

## LESSON 4 LAUNCH

# Particles in Matter



Four friends were talking about the particles that make up matter and give matter its properties. They each had different ideas. This is what they said:

Joyce: *I think you can't see the particles that make up solids, liquids, and gases. They are too small to see.*

Harold: *I think you can see the particles that make up solids, liquids, and gases.*

Royce: *I think you can see the particles that make up solids and liquids, but you can't see the particles that make up gases.*

Benito: *I think you can see the particles that make up solids, but you can't see the particles that make up liquids and gases.*

Who do you agree with most? **Joyce**

Explain why you agree.

**Sample answer: Particles in matter are too small to see with ordinary magnification tools. The arrangement and movement of particles determine the state of matter.**

You will revisit the Page Keeley Science Probe later in the lesson.

LESSON 4

# Solids, Liquids, and Gases



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## ENCOUNTER

### THE PHENOMENON

What are the different forms in which matter can appear?



#### GO ONLINE

Check out *Ice Melting* to see the phenomenon in action.

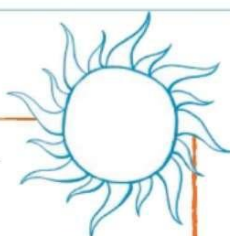
Look at the photo and watch the video. What questions do you have about the phenomenon? Record or illustrate your thoughts below.

Sample answer: What is causing the ice to melt? Can the same water turn back into ice? How are ice and water different?

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#### Did You Know?

There is a fourth state of matter called plasma. The Sun and all the stars in the universe are made up of plasma.



## INQUIRY ACTIVITY

### Hands On

## Observe Matter

Think about the phenomenon of the melting ice. You know that the ice and water are made of the same material, but they appear in different forms.

**Make a Prediction** Can we easily change the shape of different types of matter?

**Sample answer:** The shape of some types of matter, such as liquids and gases, can be changed more easily than others.

### Carry Out an Investigation

#### Station 1

1. Draw air into the syringe and cover the opposite end with your finger.
2. Push on the plunger.
3. Record your observations in the box below.

**Sample answer:** The plunger gets harder to push down. If I kept pushing, the air was forced out of the end of the syringe.

#### Materials



syringe



sponge



number cube



modeling clay



large beaker



water



graduated cylinder

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### Station 2

4. Squeeze the sponge. Observe what happens to its shape.  
Record your observations in the box below.

Sample answer: The sponge looked crushed when we squeezed it but then returned to its original shape.

5. Squeeze the number cube between your fingers. Observe what happens to its shape. Record your observations.

Sample answer: The shape of the number cube did not change when I squeezed it.

6. Squeeze the modeling clay. Observe what happens to its shape.  
Record your observations.

Sample answer: The modeling clay had an imprint where I squeezed it with my hand and stayed in that shape.

## INQUIRY ACTIVITY

### Station 3

7. Fill the beaker halfway with water.
8. Pour some of the water from the beaker into the graduated cylinder.  
Record your observations in the box below.

Sample answer: I observed water from the beaker take the shape of the graduated cylinder as it was poured.

### Communicate Information

9. Did your results support your prediction? Explain how your prediction was or was not supported by what you observed.

Sample answer: My results supported my prediction because I could easily change the shape of the gas and the liquid. Each of the stations explored the states of matter and how they behave.

## MAKE YOUR CLAIM

How do the three states of matter change shape?

Make your claim. Use your investigation.



### CLAIM

Solids \_\_\_\_\_. Liquids \_\_\_\_\_. Gas \_\_\_\_\_.

Sample answer: keep their shape; take on the shape of the container; expand to fill their container

Cite evidence from the activity.

### EVIDENCE

The investigation showed that \_\_\_\_\_.

Sample answer: the gas pushed against the closed syringe as I pushed the plunger down. The solids had a definite shape and the liquid took the shape of each container into which it was poured.

Discuss your reasoning as a class. Tell about your discussion.

### REASONING

The evidence supports the claim because \_\_\_\_\_.

Sample answer: the particles in a gas spread far apart. When pressure is added, the particles condense. The particles in a solid are packed tightly together and hold their shape. The particles in a liquid are able to move and take the shape of their container.

You will revisit your claim to add more evidence later in this lesson.

