

Kids Discover States of Matter

by

Susan Reslewic Keatley

Background and art note: *Gertrude (5-year-old girl) and Linus (2-year-old boy) are eating their dinner. Both children have chicken noodle soup for dinner. A pot of it simmers on the stove. Gertrude sits in a regular chair while Linus is stuck in a high chair.*

Linus picks a carrot out of his soup, and throws it on the floor. **Art note:** *he uses his fingers.*

**Gertrude:** “Linus, don’t play with your food! Use a spoon.”

**Linus:** “Spoon!”

**Art note:** *Linus picks up broth with his spoon and dumps it onto the floor.*

**Gertrude:** “I can pick up your carrot, Linus. But I cannot pick up your broth, because it is a LIQUID.”

**Linus:** “Liquid.”

**Gertrude:** “Without a spoon or a bowl, it spreads out.”

**Art note:** *Gertrude scoops up his spilled broth with a spoon.*

**Linus:** “No broth!”

**Gertrude:** “If you don’t like the broth, eat the other stuff.”

**Art note:** *Gertrude tries to help Linus eat only the solid parts of the soup with a spoon and it’s not working.*

**Gertrude:** “Linus, let’s see what happens if you eat the soup with a fork.”

**Art note:** *Linus puts his fork into the soup and lifts it out. Only solid items are on the fork, as the broth drips back into the bowl.*

**Linus:** “Fork!”

**Gertrude:** “See Linus, the fork can’t hold the broth, but it can hold the carrot and the chicken and the potato. Those are SOLIDS.” *Art note: Gertrude is delighted she solved this problem.*

**Linus:** “Solids, yum!”

*Art note: Linus points to the simmering soup on the stove.*

**Linus:** “Hot!”

**Gertrude:** “Yes, Linus, hot. Steam.”

**Linus:** “Eat it.”

**Gertrude:** “You can’t eat it. It’s too hot.

**Linus:** “Hold it.”

**Gertrude:** “We can’t hold it with a spoon or a fork. Not even our hands. It will escape. It’s a GAS.”

*Art note: Gertrude and Linus are finished with dinner and are eating ice cream for dessert.*

**Linus:** “Solid!”

*Art note: Gertrude and Linus eat ice cream with their forks.*

*Art note: It melts and begins dripping through the fork prongs.*

**Linus:** “Uh-oh!” *Art note: the ice cream dripping through the fork prongs has made a puddle on the floor.*

**Gertrude:** “Now it’s a liquid! Switch to spoons!”

*Art note: Some time later. The puddle has hardened and is darker than the original ice cream color, as the liquid has evaporated.*

**Linus:** “Mess!” **Art note:** *Linus points to the dried up ice cream puddle.*

**Gertrude:** “Yes, and it got darker, and harder.” **Art note:** *Gertrude is crouched down, touching the dried up puddle.*

**Gertrude:** “I wonder what happened! I think some of it went into the air, like the steam from the soup. That is my hypothesis.”

### **Definitions:**

Matter: the name for all the physical stuff in our universe. Matter is made of small particles called atoms and molecules, too small to see with the naked eye, that are in constant motion.

Matter can come in three forms, or “states”: solid, liquid, gas.

Solid: a substance with a definite volume and shape. The particles that make up a solid are close together, with little space to move.

example: a rock (**Art note:** *a picture of a rock with a zoom-in box showing the particles close together with little space to move*)

Liquid: a substance with a definite volume, but it takes on the shape of its container

example: juice (**Art note:** *a picture of juice in containers of different shapes, with a zoom-in box showing the particles farther apart than in the solid*)

Gas: a substance with a volume and shape determined by its container. Gas fills up all available space.

example: helium compressed in a tank and in a balloon (**Art note:** *a picture of a tank and a balloon, with zoom-in boxes showing lots of empty space between the gas particles, but more empty space between the particles in the balloon*)

All substances can exist as either solids, liquids, or gases. Most of the time, we see a substance as only one state, because the conditions required for another state are too extreme for us to experience. For example, in order for salt to exist a liquid, we'd need to heat it to a temperature of nearly 1,500 degrees Fahrenheit! One substance we *can* see in all three states is water (H<sub>2</sub>O) — we can see it as water (liquid), ice (solid), and steam (gas).

**Try This At Home:**

1. **One substance can cycle through all three states of matter.** Put an ice cube in a bowl and let it sit on your kitchen counter. After one hour, what does it look like? After 24 hours? After 72 hours?

*Answer:* After one hour, the ice cube should appear smaller and surrounded by liquid water, or it may have disappeared entirely and you see only water. The solid ice melted into liquid water. After 24 hours the volume of water should appear smaller — some of it has evaporated into the air as gas. After 72 hours it should have completely evaporated. If we were to measure the mass of the gas in the room, we'd see an increase from the water vapor, but this is hard to do.

2. **Liquid can evaporate from a mixture, leaving solids behind.** Mix a few drops of food coloring into a glass of water. With a magic marker, mark the liquid level on the glass. What changes do you observe after five days? After ten days?

*Answer:* Over time, the water level should go down, and the color of the water will get darker. The water is evaporating, leaving the glass and going into the air, but since the actual food

coloring particles are solids, they will stay behind. As the amount of liquid water in the glass decreases, the color of the water will appear darker, just like the spot of ice cream on the floor in the story.

**3. Gas may be invisible, but we can “see” how it takes up space.** Hold a clear plastic cup over a basin of water, cup pointing down. Push the cup into the water. What does it feel like? Was it what you expected? Now, while holding the cup down in the water, tilt the cup. What happened?

*Answer:* When you push the cup down into the water, you will feel resistance. Although the cup appears empty, it is actually full of gas, the same gas that is in the room you are in, and that you are breathing. The gas takes up space in the cup; water cannot go into the cup because air was there first. When you tilt the cup, air bubbles escape and then water can fill the cup.