

HOT CHOCOLATE SOLVENT

Experiment

WHAT YOU NEED:

- Three identical pieces of chocolate or candy – soft chocolate, like milk chocolate sections, works best
- Stopwatch or a watch with a second hand
- Volunteer (or you can be the volunteer)



Here's a yummy experiment to help you understand how hot cocoa powder becomes hot chocolate.

WHAT YOU DO:

- 1 Place the first piece of chocolate in the volunteer's mouth. Tell the volunteer to not move his or her teeth, tongue, or actively suck on the chocolate. Simply let it sit there and dissolve in the saliva in the volunteer's mouth. Time how long it takes the chocolate to dissolve from the time it is placed in the mouth until it is completely gone.
- 2 Place the second piece of candy in the volunteer's mouth. This time, tell your volunteer to use the tongue to move around the chocolate, but do not chew on it. Again, time how long it takes for the chocolate to disappear.
- 3 Place the third piece in the volunteer's mouth, this time letting him or her chew on the piece. Again, time how long it takes for the chocolate to disappear.



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WHAT HAPPENED:

All three methods worked to dissolve the chocolate because they all exposed the chocolate to the mouth's saliva. In chemistry terms, saliva is a solvent that helps to break down food (a 'solute') in the mouth before it is swallowed. (A solute is anything the solvent dissolves.) In hot chocolate, the hot water or hot milk acts as the solvent that dissolves the cocoa powder, the solute. But why did each piece of chocolate take a different amount of time to dissolve? To answer this, we must first understand how solvents and solutes work. For a solvent to break down a solute, it must be in contact with the surface area of the solute. The more surface area the solvent is exposed to, the quicker it can break down the solute. In your experiment, the only variable was the amount of agitation (movement) each piece of chocolate experienced while in the mouth.

The first piece of chocolate that just sat in the mouth and slowly dissolved away is like just emptying a packet of cocoa powder into a cup of hot water. Without any movement to expose more surface areas of the solute, it takes a while for the solvent to dissolve the solute. The second piece of chocolate that was moved around the mouth by the tongue is like stirring the cocoa powder and the hot water. It takes less time than just letting it sit there, but it still takes a while to expose all the surface area of the cocoa to the water (hence why you get dry 'clumps' of powder when trying to make hot chocolate). The third piece of chocolate dissolved very quickly because the teeth chewed it up, which allowed the saliva to come in contact with a larger surface area more quickly. This is comparable to putting your hot water and cocoa powder in a blender. The blades of the blender act like teeth and can quickly break up those dry clumps of powder, making hot chocolate that much quicker. But for practical purposes, and not having to clean up the blender every time, most people are content with just using a spoon to stir their hot chocolate.

As a side note, water is often called the universal solvent because, given enough time, it will dissolve just about anything. There are two main factors that increase how fast something will dissolve: agitation and temperature. As you found in this experiment, the more agitation and movement the solute experiences while immersed in the solvent, the quicker it will dissolve. With temperature, the hotter the solvent is, the faster the molecules in the solvent move. Therefore, the molecules have more energy and can dissolve the solute faster.