SUGAR CUBE TOWERS

Why can water travel through some materials but not others?

YOU WILL NEED

- Sugar cubes
- A plate
- A glass
- Water
- Food colouring
- Aluminium foil
- Cling film
- A4 paper
- Kitchen paper towel

WHAT YOU DO

Step 1

Fill a glass with a small amount of water and add a food colouring of your choosing. Pour a thin layer of coloured water onto the plate.

Step 2

Stack three sugar cubes on top of one another on the plate. You will notice that the coloured water is absorbed by the bottom sugar cube and travels upwards until all three sugar cubes are dyed with coloured water.

Step 3

Place four individual sugar cubes on the plate, and on top of each one rest a square of different material, slightly bigger than the face of a sugar cube. The materials to use are aluminium foil, cling film, A4 printing/writing paper and kitchen paper towel.

Step 4

Place two more sugar cubes on top of each of the individual sugar cubes. You will be left with four sugar cube towers, each with a different material separating the first sugar cube touching the coloured water from the one on top of it. Which materials can the water pass through?

THE SCIENCE BEHIND IT

Everything is made from atoms. Atoms are like tiny little building blocks that are so small you cannot even see them with a microscope! Atoms join together to make molecules, and the water molecules that make up your glass of water are quite unique. A water molecule is made from two hydrogen atoms and an oxygen atom, which is why water is called ‚H2O„ (‚H2„ means two hydrogen atoms and ‚O„ means oxygen). The special thing about this molecule is that it is bent into a V shape with the oxygen in the middle having a slight negative charge, and the two hydrogens having a slight positive charge. This means that water is a polar molecule, allowing it to do some special things.

When you hold two magnets together the positive and negative ends attract each other. Because water molecules are polar, having a slight positive charge on one side of the molecule and a slight negative charge on the other, they act like little magnets and attract each other. This is why water droplets form; if a drop of water was in space it would be a perfect sphere because all the molecules are attracting each other equally, but on Earth gravity pulls the perfect sphere into the drop shape we see. Water molecules bonding with each other like this is known as cohesion, but water molecules can also bond to other things.

The water molecules bonding to your finger is called adhesion, and because the water molecules also bond to each other by cohesion, the water droplet can hang from your finger.
In your experiment you will have noticed that the bottom sugar cube absorbs the coloured water and it slowly creeps upwards to the top sugar cube. This is because adhesive forces between the water molecules and the sugar molecules, along with cohesion within the liquid, allowed the water to move up the sugar cube tower against gravity. This process is called capillary action, and you can also see this when you light a candle; liquid wax is absorbed by the wick where it then moves up to the top and acts as fuel for the flame.

The aluminium foil and the cling film were able to prevent the water from travelling any further than the first sugar cube. The aluminium foil is made up of aluminium atoms, and they are all so close together that water molecules cannot pass through them. The cling film is made up of polymers, which are long chains of smaller molecules. Cling film has tiny little pores that atoms can pass through, but water molecules are too big to pass through them and so the coloured water did not reach the second sugar cube. The A4 paper and kitchen paper towel are made from plant fibres, and so both have relatively large pores. Water molecules can pass through these pores easily because the pores are so big, which is why the coloured water was able to reach the top!


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