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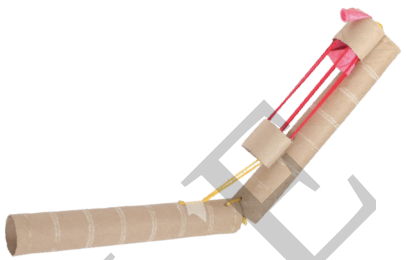

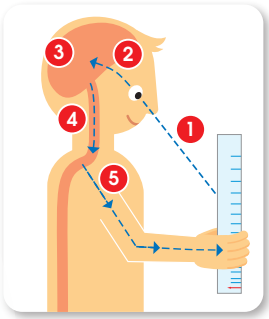

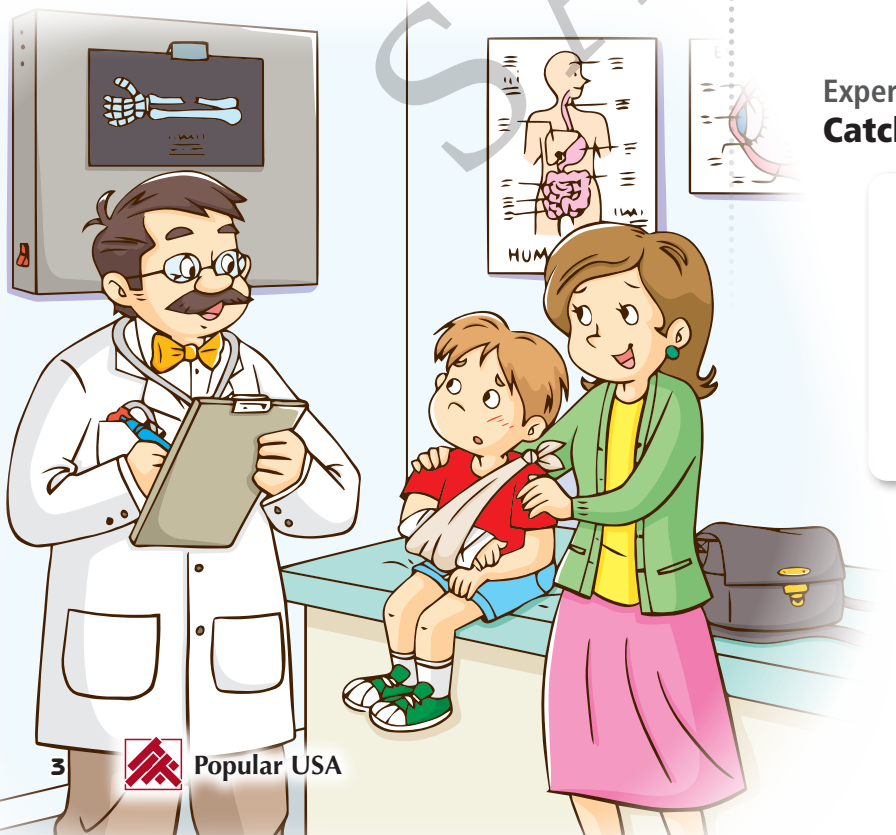

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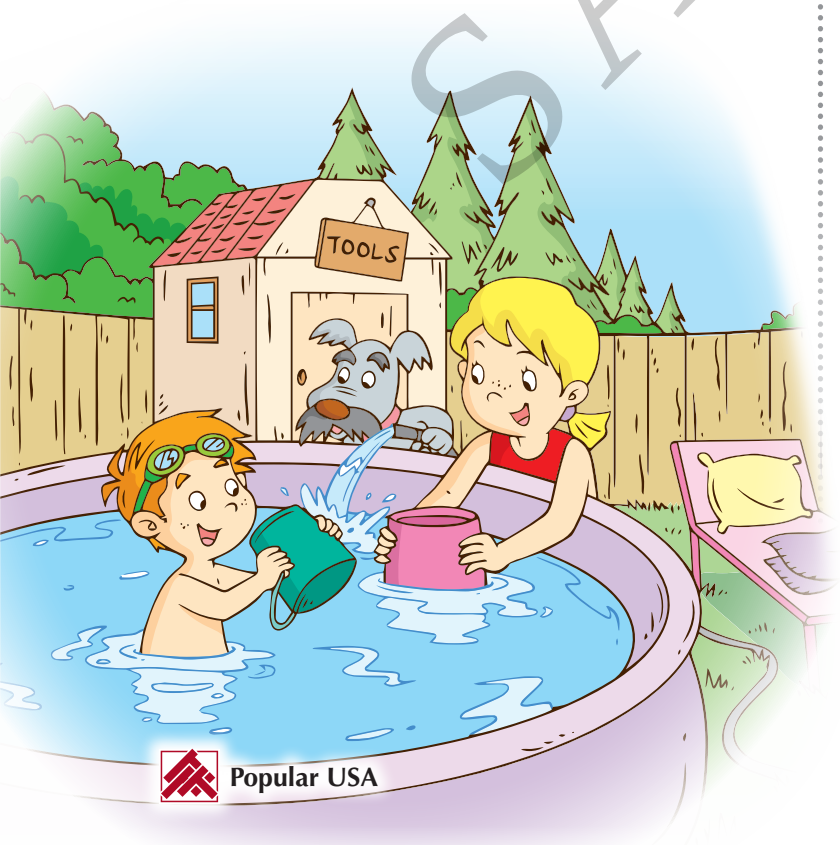

