

Lesson 4: Solid, Liquid, Gas: What's the Difference?

☐ Getting Started

In this lesson, you will begin to look more closely at the three states of matter. Keep in mind that solids, liquids, and gases represent different states of the same element or compound and that each state of matter has its own traits. The three states are defined as follows:

- A **solid** is a material that keeps its shape and resists change in shape at room temperature and normal atmospheric pressure. (**Atmospheric pressure** is the downward pressure exerted by the weight of the atmosphere.)
- A **liquid** is a substance that flows, that is a fluid at room temperature and normal atmospheric pressure, and whose shape can be changed. Unlike a solid, the volume of a liquid can be changed.
- A **gas** is a substance that is neither a solid nor a liquid at ordinary temperatures and has the ability to expand.
- Another state of matter is known as plasma. **Plasma** is a gas made up of ions (electrically charged atoms) and electrons. Plasma is abundant in the Sun and stars. On Earth, it is found in lightning, neon signs, fusion reactors, plasma television displays, and more.

In today's lesson, you will be challenged to imagine and illustrate different states of matter. You will be asked to make connections among the three classical states of matter, the conditions necessary for the states to occur, and what each state of matter will look like at the atomic level.

Stuff You Need

- construction paper (kit)
- glue stick
- hole punch

Ideas to Think About

- Why does matter "behave" the way it does in different circumstances?
- What patterns can be observed in elements?

Things to Know

- **atmospheric pressure**: the downward pressure exerted by the weight of the atmosphere
- **solid**: a material that keeps its shape and resists change in shape at room temperature and normal atmospheric pressure

- **liquid:** a substance that flows, that is a fluid at room temperature and normal atmospheric pressure, and whose shape can be changed
- **gas:** a substance that is neither a solid nor a liquid at ordinary temperatures and has the ability to expand
- **state of matter:** a state in which matter can exist, depending on temperature and pressure (the states are solid, liquid, gaseous, and plasmatic)
- **plasma:** a gas made up of ions and electrons; found primarily in the Sun and stars
- **melting point:** the temperature at which a substance changes from a solid to a liquid
- **boiling point:** the temperature at which a heated liquid turns to gas

☐ Reading and Questions

Watch the first 2 minutes and 30 seconds of the following video and then answer the following questions.

1. What causes matter to move from one state to another.

2. What are sublimation and deposition?

3. What happens to a substance at its boiling point? Its condensation point?



Changes of State of Matter

www.beyondthepage.com/link/12503/

Watch the first 2 minutes and 30 seconds.

Activities

☐ Activity 1: Modeling Different States of Matter

In this activity, you will use small circles punched out of construction paper to represent particles in solids, liquids, and gases. You should assume that the particles represent the same material in different states of matter.

To prepare for the activity, use a hole punch to punch 100-150 holes out of construction paper. You can choose the color, but the circles you create should all be the same color. Keep the hole punch and leftover paper handy in case you need to make more circles.

There are two options for this activity. Ask a parent which option you should complete.

Option 1

Use the "Modeling Different States of Matter" activity sheet for this activity; follow the steps listed for each state of matter. Feel free to refer to "Attributes of Classical States of Matter" table as needed.

Attributes of Classical States of Matter		
<u>Gas</u>	<u>Liquid</u>	<u>Solid</u>
assumes the shape and volume of its container	assumes the shape of the part of the container that it occupies particles can move/slide past one another	retains a fixed volume and shape rigid — particles locked into place
compressible lots of free space between particles	not easily compressible little free space between particles	not easily compressible little free space between particles
flows easily particles can move past one another	flows easily particles can move/slide past one another	does not flow easily rigid — particles cannot move/slide past one another

Solid

1. In the container marked "solid" on the activity sheet, use a glue stick to place punched-out holes in a straight row; use the boundaries of the container as a start and stop point.
2. Create a total of five rows.
3. Keep track of how many dots you used and record the number.

Liquid

1. Count out the same number of punched out holes that you used for the "solid" container.
2. Place the dots in the container marked "liquid" -- do NOT use a glue stick.
3. Gently move the activity sheet.
4. Keep in mind that a major difference between a solid and a liquid is not space but rather the fact that the individual particles can move/slide past one another.

Gas

Take the number of punched holes used for the solid container and divide it by twenty (20) — you may have to estimate if the number is not evenly divisible by 20. (**Note:** This division is not meant to be an accurate reflection but is used for the sake of illustration.) Next, place the punched holes in the container labeled "gas."

When you are done, answer the questions on the "Modeling Different States of Matter Follow Up" page.

