REVERSIBLE AND IRREVERSIBLE CHANGES

Key Stage 2
Programme of study: Science
Sc3 Materials and their properties; Changing materials

- 2b: to describe changes that occur when materials are heated or cooled
- 2d: about reversible changes, including melting, boiling, condensing, freezing and evaporating
- 2f: that non-reversible changes result in the formation of new materials that may be useful

Sc3 Materials and their properties; Separating mixtures of materials

- 3b: that some solids dissolve in water to give solutions but some do not
- 3c: how to separate insoluble solids from liquids by filtering
- 3d: how to recover dissolved solids by evaporating the liquid from the solution

QCA scheme of work primary science units

6C: More about dissolving and 6D: Reversible and irreversible changes

This unit brings together and consolidates work that children have done before on reversible changes eg melting, freezing, evaporating, dissolving, condensing, introduces burning as a change that cannot be reversed and, like other irreversible changes, produces new materials.

Review

Review work on reversible and irreversible changes by asking children to construct a concept map using terms eg heating, cooling, dissolving, melting, freezing, solids, evaporating, condensing, burning, change, reversible, irreversible, salt, water, clay, wood, wax, gas, new materials, steam, ice, air. Discuss outcomes with children.
Resources

- range of solids which dissolve and which do not dissolve in water
  *eg sand, salt, talc, flour, chalk, bath salts, baking powder*
- a range of solids which react with water, lemon juice or vinegar
  *eg washing soda, plaster of Paris, cement, bicarbonate of soda*
- real items, or pictures of items, which change when they are heated
  *eg egg, cake mixture, ice, dough, water, chocolate*
- materials which burn *eg wax, twigs, paper, charcoal*
- fire hazard warning labels from furniture

Selection of glass or plastic containers stirrers, jugs, balloon to collect $CO_2$

Candles

Matches

Metal container for burning paper

Charcoal

Sieves

Milk
List of Learning Objectives

Children should learn:

Mixing materials with water

- that mixing materials can cause them to change
- to make careful observations, record and explain these using scientific knowledge and understanding

Filtration and evaporation

- that insoluble materials can be separated by filtering and solids which have dissolved can be recovered by evaporating the liquid from the solution

Making new materials

- that some changes that occur when materials are mixed cannot easily be reversed
- to make careful observations, record these and explain what happened using scientific knowledge and understanding

Heating and cooling materials

- that heating some materials can cause them to change
- that cooling some materials can cause them to change

Burning

- that when materials are burned, new materials are formed
- Hazards of burning
  - that the changes that occur when most materials are burned are not reversible
  - to recognise and assess hazards and risks in burning materials
Mixing Materials with Water

Children should learn:

- that mixing materials can cause them to change
- to make careful observations, record and explain these using scientific knowledge and understanding

Activities:

- Present children with a range of materials eg sand, flour, baking powder, powder paint, salt, plaster of Paris, Andrews salts, ask them to mix each with water, describe and try to explain what has happened. Ask children to group materials into categories eg those which dissolve in water, those which don't dissolve and those where there appears to be a different sort of change. Talk with children about their groupings and introduce the idea of changes which are different from dissolving.

Outcomes:

Use observations of what happens when solids are added to water to group them and justify their groupings
Filtration and Evaporation

Children should learn:

- that insoluble materials can be separated by filtering and solids which have dissolved can be recovered by evaporating the liquid from the solution

Activities:

- Ask children to explain what they would do to separate *eg sand from water* and to recover *eg salt* from the water. Introduce the word 'reversible' to describe the changes that took place when these solids were added to water.

Outcomes:

- describe how a solid which does not dissolve and one which does can be recovered from water
- explain in terms of the size of the particle why different methods have to be used

recognise that these changes are reversible
Making New Materials

Children should learn:

- that some changes that occur when materials are mixed cannot easily be reversed
- to make careful observations, record these and explain what happened using scientific knowledge and understanding

Activities:

- Remind children of the changes that took place when *eg plaster of Paris and water, Andrews salts and water were mixed* and demonstrate some similar changes *eg vinegar and bicarbonate of soda, lemon juice and washing soda, cement and water*. Ask children to observe and describe what happens and suggest whether these changes could be reversed or not. Ask them if they think a new material has been made and their evidence for this *eg bubbles of gas from vinegar and bicarbonate of soda, a hard solid from cement and water*.

Outcomes:

- recognise that when there is vigorous bubbling a gas is being released
- identify some changes as irreversible and explain reasons for doing so
Heating and Cooling Materials

Children should learn:

- that heating some materials can cause them to change
- that cooling some materials can cause them to change

Activities:

- Present children with a series of pictures or objects/materials eg ice, cake mixture, a raw egg, dough, unfired clay, water, chocolate and ask them to describe what happens when they are heated and to classify changes as easily reversible or not. Talk with children about their ideas and ask them to suggest materials that are changed by cooling and to decide whether these changes are mostly reversible or irreversible.

Outcomes:

- describe what happens to some materials when they are cooled eg water, steam and say whether these changes are easily reversed
Burning

Children should learn:

That when materials are burned, new materials are formed

Activities:

- Demonstrate (or show pictures or a video of) what happens when a range of materials eg paper, wax, twigs, tiny pieces of fabric burn. Discuss what is made eg ash and ask children if they think other materials are made which they cannot see. Talk about how they would know if a gas were made when they can't see it. Discuss everyday examples of burning eg natural gas in cookers and fires, bonfires, flares, barbecues.

Outcomes:

- describe what is seen when common materials eg wax, wood, natural gas are burned
- recognise that in each case new materials are made eg ash, gases that cannot be seen
- classify burning as an irreversible change
**Hazards of Burning**

**Children should learn:**

- that the changes that occur when most materials are burned are not reversible
- to recognise and assess hazards and risks in burning materials

**Activities:**

- Discuss safety in relation to burning, and point out that new materials are made which may be harmful. Show hazard labels from *eg fabrics/furniture* and discuss these in relation to safety at home. Ask children to make a poster illustrating some of the hazards of burning things.

**Outcomes:**

Identify hazards associated with burning materials
Teachers notes

Reversible changes

These are physical changes where the original material can easily be recovered. For example dissolving salt in water forms a solution. The salt can be recovered from the solution by evaporating the liquid.

If an ice cube is melted, the water can be frozen back to ice again by lowering the temperature.

Steam from evaporated boiling water will condense back to water when the temperature falls.

Melted chocolate can be hardened again when it is cooled.

In none of these examples has there been any chemical change to the materials.

Irreversible changes

These are mostly chemical reactions where a completely new material is formed so it is not possible to recover the original materials.

For example cooking, heating, burning and mixing some materials.

If vinegar or lemon juice is added to bicarbonate of soda, carbon dioxide gas will be released as bubbles.

In a chemical reaction, the bonds between the particles of the substances are broken and reform in a different arrangement as a new substance.

Sometimes energy is taken in from the materials and there is a decrease in temperature (endothermic reaction). Eg the lemon juice and bicarbonate of soda.
Very often however, there is energy produced as a result of the reaction and an increase in temperature, as in the reaction eg the Plaster of Paris and water. (exothermic reaction).

**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.

Steel rusts because of its iron content. Stainless steel does not because traces of other metals have been added, this prevent 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.

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

**Charcoal** is the blackish residue consisting of impure carbon obtained by removing water and other volatile constituents from animal and vegetation substances. Charcoal is usually produced by the heating of wood, sugar, bone, or other substances in the absence of oxygen.