BACKYARD CHEMISTRY

DR HAL SOSABOWSKI PRESENTS EXPERIMENTS YOU CAN DO ON YOUR OWN

IN THIS ISSUE: non-Newtonian liquids

THE SCIENCE

Slime, cornflour, quicksand and ketchup are all non-Newtonian liquids. They are also 'thixatropic liquids', from the Greek *thixis*, meaning the act of handling and *trope*, meaning change. So when a force is applied to a non-Newtonian liquid, it can now act like a solid.

EXPERIMENT 1

A cornflour/water mixture acts counter intuitively. The harder it is pushed, the harder it feels, and the converse is also true, the softer it is pushed the softer it feels.

MATERIALS

You will need:

- half a cup of cornflour;
- mixing bowl;
- cup of water;
- tablespoon.

HEALTH & SAFETY

There are no particular health and safety issues with this demonstration.

METHOD

Put half a cup of cornflour into a bowl and add a cup of water, a little at a time, until you get a consistency like melted ice cream. The starch molecules making up the cornflour are now suspended in water. Notice that it is fairly easy to stir slowly but incredibly difficult to stir fast. Now punch the mixture or smack the surface with a tablespoon. You will find it hard and it may even crack. If, on the other hand, you press it slowly, your finger will slide through it as if it is a liquid. This is because cornflour is a non-Newtonian liquid, *ie* when it is pressed slowly the molecules flow over each other like a liquid, but when pressed hard they are squashed closer together and become solid.

EXPERIMENT 2

In this experiment you are going to make synthetic slime using borax (sodium tetraborate decahydrate) and PVA (polyvinylacetate) glue. PVA molecules are long and can slide over each other easily. This causes PVA to be viscous. When you add borax to the glue, this joins up (or crosslinks) the PVA molecules. The resulting network of molecules stops water molecules flowing away so easily, and the liquid gains some solid-like attributes of slime.

MATERIALS

You will need:

- 300 ml of water;
- 100 ml of PVA glue;
- measuring cylinder;
- two spatulas of borax (available from chemists or on e-bay, £2.99 for 300 g);
- three discardable glasses (two should be about 300 ml each, one should be a pint glass or similar);
- discardable teaspoon;
- food colouring.

HEALTH & SAFETY

Borax can be harmful if swallowed and is an irritant. Wash your hands after touching the slime – do not taste or ingest slime. Wear eye protection and apron/laboratory coat for this preparation. Slime can be removed from clothing with warm soapy water.

METHOD

Pour 100 ml of water and 100 ml of PVA glue into a glass. Mix well. Add food colouring if you want to colour your slime. Pour 200 ml water into the second glass and dissolve the borax into it. Pour the PVA glue solution into the pint glass. Slowly add the borax solution to the glue, stirring continuously. The mixture will begin to separate out into a liquid part and a slimy part. Scoop out the slimy part and start to knead it, this is your slime. The watery phase can be discarded in the sink. The slime can be stored in a plastic bag.