STEM Experiments

Popular USA

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Section 3: Matter and Energy

Basic Science Concepts

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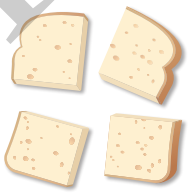

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Basic Science Concepts

STEM Experiments

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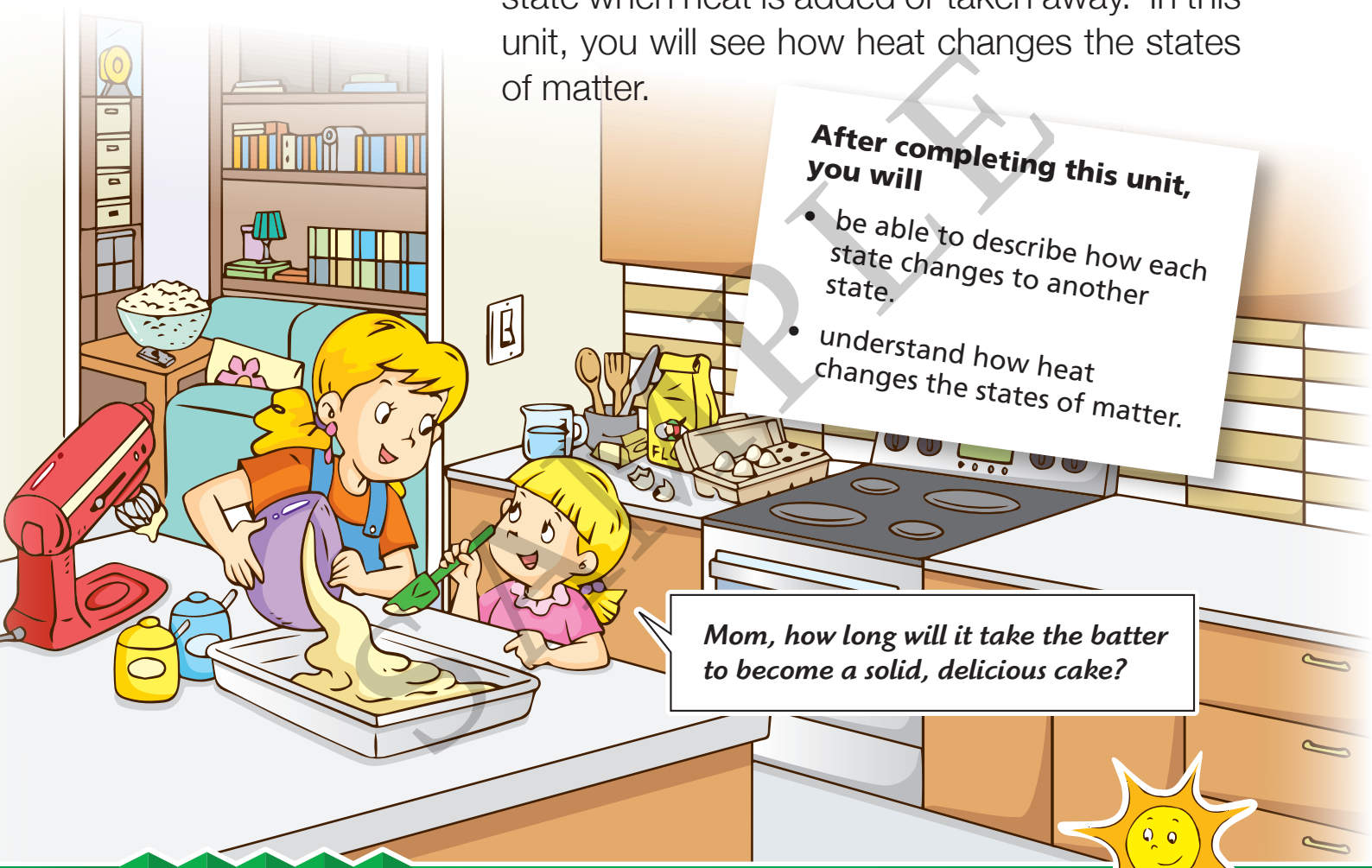
3 Changes in States of Matter