## VOCABULARY

Look for these words as you read:

gas

liquid

solid

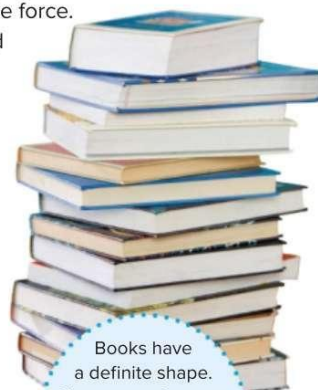
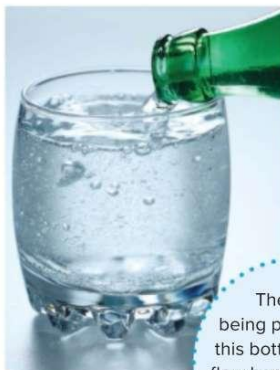
## States of Matter

State is another physical property of matter. Solids, liquids, and gases are common forms that matter can take. Each state has specific characteristics.

**GO ONLINE** Watch the video *States of Matter* to learn more about matter.

A **solid** has a definite shape and takes up a definite amount of space. A solid stays in its definite shape with a definite volume unless it is changed by an outside force. The particles in a solid are tightly packed together and vibrate in place. They are often packed in a regular pattern.

A **liquid** has a definite volume, but it does not have a definite shape. It can be poured from one container to another. The liquid fills the shape it is poured into from the bottom up. The particles in a liquid are usually less tightly packed than those in a solid and can move and slide past one another. One example in which this is not true is water. Water is actually more dense than ice!



Books have a definite shape. No matter what type of container you put them in they will still keep that shape.

The liquid being poured from this bottle is able to flow because it does not have a definite shape.

Because the basketball is a sphere, the air inside of it will be sphere-shaped too.

**Gases** have no definite shape or volume. The particles in a gas are much farther apart than particles in solids or liquids. They can move around each other very easily. Gases spread out and completely fill a closed container. If you make the container bigger, the same amount of gas will expand to fill it.



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## INQUIRY ACTIVITY

### Simulation

## Particles in Matter



### GO ONLINE

Explore the simulation *Particles in Matter*. Record data from the simulation in the table below.



**Make a Prediction** How does temperature affect the state and mass of different types of matter?

**Sample answer:** Changes in temperature can change the state of matter. The matter's mass should stay the same.

Type of Matter	Temperature	State of Matter	Mass
Iodine	$-10^{\circ}\text{C}$	solid	500 g
	$200^{\circ}\text{C}$	gas	500 g
Ethanol	$-10^{\circ}\text{C}$	liquid	500 g
	$200^{\circ}\text{C}$	gas	500 g
Olive Oil	$-10^{\circ}\text{C}$	solid	500 g
	$200^{\circ}\text{C}$	liquid	500 g

1. Explain the movement of the particles as you add energy to each substance.

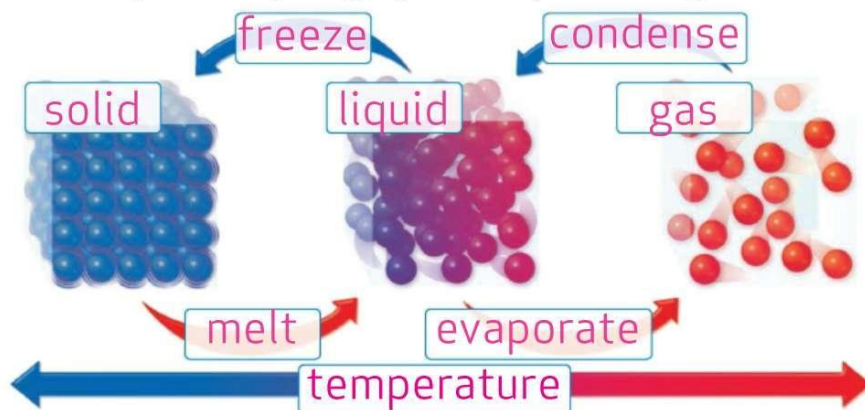
**Sample answer:** When energy is added, the particles speed up and spread out.

2. What happens to the mass of the materials in the simulation regardless of whether heat is added or removed?

**Sample answer:** The mass of the materials stays the same.

## Changing States of Matter

The average movement of particles in an object is determined by the amount of energy in the object. Temperature is a measurement of this movement. When energy is added, the particles move faster. When energy is lost, the particles move more slowly. When enough energy is gained or lost, there is a change of state.



