

States of Matter

Teacher Facilitation Notes

In General . . .

- Project the slide deck in edit mode—do not show it as a slideshow.
- Hide the speaker notes before projecting. (View/Show Speaker Notes)
- Hide the toolbar. (Click on the up arrow at the right end of the tool bar.)
- Call on students to read the various content shown on slides.
- For each investigation, assemble the needed materials for each group and place in a central location for ease of distribution.
- Duplicate copies of the data sheets for each student.

Materials Needed Per Group:

Explore—Evaporation Station:

Paintbrush	Paper Cup	Water
Paper Towels		

Explore—Melting Station:

Snack baggies, 2	Ice cubes, 2	Stopwatch
Paper towels		

Explore—Freezing Station

Scale	Baggie	Water
Beaker	Paper towels	Sharpie™ marker

Explore—Condensation Station

Clear, plastic glasses, 2	Ice	Water
Paper towels	Stopwatch	

Elaborate

Freezer pops, 1 per student		Metric ruler
Scale	Thermometer	Paper towels
Science notebook, per student		Sharpie™

Other Materials

Student Recording Sheets
Student Evaluation Document

Pencils

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Engage

- Tell students that they are going to be watching a video that answers the two questions on the slide.
- Show the video. Discuss as desired.
- Read through the slides explaining solids, liquids, and gases.
- Have students classify the materials independently. Discuss as desired.

Explore: Evaporation Station

- After watching the video, ask questions such as:
 - What causes a liquid like water to evaporate? (adding heat energy)
 - How do you know the water on the cement evaporated? (It seemed to disappear.)
 - What is the science term for water in a gaseous state? (water vapor)
 - What evidence did you see to prove that the metal surface conducts heat energy better than the other surface? (The water on the metal evaporated faster.)
- Read through the procedures as the students perform the investigation.
- Have class choose one of the investigations the children did in the video. After completing the investigation, discuss as desired.

Explore: Melting Station

- Read and discuss the introductory slides. Watch the video and discuss.
- Read through the procedures as the students perform the investigation.
- Discuss their results and conclusions. Make sure students understand that the ice cube in their hand melted faster because their body temperature is greater than the air temperature in the room.

Explore: Freezing Station

- Read and discuss the introductory slides.
- Read through the procedures the students begin the investigation.
- Once they have found the mass of the baggie of water, suspend the investigation to let the baggies freeze.
- On the next day, discuss if freezing affected the mass of the water.

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Explore: Condensation Station

- Read and discuss the introductory slides. Watch the video and discuss.
- Read through the procedures as the students perform the investigation.
- Discuss their results and conclusions.

Explain

- Call on volunteers to read each paragraph of the explanation.
- Emphasize the vocabulary terms as students read the passage.
- Discuss as desired.

Elaborate

- Review science rules for conducting a lab investigation, including:
 - Do not taste any lab materials unless given permission to do so.
 - Keep hands away from mouth and nose when touching lab materials.
 - Wash hands carefully after completing the lab activity.
- After students have jotted down observations and questions from the picture, ask, *What states of matter appear to be present in the photograph?*
- Give every student a room temperature freezer pop that has never been frozen. Have them use the marker to write their names on the pops.
- Give the groups time to record the physical properties of the unfrozen pop. Tell students that they are concentrating on what is inside the plastic bag—not the bag itself. Tell them to write *yes* or *no* in the condensation row.
- Freeze the pops overnight and redistribute to the students. Have them record the current physical properties of the pop.
- Use the Think-Pair-Share strategy and the questions to facilitate a student/class discussion.
- Let students eat their pops!

Evaluate

- Let students complete the quiz independently.
- Discuss evaluation activities as desired.

Changes of State

Teacher Background

Matter can take different forms. An ice cube, liquid water in a glass, and water vapor in the air are all different forms of the same kind of matter. They are all water, but they have different physical properties.

State of matter is the form that matter has. Most matter on Earth exists in one of three states: solid, liquid, or gas. A solid is matter that has a fixed volume and a fixed shape. An example of a solid is a wooden block. If you move a wooden block from a table to the floor, the block's shape stays the same. Its volume (the amount of space it takes up) also remains the same. A liquid is matter that has a definite volume but no definite shape. A liquid takes the shape of its container. Vinegar, water, and milk are examples of liquids. If you pour a liquid from one container to another, its shape changes but its volume stays the same. A gas is matter that has neither a definite shape nor volume. A gas spreads out in all directions and takes the shape of its container. The helium in a balloon is a gas. It stays inside the balloon while the balloon is sealed. If you open the balloon, the particles of helium gas escape into the air. Air is also made up of a variety of gases, including nitrogen, oxygen, carbon dioxide, and water vapor.

