?			

Chapter 2 – States of Matter

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DAY 16

Compare Particle Models, Part 2

This lesson is the second half of contrasting case activity 2.1.

Big Idea

- All matter is made up of particles that are always moving.
- These particles are attracted to each other, sort of like magnets or static electricity.
- The particles of a solid move slowly, and the attractions pull them so close together that they can only vibrate and wiggle in place.
- The particles of a liquid move faster. The attractions hold them near each other, but they have room to slide past each other and move randomly from place to place.
- The particles of a gas move very fast, so the attractions have little effect. The particles bounce randomly and spread out in all directions, so gases contain a lot of empty space.

Materials

Teacher:

1. slides – day16.ppt

Students:

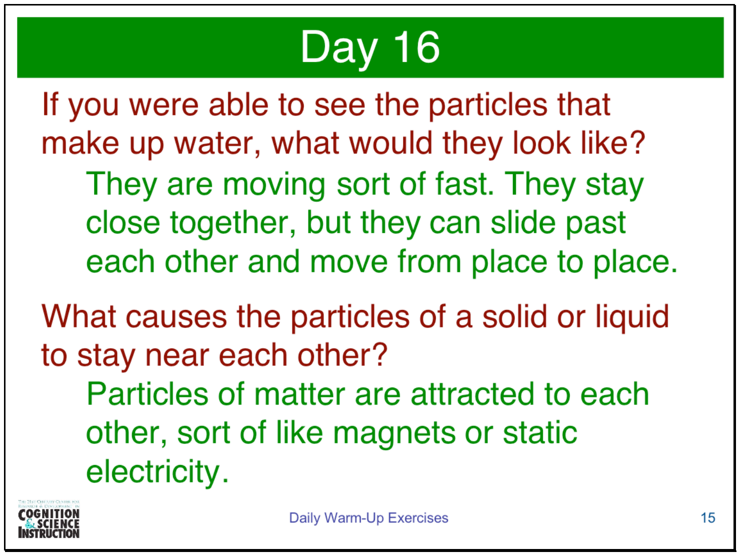
1. solid, liquid, & gas models – worksheets 6-8
2. data table & Venn diagrams – worksheets 9-12

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
35 minutes – cc activity – Compare Particle Models, part 2

Day 16 – Compare Particle Models, Part 2

Warm-Up Activity

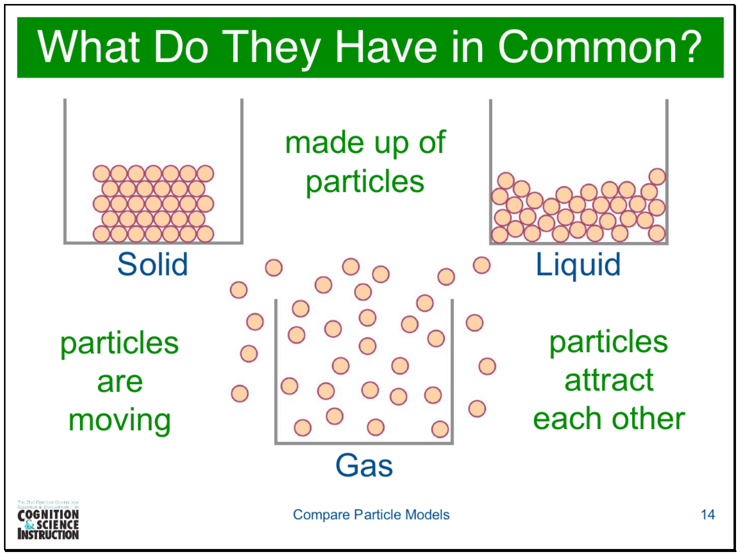


Why can't the particles of a solid move from place to place?

Particles of a solid move very slowly, and the attractions pull them so close together that they can only vibrate and wiggle in place.

Day 16 – Compare Particle Models, Part 2

Compare Particle Models, part 2



Have students spread all three diagrams and the data table in front of them. Working in groups, see if they can find three things that all three models have in common.

- they are all made up of particles
- the particles are moving
- the particles attract each other

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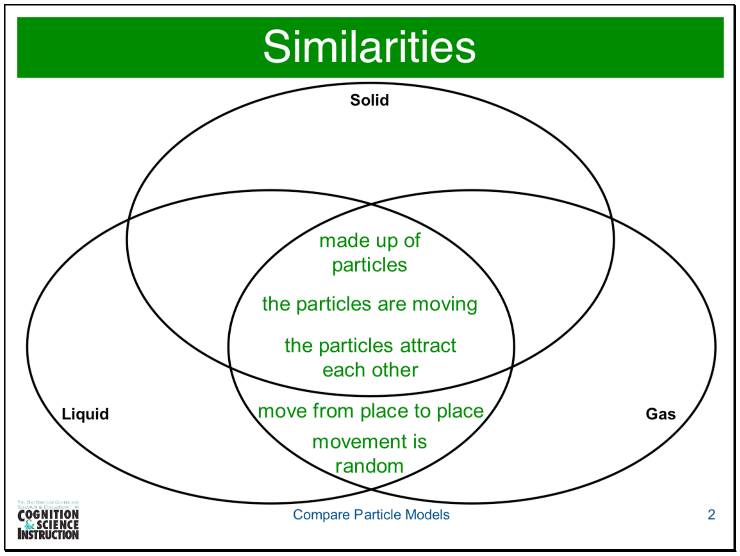
Day 16 – Compare Particle Models, Part 2

Compare Particle Models, part 2 (cont.)



Distribute the Venn diagram and the page of description boxes (worksheets 10 & 11). Have students cut the boxes apart and find the three that are common to solids, liquids and gases. Point out that the Venn diagram has three circles -- one for solids, one for liquids, and one for gases. Where would you put something all three have in common?

in the center, where all three circles overlap

[Descriptions will appear separately on keypress.]

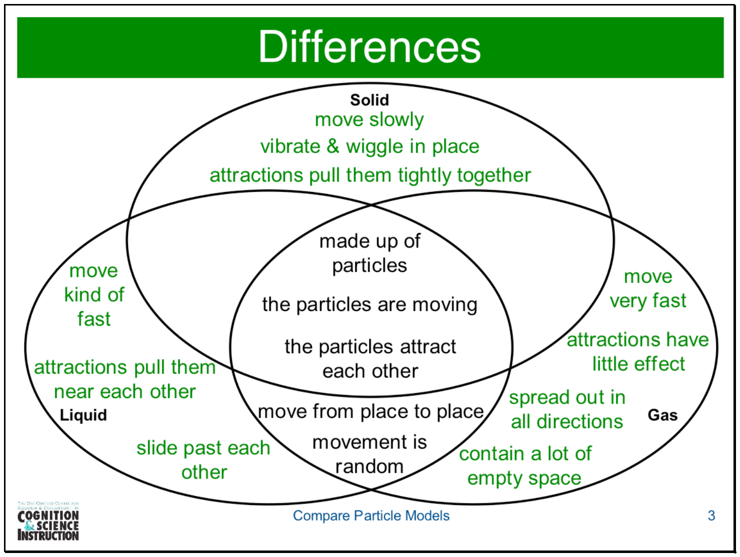
Is there anything that two of the three have in common?

In both liquids and gases, particles move from place to place, and their movement is random.

Have students find each description and figure out where they go in the Venn.

Day 16 – Compare Particle Models, Part 2

Compare Particle Models, part 2 (cont.)



What is true of solids only?
    the particles move slowly; they vibrate and wiggle in place; attractions pull them tightly together

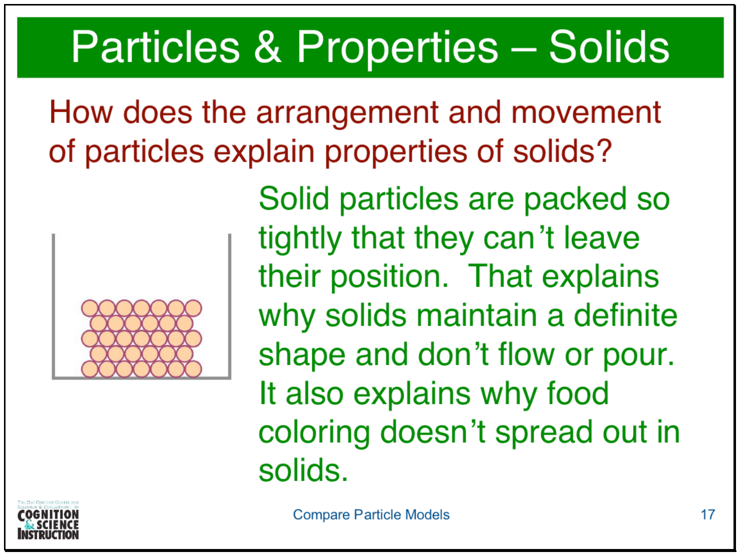
What is true of liquids only?
    the particles move kind of fast; attractions pull them near each other; the particles slide past each other

What is true of gases only?
    the particles move very fast; attractions have little effect;
    the particles spread out in all directions;
    they contain a lot of empty space

Distribute the partially completed Venn diagram and have students fill in the blanks.

Day 16 – Compare Particle Models, Part 2

Compare Particle Models, part 2 (cont.)



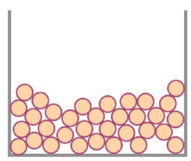
To begin this discussion, you might have students review the lists of properties they generated in Compare Solids & Liquids and Compare Liquids & Gases. If necessary, ask specifically about the properties revealed by the experiments and demos. For example, food coloring spreads in liquids but not in solids; gases can be squished but liquids can't; gases can leave a container and spread throughout a room.

Day 16 – Compare Particle Models, Part 2

Compare Particle Models, part 2 (cont.)

Particles & Properties – Liquids

How does the arrangement and movement of particles explain properties of liquids?



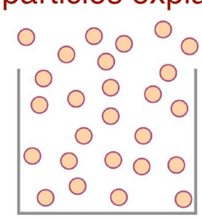
Liquid particles are constantly moving all around. That explains why liquids don't maintain a definite shape and why they flow or pour. It also explains why food coloring spreads out. There isn't a lot of empty space between particles, which is why liquids can't be compressed.

COGNITION & SCIENCE INSTRUCTION Compare Particle Models 18

Saying liquids can't be compressed is another way of saying they have a definite volume.

Particles & Properties – Gases

How does the arrangement and movement of particles explain properties of gases?



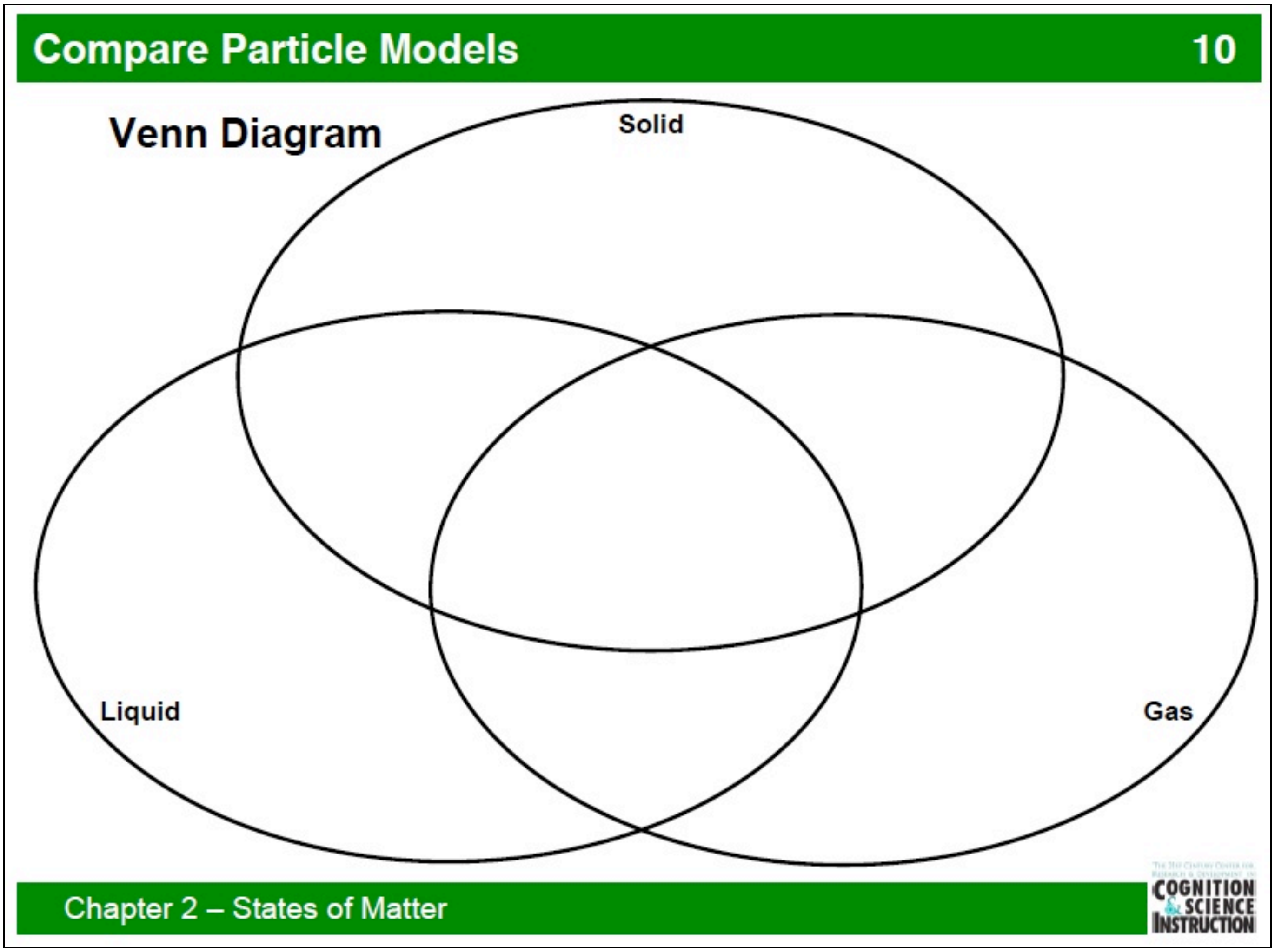
Gas particles move rapidly in all directions. That explains why gases can leave a container and spread throughout a room. Gases contain a lot of empty space, which is why they can be compressed.