**Adding Energy** When energy is added to a solid, the particles start to move more quickly. When the particles move quickly enough that they slide past each other, the solid becomes a liquid by melting. If even more energy is added to this liquid, the particles' speed continues to increase and they move away from each other. As the particles spread out enough, liquid evaporates, becoming a gas.

**Removing Energy** If a gas loses energy, its particles slow down and move closer together. They start to slide past each other again. A liquid forms through a process called condensation. If the liquid loses enough energy, freezing occurs and a solid forms.

**Label a Diagram** Use information that you read to label the states of matter in the diagram above. Label the process of how each state of matter changes from one to the other.

### COLLECT EVIDENCE

Add evidence to your claim on page 55. Use what you have learned about the changing states of matter to add evidence and reasoning to your claim.



**REVISIT** Revisit the Page Keeley Science Probe on page 49.



# Model Matter

You have learned about the three main states of matter and how the organization of their particles affects how they behave.



Choose an object for each of the three states of matter. Draw each object. Use unit cubes to **develop and use a model** to show **the scale** of the volume and number of particles in the object and how the particles in each object are organized. Add this information to your drawings. Below each model, describe how the arrangement of the particles determines the properties of each of the objects.

Solid	Liquid	Gas
Students can draw any object that is a solid. In their drawing, they can add that the particles in the solid are packed tightly together.	Students can draw any object that is a liquid. In their drawing, they can add that the particles in the liquid are loosely packed together and move past one another.	Students can draw any object that is a gas. In their drawing, they can add that the particles in the gas are very far apart from each other and move rapidly.

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## STEM Connection

# A Day in the Life of a Pharmacy Technician



**Pharmacy technicians** work in hospitals and pharmacies. They work closely with pharmacists and people in the health industry. Some technicians are responsible for inputting prescription orders given over the phone or in person. They take orders from both patients and health care providers. Pharmacy technicians are also responsible for counting pills, mixing medicines, and labeling prescriptions.

Pharmacy technicians need to have good communication skills as they interact with patients on a regular basis. They relay information from the pharmacist to patients. They give out prescription medication and medical devices to patients. They explain how to use the prescription, what it is for, and how often to take it. They also explain what the patient can expect when taking a prescription.



## It's Your Turn

What types of information does a pharmacy technician need to know about matter?

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**WRITING Connection**

Read the Investigator article *Slower Melting Ice Cream*. How does the article provide an example of how the particles in matter determine its state? Use the graphic organizer below to organize your thinking. Write your response on the lines below. Use a separate piece of paper if you need to.

## Cause

Scientists have found a way to add protein to ice cream to make its particles hold together at higher temperatures.



## Effect

The ice cream will not melt as quickly because its particles will stay closer together for longer time.

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## LESSON 4

# Review

### EXPLAIN THE PHENOMENON

What are the different forms in which matter can appear?

#### Summarize It

Use what you have learned to explain what you know about the particles in solids, liquids, and gases. Use the space below to write a summary or draw a diagram of what you learned.

Sample answer: The particles in a solid are tightly packed together and vibrate in place. The particles in a liquid are less tightly packed than those in a solid (except for water) and can move and slide past one another. The particles in a gas are far apart and can move around each other very easily.

### REVISIT



Revisit the Page Keeley Science Probe on page 49. Has your thinking changed? If so, explain how it has changed.

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### Three-Dimensional Thinking

1. How does matter change from one state to another?

Circle all that apply.

- ☒ A. adding energy
- ☒ B. removing energy
- ☐ C. adding mass
- ☐ D. removing volume

2. Liquid has \_\_\_\_\_. Circle all that apply.

- ☒ A. definite volume
- ☐ B. definite shape
- ☐ C. no definite volume
- ☒ D. no definite shape

3. Use evidence to support the argument that particles in water change when heat energy is added.

The particles begin to move faster and faster when heat is added. They also start to move farther apart, forming water vapor, which is a gas.

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### Extend It

A type of matter called plasma is the fourth state of matter. It is mostly found in stars and other planets in space. Conduct a short research project on plasma. Use multimedia to organize your research and present it to the class.

Student answers will vary. Plasma has different properties than the three main states of matter and does not exist naturally under normal conditions. Plasma is found in stars in the universe. It can be found on Earth in neon signs and lightning.

### KEEP PLANNING

STEM Module Project

Engineering Challenge



Now that you have learned about how the states of matter behave based on their structure, move on to your Module Project to explain how the information will affect your pancake recipe.

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