All matter is made up of tiny particles. These particles are constantly moving. However, they are so small, we can't see or feel their movements. The particles of a solid are very closely packed together. They vibrate but do not move away from each other. The particles in a liquid are not as close together as those in a solid. These particles have more freedom to move around. They can move enough to slide past each other. The particles in a gas can move about freely.

Matter can change from one state to another if it is heated or cooled. When matter is heated, its temperature increases. At a certain temperature, the matter will change from one state to another. Once the matter changes state, adding thermal energy will make its temperature rise again.

Ice is the solid state of water. If enough heat is added to ice, it changes to a liquid. The change in state from a solid to a liquid is known as melting. Different kinds of matter change state at different temperatures. The temperature at which ice melts is 0°C. This is known as ice's melting point.

Adding more heat can cause a liquid to change to a gas. Liquid water changes to a gas called water vapor. Evaporation is the change from a liquid to a gas at the surface of a liquid. Water in a puddle evaporates when sunlight warms it.

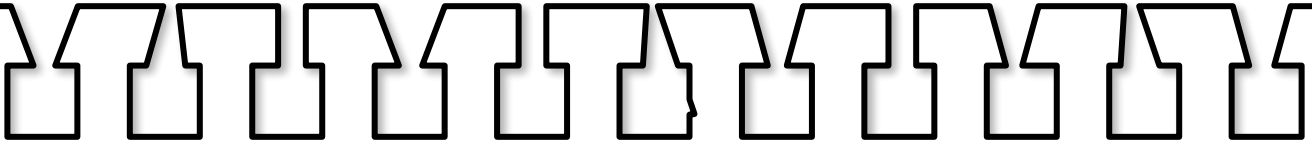
Boiling is the bubbling that takes place in a liquid when enough heat is added to change the liquid quickly into a gas. When a liquid boils, bubbles of gas form throughout the liquid and rise to the surface. The temperature at which a liquid boils, is called its boiling point. The boiling point of pure water is 100°C.

When gases are cooled, they can change to a liquid. This change from a gas to a liquid is known as condensation. If water vapor is cooled, it condenses to form liquid water. If the liquid water is cooled enough, it can change to a solid. Freezing is the change of matter from a liquid to a solid. The temperature at which a liquid freezes is called its freezing point. Liquid water freezes and ice melts at the same temperature, 0°C.

States of Matter

Name: KEY

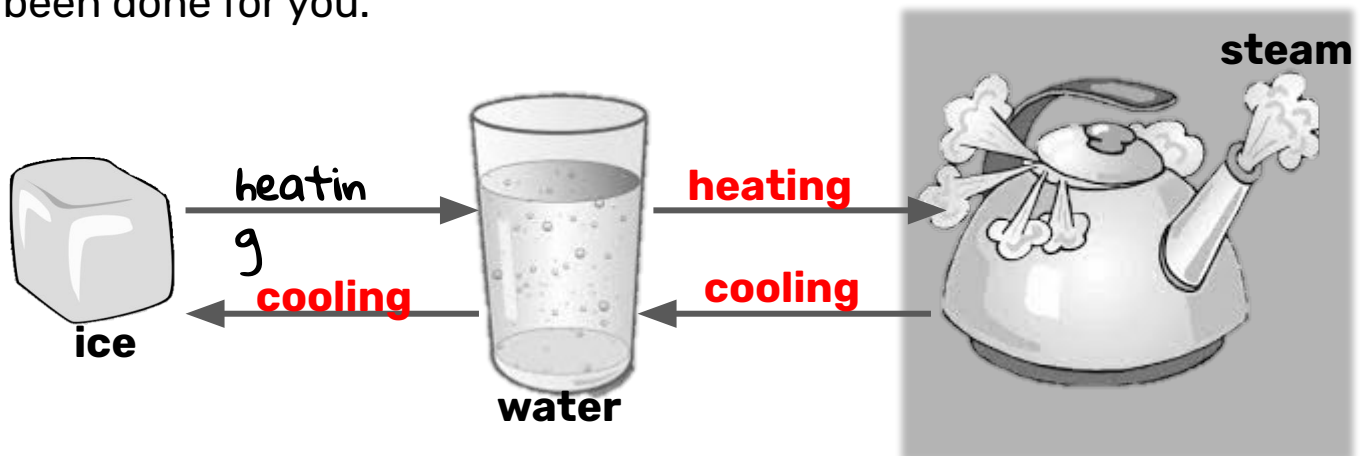
Evaluation



Look at each phrase below. Tell whether the change in state is caused by heating or by cooling.

