

Reflect

How can matter change?

Water is one of the most important parts of our planet. All living things need water to survive. You use many forms of water every day. You may use ice (solid water) to keep your iced tea cold. You drink liquid water and use it to take baths and showers. But did you know that there is also water in the air that you cannot see? Heating and cooling matter can cause it to change.



What happens when air is cooled? When you put ice in a glass of water, the ice cools the water and the glass, but the ice also cools the air around the glass. Cooling the air causes something surprising to happen. Do you know what happens?

The air around us contains water in the form of a gas called *water vapor*. When the ice cools the air next to the glass, the water in the air changes from a gas into liquid water. Water vapor forms drops of water on the outside of the glass. This process is called **condensation**.



condensation – when a gas changes to a liquid

What Do You Think?

Cooling causes condensation on surfaces such as mirrors and drinking glasses, so cooling can cause water to change its physical state from a gas to a liquid.

Think about when you've seen it happen. You have just taken a hot shower or bath and you try to look in the mirror. It's covered in a fog. What do those drops on the glass look like?



Frozen condensation on a car window and mirror

What are some other examples of condensation? Have you ever seen drops of water on the grass on a cool morning? That is one example. Droplets on the windshield of a car in the morning are another example.

Reflect

What happens to ice when it is heated?

Imagine that you place five ice cubes on the road on a warm summer day. You let them sit for a few minutes. What do you think you will see? You will probably see a puddle of liquid water! But where did the ice go?

Stranger yet, if the puddle of liquid water is left alone, it will disappear, too! The heat caused the solid ice to change into liquid water. The heat will continue warming the liquid water, and the water will **evaporate** and change into gaseous water vapor, the same water vapor that condensed on the outside of the iced-tea glass.

evaporation – when a liquid changes to a gas

Where did the matter go?

You know that all matter is made up of tiny particles. When the particles are heated or cooled, they move differently. Heating something will cause the particles to move faster and farther apart. They can move so fast and far apart that you cannot see the substance anymore! The same number of particles are there—they just spread out!

When the gas is cooled, it can turn back into a liquid. It may seem like a new substance appeared, but the particles were in the air all along. As they cooled, they got closer together, until you were able to see them in liquid form.



Look Out!



Combining two substances together can cause a chemical reaction! Sometimes a brand-new substance is created. Even when these changes happen, we still have the same amount of matter before and after the reaction. If you were to weigh the matter before and after, the weight would be the same!

Reflect

How can we prove matter is conserved?

No matter what changes happen, the total weight of the matter does not change. This is because the amount of matter is conserved, or remains the same, even through changes of state.



How can we prove it? You can start by making a fruit salad or a trail mix. All you'll need are your favorite ingredients, a bowl, a pencil and paper, and something to weigh the amounts. Find the weight of the bowl you will be using. Make a note of the weight for later. Measure 125 grams of each item you want in the trail mix or fruit salad. Place each amount in the bowl and mix all the ingredients together.

Now it is time to weigh the filled bowl. Remember, if you had six different ingredients in the mix or salad, then you will have 750 grams in the bowl.

Subtract the weight of the empty bowl from the total weight of the filled bowl. The answer should equal the amount of ingredients you used to make the trail mix or fruit salad.

Look Out!

The weight of the trail mix or fruit salad probably wasn't a big surprise. All you have to do is look at the trail mix or fruit salad to know it is all in the bowl. Do the same results happen if one ingredient disappears into another ingredient?

Weigh a graduated cylinder like the one shown, and make a note of the mass of the empty container. Fill the graduated cylinder with 200 mL of water. Stir 5 grams of sugar or salt into the water in the cylinder. The solid should dissolve, or disappear completely, into the liquid. Since you no longer can see the sugar or salt, does it mean the matter has disappeared? What is the volume of liquid in the container? It should be 200 mL. But you can prove that matter has been conserved even though it seems to have disappeared.

Now, leave the liquid open in the container for several days so the water can evaporate. When the 200 mL of water changes into water vapor, reweigh the graduated cylinder. There will be 5 g of sugar or salt remaining after you subtract the weight of the empty cylinder.