Option 2

In this activity, you will investigate and list characteristics of the three states of matter. Using your book (pp. 16-21) and other available resources, list the characteristics of gases, liquids, and solids with an emphasis on what makes each state of matter unique from the others. Complete the chart provided on the "Modeling Different States of Matter" (Option 2) activity sheet.

For the second part of the activity, create a diagram or illustration that represents the differences between solids, liquids, and gases. Use the colored dots you punched out to represent the particles of each state of matter. (You may want to use a glue stick to affix the dots to your diagram.)

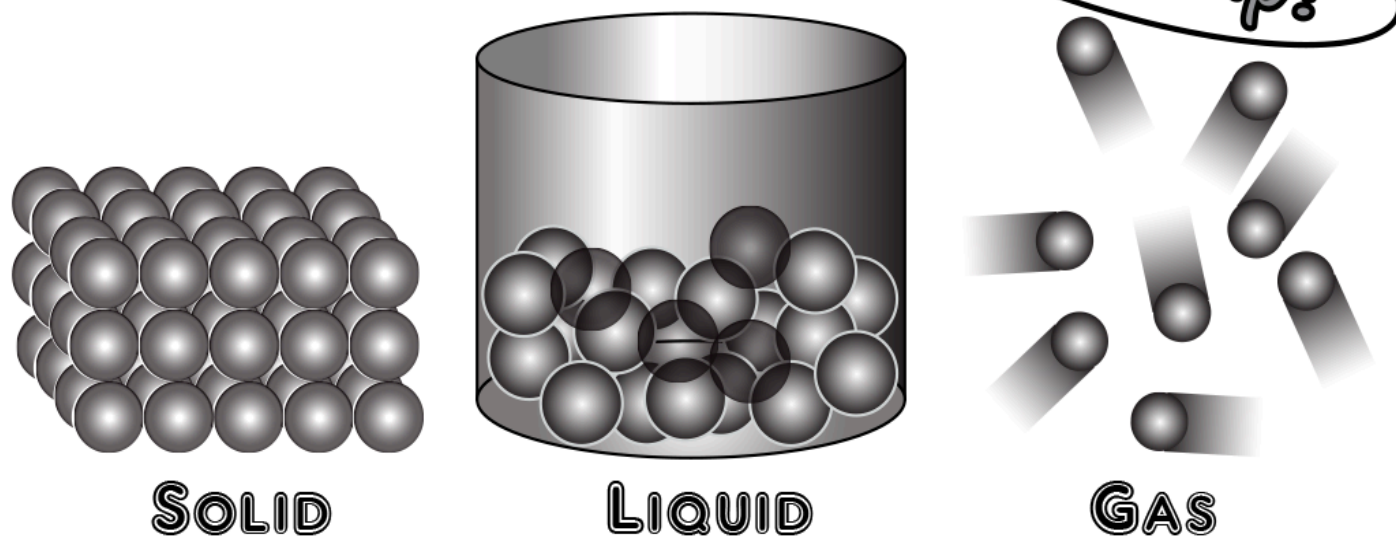
Wrapping Up

In this lesson, you have looked more closely at the differences among the states of matter. As the unit progresses, keep in mind that each of the elements has unique characteristics that influence which state the molecules are usually found in. This lesson was designed to help you to make connections between the classical states of matter, conditions necessary for the states to occur, and what each state of matter might look like at the atomic level.

Note: In Day 2 of Lesson 5, you will need to work with ice. To prepare for this, please freeze at least two small plastic cups of water that can be used for the activity.



MODELING DIFFERENT STATES OF MATTER



In looking at the jars, what is a major difference between a solid and a gas? A solid and a liquid?

What is a major difference between the particles of a solid, a liquid and a gas (HINT: The answer can have liquids and gases in the same category)?

MODELING DIFFERENT STATES OF MATTER

Solid, Liquid, and Gas Characteristics

SOLID	LIQUID	GAS

STATES OF MATTER ILLUSTRATION

In looking at the jars, what is a major difference between a solid and a gas? A solid and a liquid?

What is a major difference between the particles of a solid, a liquid and a gas (HINT: The answer can have liquids and gases in the same category)?

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Getting Started

✿ Ideas to Think About

- Why does matter "behave" the way it does in different circumstances?
- What patterns can be observed in elements?



