

YEAR 5 UNIT 2: Material World (Properties and changes of materials)

Enquiry Question: How can materials change?

Related units:

Year 4 Unit 3 States of Matter- What happens to materials if they are heated or cooled?

Year 6 Unit 3: How have things changed over time?

Unit overview

National Curriculum links Year 5: Properties and changes of materials

Children will compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets. Children will know that some materials will dissolve in liquid to form a solution and describe how to recover a substance from a solution. They will use their knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating. They will give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic. They will demonstrate that dissolving, mixing and changes of state are reversible changes and explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda. Children already know about everyday materials and their properties (Y1/2); that materials can be altered by squashing, bending and twisting (Y2); about magnetic material (Y3); about rocks and that they can become soils (Y3) and about temperature and heating cooling and that some materials change state (Y4).

Scientific vocabulary

- rigid
- elastic
- plastic
- flexible
- electrical conductor
- thermal conductor
- solution
- solute
- solvent
- dissolve
- evaporate
- mixture
- soluble
- filter
- reversible/physical change
- irreversible/chemical change
- burning

Working Scientifically

1. Why that material?

Planning different types of enquiries to answer questions, including recognising and controlling variables where necessary.

2. Foamy fun

Planning different types of enquiries to answer questions, including recognising and controlling variables where necessary.

3. Going, going, gone!

Planning different types of enquiries to answer questions, including recognising and controlling variables where necessary.

4. Mix it up

Planning different types of enquiries to answer questions, including recognising and controlling variables where necessary.

5. Signs of change

Recording data and results using a range of scientific equipment reporting and presenting findings, including conclusions, causal relationships.

6. Modern accidental discoveries

To know about the life and work of scientists – (not statutory)

Cross-curricular links

English:

- Write up a fair test using the correct scientific vocabulary
- Write an information text about 'Modern, accidental discoveries'

Maths:

- Calculate averages
- Produce bar charts and record data in tables

Assessment

Assessment:

1. Describe 2 ways in which to separate mixtures
2. Name 1 reversible and 1 irreversible change
3. Explain what dissolving and separation mean
4. Explain the difference between boiling and evaporation

Teacher knowledge

There are many ways to group materials, from their colours to their textures, but there are also standard groupings such as metal and plastic. Standard groupings are based on properties and origins which are not always easy to grasp. Plastics, for example, have a huge range of properties. It's important that children experience how materials behave in their natural state and when changed (e.g. clay or a sheet of newspaper rolled up). This helps them appreciate why things are made from specific materials. The choice of a material for a job is often a compromise. For instance, silver is a better electrical conductor than copper, but it would be too expensive to use in electrical wires. Material chosen depends on the appearance, comfort or cost, or all of these. For instance, wood, steel and plastic are all strong enough to make chairs and can all be manufactured into suitable shapes. Sometimes the properties of materials may be combined to produce a material which ends up with properties of neither of them. For example, copper is a soft metal and zinc is rather brittle, but together they make brass, which is hard and tough.

A mixture contains more than one substance. These are not chemically joined, which means they are easy to separate using their properties, e.g. size, magnetism, solubility. Mixtures can be: gas in solid (e.g. pumice stone), solid in solid (e.g. muesli), solid in gas (e.g. smoke), gas in gas (e.g. air), liquid in gas (e.g. clouds, mist and aerosol), gas in liquid (e.g. fizzy drinks), liquid in liquid (emulsion – e.g. milk), insoluble solid in liquid (suspension – e.g. muddy water), soluble solid in liquid (solution – e.g. salt water).

This unit is mainly about soluble solids. A substance may dissolve in one liquid but not in another. For instance, nail varnish dissolves in acetone but not in water. A solution is usually transparent, even if it's coloured. Things like instant coffee do not really dissolve – instead, small solid particles remain in suspension and the liquid is murky: focus on the 'disappearance' of the solid granules as evidence of dissolving. When a solid is added to water, the water particles surround the solid edges. If the attraction between the water and solid particles, is greater than that between the solid particles then it will dissolve. This process is affected by things like temperature and the amount of solid. There is always a limit as to how much solid can dissolve in a given amount of water.

Materials change and are sometimes valued according to how they change or how they resist change. When materials come into contact they can:

- mix but remain as discrete substances
- interact and dissolve
- interact and make something new.

When materials are heated, they can:

- change from liquid to gas
- change from solid to liquid
- go hard or soft
- change colour or size
- burn or burst into flames.

Reversible (physical) changes do not produce a new substance or change the amount of substance. For instance, something like solid butter may look different from melted butter, but it is still the same chemically. Likewise, if you freeze 100 cm³ of water and then thaw it, you'll still have 100 cm³ of water. These changes are usually changes of state, e.g. solid to liquid or gas to liquid. They are mainly caused by particles changing their spacing. Irreversible (chemical) changes do produce new substances. Although no matter is lost or destroyed, some may become gas and float away. This sort of change is usually permanent and very difficult to reverse. Burning, rusting and chemical reactions are all examples of this. Here, the particles are recombined into different substances. Clues that a chemical reaction has taken place might be:

- a colour change (this can happen with
- physical changes too)
- the production of gas
- the production of light or heat, or a change of temperature.

Did you know?

- Graphene is the thinnest material, but still stronger than Superman.
- Geckskin™ is a super strong adhesive that can hold up to 330 kg on a smooth wall.
- That's the weight of a Harley-Davidson motorbike!
- A thread of spider silk breaks less easily than a thread of steel.
- Pearls will melt in vinegar.
- All materials on Earth are made from just 92 naturally occurring materials.

Misconceptions:

- Children might think that 'material' just means 'fabric'. In fact, a 'science material' means any kind of matter in the world around us.
- Some children might think that 'everyday materials' are single substances. Actually, they can be mixtures or compounds (e.g. brick, glass). Be aware that pupils sometimes compare objects and not properties.
- Also, sometimes children confuse the following properties: Tough and hard – a diamond is very hard, but if hit with a hammer it will shatter because it's brittle. Tough and strong – polythene doesn't break when dropped but is not strong as it's easy to tear apart.
- Children might think that all liquids contain water. In fact, liquids like nail varnish remover and cooking oil are non-polar; water is polar. that dissolving means that the substance has disappeared. If the liquid is evaporated the substance is still there.
- Children might think that melting and dissolving are the same thing. In fact, melting involves one substance and dissolving involves two substances.
- Children might think that rusting is a physical change. In fact, it is a chemical reaction of iron with air and water: rust doesn't conduct electricity.

Resources

Range of useful websites to help you teach your children about materials. resources.woodlands-junior.kent.sch.uk/revision/science/changingmaterials.htm
 Great class clip on changes in the state of materials www.bbc.co.uk/learningzone/clips/changes-in-the-state-of-materials-clip-compilation/2286.html
 Teaching your children about separating mixtures www.tes.co.uk/teaching-resource/Primary-Science-Demonstrations-Separating-Mixtures-6290933
 A great class clip on changes in the state of materials: www.bbc.co.uk/learningzone/clips/changes-in-the-state-of-materials-clip-compilation/2286.html
 *please see note on page 4 concerning YouTube use.