1. ice to liquid water heating
2. liquid water to water vapor heating
3. liquid water to ice cooling
4. evaporating heating
5. Melting heating
6. condensing cooling
7. freezing cooling

Study the diagram below. Write *heating* or *cooling* on each arrow to show what causes the matter to change state. The first one has been done for you.



States of Matter

Name: KEY

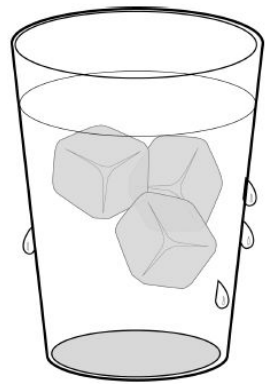
Evaluation

8. On a warm day, a student accidentally spilled water onto a metal picnic table outside. Later in the day, the water was gone. What most likely happened to the water that was spilled on the table?

- A** A dog came along and drank the water.
- B** The water soaked into the metal table.
- C** The water evaporated into the air.
- D** All the water ran off the table to the ground.

9. Small drops of water form on the outside of a glass of ice water. What causes the drops to be on the outside of the glass?

- F** Water leaks through cracks in the glass.
- G** Water vapor in the air condenses on the cold glass.
- H** The melting ice causes the glass to overflow.
- J** The ice causes rain to fall from the clouds.



10. One way a solid is different from a liquid is that a—

- A** solid has a definite shape
- B** liquid has a definite shape
- C** solid has more mass
- D** liquid can be poured

11. A child left a crayon on the windowsill on a hot, summer day. After a time, she noticed that the crayon had melted. What most likely caused the crayon to melt?

- A** The crayon was cooled by the glass window.
- B** Cool air coming through the window melted the crayon.
- C** The girl did not pick up the crayon all day.
- D** Heat from sunlight coming through the window melted the crayon.

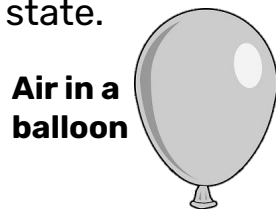
States of Matter

Name: KEY

Evaluation

12. Which of these describes water in a solid state?
- F Vapor rising up into the sky
 - G Hail during a thunderstorm
 - H Waves crashing on the seashore
 - J Rain falling from the clouds
13. Which of the following objects or materials are solids? Mark more than one answer.
- A Ice cream
 - B Orange juice
 - C Water vapor
 - D Banana
 - E Orange
 - F Air
 - G Milk

14. A student placed three materials into a group based on their physical state.



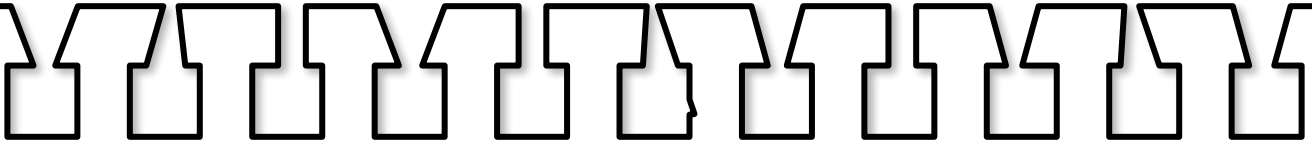
Which other material also belongs in this group?

- F Ice cream melting in a bowl
- G A ball rolling on the ground
- H Scrambled eggs cooking
- J Wind blowing leaves

States of Matter

Name: _____

Engage



Write the name of each substance/object in the correct column of the table.

<u>Solid</u>	<u>Liquid</u>	<u>Gas</u>

In the space below, define *matter* in your own words.

States of Matter

Name: _____

Adding Heat: Evaporation Station

Question

How does evaporation affect the temperature of your skin?

My Hypothesis



My Observations:

1. Water on still arm
2. What happens to the water when you blow on it?
3. Did your arm feel any differently when you blew on it? Explain.
4. When did the water seem to evaporate more quickly? Why?

My Conclusions: (Was your hypothesis correct?)

States of Matter

Name: _____

Adding Heat: Melting

Question

How does adding heat affect the time it takes for an ice cube to melt?

My Hypothesis

1. Which ice cube melted first?
2. How long did it take that ice cube to melt?
3. Was your hypothesis proved or disproved? Explain.



