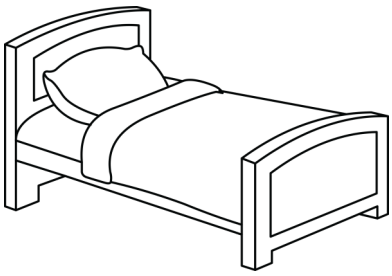
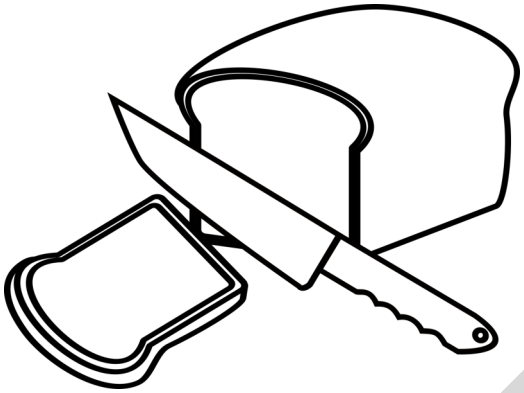
Physical and Chemical Changes



You know that everything you can see and touch is made of matter. Matter is made of molecules, and those molecules are made of even smaller atoms. Even though it's all made of atoms, matter has many different shapes and forms. The wood in your walls is different than the stuffing in your mattress (which is a good thing!). Water from your faucet is different than cotton candy.

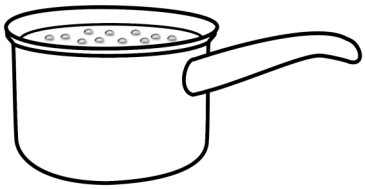
Matter can also change. Steam and ice are both water, but they are not the same. A piece of wood can burn up in a fire. Let's look at some of the ways matter can change and then learn a little about ways it cannot change.



There are two basic ways matter can change. There can be a physical change or a chemical change. Physical changes happen all the time. Have you cut a piece of bread from a loaf? The bread is in a different shape now. It's in two pieces. But both the piece of bread you cut and the loaf are still bread. The substance of the bread hasn't changed, just the form.

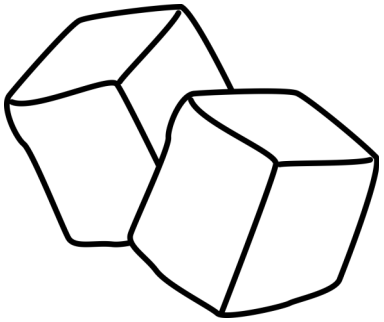
What if you cut a piece of watermelon, chopped it up, and put it in the blender so you could make it into pulp for a smoothie? Is the pulp still watermelon? Of course it is. It's just watermelon in a different form.

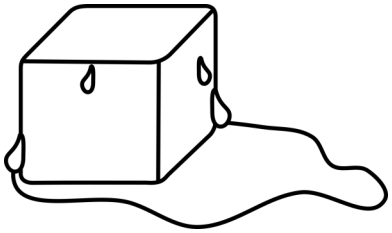
A **physical change** is a change in form or shape. When a physical change happens, you are left with the same substance you started out with. It might just look different.



What about water when it changes to steam or ice? You know that there are three basic states of matter—solid, liquid, and gas. When you heat water, you can cause it to reach the **boiling point**, which is the point where a liquid turns into a gas. Different types of matter boil at different temperatures. For example, water boils at 212 °F (100 °C), but iron boils at 5,432 °F (3,000 °C).

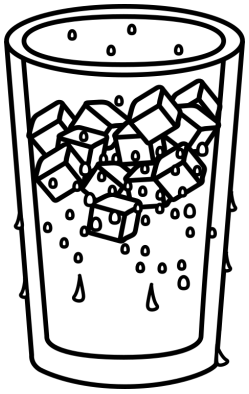
You can also freeze water. The **freezing point** of matter is the point where a liquid changes into a solid. Water turns into a solid at 32 °F (0 °C).





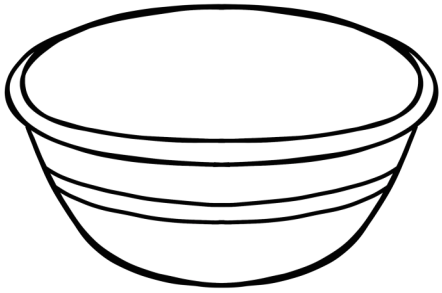
But of course, ice can also melt back into water. The **melting point** is the point where a solid becomes a liquid.