COGNITION & SCIENCE INSTRUCTION Compare Particle Models 19

Saying gases can be compressed is another way of saying they don't have a definite volume.

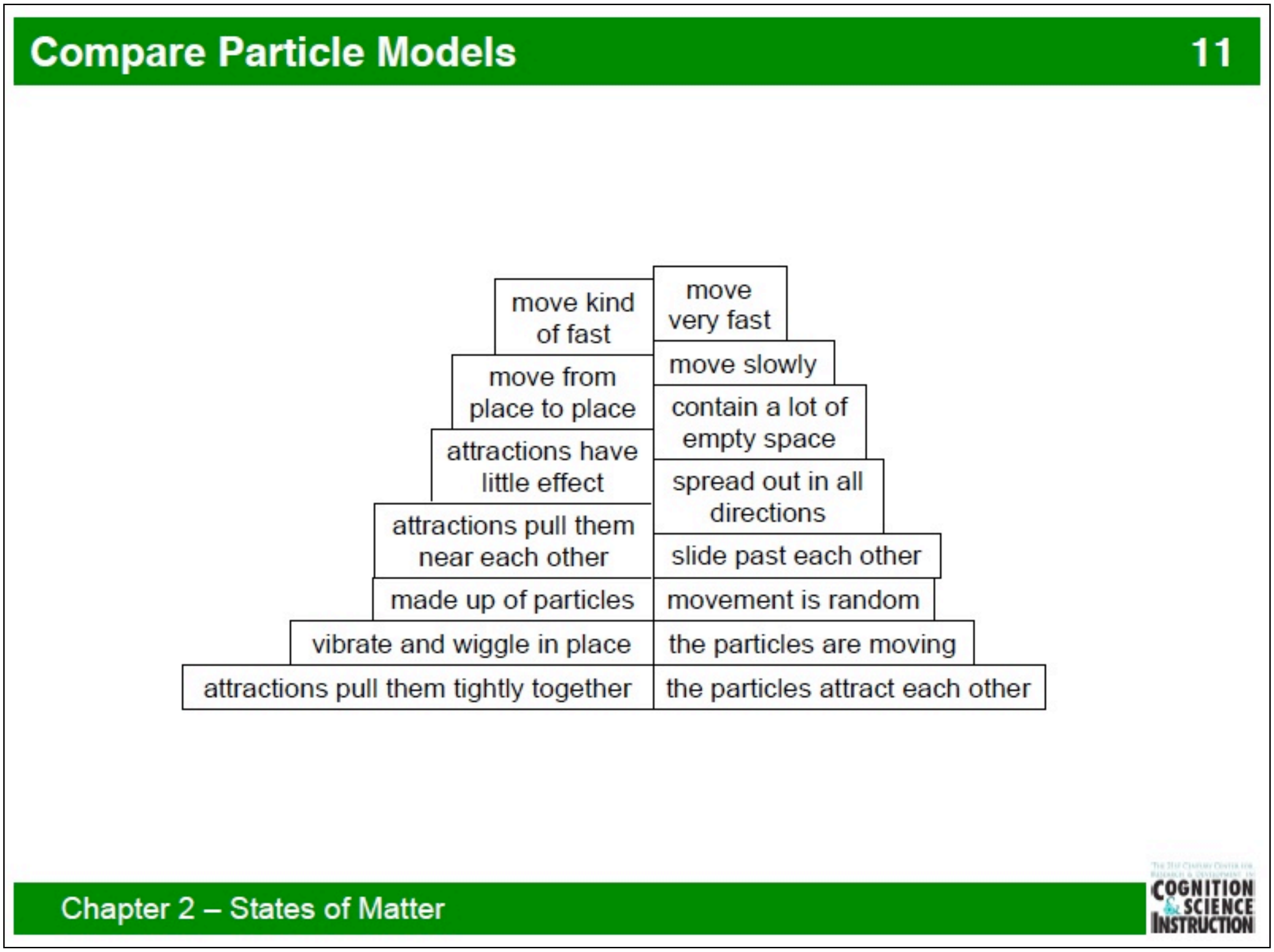
Day 16 – Compare Particle Models, Part 2

Worksheet 10



Day 16 – Compare Particle Models, Part 2

Worksheet 11



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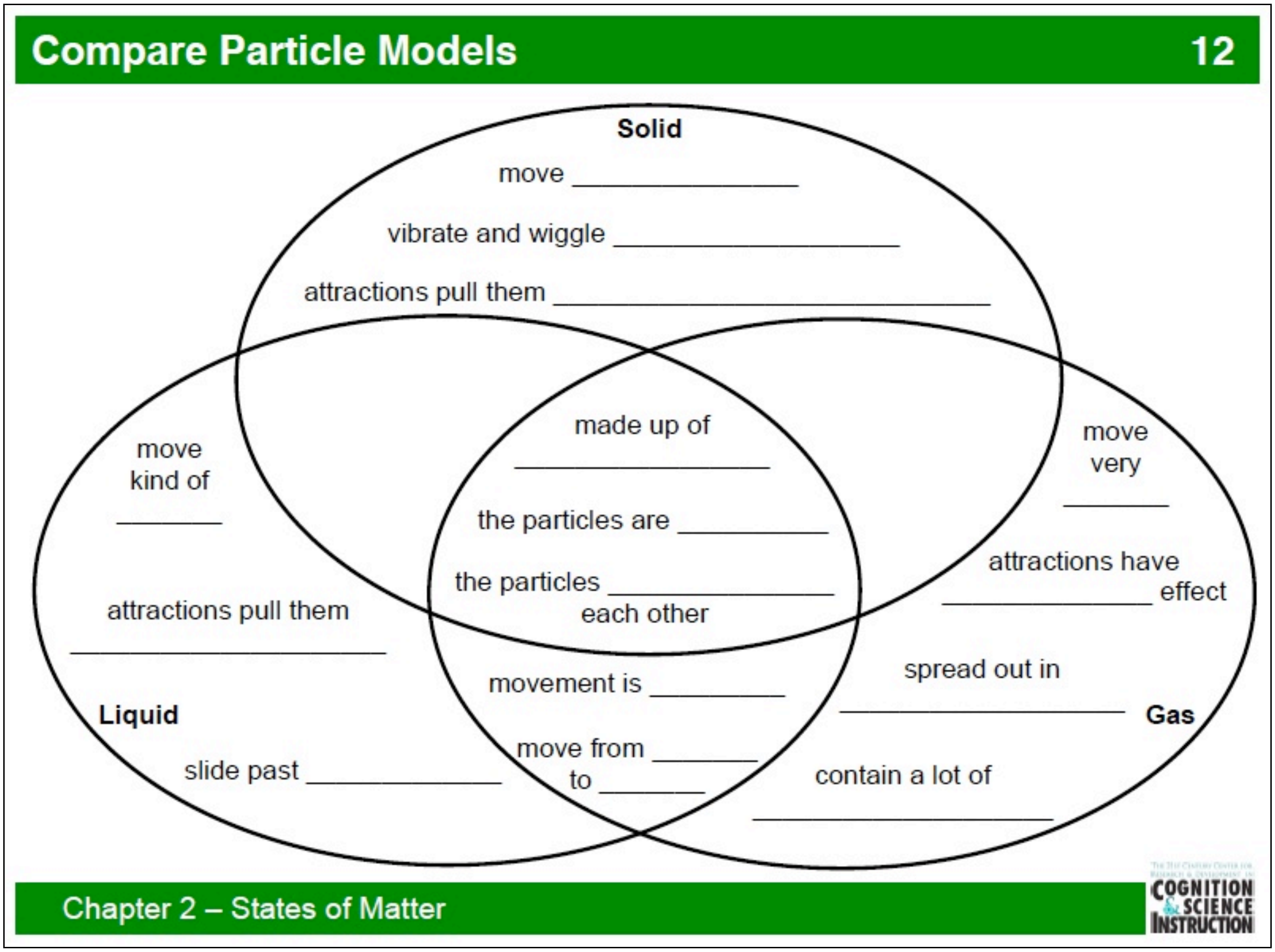
Day 16 – Compare Particle Models, Part 2

Worksheet 12



DAY 17

Three States of Matter

This lesson covers section 2.1 (pages 30-35) and includes three visualization exercises.

Big Idea

- States of matter are the physical forms that matter can take. They include solid, liquid, and gas.
- Different states have different physical properties that are caused by the arrangement and movements of particles.

Materials

Teacher:

1. slides (visualization exercises) – day17.ppt

Students:

1. solid, liquid, & gas models – worksheets 6-8

Activities & Allotted Time (40 minutes total)

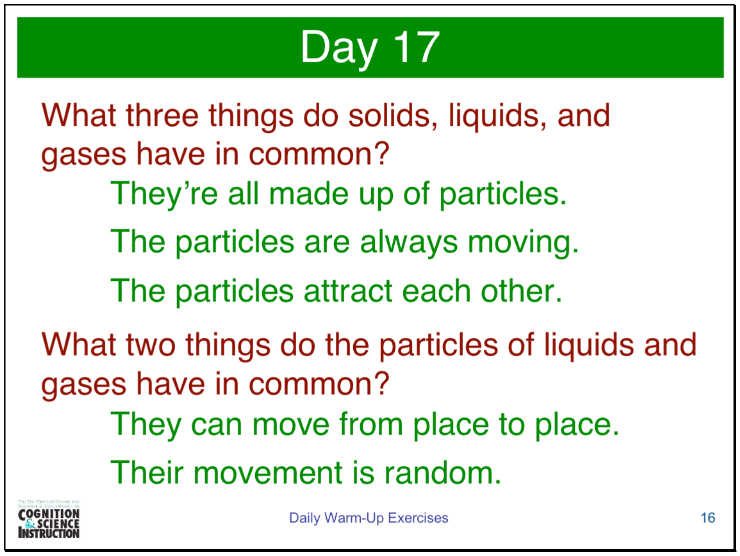
5 minutes – warm-up activity
2 minutes – visualization 2.1a – Diagram vs. "Real" Image
2 minutes – visualization 2.2a – Zoom
2 minutes – visualization 2.2b – Diagram vs. "Real" Image
10 minutes – chapter 2.1 – *Three States of Matter*

Chapter 2.1 – Three States of Matter

Although much of the information in this section was presented in the particle models cc activity, some is new and not very well explained. We strongly recommend that you use the particle models to help students build on the understanding they gained from that activity. You might begin by asking your students to compare the contrasting case drawings with the models on page 32. There are a number of differences. For example, the textbook drawings are three-dimensional and look more realistic, the containers have lids, and the gas particles have marks that make it look like they're zooming all around. But the ideas about particle motion, attractions, and arrangements are all very similar.

Day 17 – Three States of Matter

Warm-Up Activity



Why can't solid particles move from place to place?
because they move very slowly, so the attractions pull them tightly together

Chapter 2.1 – Three States of Matter (cont.)
Next, you might ask your students to see if they can find anything in the paragraphs on page 32 that they didn't learn from the contrasting case activity. There are three main differences. First, the book defines states of matter as the physical forms in which matter can exist. Second, it uses one kind of material – water – to exemplify all three states. Third, it points out that the way particles interact with each other "helps determine the state of the matter."

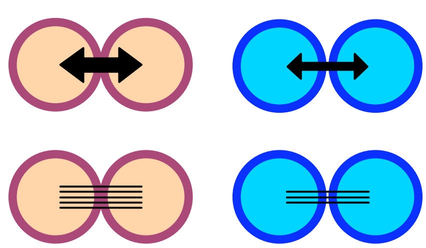
You can use these differences to help your students realize a very important point. So far, all of the contrasting case activities have focused on different kinds of material – for example, comparing clay and water, or water and air. But the book points out that the same kind of material can be a solid, a liquid, or a gas. The contrasting case activity emphasized the connection between speed, attractions, and arrangement. Solid particles move slowly, so the

Day 17 – Three States of Matter

Chapter 2.1 – Three States of Matter (cont.)
attractions are able to hold the particles tightly together. Gas particles move fast, so the attractions have little effect, allowing the particles to spread far apart. But the book invites us to look at this from a slightly different angle. When water particles move slowly, the attractions pull the particles tightly together, forming ice. When water particles move fast, the attractions have little effect, and the particles spread far apart, forming water vapor . Looking at it from this angle, students can easily figure out the answer to a key question: What causes particles of matter to speed up or slow down? The answer is the same thing that causes water to freeze or evaporate. When particles get cooler, they slow down. When they get warmer, they speed up. To reinforce this idea, you might have students use the student model to depict solid, liquid, and gas particles getting warmer and cooler.

After reading about crystalline and amorphous solids (page 33), ask about both kinds of particle models. Does the dot drawing show a crystalline solid or an amorphous solid? [crystalline – the particles are arranged in a pattern] When students modeled a solid, was it crystalline or amorphous? [most likely amorphous, unless they arranged themselves in rows] Have students use both the dot model and the student simulation to depict both kinds of solids.