Things to Know

- **atmospheric pressure:** the downward pressure exerted by the weight of the atmosphere
- **solid:** a material that keeps its shape and resists change in shape at room temperature and normal atmospheric pressure
- **liquid:** a substance that flows, that is a fluid at room temperature and normal atmospheric pressure, and whose shape can be changed
- **gas:** a substance that is neither a solid nor a liquid at ordinary temperatures and has the ability to expand
- **state of matter:** a state in which matter can exist, depending on temperature and pressure (the states are solid, liquid, gaseous, and plasmatic)
- **plasma:** a gas made up of ions and electrons; found primarily in the Sun and stars
- **melting point:** the temperature at which a substance changes from a solid to a liquid
- **boiling point:** the temperature at which a heated liquid turns to gas

⦿ Skills

- Know that the states of matter (solid, liquid, gas) depend on molecular motion. (S)
- Know that in solids the atoms are closely locked in position and can only vibrate. (S)
- Know that in liquids the atoms and molecules are more loosely connected and can collide with and move past one another. (S)
- Know that in gases the atoms and molecules are free to move independently, colliding frequently. (S)

Introducing the Lesson

In this lesson, your child will be challenged with the abstract idea that energy determines which state of matter is present. Although this lesson does not focus specifically on energy, the activity is designed to challenge your child to imagine that matter is made up of atoms that are interacting with one another and that these interactions are influenced by the amount of energy present.

Note: In Day 2 of Lesson 5, your child will need to work with ice. To prepare for this, please freeze at least two small plastic cups of water that can be used for the activity.

Reading and Questions

1. What causes matter to move from one state to another.

Changes in temperature and/or pressure.

2. What are sublimation and deposition?

Sublimation is when a substance changes directly from a solid into a gas. Deposition is a change from a gas directly into a solid.

3. What happens to a substance at its boiling point? Its condensation point?

At the boiling point a liquid becomes a gas. At the condensation point a gas becomes a liquid.

Activities

Activity 1: Modeling Different States of Matter

This activity has two options. In the first option, a table provides students with various attributes of the three states of matter and gives them a sheet with an illustration of jars representing solids, liquids, and gases. Option 2 is the more advanced option, where students must use the *Atoms* book or other resources to complete a chart about the attributes of the three states. They must also create their own diagram or illustration. Tell your child which option to complete.

Option 1

Answer Key - Option 1

In looking at the jars, what is a major difference between a solid and a gas? A solid and a liquid?

Answer: The number of particles in the same space is much less for a gas than a solid. There are fewer particles for the same space when comparing a liquid to a solid. Both liquids and gases can take the shape of their containers with a liquid much more easily observed.

What is a major difference between the particles of a solid, a liquid and a gas (HINT: The answer can have liquids and gases in the same category)?

Answer: The particles in a solid do not freely move as they do with a liquid and a gas.

Option 2

Answer Key - Option 2

In looking at the jars, what is a major difference between a solid and a gas? A solid and a liquid?

Answer: The number of particles in the same space is much less for a gas than a solid. There are fewer particles for the same space when comparing a liquid to a solid. Both liquids and gases can take the shape of their containers with a liquid much more easily observed.

What is a major difference between the particles of a solid, a liquid and a gas (HINT: The answer can have liquids and gases in the same category)?

Answer: The particles in a solid do not freely move as they do with a liquid and a gas.

In this lesson, your child has looked more closely at the difference between states of matter. This lesson will be beneficial as the unit progresses. Your child has been asked to imagine and create in order to make connections among the classical states of matter. Remind her to think about what conditions are necessary for the states to occur and that each state of matter occurs at the atomic level. Ask your child to consider the illustration and the characteristics of each state of matter.

You can use the activity pages and answer key from Option 1 as an assessment guide.

Wrapping Up

Questions to Discuss

- Compare gas and liquid states of matter. What are two major differences? (Gas volumes can continue to expand; liquid volumes will remain fairly constant. When comparing the concentration of gas particles compared with liquid particles in an equal-sized container, the concentration of liquid particles is much higher.)
- Compare gas and solid states of matter. What are two major differences? (Gas volumes can continue to expand; solid volumes remain constant regardless of container; the shape of gases can change based on container; solid shapes are constant; gas molecules move freely and solid molecules are fixed in their positions.)
- Compare liquid and solid states of matter. What are two major differences? (Solid volumes remain constant regardless of container; the shape of liquids can change based on container. Solid shapes are constant; liquid particles move freely, but solid molecules are fixed in their positions.)
- *Challenging Question:* What causes solids to transition to liquids and liquids to transition to gases? (Chemical bonds between particles of matter influence the state of matter. Strong bonds link particles together. The bonds that hold particles together are influenced by the strength of the bond and the amount of energy present in the surroundings. Higher amounts of energy begin to weaken bonds. The more energy present, the greater the likelihood of a transition into a different state of matter.)

Things to Review

- Solids have fixed shapes, and the particles of solids do not freely move.
- Liquids have flexible shapes based on the shape of their containers; liquid particles move by each other.
- Gases have flexible shapes; gas particles move freely by each other; the volume of gases can continually increase.