

► **Key Question: What happens to a substance's particles in a solution?**

To help you understand how things dissolve, you can try this experiment at home. Follow these steps:

1. Fill a glass with milk.
2. Slowly add popcorn to the milk, one piece at a time.

How many pieces of popcorn can you add before the milk spills out of the glass (Figure 1)?



Figure 1 You can add pieces of popcorn to a full glass of milk without spilling it.

You can add a lot of popcorn! The milk and popcorn particles fit close together.

This experiment tells you about the volume of mixtures and solutions. When particles dissolve, the total volume of a mixture is less than the volume of its parts. In this example, the milk and popcorn separately have a larger volume.

DISSOLVING SUGAR

The particle theory helps explain what happens when a solute is dissolved. Remember that the particle theory says that there are spaces between all particles. In water, there are spaces between the water particles.

The particles in sugar are the same. You can see many grains, or crystals, of sugar. Each grain is made of many particles that you cannot see. There are empty spaces between the sugar particles.

Look at Figure 2. When sugar dissolves, the particles break apart. These particles mix with the small water particles. The small water particles fit in the spaces between the larger sugar particles.

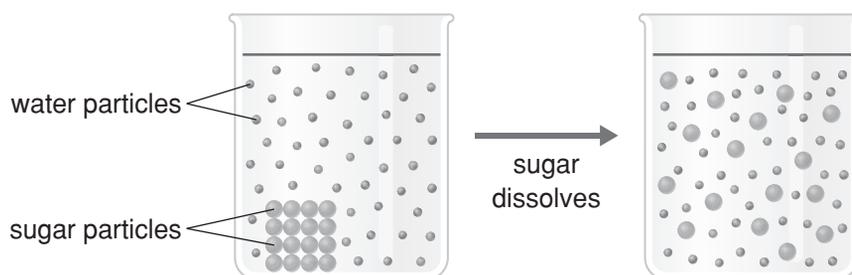


Figure 2 Sugar particles are attracted to the water particles. They separate and mix with the water particles. There is less space between the particles when sugar and water are mixed.

Hint

Remember *volume* is how much space an object takes up.

The water and sugar particles are attracted to each other. When they mix, the particles move closer together. This makes the total volume of the mixture less than the volume of the sugar and water separately.

SOLUBLE OR INSOLUBLE?

Sometimes particles are not attracted to one another. Sugar dissolves well in water. It does not dissolve as well in other solvents.

A solute that is able to dissolve into a certain solvent is called **soluble**. When solute particles are attracted to the solvent particles, the solute is soluble.

A solute that is not able to dissolve into a certain solvent is **insoluble**. When solute particles are not attracted to the solvent particles, the solute is insoluble.

Some solutes are soluble in one substance but not another. Sugar is soluble in water. The sugar and water particles are attracted to each other. Sugar is insoluble in vegetable oil. The sugar and vegetable oil particles are not very attracted to each other.

soluble

able to dissolve in a specified solvent

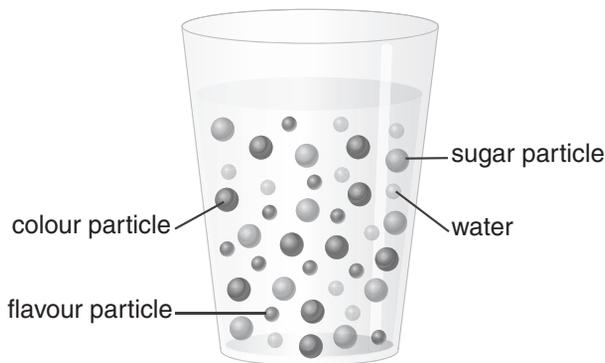
insoluble

unable to dissolve in a specified solvent

 **CHECK YOUR UNDERSTANDING**

1. Define the terms "soluble" and "insoluble" in your own words.

2. Fruit-flavoured drink crystals are a mixture of sugar, flavour particles, and colouring particles. The crystals dissolve in water.



This picture shows the mixed particles of a fruit-flavoured drink. Use the picture and the particle theory to explain what happens to the particles in this solution.

3. Why is the volume of a sugar and water mixture less than the volume of each substance alone? Explain.