The section on unique characteristics (page 34) describes surface tension and viscosity. Both of these properties depend on the strength of the attractions between particles. Encourage your students to figure out some way of representing these attractions in their dot models. Two possibilities are depicted below. They can then use the models to show why water drops are round and gasoline drops are flat (surface tension), or why honey flows more slowly than water (viscosity).



Day 17 – Three States of Matter

Visualization Exercise 2.1a – Diagram vs. "Real" Image

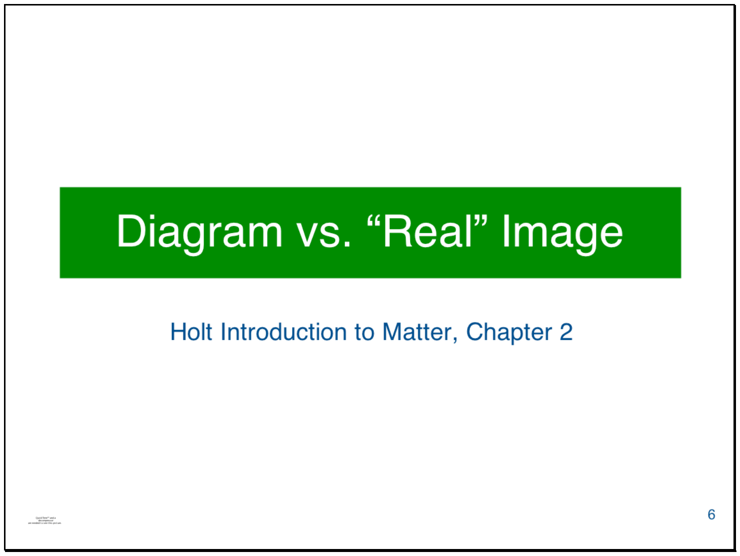


Image comprehension focus: Diagram vs. "Real" Image

Goal: To practice being able to map a real image and a diagram

Type of Activity: Teacher guided student activity

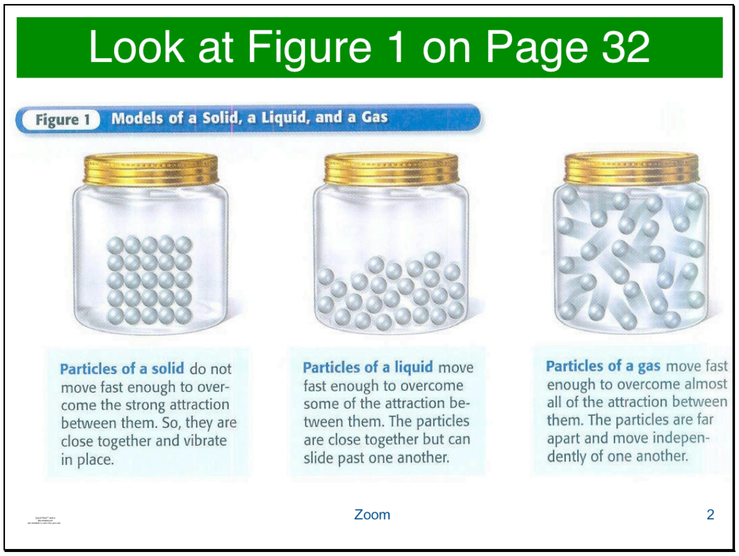
Overview: In this activity, the teacher will explain aspects of the diagram that might otherwise lead to student misconceptions. Students will have opportunities to make connections between features of real images and features of diagrams to practice their diagram mapping skills. An understanding of how diagrams represent real objects is an important component of diagram comprehension.

Procedures: Pre-Activity Task: To avoid or correct the misconception that particles are something inside of a solid, as opposed to the things that actually make up the solid. Similarly, to avoid misconceptions that particles are "contained" in liquids, or "move through" gases, as opposed to actually being the liquid or gas.

Day 17 – Three States of Matter

Visualization Exercise 2.1a – Diagram vs. "Real" Image (cont.)

The Teacher starts by emphasizing what particles of matter are: Matter is made up of/constituted of numerous tiny particles called atoms and molecules.



Have the students look at the unmodified version of Figure 1 on Page 32 and explain that this diagram might easily be misinterpreted to mean that particles are inside, but separate from a solid object, or that they are something that travels through liquid or gas.

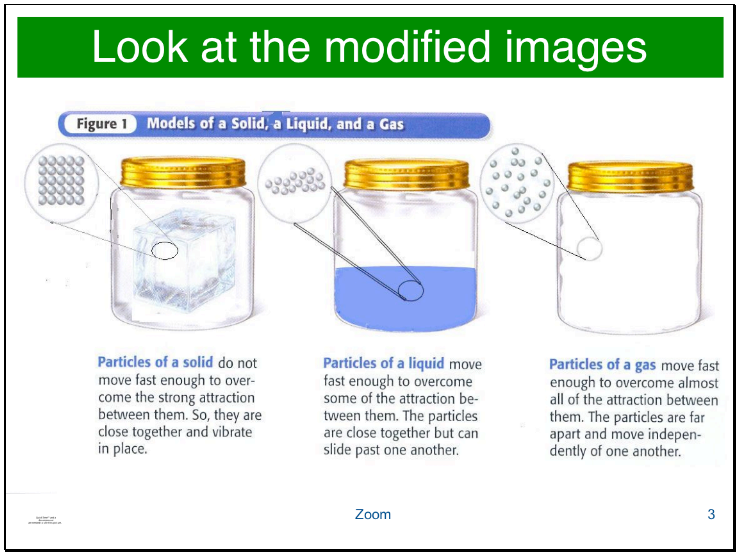
Another misconception that particles can be seen by the naked eye can easily be formed by looking at this figure, because the diagram does not explicitly distinguish between the scale of the jars, and the scale of the particles.

The Teacher should ask the students:
"What diagrammatic convention that we learned in chapter 1 could be added to this diagram to improve it so that viewers would not easily misinterpret the size of particles? (The zoom convention.)

(Proceed to the next slide)

Day 17 – Three States of Matter

Visualization Exercise 2.1a – Diagram vs. "Real" Image (cont.)



The Teacher can then display the modified version of Figure 1 and remind students that a zoom convention is used in a diagram when one part of an image is magnified more than the rest of the image.

The Teacher next asks the students: "What is a cue that you learned already that shows there is a zoom in the diagram?" (They have already seen an example that uses an arrow to indicate a zoom - p.5/Fig 2, a graduated cylinder). The Teacher then explains that this figure uses a different cue to indicate a zoom — the connected-bubbles convention. In the larger bubble, the viewer can see a magnified image of the part of the object that is found in the smaller bubble.

In this figure, the bubbles illustrate some of the particles that make up a solid, liquid and gas. The zoom convention helps the reader understand that these particles have been highly magnified, and that they would not appear that way to the naked eye. In fact, these particles are so small that they would not be visible with a magnifying glass, or with most microscopes. The connected bubbles also help to emphasize that the particles are the ice (and liquid water, and water vapor), just at a different level of magnification. (End of activity)

Day 17 – Three States of Matter

Visualization Exercise 2.2a – Zoom

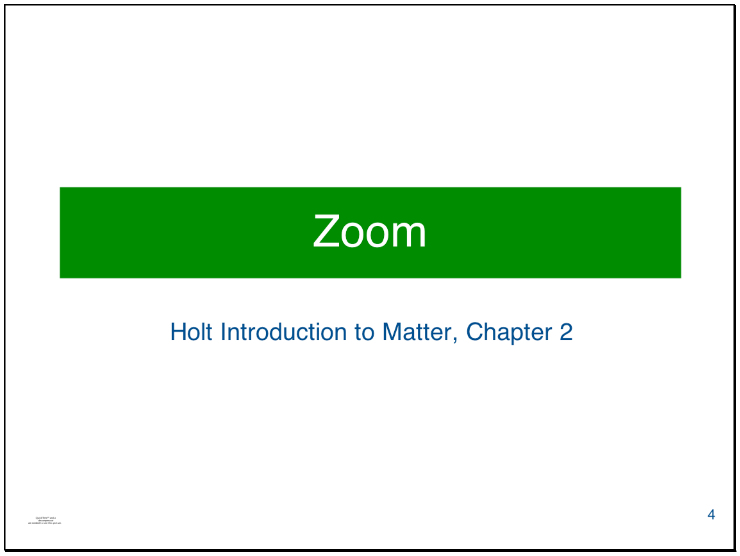


Image Comprehension Focus: Zoom

Goal: To Reinforce the understanding of what a "zoom" convention illustrates

Type of Activity: Teacher Comment

Overview: This activity is designed reinforce students' understanding of the "zoom" convention by explicitly discussing how the things hidden by a surface are sometimes shown. An understanding of the function of the zoom-in convention from another perspective should assist students in developing strong image comprehension skills.

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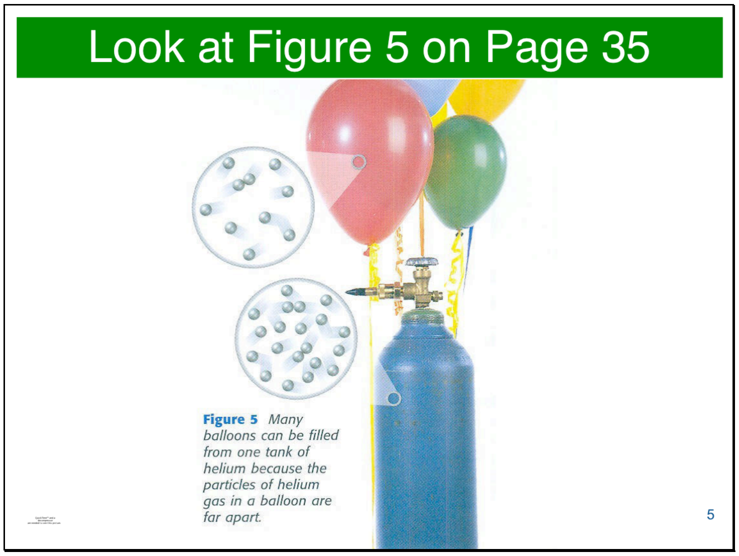
Visualization Exercise 2.2a – Zoom (cont.)



Teacher Comment: Remind students that one zoom cue they saw in chapter 1 was an arrow showing where the magnified image came from and that the magnified part can be seen in the original image. Remind them that a second cue they have seen is the use of connected bubbles. In this image (p. 35/Fig 5), the connected-bubbles convention is present, but there are some important differences in this image.

Explain that, unlike in the previous examples, the zoom in this image shows a magnified view of the contents of containers (a balloon and a helium tank). In previous examples, the magnified part of the diagram showed a close-up of a visible part of the larger object. Students might incorrectly infer that the larger bubbles in this diagram show rubber and the metal shell of the tank at high magnifications.

In this diagram the level of magnification or extent of "zoom" is very large, and what is shown in the bubbles are the movements of gas particles inside of the balloon and inside of the tank. In this case, you cannot see the source of the magnified image (the gases) in the original image (the balloon and the tank), because they are inside the containers. (End of activity)

Day 17 – Three States of Matter

Visualization Exercise 2.2b – Diagram vs. "Real" Image

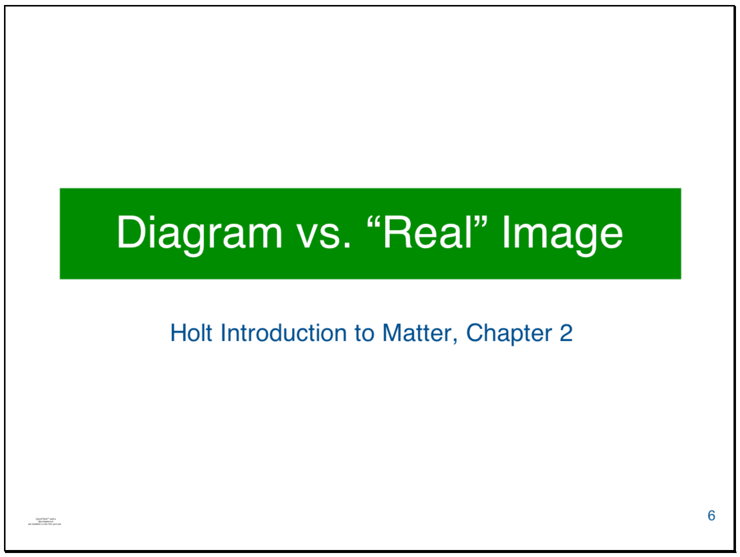


Image Comprehension Focus: Diagram vs. "Real" Image

Goal: Reinforce the understanding that diagrams may not be realistic but are designed to capture key aspects of an object or a process.

