MODULE: *Chemical Change*

Intervention Session

Teaching Guide

Introduction

This 1-hour intervention has been designed for students to practice answering TIMSS style assessment items that assess the key ideas that compose the Chemical Change component of the TIMSS framework. It also helps them to practice explaining the key concepts and apply their understanding.

The key ideas are listed below. Firstly give students time to answer questions 1-12, and then go through the answers and explanations where appropriate.

Please note: It is really important that you spend time explaining the answers to the assessment items when you go through them with the students.

Key ideas

- a chemical change or reaction occurs when atoms and molecules of one or more substances (reactants) react to form new substances (products)
- when new substances are formed in a reaction it is very difficult to reverse the reaction
- a chemical substance can be broken down or decomposed by heat or an electric current to form one or more new substances
- chemical changes are different from physical changes
- a physical change involves a change in shape or a change in state (solid, liquid or gas) but no new substance is formed
- chemical and physical changes involve taking in or giving out energy
- a chemical reaction can often be detected by observing changes in appearance; energy changes (temperature, sound or light); colour change; gas production
- a chemical reaction which gives out energy as either heat, light or sound is called an exothermic reaction
- a chemical reaction which absorbs/takes in heat is called an endothermic reaction
- an exothermic reaction is usually accompanied by an increase in temperature when energy is transferred to the reaction mixture and its surroundings, which get hotter
- an endothermic reaction is usually accompanied by a decrease in temperature of the reaction mixture and its surroundings
- a chemiluminescent reaction (as in glowsticks) is an exothermic reaction which gives out energy in the form of light with little or no rise in temperature
- burning is a common oxidation reaction which needs oxygen
- fuels react with oxygen to burn and release energy as heat, light, sound and kinetic energy
- fireworks contain their own oxygen supply and chemical energy stored in the fuel
- oxygen, fuel and heat are three components of the fire triangle – remove any one and the fire can be stopped.

- chemical reactions have many useful technological applications in everyday life such as self-heating drinks and food, chemiluminescence in medicine, emergency lighting, and in fireworks.

Assessment item answers:

1. B
2. D
3. C
4. C
5. A
6. B
7. C
8. C
9. B
10. B
11. The candle in Jar Z will burn the longest because it has a supply of oxygen that will not run out.
12. The candle in Jar R will go out first because it has the smallest supply of oxygen.

Longer Assessment item answers:

1) Physical changes are concerned with energy and states of matter (solids, liquids, gases) and unlike Chemical change, a new substance is not formed. It can usually be reversed. Examples: e.g. breaking egg shells; melting ice, dissolving sugar in tea, etc

   Chemical changes occur when atoms/molecules of one or more substances react to form new substances. They are difficult to reverse. Examples: frying an egg, burning fuel, digesting food, etc

2) Examples of changes observed in a chemical reaction:

   - Change of appearance – products look different to reactants
   - Energy changes e.g. temperature, light, noise
   - Colour change – one or more products have a different colour
   - Gas production – bubbles of gas observed or smell detected

3) Exothermic reactions – transfer energy to the surroundings usually as heat so reaction mixture and surroundings get hotter – increase in temperature recorded
e.g. Magnesium metal burning in air produces magnesium oxide + HEAT;
calcium oxide + water produces calcium hydroxide + HEAT

Endothermic reactions – take in energy from the surroundings usually as heat so reaction mixture and surroundings get colder – decrease in temperature recorded
e.g. breakdown of calcium carbonate by HEAT produces calcium oxide + carbon dioxide;
ethanoic acid + sodium carbonate + HEAT produces sodium ethanoate + water + carbon dioxide

4)

(i) Labelled drawing of Hot-Can

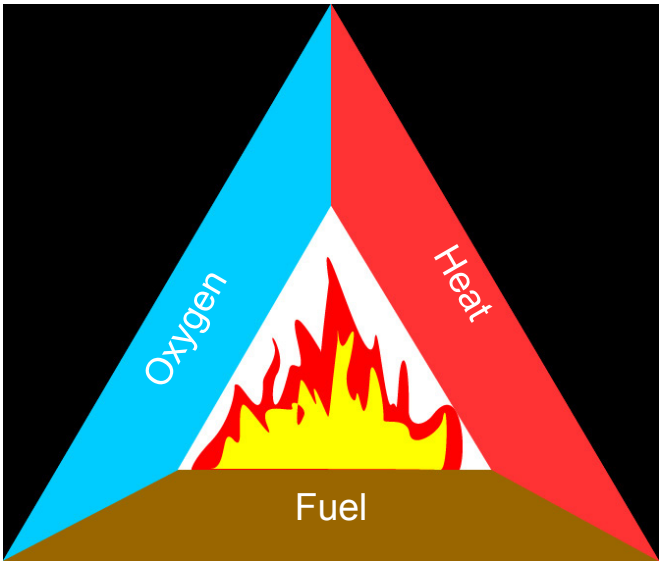
(ii) Calcium oxide + water = calcium hydroxide + HEAT
(iii) Exothermic reaction
(iv) The coffee in the outer section of can is heated by the heat energy produced from the exothermic reaction between calcium oxide and water mixing.

5)

(i) E.g. Magnesium, aluminium, iron or steel powders, carbon, sulphur
(ii) The oxidiser such as potassium nitrate provides the oxygen to enable the fuel to burn
(iii) A burning or oxidation reaction
(iv) Heat, light, sound and kinetic energy is released
(v) Different metal salts (chemicals) are put in the firework which when they burn produce different colours e.g. lithium salts - red; copper salts - blue; sodium salts - gold, etc

6)

(i) Fuel + Oxygen + Heat = FIRE
(ii)



(iii) Removing either the fuel, the oxygen/air and or the heat will stop the fire burning – a fire blanket will stop oxygen/air from getting to the fire; water will reduce flames and heat; fuel where possible can be removed.