Solid, liquid, and gas are the three states of matter. Matter can go through changes of state when heat is added or taken away. In this unit, you will see how heat changes the states of matter.



After completing this unit, you will

- be able to describe how each state changes to another state.
- understand how heat changes the states of matter.

Mom, how long will it take the batter to become a solid, delicious cake?

Vocabulary

melting: the change in state from solid to liquid

evaporation: the change in state from liquid to gas

condensation: the change in state from gas to liquid

freezing: the change in state from liquid to solid

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Extension

On a hot summer day, it is nice to have a cold drink to cool you down. However, have you noticed that something is formed outside the container when your cold drink has been sitting out for a while? It is water. The water droplets start to drip down the sides, making the container wet. Where do you think this water comes from?

(A) your hands (B) the drink

(C) the air (D) the glass

Answer: C

A. Describe the changes of state with the correct words. Then identify the change of state each picture shows.

condensation evaporation melting freezing sublimation*

*sublimation: the change in state from solid to gas

Changes of State

1. _____ liquid → solid _____

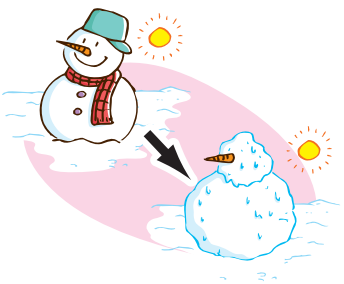
2. _____ gas → liquid _____

3. _____ solid → liquid _____

4. _____ solid → gas _____

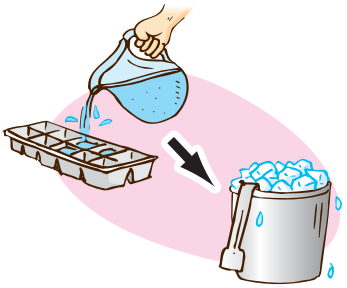
5. _____ liquid → gas _____

6. _____



7. _____

8. _____



9. _____

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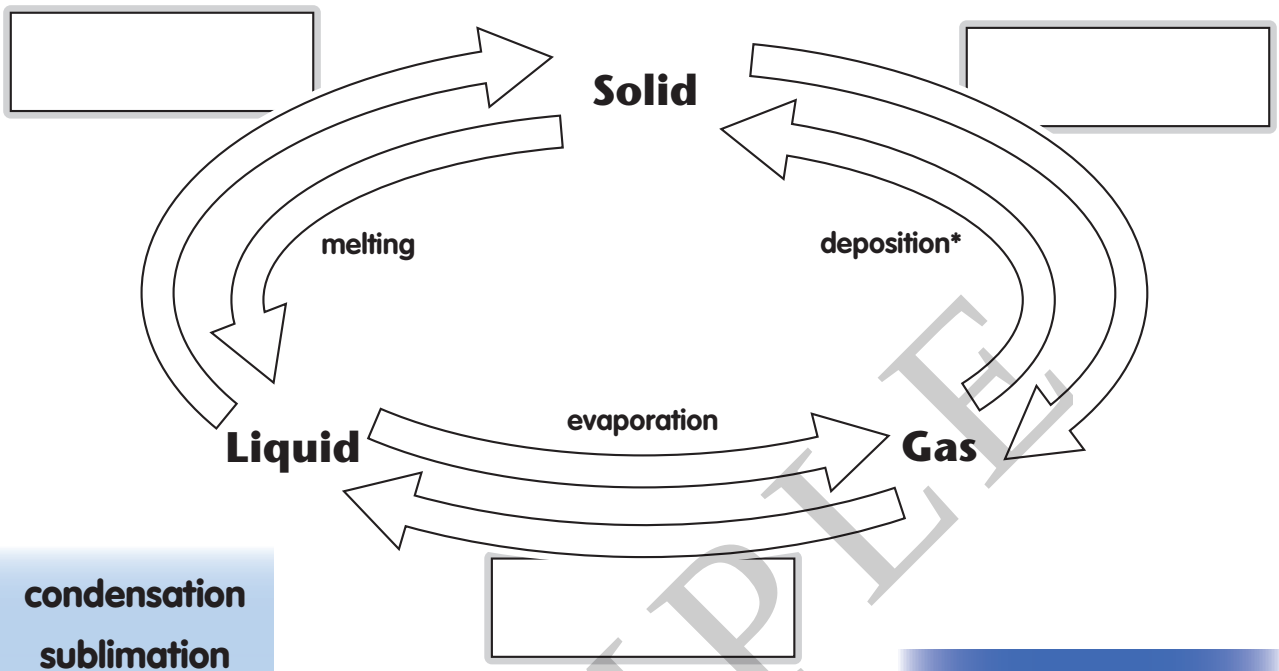
B. Color the arrows to show the heat added or taken away. Fill in the blanks with the given words. Then describe each situation.