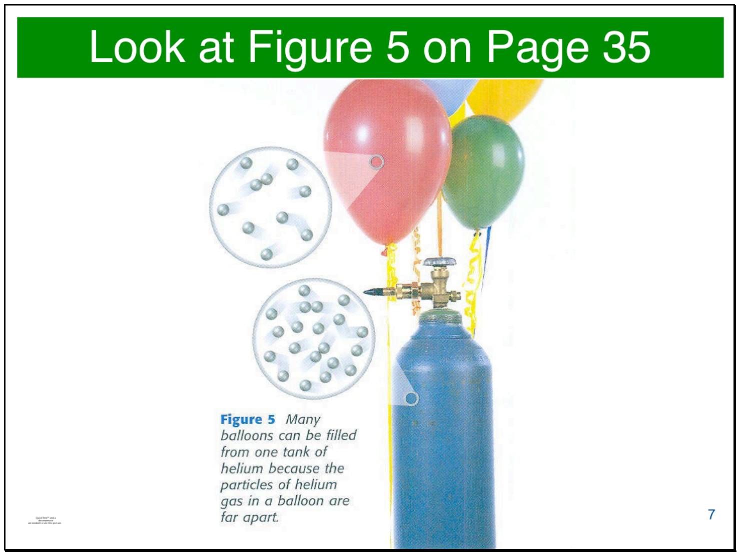
Type of Activity: Teacher guided student activity

Overview: The purpose of this activity is to highlight that diagrams may not be realistic but they capture enough key features of an object in order to aid in understanding about it or about the process in which it is involved. This type of understanding is important so that students can understand the role of diagrams as well as not develop misconceptions that diagrammatic representations are always realistic.

(Proceed to the next slide)

Day 17 – Three States of Matter

Visualization Exercise 2.2b – Diagram vs. "Real" Image (cont.)



Teacher guided student activity: Ask students to recall from the last activity that the images in the zoom bubbles show the movements of gas particles inside the balloon and the tank.

Next, ask the students to tell whether the images in the bubbles are photographs (real images) that show the actual particle movement or drawings that represent the movement in a simplified way. (A show-of-hand vote can be conducted.)

The teacher should conclude that images in the zoom-in bubbles are diagrams (not real images) that represent the movement of gas particles with key features. The teacher should then emphasize that now we are looking at greatly magnified diagrams of particles, which facilitate the visualization and comprehension of particle movement.

At this point, the students may appreciate that the images do NOT reflect the real size, of the particles, but the teacher should take this opportunity to emphasize that the image also uses convenient (not accurate) shapes and colors for the gas particles. (End of Activity)

DAY 18

Behavior of Gases

This lesson covers section 2.2 (pages 36-39) and includes two visualization exercises.

Big Ideas

- Gases behave in predictable ways in response to changes in pressure, volume, or temperature.
- Gas behaviors are caused by the movements of gas particles.

Materials

Teacher:

1. slides (visualization exercises) – day18.ppt

Students:

1. syringes

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
25 minutes – chapter 2.2 – *Behavior of Gases*
5 minutes – visualization 2.2c – Cut-Away
5 minutes – visualization 2.2d – Labels

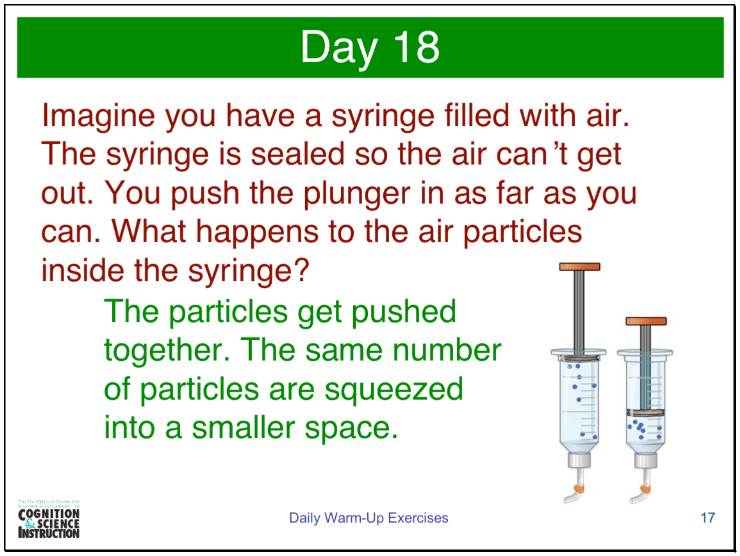
Chapter 2.2 – Behavior of Gases

Page 37 uses the word force to define pressure. Tell your students that a **force** is a push, pull, or similar action, and that **pressure** is a force or set of forces that is spread out over a surface. For example, when a balloon is filled with air, the air particles that are bouncing wildly in all directions bump against the inside of the balloon. Each bump is a force. The combined bumping of all the particles creates pressure on the inside surface of the balloon.

Before talking about figure 2 on page 37, ask students if they've ever pumped air into a deflated ball or tire. What happens as you add more and more air? [The ball or tire gets bigger and harder.] Why? What is happening to the air particles inside the ball or tire? [Adding air increases the number of particles

Day 18 – Behavior of Gases

Warm-Up Activity



Ask your students to draw a particle model to show the air inside the syringe before and after the plunger is pushed in. Encourage them to compare the mass, volume, and density of the air in the two situations. [Images will appear separately on keypress.]

What is in the spaces between the air particles?
nothing -- the spaces are empty

What happens to the density of the air when you push the plunger in?
You have the same amount of matter (same number of particles) in a smaller space, so density increases.

Chapter 2.2 – Behavior of Gases (cont.)
bumping around inside. More bumps means more pressure against the inside surface. The increased pressure causes the ball or tire to get bigger and harder.]

Part 2 focuses on two gas laws that describe relationships among volume, temperature, and pressure in gases. Rather than simply presenting the laws to your students, use questions to help them generate the laws themselves. For example, before reading about Boyles law on page 38, distribute the syringes

Day 18 – Behavior of Gases

Chapter 2.2 – Behavior of Gases (cont.)
and have students repeat the syringe-with-air experiments they did at the beginning of chapter 1, then ask questions like the following: If you keep the end of the syringe tightly sealed, what happens to the amount of air inside the syringe? [It remains the same.] As you push in on the plunger, what do you feel? [The plunger gets harder and harder to push.] Why? What's happening to the air particles inside the syringe? [They get pushed into the empty spaces between particles, so they move closer and closer to each other. As they get closer, they bump more, resulting in more pressure. The plunger gets harder and harder to push because the air particles are exerting more and more outward pressure on the inside of the syringe.]

What happens when you let go of the plunger? [The plunger moves back out, then stops moving.] Why? What is happening to the air particles inside the syringe? [At first the air particles are very close together, so they bump a lot and exert a lot of pressure. The pressure pushes the plunger out, which increases the size of the container. The air particles spread out to fill the larger volume. Since they're not as close together, they don't bump as much, so they exert less and less pressure. At some point, the air particles inside the syringe exert the same amount of pressure as the air particles outside the syringe, so the plunger stops moving.]

What happens when you pull out on the plunger and let go? [The plunger moves in, then it stops moving.] Why? What is happening to the air particles inside the syringe? [Pulling out on the plunger makes the container larger. The particles spread out more and bump less, so the pressure decreases. When you let go, the air outside the syringe exerts more pressure than the air inside, so the plunger moves in. At some point, the air particles inside and outside exert the same amount of pressure, so the plunger stops moving.]

Ask students to write a rule that describes the relationship between volume and pressure. [When you decrease the volume of a container, the gas particles inside the container squeeze together and bump more, which causes pressure to increase. When you increase the volume, particles spread out and bump less so pressure decreases.] Point out that this rule is called Boyle's law, and that it is true when you have a constant (fixed) amount of gas at a constant temperature.

Day 18 – Behavior of Gases

Chapter 2.2 – Behavior of Gases (cont.)
Boyle's Law – When temperature and the amount of gas are constant, volume and pressure are inversely related. The phrase "inversely related" means that when one quantity increases, the other decreases by the same proportion. So when volume doubles, pressure is cut in half. When volume is halved, pressure doubles.

Before reading about Charles's law, ask students to predict what would happen if a balloon filled with air were left in the sun. What would happen to the air particles inside, and what would happen as a result? [The air particles would get warmer, move faster, and bump more. This would result in more outward pressure on the inside of the balloon, which would cause the balloon to get bigger until the pressure inside equals the pressure outside.] What would happen if the volume couldn't change? For example, what if the balloon couldn't stretch anymore? [Pressure increase would cause the balloon to pop.]

Ask your students to write a rule to describe the relationship between temperature and volume. [When you increase the temperature, particles move faster and bump more, which causes volume to increase. When you decrease the temperature, particles move slower and bump less, so volume decreases.] Point out that this is called Charles's law, and that it is true when you have a constant amount of gas in a container that can change volume. There is a second part of the law that is true when a container can't change volume.

Charles's Law – When the amount of gas is constant and volume can change, temperature and volume are directly related. The phrase "directly related" means that when one quantity increases, the other increases by the same proportion. So when temperature doubles, volume also doubles. When temperature is halved, volume is also halved. When the amount of gas is constant and volume can't change, temperature and pressure are directly related. When temperature doubles, pressure also doubles. When temperature is halved, pressure is also halved.

Day 18 – Behavior of Gases

Visualization Exercise 2.2c – Cut-Away

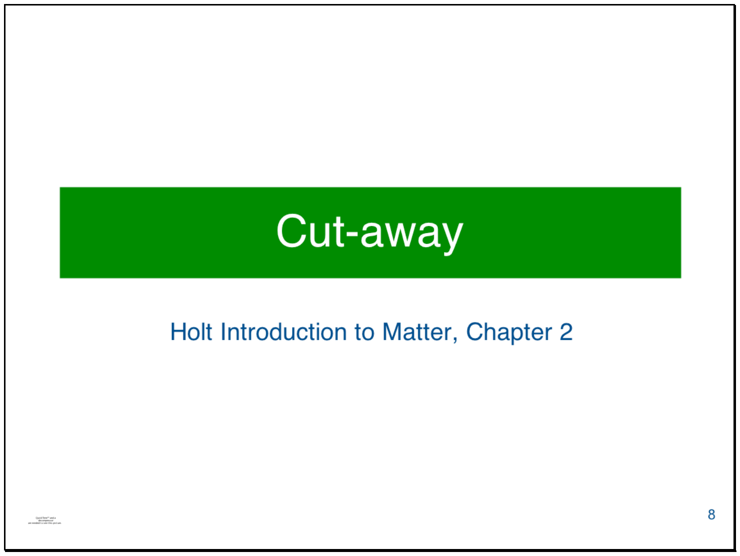


Image comprehension focus: cut-away convention

Goal: Assess students understanding of the "cut-away" convention.

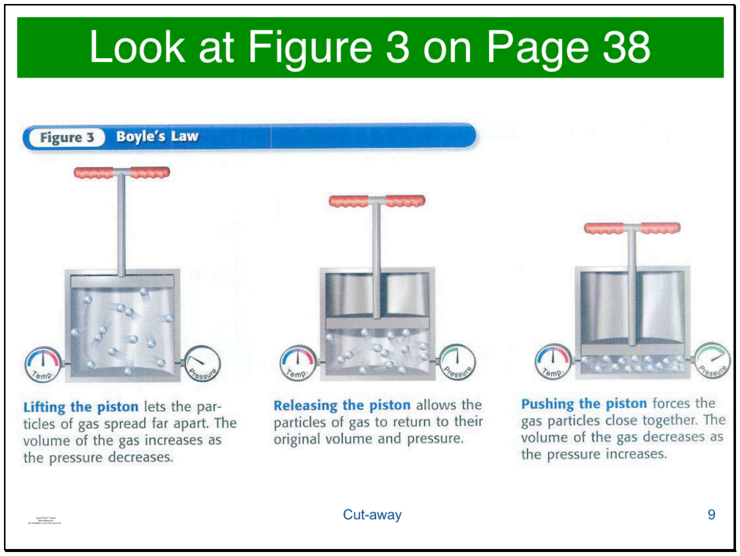
Type of Activity: Student Activity

Overview: This activity is intended to evaluate if the students understand how to recognize when a cut-away convention is being used in a diagram as well as the perspective that is employed by this type of convention.

(Proceed to the next slide)

Day 18 – Behavior of Gases

Visualization Exercise 2.2c – Cut-Away (cont.)



Teacher Comment: Verbally explain that a cut-away diagram allows one to see structures inside the object. Use the analogy of using a knife to remove a section of an orange with the peel still on

Teacher Demo: Demo removal of a section of an apple/orange (for example, cut it in half) using a plastic knife to show the class that the inside part of the orange can now be seen after removing a half of the orange, just as we can see the inside of the piston in the diagram.

Note: Students may not be familiar with pistons. You may need to explain how they work, and may find it helpful to form an analogy using the syringes that they are already familiar with.

