Science Age 13-14

BIOLOGY: ORGANISMS, THEIR BEHAVIOUR AND THE ENVIRONMENT

1. Cells and their functions

- know that the nucleus contains genes which control the production of protein in the cell and that genes are made of DNA which determines an organism's characteristics

- learn how to use a microscope to observe plant and animal cells and how to prepare a temporary microscope slide, e.g. using methylene blue as a stain for nuclei. (Know that plant cells contain permanent fluid-filled vacuoles)

- learn about fertilisation in humans and flowering plants as the fusion of a male and female cell

- learn that fertilisation in humans occurs when the head of a sperm (a male cell) enters the ovum (a female cell) and the nuclei fuse together and that fertilisation in flowering plants occurs when a male nucleus in a pollen tube fuses with a nucleus in a female egg cell(ovum) in an ovule.

2. Humans

Respiration

- know that aerobic respiration involves a reaction in cells between oxygen and food, in which glucose is broken down to carbon dioxide and water

- understand the difference between breathing and respiration)

- summarise aerobic respiration in a word equation glucose+oxygen leads to water+carbon dioxide+energy. Test exhaled air for carbon dioxide using limewater

- know that the reactants and products of respiration are transported throughout the body in the bloodstream that oxygen and carbon dioxide are carried in the blood and exchanged with the atmosphere through the lungs

Reproduction

- learn about the physical and emotional changes that take place during adolescence

- learn about the human reproductive system, including the menstrual cycle and fertilisation

- learn how the foetus develops in the uterus, including the role of the placenta (how the foetus is protected and nourished in the uterus and how its waste materials are eliminated)

3. Plants

- learn more about photosynthesis: the global importance of photosynthesis in producing food and maintaining the composition of the atmosphere

- learn about gas production during photosynthesis in, e.g. *Elodea and* how to perform a controlled experiment to show that light is needed for starch production by a potted plant, e.g. *Pelargonium*

- summarise photosynthesis in a word equation using light energy chlorophyll carbon dioxide + water glucose + oxygen. Know that in most plants the glucose is then converted into starch which can be tested, using iodine solution

4. Living things in their environment

- understand how predation and competition for resources affect the size of populations *[e.g. bacteria, growth of vegetation]*

5. Variation and inheritance

Variation
- learn about environmental and inherited causes of variation within a species
- use blood groups as an example of discontinuous variation and height as an example of continuous variation
- learn how to detect and describe variation within and between species and suggest possible causes

Inheritance
- know that selective breeding can lead to new varieties (study one example of selective breeding, such as dogs)

(B) CHEMISTRY: MATERIALS AND THEIR PROPERTIES

1. Classification
- classify elements into **metals and non metals** according to whether they give acidic or basic oxides. Carbon, copper, iron, magnesium, sulphur and zinc are suitable examples for experiments on burning the elements in air and testing the oxides.

2. Elements, compounds and mixtures
- know that elements are shown in the periodic table consist of atoms which can be represented by symbols

- represent compounds by formulae and summarise reactions by word equations
Recognise simple formulae: H_2O, CO_2, O_2, CH_4, NaCl, HCl, NaOH, $CaCO_3$

- use the term **element** as used in chemistry and understand the idea that samples of the same element contain the same type of atom, that the elements are organised in the periodic table

- know the symbols for the elements H, C, O, N, S, Mg, Na, Cl, Ca, Cu, Fe and He and understand that the symbol can represent one atom of that element

3. Separating mixtures
- learn how to separate mixtures into their constituents using:

- *evaporation* to recover a solute and the testing of water purity by measurement of its boiling point and freezing point

- *simple distillation* to recover a solvent from a solution, e.g. obtain a sample of pure water from seawater or washable ink

- *fractional distillation* to recover ethanol (alcohol) from wine or beer

- *paper chromatography* to separate a mixture of two or more coloured solutes from a solution, e.g. coloured inks, food dyes, Smartie-type sweets. Interpret simple chromatograms

- *filtration* to remove insoluble solids from a suspension. Use the terms filtrate and residue and know how to purify rock salt

4. Physical changes

- learn about the variation of **solubility** with temperature, the formation of saturated solutions and the differences in solubility of solutes in different solvents (that when soluble solids form a solution, a chemical change is not involved; know that a solution is a mixture which may be separated using physical techniques

- learn about the abundance of **water** in nature, including its existence as vapour in the air; the water cycle; about the use of anhydrous copper sulphate and anhydrous cobalt chloride to test for the presence of water vapour in the air; the effect of air flow and temperature changes on evaporation from oceans or in laboratory experiments; how to make predictions about the amount of water lost; the need for filtration; the differences between sea, tap and distilled water, demonstrated by evaporation; the importance of water as a solvent.