1.

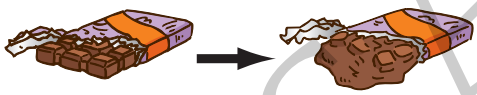


condensation
sublimation
freezing

red: heat added
blue: heat taken away

**deposition: the change in state from gas to solid*

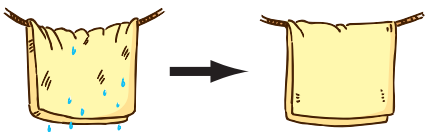
2.



heat _____ ;
added/taken away

_____
change of state

3.



heat _____ ;

_____

4. spraying water over an ice rink

heat _____ ; _____

5. mothball decreasing in size

heat _____ ; _____

6. steam escaping from a kettle

heat _____ ; _____

7. steam making a window foggy

heat _____ ; _____

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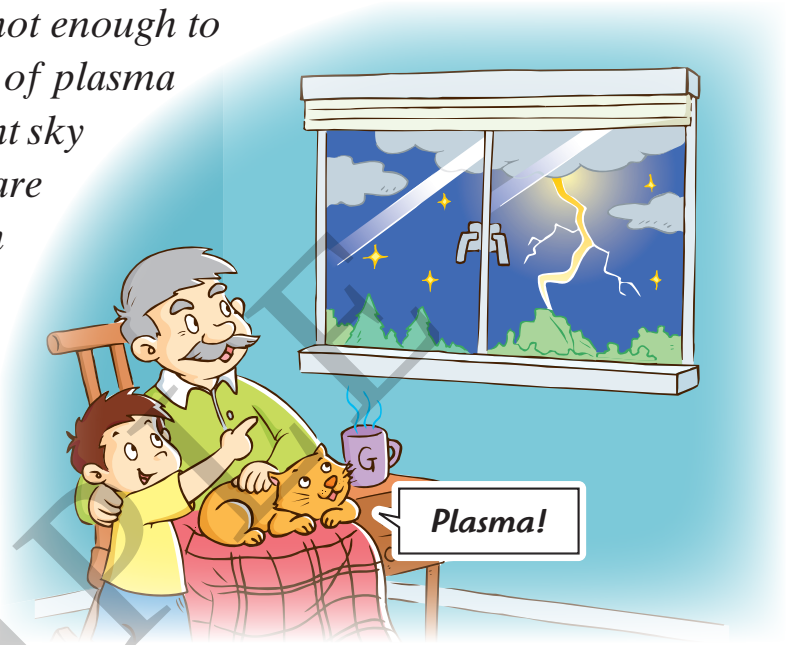
C. Read the paragraph. Then answer the questions.

When a solid is heated, it melts into a liquid. When more heat is added, the liquid evaporates into a gas. What will happen if a gas is heated vigorously? It will turn into the fourth state of matter – plasma. Plasmas are like gases, but plasmas are hotter and are even hot enough to emit light. Lightning is an example of plasma that occurs naturally. Stars in the night sky are another form of plasma. They are balls of plasma burning brightly from millions of miles away. Fluorescent light is an example of plasma too. When the light is turned on, the electricity flows through the gas inside the glass tube. The gas gets heated up to become plasma and gives off light.



1. Name the states of matter and give an example of each.

States of Matter

S → ____ → ____ → ____

e.g. ____ e.g. ____ e.g. ____

➡ means ____

2. How are plasmas related to gases?

_____

3. Give an example of plasma that does not occur naturally. Explain how it works.

_____

_____

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Have you ever watched a piece of firewood burning in a campfire? When firewood is burned, it changes by releasing carbon dioxide and leaving a residue of ash. These new substances – carbon dioxide and ash – are the result of the chemical change of burning firewood. Since the ash and carbon dioxide cannot be changed back to the firewood, burning firewood is an irreversible chemical change. Try this experiment to learn about another common chemical change in our daily lives – rusting.