Reminder: The Teacher should then remind students that in this figure the image of gas particles are again many times magnified in order to demonstrate the particle movement inside, but gas particles are actually so small that they are much smaller than shown in this figure compared to the size of the container and that they are actually invisible to the naked eye. (End of Activity)

Day 18 – Behavior of Gases

Visualization Exercise 2.2d – Labels

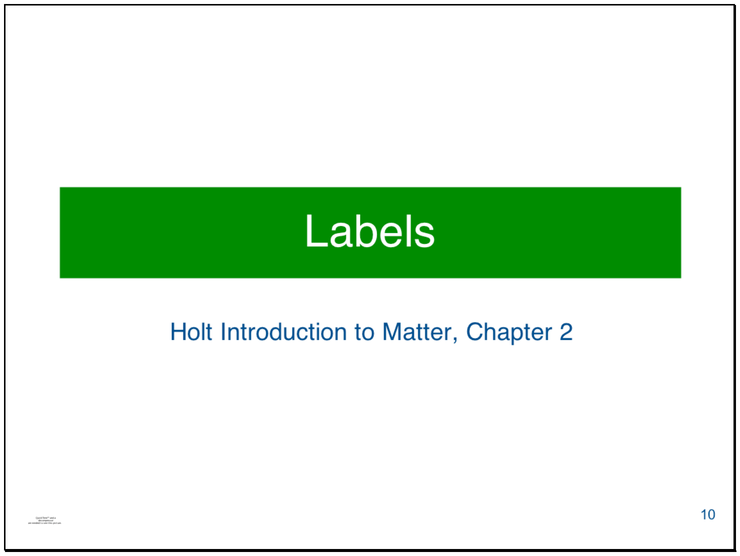


Image comprehension focus: cut-away convention

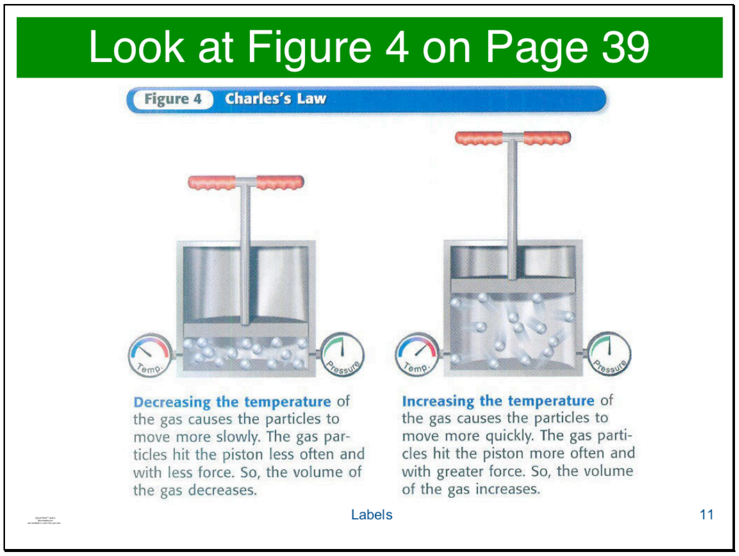
Goal: Assess students understanding of the "cut-away" convention.

Type of Activity: Student Activity

Overview: This activity is intended to evaluate if the students understand how to recognize when a cut-away convention is being used in a diagram as well as the perspective that is employed by this type of convention.

(Proceed to the next slide)

Visualization Exercise 2.2d – Labels (cont.)



Teacher Comment: Point out that the diagram is similar to Figure 3. Both use cut-away views of identical pistons, the pistons contain drawings of balls that represent gas particles, and both have temperature and pressure gauges. Explain that when diagrams are very similar to each other, there is probably a good reason. The authors are using similarities in the diagrams to draw attention to similarities in the underlying ideas. In this case, Boyle's Law and Charles's Law both describe relationships among temperature, pressure and volume of gases.

Direct the students to read the explanatory labels. These labels describe the way in which volume expands when temperature increases, and volume is reduced when the temperature decreases. However, the WAY in which the volume changes has been left out, requiring the students to infer. Ask the students to explain how the volume gets larger when the temperature increases. Guide the discussion, giving prompts where necessary, until they understand that the collisions of the gas molecules are literally supporting the weight of the plunger. When the temperature increases, the molecules move more quickly, producing collisions that are more frequent, and have more force, which lifts the plunger. (End of Activity)

Comprehensive Review

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

Big Ideas

- See list of big ideas, Days 1-18.

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)

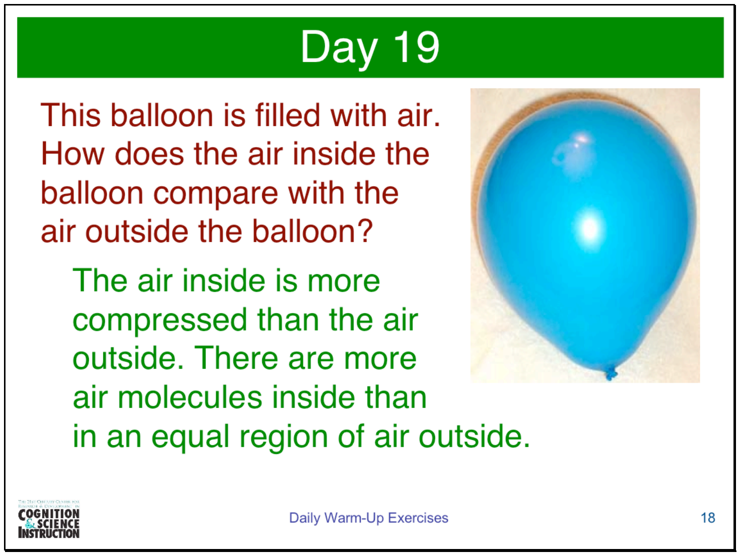
5 minutes – warm-up activity
35 minutes – review chapter 1 and sections 2.1 & 2.2

Review Chapter 1 and Sections 2.1 & 2.2

After reviewing the meanings of vocabulary words and the big ideas from days 1-18, use the Chapter 1 review on pages 24 and 25 and the section review questions on pages 35 and 39 to identify areas that need additional attention.

Day 19 – Comprehensive Review

Warm-Up Activity



What are the air molecules inside the balloon doing?

flying all around, bumping into each other and bouncing against the balloon's inner surface

What is pressure?

one or more forces that are spread out over a surface

DAY 20

Quiz 3

Quiz 3 is a comprehensive assessment that covers chapter 1 and the first two sections of chapter 2.

Big Ideas
See list of big ideas, Days 1-18.

Materials

Teacher:
none

Students:
1. Quiz 3

Activities & Allotted Time (40 minutes total)

40 minutes – quiz

Day 20 – Quiz 3

Quiz 3 – Page 1

1. Imagine you have two blocks. One is made of steel and the other is plastic. Each block has a mass of 25 grams. If you use displacement to measure each object, what will you find?
   a. The steel block will displace more water than the plastic block.
   (b.) The plastic block will displace more water than the steel block.
   c. The two blocks will displace the same amount of water.

2. Which of the following best describes your thinking about question 1?
   (a.) Displacement depends on volume. The two blocks have the same mass, so the plastic block must be larger than the steel block.
   b. Displacement depends on heaviness. They have the same mass, so they will displace same amount.
   c. If the two blocks have the same mass, they must be the same size. So they will displace the same amount.

3. Imagine you have two vials. One contains 40 ml of water and the other contains 40 ml of oil. Which of the following statements is correct?
   a. They both have the same mass.
   (b.) They both have the same volume.
   c. They both have the same density.

4. Which property is commonly measured in grams?
   a. density
   (b.) mass
   c. volume

5. A feature that can be observed or measured without changing the chemical composition is called a ________.
   (a.) physical property
   b. chemical property
   c. characteristic property

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Day 20 – Quiz 3

Quiz 3 – Page 2

6. A feature that doesn't change with sample size is called a _______.
   a. physical property
   b. chemical property
   (c.) characteristic property

7. Which of the following is a chemical property?
   a. density
   b. solubility
   (c.) flammability

8. Imagine you have a beaker of vinegar and a small cup of baking soda. You place them on one side of a balance, and you add paper clips to the other side until the balance is level. With the beaker still on the balance, you pick up the cup, pour the baking soda into the vinegar, and set the cup back down on the balance. What will happen to the balance?
   a. It will still be level.
   b. The side with the vinegar and baking soda will tilt down.
   (c.) The side with the vinegar and baking soda will tilt up.

9. Which of the following best describes your thinking about question 8?
   (a.) The chemical reaction produces a gas that is released into the atmosphere.
   b. Nothing was added or taken away. The only thing that changed is the location of the baking soda.
   c. The chemical reaction creates a new material that adds to the mass.

10. All matter is made up of tiny particles that _______.
   (a.) are always moving
   b. vibrate and wiggle in place
   c. slide past each other and move around randomly

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Day 20 – Quiz 3

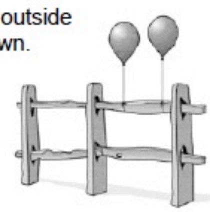
Quiz 3 – Page 3

11. The force of gravity acting on an object is called _______.
    - a. mass
    - (b.) weight
    - c. density

12. How do particles of a liquid compare with particles of a solid?
    - a. Liquid particles are slower and farther apart than solid particles.
    - (b.) Liquid particles are faster and farther apart than solid particles.
    - c. Liquid particles are slower and closer together than solid particles.

13. A force or set of forces that is spread over a surface is called _______.
    - a. inertia
    - b. weight
    - (c.) pressure

14. Two latex balloons filled with helium are taken outside on a hot, sunny day and tied to a fence as shown.



    What will happen to the balloons?
    - a. They will get smaller.
    - (b.) They will get bigger.
    - c. They will stay the same.

15. Which of the following best describes your thinking about question 14?
    - (a.) The particles of helium get warmer and move faster.
    - b. Nothing is being done to the balloons.
    - c. Some of the helium gas will leak out of the balloons.

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Day 20 – Quiz 3

Quiz 3 – Page 4

16. If you could see the particles that make up a drop of water, what would they look like?

The particles are always moving. They are close together, but with room to squeeze past each other and move from place to place. They move in random directions, but they tend to stay close enough to touch each other.

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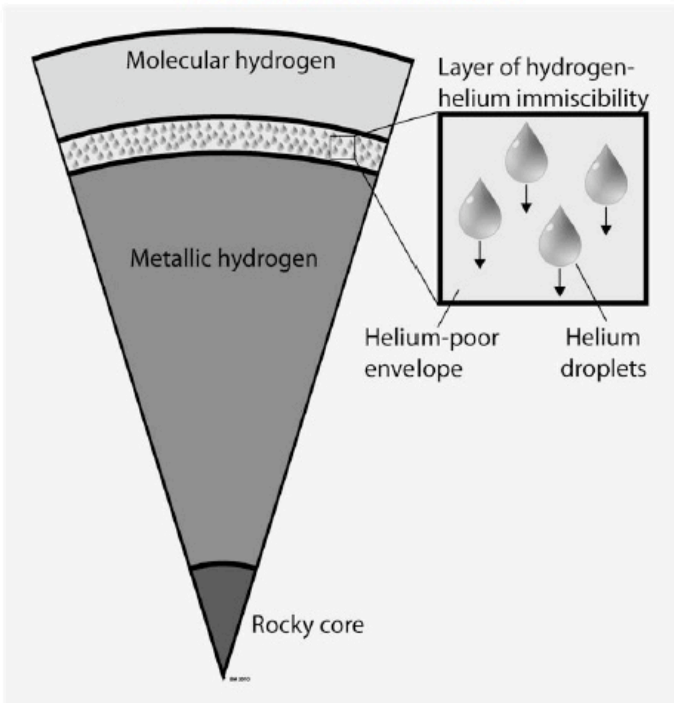
Day 20 – Quiz 3

Quiz 3 – Page 5

17. **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.

The Layers of the Planet Jupiter



According to the diagram above, there are helium droplets in which layer?

a. molecular hydrogen layer
(b.) layer of hydrogen-helium immiscibility
c. metallic hydrogen layer
d. rocky core

Introduction to Matter

DAY 21

Changes of State

This lesson covers most of section 2.3 (pages 40-44) and includes two visualization exercises and a quick lab.

Big Ideas

- Matter can change from one state to another.
- Change of state is a physical change that requires the gain or loss of energy.

Materials

Teacher:

1. slides – day21.ppt

Students:

1. syringes
2. water

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
5 minutes – visualization 2.3a – Arrows
5 minutes – visualization 2.3b – Use of Colors
20 minutes – chapter 2.3, parts 1-6 – *Changes of State*
5 minutes – quick lab – *Boiling Water is Cool* – page 44

Chapter 2.3, parts 1 - 6

Throughout this section, the text refers to changes as endothermic or exothermic, depending on whether energy is gained or lost. We recommend that you omit the big words and encourage students to use their own words to describe energy changes. You might begin by telling your students that heat is one form of energy, and they will learn about other forms in the *Forces, Motion & Energy* module. Use questions to help students explain that, when matter gains energy, its particles move faster. If the particles are moving fast enough, a solid will change to a liquid (melting) and a liquid will change to a gas (evaporation or boiling). When matter loses energy, its particles move slower. If they are moving slowly enough, a gas will change to a liquid (condensation) and a liquid will change to a solid (freezing).

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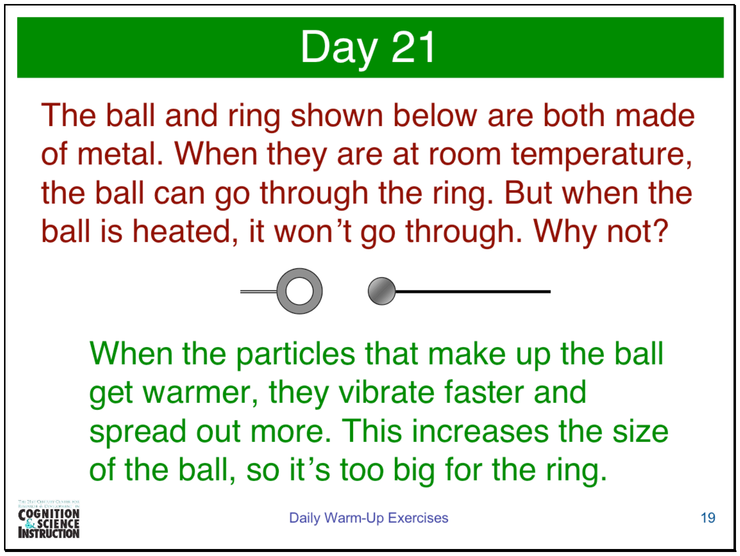
Day 21 – Changes of State

Warm-Up Activity



What happens to the mass of the ball when it gets bigger?

Nothing, because it's still made of the same number of particles so it still contains the same amount of matter. The particles are just spread out more.