My Conclusions:

States of Matter

Name: _____

Cooling (Removing Heat): Freezing Station

Question

How does freezing change the mass of water in a baggie?

My Prediction

Mass of Frozen Water and Baggie

Mass of Liquid Water and Baggie

My Conclusions:

States of Matter

Name: _____

Cooling (Removing heat): Condensation Station

Question

How does condensation form on the outside of a glass?

My Hypothesis

Control Cup



Experimental Cup



1. How did the water get on the outside of the glass of ice water?
2. Why wasn't there water on the outside of the other glass?
3. What is condensation?

My Conclusions:

States of Matter

Name: _____

Elaboration

Question

How does changing state affect the physical properties of a freezer pop?

My Hypothesis

Physical Properties of a Freezer Pop

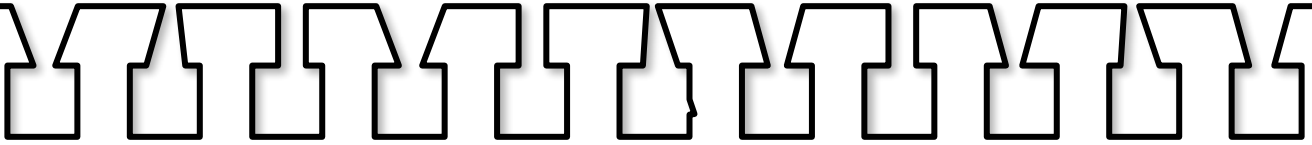
	Before Freezing	After Freezing
Color		
Length		
Width		
State		
Mass		
Temperature		
Condensation (outside)		

My Conclusions:

States of Matter

Name: _____

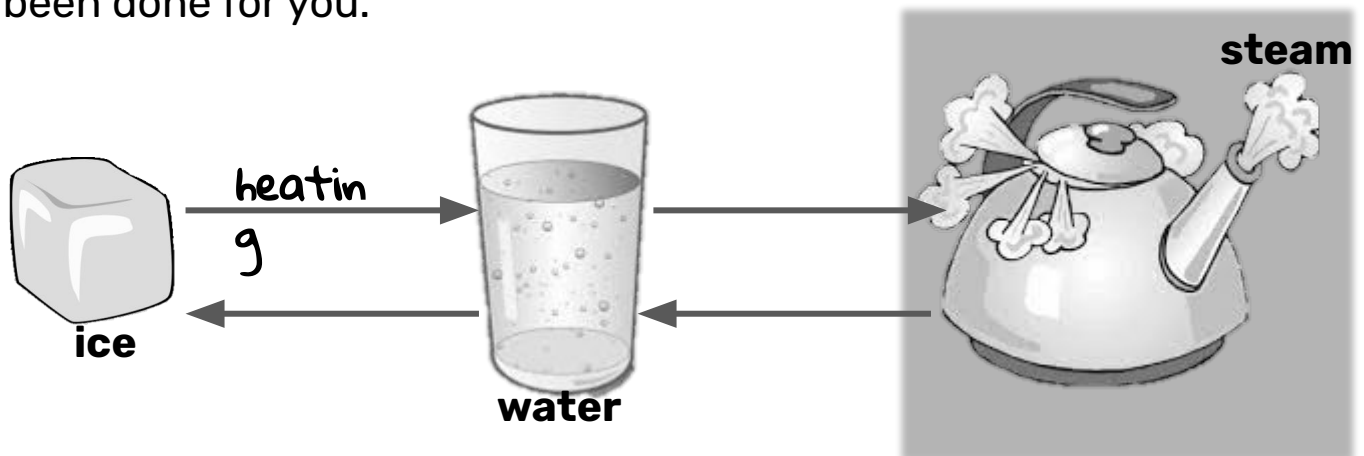
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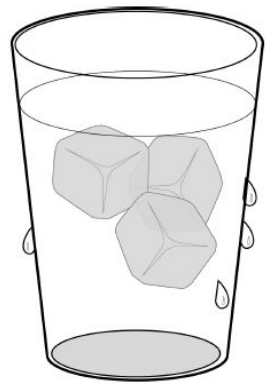
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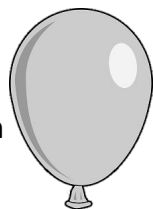
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Air in a balloon



Oxygen in a tank



Hot air in a balloon



Which other material also belongs in this group?

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- H Scrambled eggs cooking
- J Wind blowing leaves