Chemistry

Big idea (age 11-14)
CCR: Chemical reactions

What's the big idea?

A big idea in chemistry is that during a chemical reaction, atoms are rearranged resulting in the formation of a new substance or substances.

Topics

The big idea is developed through a series of key concepts at age 11-14, which have been organised into teaching topics as follows:

Topic CCR1
Chemical change
Key concepts:
1.1 Formation of new substance

Topic CCR2
Understanding chemical reactions
Key concepts:
2.1 Reactions in solution
2.2 Combustion

Topic CCR3
Energy and reactions
Key concepts:
3.1 Exothermic and endothermic reactions

Topic CCR4
Acids and alkalis
Key concepts:
4.1 Neutralisation

Topic CCR5
Periodic table
Key concepts:
5.1 Periodic patterns

The numbering gives some guidance about teaching order based on research into effective sequencing of key concepts. However, the teaching order can be tailored for different classes as appropriate.

Guidance notes

As a subject, chemistry often requires an understanding of both macroscopic observations and a sub-microscopic (particulate) model that explains what is being observed. On other occasions an understanding of the substances involved and the reactions taking place is required. For this reason, several chemistry topics consist of key concepts from more than one big idea.

The 'Understanding chemical reactions' topic also includes key concepts from the 'Particles and structure' big idea (topic CPS3) and the 'Acids and alkalis' topic contains key concepts from the 'Substances and properties' big idea (topic CSU3).

The 'Periodic Table' topic spans three big ideas and includes key concepts from topics CSU4 and CPS5.

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Learning progression

The science story associated with the big idea develops from age 5 to age 16, and could be summarised as follows:

Science story at age 5-11

Physical and chemical change

Everyday materials are observed to change. Some materials change state if warmed or cooled. Some materials can dissolve. These are examples of physical changes since the material is still there. It has not changed into a different material.

Some materials burn. The original material is no longer present but another material, such as ash, is observed.

Science story at age 11-14

Chemical change

During a chemical reaction a new substance or substances are formed. This can happen when the atoms of elements react (e.g. oxidation) or compounds split apart (e.g. thermal decomposition).

During a chemical reaction, atoms are rearranged. This is the reason that the products of a reaction have different properties to the reactants.

Understanding chemical reactions

Chemical reactions can take place when substances are in solution.

Observations of chemical reactions can be explained by differences in the properties of the reactants and products. For example:

- A precipitate is created when an insoluble product is formed from soluble reactants.
- A product may have a lower boiling point and therefore be in the gas state.

During a chemical reaction, atoms are rearranged. No atoms are created or destroyed so the mass of the reactants is equal to the mass of the products.

The products of combustion arise from the rearrangement of atoms from both the reactant (e.g. the fuel) and oxygen. During combustion, a substance reacts with oxygen from the air, so the measured mass will increase.

Energy and reactions

During a chemical reaction, energy is conserved. However, the chemical energy store of the reactants may be more or less than that of the reactants. This means that energy can be transferred to and from the surroundings. This is observed as a change in temperature.

Acids and alkalis

Acids and alkalis are solutions commonly used in chemical reactions, including the making of salts. An indicator can be used to identify a solution as an acid or alkali. Universal indicator or a pH meter provide information on the pH of the solution.

Periodic Table

When the elements are listed in order of their atomic number, elements with similar chemical properties recur at periodic intervals. The Periodic Table is structured so that these elements are shown within the same vertical group.

Science story at age 14-16

Rates of reaction

The rate of a chemical reaction is a measure of the rate of formation of a product (or loss of a reactant). Rate of reaction can be affected by a variety of factors including temperature, surface area, concentration, pressure and use of a catalyst.

Dynamic equilibrium

A chemical reaction can be reversible. The system is in a state of dynamic equilibrium when the rate of the forwards and reverse reactions are at the same.

Energetics

Energy input is required to break chemical bonds. Energy is released when chemical bonds are formed. The difference in total bond energy between reactants and products is equal to the energy transferred to or from the surroundings.

Chemical analysis

A series of chemical reactions can be used to identify an unknown inorganic compound.

Titration provides a quantitative method to find out the concentration of an acid or alkali.

Synthesis

Chemical reactions can be used to produce a desired chemical product. For example, polymerisation can be used to create plastics.