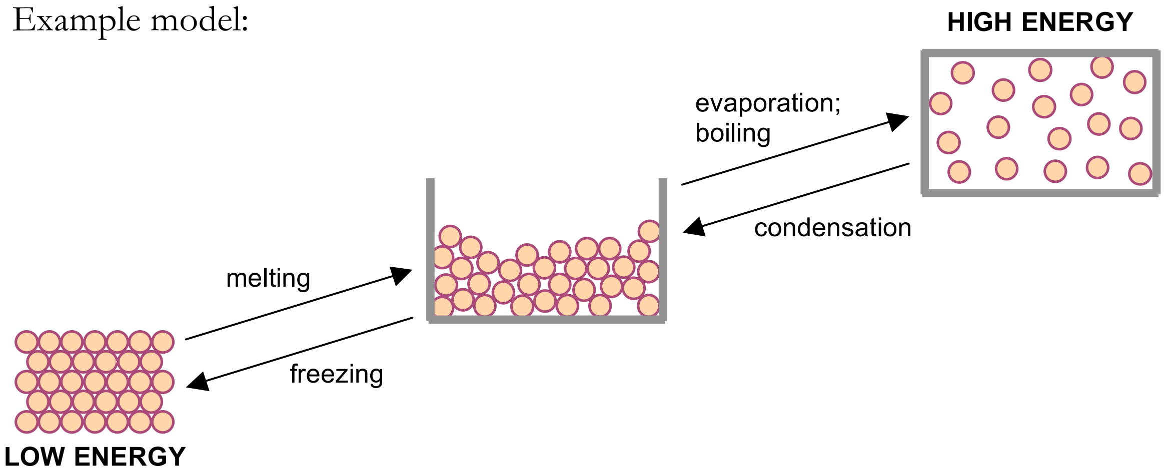
What happens to the density of the ball when it gets bigger?

You have the same number of particles in a larger space, so density decreases.

Day 21 – Changes of State

Chapter 2.3, parts 1 - 6 (cont.)
Once they are able to describe the energy changes, ask your students to examine Figure 1 on page 40 and try to come with a model that shows which changes involve losing energy and which involve gaining energy.

Example model:



After talking about melting point (page 41), ask if melting point is a characteristic property. [Yes, because it stays the same no matter what sample size you use. For example, water freezes or melts at 0°C regardless of how much water or ice you have.] After talking about evaporation (page 42), ask students to explain why it felt cool when the alcohol on their skin evaporated. [Because their skin transfers energy to the alcohol, and this energy causes the alcohol particles to evaporate.]

When you talk about the effects of pressure on boiling point (page 43), try to elicit some of the ideas from your students. For example, if atmospheric pressure is caused by the weight of gas particles pushing down, would pressure be higher or lower at high altitudes? [Lower because there are fewer particles above you.] Have students complete the quick lab (page 44) immediately after this discussion to see that lower pressure results in lower boiling point.

Day 21 – Changes of State

Visualization Exercise 2.3a – Arrows

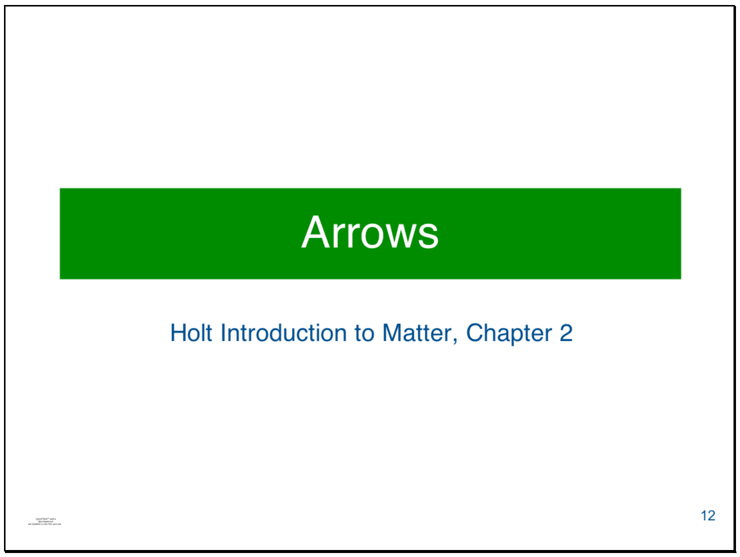


Image comprehension focus: arrows

Goal: Expand understanding how arrows can indicate change

Type of Activity: Teacher Comment

Overview: This activity is intended to extend students' understanding of the use of arrows in diagrams by introducing them to the diagrammatic convention of using arrows to indicate a process or change.

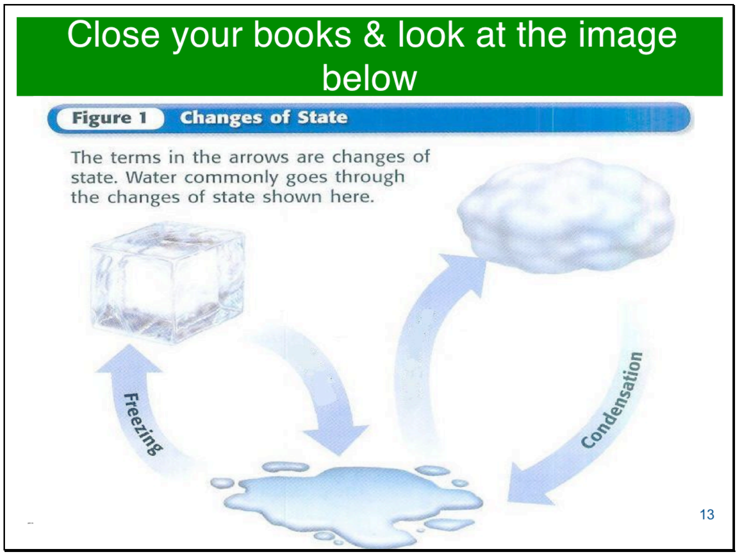
Procedure: The teacher reminds students that they have already seen how arrows can be used in a diagram as:

a cue for a zoom
a cue for measuring/indicating length

Explain that now we are going to investigate an additional role for arrows, showing change (of states).

(proceed to the next slide)

Visualization Exercise 2.3a – Arrows (cont.)



Teacher Comment: In addition to their roles in indicating magnification and indicating length, arrows can also be used to indicate that substances are changing (from one state to another, in this case).

Display the image above, which is a modified version of Figure 1 on Page 40. Explain that the arrows show that ice cubes and water are interchangeable through the processes of melting and freezing, and clouds and water are also interchangeable through the processes of condensation and evaporation.

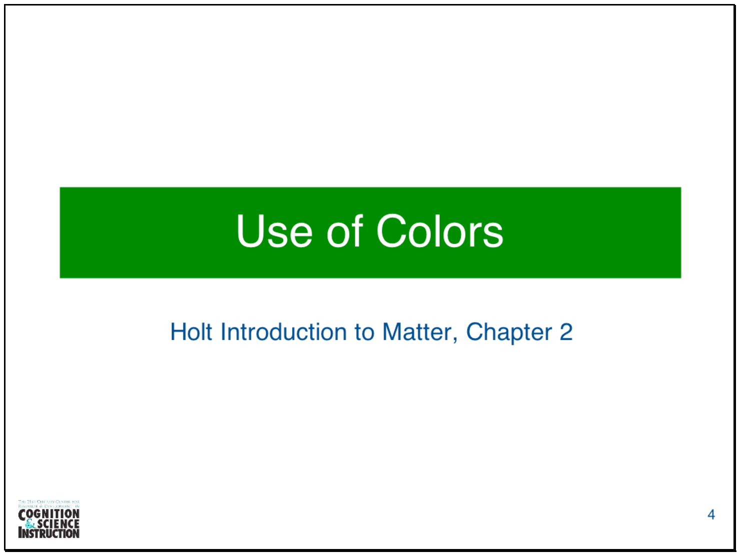
The directions of the arrows show the states before and after the change (for example, changing from water to ice is the process of freezing, and changing from cloud to water is the process of condensation, etc).

Remind students that, from what they learned in chapter 1, what is written in the arrows are naming labels which identify the processes.

(Proceed to Exercise 2.3b.)

Day 21 – Changes of State

Visualization Exercise 2.3b – Use of Colors



NOTE: This activity is designed to help student notice that there are very subtle differences between the two images, which are crucial to understand the two situations: boiling and evaporation.

Image comprehension focus: Color

Goal: To understand subtle difference in colors can indicate huge difference in meaning conveyed by images.

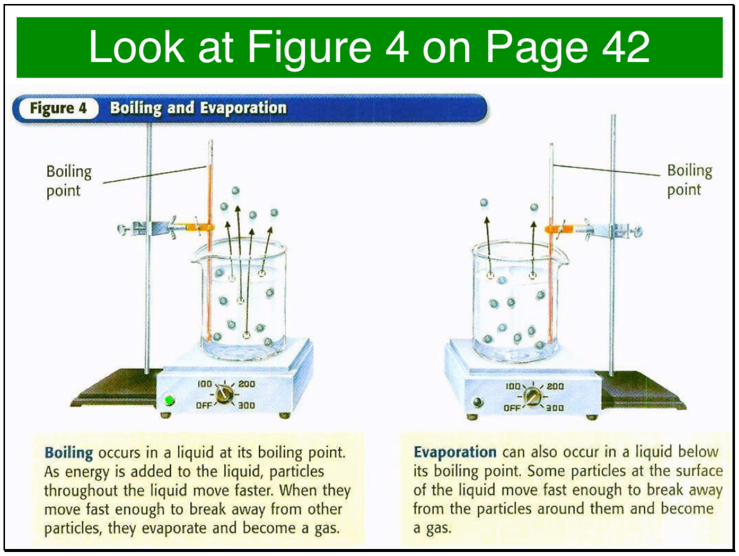
Type of Activity: Teacher comment

Overview: The purpose of this activity is to make explicit the idea that some colors shown in line diagrams are indicative of something important and that when looking at a diagram, color is one important element to pay attention to in order to accurately comprehend the meaning of the diagram.

(Proceed to the next slide)

Day 21 – Changes of State

Visualization Exercise 2.3b – Use of Colors (cont.)



Ask students which heater is 'on' and which is 'off.' (If needed, tell them they can use the hints of color use to help figure it out.)

Tell students that the one on the left is turned on because the on/off light at the left bottom corner is shown green, which is a conventional choice of color to indicate that a machine or piece of equipment is turned on. The light on the right is dark, which on the contrary indicates a machine or piece of equipment is turned off.

Point out that there is another use of color that indicates that the temperature of the water on the left is at the boiling point—the reading on the thermometers (represented by the length of the red part). On the thermometer on the left, the red line is longer and reaching the boiling point, but the red line on the right is shorter and below the boiling point.

(End of Activity)

DAY 22

Skills Practice Lab

This lesson combines two skills practice labs from the back of the book. Students complete all but steps 3, 8 and 9 of *Full of Hot Air!* (page 134). Those steps involve placing a beaker-and-balloon in boiling water, and we recommend that you do them as a teacher demo. The lesson ends with a teacher demo of *Can Crusher* (page 135), which also involves boiling water.

Big Ideas

- Air that is not in a container with a fixed volume expands when heated and contracts when cooled.
- Air that is in a container with a fixed volume can't expand or contract, so heating causes an increase in air pressure and cooling causes a decrease in air pressure.

Materials

Teacher:

1. hot plate & heat-resistant gloves
2. large beaker of water
3. empty soda can

Students:

1. balloon
2. 250-ml beaker
3. container of ice water

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
15 minutes – student lab – *Full of Hot Air!* – page 134
5 minutes – teacher demo of *Full of Hot Air!*, steps 8 & 9
15 minutes – teacher demo of *Can Crusher* – page 135

Hot Air Demo

After immersing the beaker-and-balloon in hot water and students see that it expands, we recommend you place it in ice water. This will provide a more

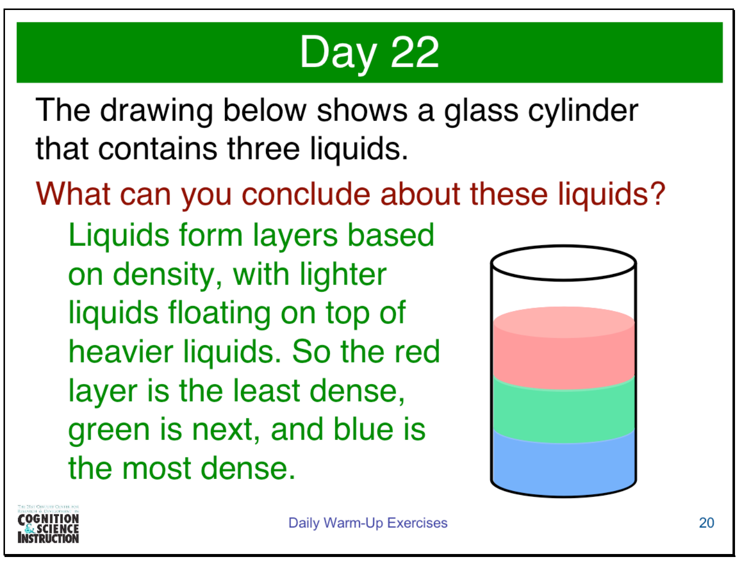
Hot Air Demo (cont.)

noticeable demonstration of contraction than students observe when they placed a room-temperature balloon in ice water.

Can Crusher Demo

The Holt text asks students to explain what happened to cause the atmospheric pressure outside the can to become greater than the pressure inside the can. In the sample answer, it explains that the steam inside the can cooled and condensed. The volume of the liquid water was less than the volume of the steam, so the pressure inside the can was reduced. A more detailed explanation can be found at www.stevespanglerscience.com/experiment/incredible-can-crusher.

