

B1 Investigate materials, and describe them in terms of their physical and chemical properties

B1.1 investigate and describe properties of materials (e.g., investigate and describe the melting point, solubility and conductivity of materials observed)

B1.3 identify conditions under which properties of a material are changed, and critically evaluate if a new substance has been produced

B2.2 observe and describe evidence of chemical change in reactions between familiar materials, by:

- *describing combustion, corrosion and other reactions involving oxygen*
- *observing and inferring evidence of chemical reactions between familiar household materials*

Matter

Matter can be defined as anything that has mass and occupies space. Matter can be identified by its physical and chemical properties. **Physical properties** are easily observable and include characteristics such as melting point, density, colour, and state. **Chemical properties** refer to how the substance reacts with other substances. For example, iron is a reddish solid (physical properties) that reacts with oxygen to form rust (chemical property).

Matter cannot be created or destroyed, but it can undergo change.

Physical changes can be made by altering the following properties of matter:

- State - melting, freezing, boiling, or condensing
- Shape - cutting, breaking, or crushing
- Colour - Dying or painting

A physical change occurs when matter changes its shape or state but retains its physical properties, or identity. For example, freezing water to make ice simply changes the water's form. A change of state is a physical change. A physical change does not change the substance into another material. Ice is another form of water. It is not a new material. Another characteristic of a physical change is that it can be reversed. Ice can melt to form liquid water. It can then be frozen to make ice again. Another example of a physical change is when large pieces of copper are heated and stretched into copper wire. During the change, the copper changes its physical appearance but keeps its identity. The type of matter has not changed, but its shape has.

A chemical change is a change in matter that produces one or more new substances. The new substance has properties that are different from the properties of the starting materials. For example, fire is created when oxygen and wood react in the presence of heat. Ash and smoke are new substances created when wood is burned. It is important to note that a chemical change cannot always be reversed. You cannot take ash from a fire and turn it back into wood.

Another example occurs when you apply heat to a raw egg. The egg cooks. The heat has caused a chemical change, and you cannot uncook the egg.

How can you tell when a chemical change or a chemical reaction has occurred? Scientists look for the following signs, or evidence, of a chemical change:

- A gas is produced.
- A substance disappears
- A solid is formed.
- Heat is given off.
- A smell is produced.

A good example of a chemical reaction is what happens when you take a tablespoon of baking soda and mix it into a cup of vinegar. You will see a lot of bubbles and foam forming. These bubbles and foam are evidence of a chemical reaction. The gas that is produced in the bubbles and foam is called carbon dioxide.

A physical change does not affect the type of matter but it will result in the matter having different physical properties. On the other hand, a chemical change will produce new matter with different characteristics from the original matter.

B1.2 describe and apply different ways of classifying materials based on their composition and properties, including:

- ***distinguishing between pure substances, solutions and mechanical mixtures***
- ***distinguishing between metals and nonmetals [Note: Metalloids may also be introduced at this level but are not required.]***
- ***identifying and applying other methods of classification***

Classifying Matter

Scientists have divided the types of matter into subcategories based on distinct characteristics and properties. Remember that all matter exists as a solid, a liquid, or a gas.

As well, all matter can be classified as a pure substance or a mixture.

There are two types of pure substances: elements and compounds. There are two types of mixtures: heterogeneous and homogeneous.

Heterogeneous mixtures can be further classified into three other types:

- Mechanical Mixtures
- Suspensions
- Colloids (including emulsions)

There is only one type of homogeneous mixture: solutions.

The following flowchart shows how matter is organized and classified.



A **pure substance** cannot be broken down into simpler substances by physical means. A **mixture**, however, can be separated into component parts by physical means, such as filtration. Pure substances are grouped into **elements**, which are substances composed of only one kind of atom, and **compounds**, which are substances composed of two or more elements that are chemically combined. Hydrogen, oxygen, and gold are examples of elements. Water and sugar are examples of compounds. Compounds can only be separated by a chemical reaction.

A common method of classifying matter is by separating it into metals and non-metals. Substances that are classified as metals generally are shiny, malleable, ductile, and electrical conductors. Iron, copper and aluminum are metal. Non-metals are dull, brittle, and do not conduct electricity. Examples of non-metals are oxygen, phosphorous, and sulfur.