So when water freezes into ice cubes, melts into liquid water, or boils and changes into water vapor, what kind of change is that? These are all physical changes because no matter what state or form it's in, the water is still water. It looks different and acts differently, but it is still water. Nothing about the atoms in its molecules has changed. It's still two atoms of hydrogen and one atom of oxygen in each molecule, so it is still water.



What about when something like ice cubes in a glass cause the outside of the glass to drop in temperature? When the air hits the glass, some of it condenses into water droplets. The **condensation point** is the point where a gas turns into a liquid. Is this still a physical change? The answer is yes because the air is made up partly of water vapor. The air hasn't changed, but part of it has changed form from a gas to a liquid. But the water vapor was in the air all the time.

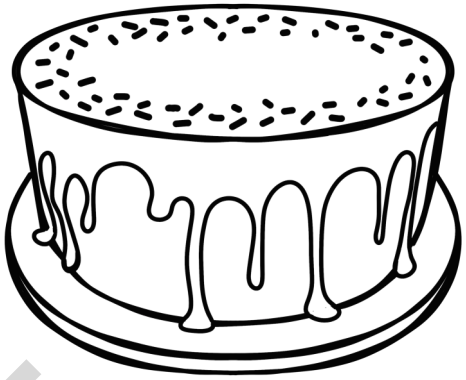
A few solids can change directly from a solid into a gas without changing into a liquid first. This is called **sublimation**. Only a few substances can do this, such as dry ice, iodine, arsenic, and camphor (moth balls).

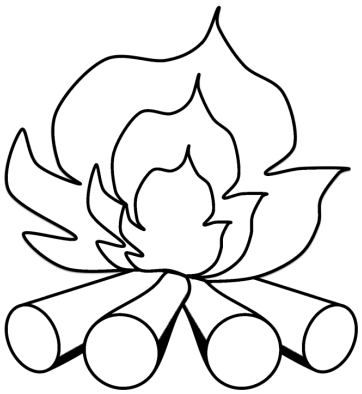


What about when you mix together ingredients for a cake? This one gets tricky. When you have the ingredients together in the bowl, it's just a physical change. But when you bake it, something different takes place. We're going to look at chemical changes next to understand what happens.

Now we know that a physical change is a change in form or shape that leaves you with the same substance. A **chemical change** is a change that happens in the molecules themselves that forms new substances.

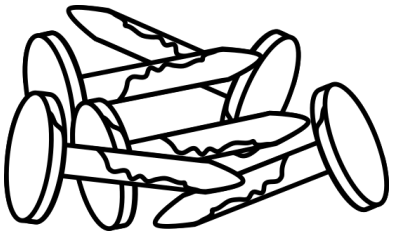
When we bake a cake, a lot of changes happen. Heat changes some of the protein in the eggs, which makes the cake firm. Heat also causes baking powder to produce bubbles of gas, which makes the cake rise. Bubbles are often a sign of a chemical change. Another sign that it's a chemical change is that the ingredients can never be broken back down into the individual ingredients. They are permanently changed, and the molecules themselves are different in a baked cake than they were in the raw ingredients.





When you burn wood, you aren't left with wood anymore. You are left with ashes and smoke. Neither one of those can ever be wood again. As the fire burns, it gives off light and heat energy. Giving off energy is another good sign that something is a chemical change.

Sometimes, even a change in color is a sign of a chemical change. When iron and oxygen combine, a chemical change happens that produces rust. The rust isn't oxygen, and it's not iron. It's reddish-brown and not the color of the original iron. This happens on iron nails often. A chemical change has occurred.



Let's take a closer look at a chemical change in action. We're going to see what happens when we combine baking soda and vinegar. Remember that you should never try any experiment without a parent or teacher who can let you know what is safe to combine. Some combinations can be poisonous or even deadly.

Terminology

Using what you learned, define these words in the best way you can. Use the back of the page if you need more room.

Physical change: _____

_____

Boiling point: _____

Freezing point: _____

Melting point: _____

Condensation point: _____

Sublimation: _____

_____

Chemical change: _____

_____

Oxidation: _____

Exothermic: _____

_____

Endothermic: _____

_____

Thermodynamics: _____

_____

First law of thermodynamics: _____

_____

Review

Circle the chemical changes shown below. Draw an X over the physical changes.