FORMATION OF NEW SUBSTANCES

understanding what a chemical change is

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What you need:


steel wool


vinegar


a jar


gloves


a plate

Difficulty:

Time needed:
1 day

In this experiment, you will learn about chemical changes through rusting.

You may put the steel wool back into the vinegar and leave it for another week to observe.

What to do:

1. Place the steel wool in the jar.
2. Pour vinegar into the jar until the steel wool is fully submerged.
3. Touch the jar and observe the steel wool for five minutes. Did you notice any changes?
4. Let the jar sit overnight.
5. Take out the steel wool with your gloves on and put it on the plate. Did the steel wool look different?

STEM Note

Steel is an alloy of iron and carbon. The carbon in steel makes it harder than wrought iron but not as brittle as cast iron. Steel has a unique balance of hardness, flexibility, and tensile strength.

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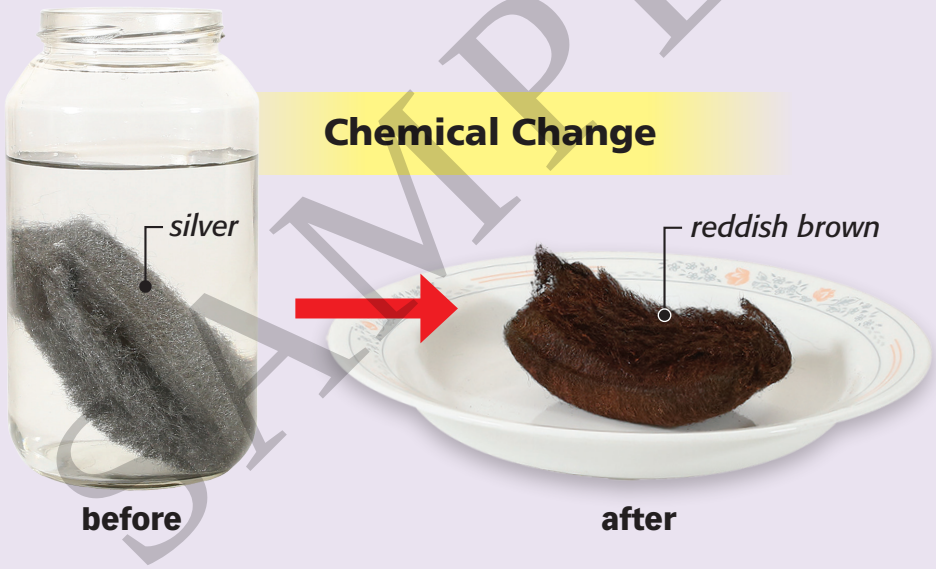
WHAT *just* happened?

When the steel wool came into contact with the vinegar, the vinegar removed the steel wool's protective coating. This made the iron in the steel wool expose to the oxygen in the air and a chemical reaction occurred as a result. You should have noticed that the steel wool's color changed to reddish brown. The reddish-brown substance is what we call rust, which is a combination of iron and oxygen through a chemical process. This new substance showed you that the steel wool underwent a chemical change.

Furthermore, during this chemical reaction, heat was produced. That is why the jar felt warm when touched.



Rusting

Iron + Oxygen ⟶ Rust

in the presence of water

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STEM INQUIRY

- Can you give more examples of chemical changes at home and in nature? How do they affect our lives and the environment?
- If you combine vinegar and baking soda, a chemical change will occur. What are the characteristics of this chemical change?
- Is rusting a reversible or irreversible chemical change?
- What problems can rusting cause to our lives? How can we avoid it?

- Food goes through chemical changes in human bodies. Research online with the permission from an adult to learn how human bodies turn food into energy for daily activities and functions.
- Research online with an adult to learn what chemical changes undergo in batteries to create electricity.

- In the experiment, the chemical change destroyed the structure of the steel wool and changed its properties. How do engineers protect steel structures, such as bridges and railways, from damaging?

- Use a thermometer to measure the temperature change of the liquid in the steel wool jar during the experiment. How much did the temperature change?

Fun to know

Rusty Stain

Did you know that the solution you made in the experiment by soaking steel wool in vinegar can be used as a wood stain? Carpenters sometimes stain wood with this mixture to give the wood a reddish-brown color. Now, that is making good use of a chemical change!

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