Properties and Changes of Materials

Properties of materials

All objects are made from materials. Different materials have different properties. For example:

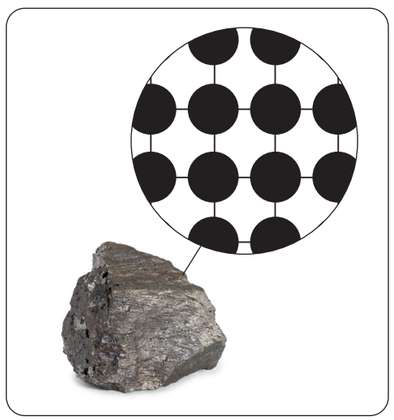
- hard or soft
- stretchy or not stretchy
- rough or smooth
- bendy or not bendy
- opaque or transparent
- waterproof or not waterproof
- absorbent or not absorbent
- strong or not strong
- magnetic or not magnetic
- reflective or non-reflective
- electrically conductive or electrically non-conductive
- thermally conductive or thermally non-conductive
- soluble or insoluble

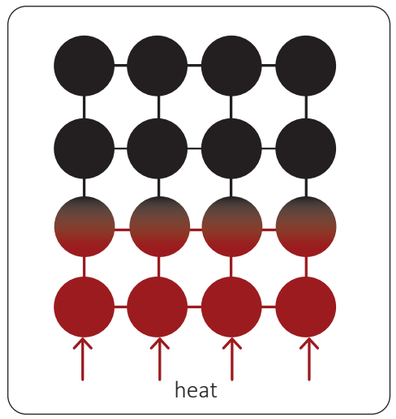
Various tests can be carried out to investigate which properties materials have. A material's properties make it suitable for specific purposes. For example, oil cloth is a waterproof fabric, which makes it suitable to be used as a wipe clean tablecloth.

Thermal conductors

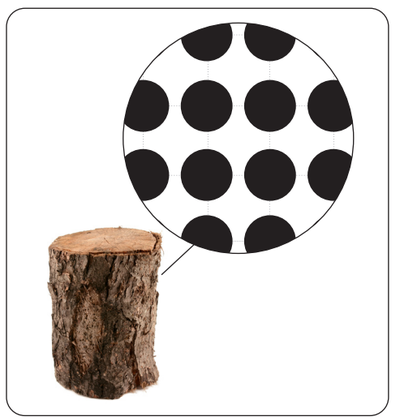
Thermal conductivity is a measure of a material's ability to conduct heat. Materials can be thermally conductive or thermally non-conductive. Thermally conductive materials allow heat to pass through them. Thermally non-conductive materials do not allow heat to pass through them. Whether a material is thermally conductive or thermally non-conductive depends on its state of matter and how its particles are arranged.

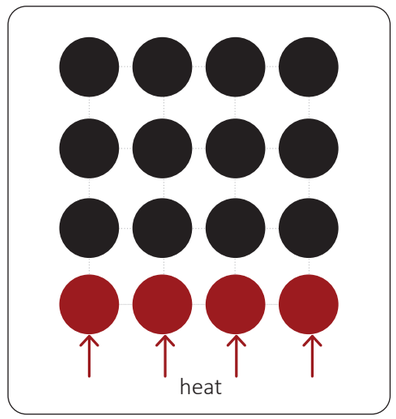
Solid metals are good thermal conductors because their particles are closely packed and they have strong, lattice metallic bonds. When heat is applied to a metal, the particles vibrate and the bonds transfer heat energy to adjacent particles. Other solids, such as plastic, wood and glass, do not have these strong metallic bonds so they do not conduct heat. They are thermal insulators. Liquids and gases are thermally non-conductive because their particles are far apart.





Solid metals are thermal conductors because their strong, metallic lattice bonds transfer heat.



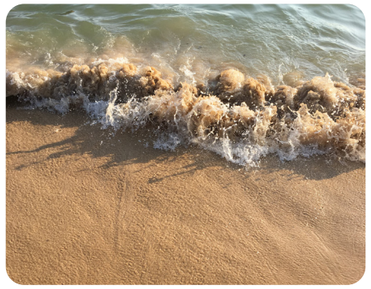


Other solids do not have strong, metallic lattice bonds so they do not conduct heat.

Solubility

Solubility is a measure of a material's ability to dissolve. When a material dissolves it disappears and becomes incorporated into another material. The material that dissolves is called the solute. The material it dissolves into is called the solvent. When the solute has dissolved in the solvent, it is known as a solution. A material that can dissolve is described as soluble. A material that cannot dissolve is described as insoluble.

sugar is soluble in water



sand is insoluble in water

Dissolving can also happen with other states of matter. Air is a mixture of dissolved gases. Carbon dioxide gas is dissolved into liquids to make drinks fizzy.

Mixtures

A mixture is a combination of two or more substances that aren't chemically joined and can be separated into their individual substances. There are two types of mixtures: heterogeneous and homogeneous.