Warm-Up Activity



How do you decide whether an object will float or sink in water?

Measure its density. If it's less dense than water, it will float. If it's more dense, it will sink.

What is the density of water?

one gram per milliliter (g/ml)

DAY 23 Temperature vs. State Change

This lesson covers the last part of section 2.3 (pages 44-45) and includes four visualization exercises.

Big Ideas

- The temperature of a substance does not change when the substance is changing from one state to another.

Materials

Teacher:

1. slides – day23.ppt

Students:

none

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
3 minutes – visualization 2.3c – Arrows
2 minutes – visualization 2.3d – Use of Colors
5 minutes – visualization 2.3e – Captions
5 minutes – visualization 2.3f – Labels
20 minutes – chapter 2.3, part 7 – *Temperature vs. State Change*

Chapter 2.3, part 7

Part 7 is only one paragraph long, but it describes a phenomenon that is difficult for students to understand. The key is to recognize that temperature is a measure of how fast particles of matter are moving. So when particles speed up, the temperature rises. When they slow down, the temperature falls. When they don't change speed, the temperature stays the same.

Figure 7 on page 45 shows that, when a substance gains energy, its particles move faster and its temperature rises until it reaches its melting or boiling point. At that point, the energy that is added is used to break the attractions between particles, allowing a solid to become a liquid or a liquid to become a gas.

Day 23 – Temperature vs. State Change

Warm-Up Activity

Day 23

When you place a thermometer in a cup of warm water, the liquid inside the thermometer will rise and then stop. What causes this liquid to rise?

The particles that make up the liquid get warmer, move faster, bounce harder, and spread out more. The liquid is sealed inside a narrow tube, so when the particles spread out, the liquid rises.

COGNITION & SCIENCE INSTRUCTION — Daily Warm-Up Exercises — 21

What are states of matter?

the physical forms that matter can take, like solid, liquid, and gas

Why do solids, liquids, and gases have different physical properties?

because the particles are arranged differently and move differently

Chapter 2.3, part 7 (cont.)

Tell your students that, in the *Compare Particle Models* contrasting case activity, they learned that liquid particles move faster than solid particles. During phase change, however, all the particles move at the same speed even though some are solid and some are liquid. The same is true of liquid and gas particles. Gas particles generally move faster than liquid particles, but during phase change, they all move at the same speed.

Day 23 – Temperature vs. State Change

Visualization Exercise 2.3c – Arrows

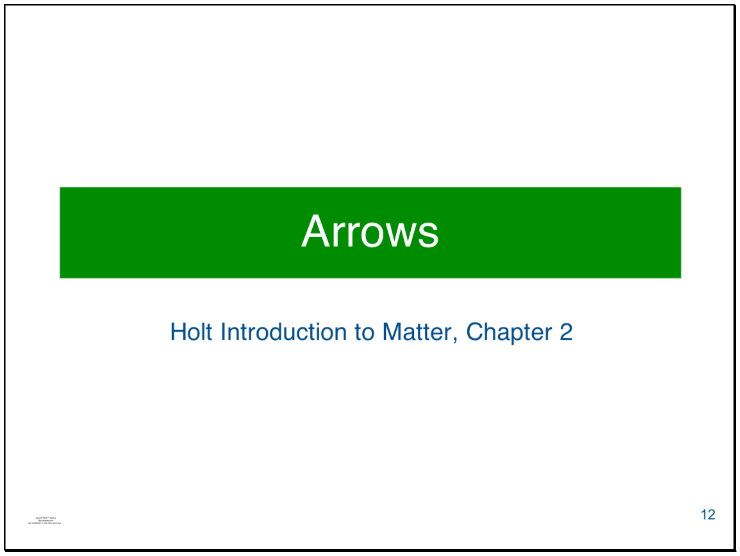


Image comprehension focus: arrows

Goal: Expand understanding of the roles of arrows in diagrams to include change of position

Also to reinforce that water particles constitute water to avoid the possible misconception that water particles are something traveling through or floating in water.

Type of Activity: Student activity and teacher comment

Overview: The purpose of this activity is to make explicit the idea that arrows sometimes indicate change of position.

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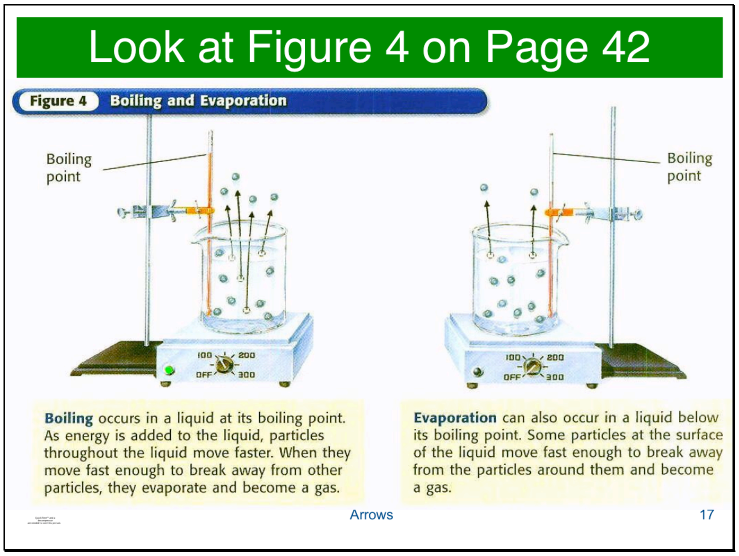
Day 23 – Temperature vs. State Change

Visualization Exercise 2.3c – Arrows (cont.)



Student Activity: Ask students to recall p.32/Fig 1 (images of solid, liquid, and gas particles in jars) and ask what they think the small blue circles represent: water bubbles as we usually see in boiling water or particles that make up water vapor.

Teacher Comment: Explain that this text book consistently uses blue circles to represent the particles that make up matter. In some cases, these particles are displayed as though they have been magnified to make them visible, but without any specific cues that might make this obvious (like a zoom convention)

In this image, the circles are not water bubbles on the scale that we usually see in boiling water. This can be further clarified by looking at the right-hand-side image, where the liquid is not boiling but there are still blue circles to represent particles of water vapor.

Visualization Exercise 2.3c – Arrows (cont.)
Given the clarification that the blue circles are water particles instead of water bubbles, the function of the arrows is more clear: indicating water particles changing positions (from the liquid water in the beaker to water vapor in the air.)

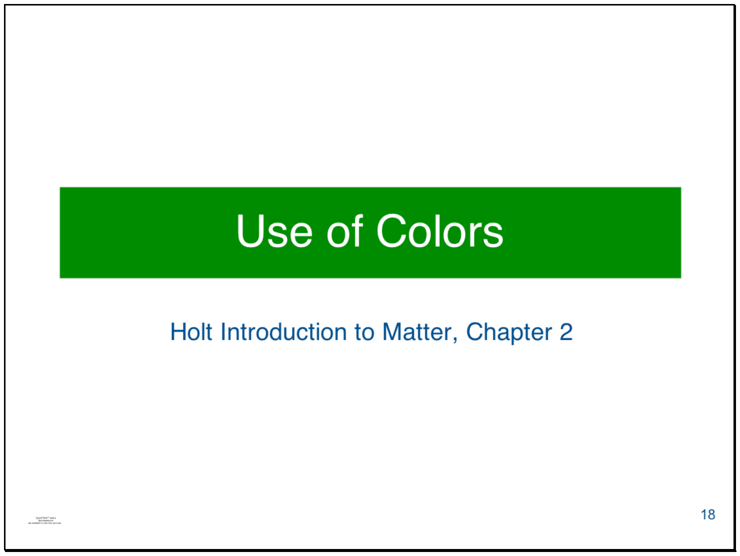
In addition to their role in indicating magnification, indicating length, and indicating change of state, arrows can also be used to indicate movement. The teacher should explain that in the left-hand image (boiling) the arrows show that particles in a deeper position become gas particles, and exit the beaker. The direction of the arrows indicates the path of particle movement.

In this image, empty circles at the base of the arrows are used to represent the place that the particle started, and from the different original positions one can see the difference between boiling (particles travel through the liquid and get out to the air) and evaporation (only particles on the surface of the liquid move and get out to the air).

(End of Activity)

Day 23 – Temperature vs. State Change

Visualization Exercise 2.3d – Use of Colors



NOTE: This activity is designed to help student notice that there are very subtle differences between the two images, which are crucial to understand the two situations: boiling and evaporation.

Image comprehension focus: Color

Goal: To understand subtle difference in colors can indicate huge difference in meaning conveyed by images.

Type of Activity: Teacher comment

Overview: The purpose of this activity is to make explicit the idea that some colors shown in line diagram are indicative and that when looking at a diagram, color is one important element to pay attention to in order to accurately comprehend the meaning of the diagram.

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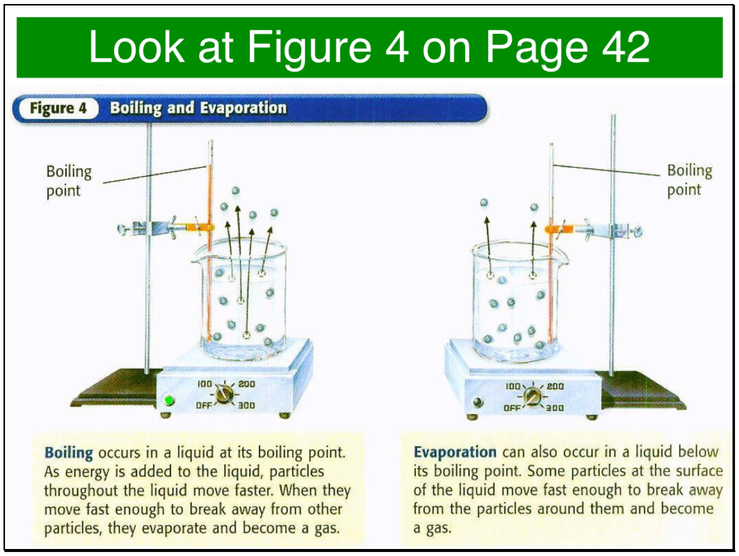
Day 23 – Temperature vs. State Change

Visualization Exercise 2.3d – Use of Colors (cont.)



Student Activity: Teacher asks students which heater is on and which is off and explain how they know about that. (The one on the left is on and the other is off, given the hint(s) of color use in this diagram)

Teacher Comment: Teacher concludes that the one on the left is on because the on/off light at the left bottom corner is shown green, which is a conventional choice of color to indicate a machine or piece of equipment is turned on, while the light on the right is dark, which on contrary indicates a machine or piece of equipment of turned off.

Teacher adds the comment that there is another color-use convention can indicate the temperature of the water on the left is at the boiling point—the results read on the thermographs (represented by the red lines inside). On the thermograph on the left, the red line is longer and reaching the boiling point, but the red line on the right is shorter and below the boiling point.

(End of Activity)

Day 23 – Temperature vs. State Change

Visualization Exercise 2.3e – Captions

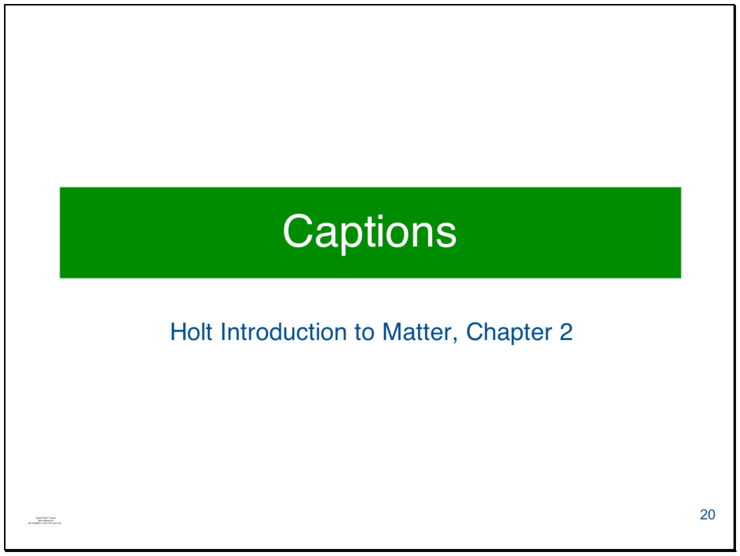


Image comprehension focus: Captions

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.

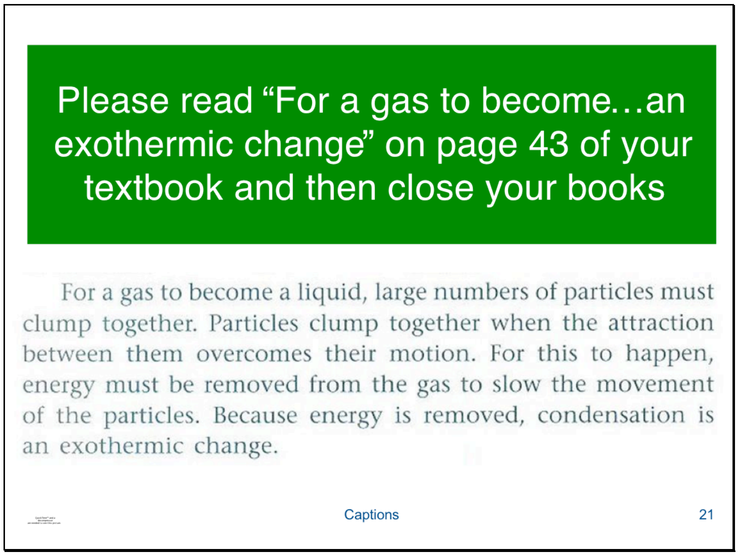
Module Activity: Teacher guided student activity

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 to encourage them not to skip them when viewing images.

