

Most changes that cannot be reversed are **chemical reactions** where a new material is formed, and it is not possible or extremely difficult to recover the original materials. Children will experience such changes all the time in their everyday life and in the science activities they do in school, but it is not always obvious that a chemical reaction has taken place. Changes that take place in cooking, some heating, mixing some materials, such as vinegar and bicarbonate of soda, and burning are all chemical reactions. As children experience these activities it is worth discussing this with them as an on-going idea so that they begin to develop and build on the concept.

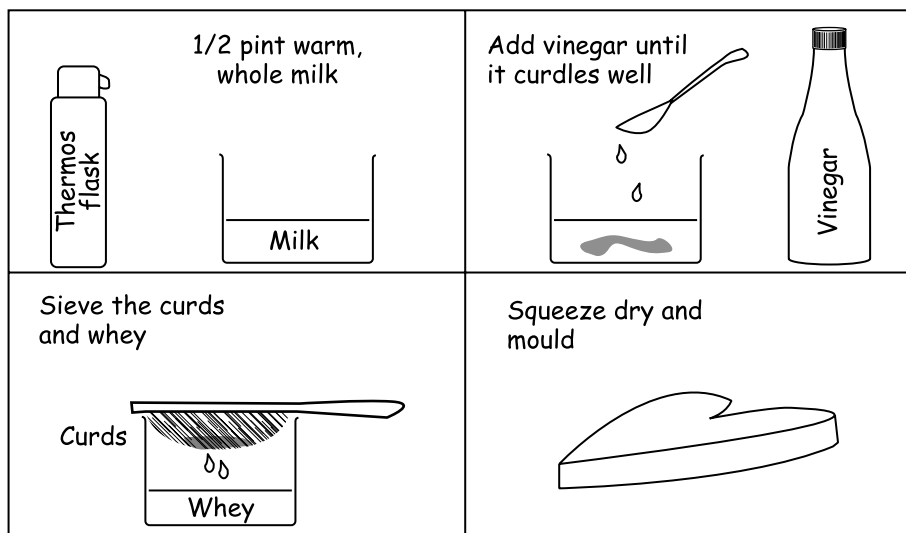
In a chemical change, the bonds between the particles of the substances are broken and reform in a different arrangement as a new substance. This may require energy taken from the surrounding material, and there is a drop in temperature as happens when lemon juice and bicarbonate of soda are mixed. Very often however, there is energy produced as a result of the reaction and an increase in temperature, as in the reaction between Plaster of Paris and water.

**Rusting** and the **burning** of a fuel in the presence of oxygen are both chemical reactions known as **oxidation**. Iron, in the presence of water and oxygen, reacts to form iron oxide or rust. Whilst the rust can be rubbed off to reveal the 'good' iron underneath, the top layer has been changed and removed permanently. Since this change is one that children will see happening and causes such a lot of corrosive damage, it is worth investigating the factors that affect it and what may prevent it from happening. Steel rusts because of its iron content. Stainless steel does not because traces of other metals have been added, this prevents the oxidising process which gives rise to the rusting. Galvanised steel or iron is coated in zinc, which also prevents rusting. Old copper coins react with the air and copper oxide forms making them 'dirty' and black. If they are dropped into cola, the strong phosphoric acid in the cola reacts with the copper oxide and cleans the coins.

**Other chemical changes** Mixing materials together often causes a chemical reaction and it is interesting for children to do some examples of these and compare them with mixtures that only change physically. Salt dissolves in water to form a solution, a physical change that can be reversed by causing the water to evaporate leaving salt crystals behind. Alka-Seltzer also dissolves in water to form a solution, but there is also a chemical change and carbon dioxide, a new material is produced. This is a chemical change that cannot be reversed.

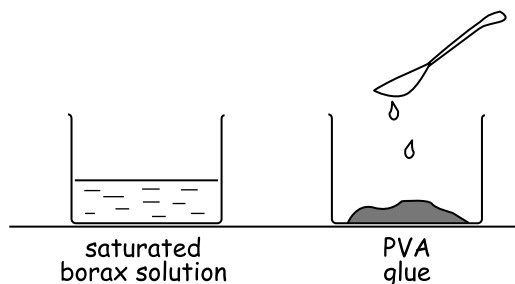
Non-reversible changes result in the formation of a new material that may be useful

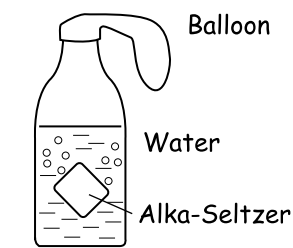
**Making plastic with milk and vinegar** This can be a directed activity or a demonstration. Warm about half a pint of **whole** milk and add about 1 tablespoon of white vinegar to it. The milk immediately curdles. Strain and keep the solid curds and put the plastic on kitchen paper to dry it. You can then handle it, put it in a mould or shape it yourself. This will dry firm overnight if kept in a warm place, become very hard in time and can be painted and varnished. Milk can be kept warm in a thermos flask. The temperature and exact quantities are not critical for this activity.



**Making plastic with PVA glue and Borax** This will make a similar but translucent plastic. (Borax can be bought very cheaply from a chemist.) Make up a small quantity of saturated borax solution (this is when no more solid will dissolve in the water, there maybe a little borax left in the bottom of the container). Add a teaspoon at a time of this solution to one tablespoon of PVA glue. Mix continuously and the glue will absorb the borax solution. Keep adding and mixing as the PVA changes to a solid that is 'bouncy' and can be handled and moulded. Leave to dry for a few days in the warm, it will go very hard. This is a good group activity, as a small jar of saturated borax solution can be used by a group of six children each with their own spoonful of glue in a container.

Mix the borax solution really well into the PVA glue. Add more until it changes.





## Safety!

- Care when handling any glass-ware.
- Spirit thermometers should be used.
- Care when handling hot water.

- Alka-Seltzer tablet and water. The carbon dioxide can be collected in a balloon on top of a bottle.
- Sodium hydrogencarbonate (bicarbonate) and vinegar, produces lots of 'froth'.
- Sodium hydrogencarbonate (bicarbonate) and lemon juice, which is an endothermic reaction. (The temperature of reaction mixture will decrease as heat from the surroundings is used up.)
- Baking powder and hot water. (The reaction that often occurs in cake making.)
- Dried or fresh yeast, sugar and warm water. This reaction takes 5-10 min. It is used in bread and pizza baking.
- Lemonade 'fizz' is carbon dioxide. Drop currants in new, fizzy lemonade and watch them dance up and down as the gas lifts them to the surface, pops, escapes and allows them to drop to the bottom.