5. Chemical reactions

- know that virtually all materials, including those in living systems, are made through chemical reactions, and to recognise the importance of chemical change in everyday situations, *[e.g. ripening fruit, setting superglue, cooking food]*

- Copper oxide, zinc oxide and magnesium oxide - previously dried in an oven- may be used to illustrate that some substances do not change chemically when heated

- know that chemical reactions are needed for the extraction of copper, iron and aluminium from their ores

- learn about possible effects of the burning of fossil fuels on the environment *[e.g. production of acid rain, carbon dioxide and solid particles]* and how these effects can be minimised. Know that when things burn in air they react with oxygen

- perform the glowing splint test for oxygen and the limewater test for carbon dioxide

- identify the products of combustion, e.g. of a candle; understand the importance of oxygen as a reactant in respiration, the effect of burning fossil fuels and that air is often polluted by sulphur dioxide and carbon monoxide (and the sources of these pollutants)

6. Metals

- learn about the displacement reactions that take place between metals and solutions of salts or sulphates of other metals

- know how a reactivity series of metals can be determined by considering these reactions, and used to make predictions about other reactions. Use the reactivity series of metals to deduce that those higher in the series might burn more vigorously in air, react faster with water and dilute acids, and replace a lower metal from its oxide

- learn about the uses of metals low down the series, such as lead and copper, for roofing and piping; about the need for methods of covering the surface when the more reactive iron is used and about the exceptional lack of reactivity of silver and gold which makes them useful for jewellery and electrical contacts *Reference should be made to the fact that most metals are not found in their free state and that chemical reactions are necessary to extract metals from their ores.*

7. Acids and bases

- identify patterns in chemical reactions: use the terms oxidation, reduction, neutralisation and decomposition

-learn about the use of carbon to illustrate reduction; about the action of heat on copper and magnesium in air to illustrate oxidation; about the combustion of methane and similar fuels; about hydrated copper sulphate, hydrated cobalt chloride, copper carbonate and potassium

permanganate to illustrate thermal decomposition

(C) PHYSICS: ENERGY, FORCES AND SPACE

1. Force

Force and motion

- know that unbalanced forces change the speed or direction of objects and that balanced forces produce no change in the movement of an object

- understand the concept of constant speed and of speeding up and of slowing down, without a formal definition of acceleration

- learn about the effects of forces on an object, that forces can act in different directions and about experiments and calculations with springs and combinations of springs

Force and rotation

- understand the principle of moments and its application to situations involving one pivot. Use simple quantitative examples involving moments about a single pivot (know that the unit of a moment is a newton metre , or newton centimetre

Force and pressure

- study the quantitative relationship between force, area and pressure and its application *[e.g. the use of skis and snowboards, the effect of sharp blades]*
- use this for simple quantitative work; know that the unit of pressure is N/m2 or N/cm2

2. Density

- study density and its measurement the relationship between density, mass and volume

- use this for simple quantitative work (know that the unit of density is kg/m3 or g/cm3)

- study the measurement of the mass and volume of regularly-shaped solids and of irregularly shaped solids (use the displacement of water to find a volume), and of liquids to calculate their density; know that air has mass and that it is possible to measure its density

3. Conservation of energy

- study ways in which energy can be usefully transferred and stored

- know that energy can exist in many different forms: chemical, electrical, gravitational, kinetic, light, sound, strain (elastic) and thermal (internal)

- study the form in which energy is stored in a particular situation (e.g. a stretched spring stores energy as strain energy)

- describe the energy transformation taking place in simple situations (e.g. a lamp transforming electrical energy into light and thermal energy)

- know that although energy is always conserved, it may be dissipated, reducing its availability as a resource. What is the significance of the Law of Conservation of Energy?