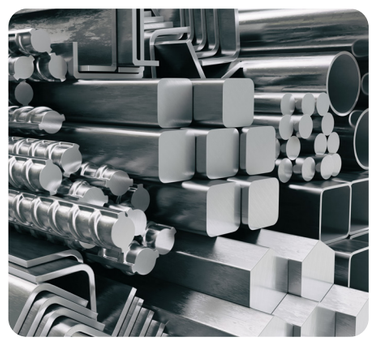
mixture of soil and water

Heterogeneous mixtures

Heterogeneous mixtures consist of distinctly different substances. This means you can easily see the different parts and they are easy to separate. Soil is an example. It is a mixture of solid, decayed organic matter and eroded rock. Salad is an example. It is a mixture of different solid fruits and vegetables.

Homogeneous mixtures

Substances in homogeneous mixtures are evenly distributed and you cannot see the different parts. Homogeneous mixtures are difficult to separate. Coffee is an example. It is a mixture of solid coffee granules dissolved in liquid water. Steel is an example. It is a mixture of iron and carbon.

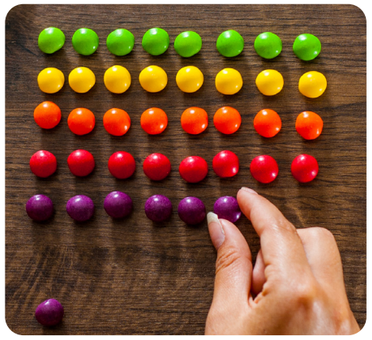


Separating heterogeneous mixtures

Heterogenous mixtures can be separated in different ways, including:

Classifying and grouping

When classifying and grouping, the substances in a mixture are observed and the individual parts are then put into groups by hand. A mixture of sweets can be separated by classifying and grouping.



Sieving

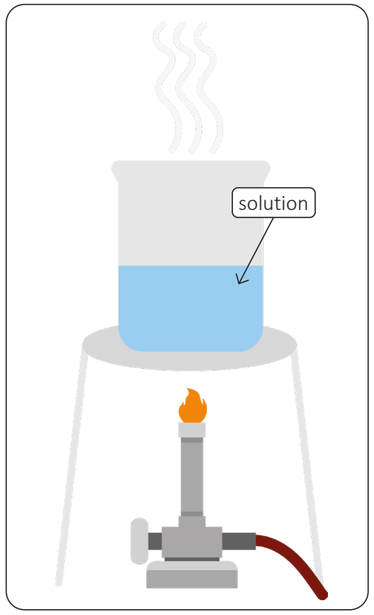
A sieve is a mesh that separates solids from liquids or large solid particles from smaller solid particles. This mixture of oats and milk can be separated by sieving.

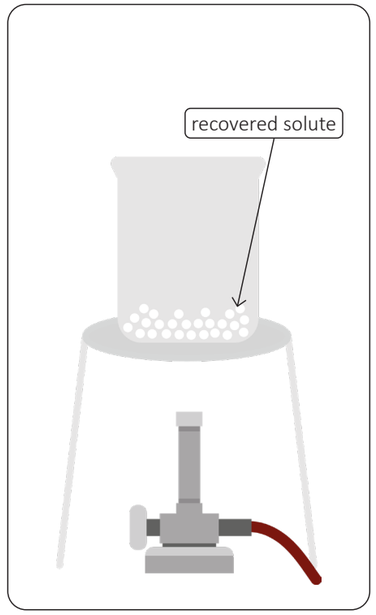
Filtration

Filtration is a way of separating very small solid particles mixed with liquids or gases using a filter. Filters can be made from thin materials, such as filter paper, which contain tiny holes, or from layers of solid materials, such as sand, gravel or charcoal. This mixture of ground coffee beans and water can be separated by filtering.

Separating homogeneous mixtures

Some homogeneous mixtures, such as seawater, can be separated into their different parts by evaporating. Evaporating involves heating a solution until the solvent changes states from a liquid to a gas. When all the solvent has evaporated, the solute is left behind. The solvent is usually lost during evaporation.





Other techniques are used to separate homogeneous mixtures, such as air, metals and oil in water. For example different gases in air can be separated using cooling. The separated gases can then be used in industries, such as hospitals and manufacturing.

Reversible and irreversible changes

There are two types of changes, reversible and irreversible changes.

Reversible changes

Reversible changes can be reversed or changed back to recover the original materials. They are physical changes, which means no new materials are formed, and recovered materials are the same, even if they look or feel different. Reversible changes happen between the three main states of matter: solids, liquids and gases. Melting, freezing, evaporation, condensation and dissolving are all reversible changes.

Irreversible changes

Irreversible changes cannot be reversed or changed back to recover the original materials. They are chemical changes that form new materials. Several processes cause irreversible changes, including cooking, burning, rusting, decaying and chemical reactions. Signs of irreversible changes include the production of a gas, a sound, a smell or light. The temperature, colour and smell can also change.

burning

rusting

decaying

chemical reaction

Glossary

absorbent	To be able to take in or soak up another material.
chemical reaction	A process when two or more materials react together to make new materials.
conduct	Able to let heat or electricity pass through.
filter	A device that removes small solid particles from a liquid or gas, by not permitting the solid particles to pass through.
solute	A dissolved substance, such as salt.
solution	A mixture in which the solute and solvent particles are evenly spread out, such as seawater.
solvent	A substance that dissolves a solute, such as water.