(Proceed to the next slide)

Day 23 – Temperature vs. State Change

Visualization Exercise 2.3e – Captions (cont.)

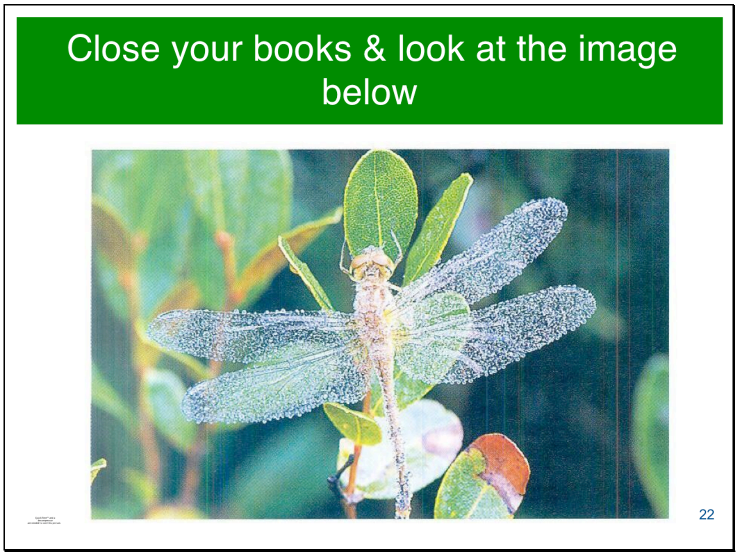


Procedure: Teacher describes what role captions serve (to indicate what is important in an image and indicating what part of the image to pay attention to).

Guided Student Activity: Teacher asks students to read text "For a gas to become…an exothermic change" on p. 43.

(Proceed to the next slide)

Visualization Exercise 2.3e – Captions (cont.)



Teacher asks:

1) what the key object (an animal) is in the photograph: A dragonfly;
2) according the text they read, what part of the dragonfly is the key element of this photograph: its wings;
3) what on its wings make it important: the water beads;
4) how do the water beads get on the dragonfly's wings?

Then the teacher asks students to connect this photograph with the text and write a caption that describes how the water beads end up on the dragonfly's wings.

Teacher has students share their captions and discuss whether or not the captions function as they should to clarify the image and indicate what is important in this image.

(Proceed to the next slide)

Day 23 – Temperature vs. State Change

Visualization Exercise 2.3e – Captions (cont.)

Show the original caption to the class.

(End of Activity)

Day 23 – Temperature vs. State Change

Visualization Exercise 2.3f – Labels

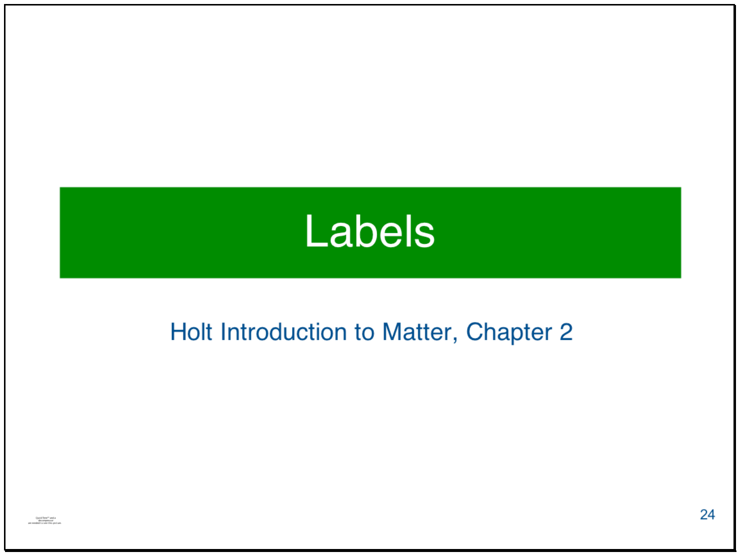


Image comprehension focus: Labels

Goal: To re-emphasize the idea that labels should never be skipped when viewing a diagram as labels often contain information critical to understanding the image.

Module Activity: Teacher guided student activity

Overview: This activity is designed as a brief review as to the important role that labels can play in being able to understand certain concepts presented in a diagram.

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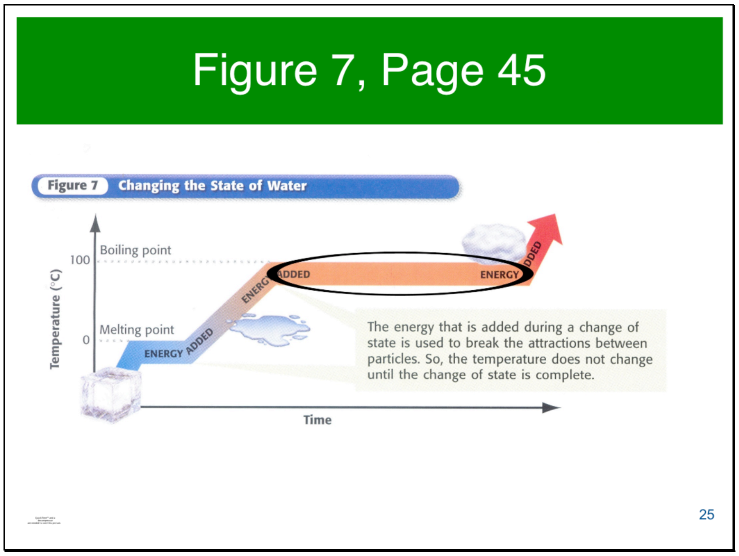
Day 23 – Temperature vs. State Change

Visualization Exercise 2.3f – Labels (cont.)



Procedure: The teacher projects the above (altered) image of Figure 7 from page 45 of the textbook and asks students to take a few minutes and study the diagram, paying particular attention to the area within the black circle. The teacher asks, "what is happening to the temperature in the area that has been circled?" [The temperature is remaining the same.] The teacher asks, "what is happening to the energy in the area that has been circled?" [Energy is being added. Students may believe that, if the temperature is staying the same, energy must also be staying the same.]

The teacher asks the students, "how did you know the answers to these questions?" [In this case, the explanatory label provides the information needed to answer the questions. Emphasize the importance of labels in being able to understand a diagram. If time allows, point out other ways that students can tell what is happening during this stage such as the color changes connected to temperature changes. In the circled region color remains the same, indicating that temperature has not changed.]

(End of Activity)

DAY 24

Hot & Cool Lab

This lesson is the skills practice lab at the end of chapter 2 (pages 46-47).

Big Idea

- The temperature of a substance does not change when the substance is changing from one state to another.

Materials

Teacher:

none

Students:

1. hot plate
2. heat-resistant gloves
3. large beaker of water
4. thermometer
5. stopwatch
6. graph paper
7. graduated cylinder with water
8. large coffee can
9. crushed ice
10. rock salt

Activities & Allotted Time (40 minutes total)

5 minutes – warm-up activity
35 minutes – student lab – *Hot and Cool Lab* – pages 46-47

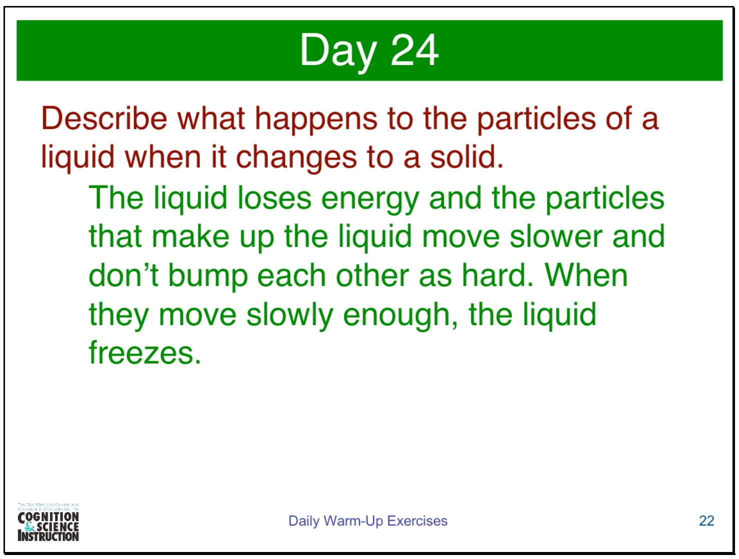
Hot & Cool Lab

The first half of the lab involves heating water and measuring its temperature every 30 seconds until half boils away. You might want to have two or three students do this part while the rest of the class records the data they collect. In the second half, students use crushed ice and rock salt to cool water, measuring its temperature every 30 seconds until it freezes.

Day 24 – Hot & Cool Lab

Hot & Cool Lab (cont.)
We recommend that you have students graph their data and compare their graphs with Figure 7 on page 45. Encourage students to explain how this activity relates to what they learned about temperature and phase change on Day 23.

Warm-Up Activity



What other change of state happens when matter loses energy?
condensation -- when a gas changes to a liquid

DAY 25

Quiz 4/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 1-24.

Materials

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

Students:
1. Quiz 4

Activities & Allotted Time (40 minutes total)

10 minutes – quiz
10 minutes – go over quiz
20 minutes – re-teach/review chapter 2.3

Reteach/Review Chapter 2.3
After going over the quiz and reviewing the meanings of vocabulary words and the big ideas from days 1-24, use the section review questions on page 45 and the chapter review questions on pages 48-49 to identify areas that need additional attention.

Day 25 – Quiz 4/Reteach/Review

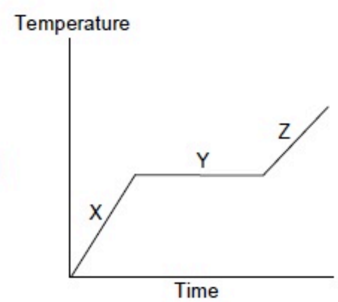
Quiz 4 – Page 1

1. The particles that make up a solid _______.
   a. do not move unless heat is applied
   (b.) vibrate and wiggle in place
   c. move randomly from place to place

2. If you have a fixed amount of gas at a constant temperature and you increase the size of the container that holds the gas, what will happen to pressure?
   a. It will increase.
   (b.) It will decrease.
   c. It will stay the same.

3. What could you do to change a gas to a liquid?
   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.

4. The graph below shows how the temperature of a solid changes as it is heated. What is happening to the particles of the solid during segment X?
   a. They gradually start to move as the temperature increases.
   b. They are moving so fast that solid particles are changing to liquid particles.
   (c.) They move faster and faster and begin to spread out more.



5. What is happening to the particles of the solid during segment Y?
   a. They gradually start to move as the temperature increases.
   (b.) They are moving so fast that solid particles are changing to liquid particles.
   c. They move faster and faster and begin to spread out more.

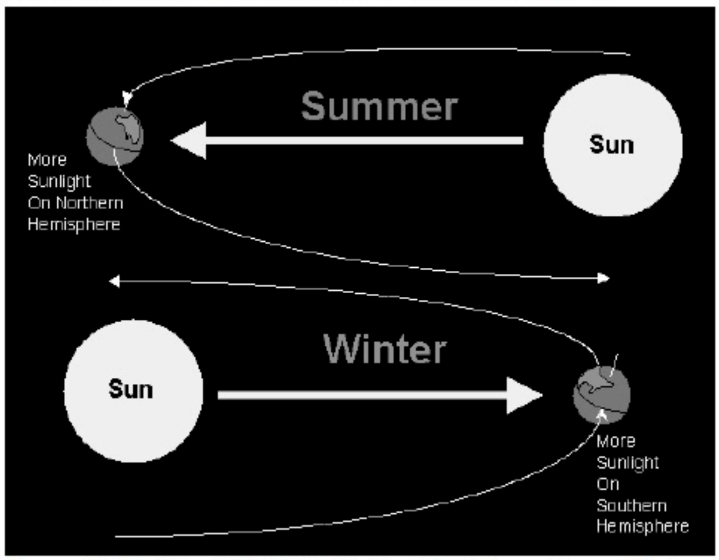
Introduction to Matter

Day 25 – Quiz 4/Reteach/Review

Quiz 4 – Page 2

6. Change of state is a _______ that requires the gain or loss of _______.
   a. physical change; energy
   b. chemical change; electrons
   c. physical property; density

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.



Because the Earth's axis is tilted, the Northern Hemisphere gets more direct sunlight during the summer than it does during the winter. This is the main reason that temperatures are higher in the summer.

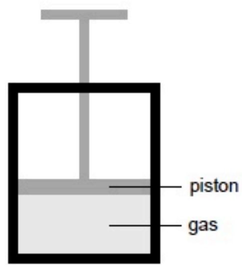
According to the above diagram, the reason Northern Hemisphere temperatures are higher in the Summer is _______.
   a. the rotation of the Earth
   b. the tilt of the Sun's axis
   c. the tilt of Earth's axis
   d. there is less sun

Introduction to Matter

Day 25 – Quiz 4/Reteach/Review

Quiz 4 – Page 3

8. The figure below shows a sealed container of gas with a piston that can move up and down. The pressure inside the container is the same as the pressure outside, so the piston is not moving.



What will happen if the temperature of the gas decreases?

The gas particles will move slower, so they won't bump into things as often or as hard as when they were warmer. The pressure will decrease and the piston will move down. The same number of particles will be in a smaller space, so the density will increase.

Introduction to Matter