**Teaching syllabus for Forms 1 and 2**

**Form 1**

**Core element** Analytical skills in chemistry

**Outcome** The students will be able to show an understanding of appropriate uses of scientific methods, techniques and materials to solve problems in their daily lives.

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment resources** |
| We will know this when the students are able to:   * demonstrate an understanding of chemistry as a field of study and its applications | Students must be able to:   1. define chemistry 2. describe various branches of chemistry | **Introduction to chemistry** | * brainstorming the meaning of chemistry * discussing the meaning of chemistry * discussing branches of chemistry as   + physical   + environmental   + analytical   + industrial   + Inorganic   + Organic | * field/industrial visits * question and answer * discussions * reading assignments * written exercises * demonstrations * brainstorming * practical work * experimentation * role plays | * + resource persons * various industrial products such as soap, pesticides, * cosmetics and cooking oils * textbooks * newspaper articles * activity sheets * charts * pictures * internet * videos * protective equipment eg goggles, gloves * triple beam balances |

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment resources** |
|  | 1. explain the importance of chemistry in every day life 2. outline careers in chemistry and their importance |  | * discussing applications of chemistry such as water treatment, making a cup of tea, cooking *nsima*, soap making, pharmaceutical, pesticide and food industries * naming areas where chemistry is applied * discussing some careers in chemistry (biochemist, teacher chemist, geochemist, pharmacist, environmental chemist, food chemist, quality control and assurance personnel, photochemist) * discussing their importance in society |  | * digital balances * rulers * thermometers * stop watches * tripod stands * glassware * fire extinguishers |

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment resources** |
|  | 1. observe laboratory safety rules |  | * discussing the role of a laboratory in the study of chemistry * discussing the importance of maintaining cleanliness of the laboratory * discussing general laboratory safety rules * discussing the proper use of protective equipment in the chemistry laboratory eg goggles, eye wash station, safety shower, gloves, lab coats, respirator/gas mask, fume hood and fire extinguisher |  |  |

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment resources** |
|  | 1. relate the hazard symbols to dangers associated with handling laboratory chemicals and equipment 2. describe common units of measurements and their symbols |  | * discussing and interpreting hazard symbols * demonstrating safe ways of handling laboratory chemicals and apparatus * discussing potential hazards associated with laboratory activities such as heating and handling of chemicals and apparatus * listing common units of measurements and their symbols such as mass, length, time, volume and temperature * discussing the importance of units of measurements to the study of chemistry * discussing SI prefixes including micro-, nano-, mega- and giga |  |  |

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment** **resources** |
|  | * + 1. differentiate between basic and derived units of measurement     2. measure some physical quantities using appropriate instruments     3. describe the scientific method of investigation |  | * + converting experimental data from one form of measurement to another   + compare basic and derived units of measurement using specific physical quantities   + graduating scientific instruments   + demonstrating how to measure mass, length, time, temperature and volume   + assigning appropriate SI units   + discussing the steps in a scientific inquiry   + discussing how scientific inquiry leads to formulation of laws and theories |  |  |

**Core element** Analytical skills in chemistry

**Outcome** The students will be able to show an understanding of the appropriate use of scientific methods, techniques and materials to solve problems in their daily lives.

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment resources** |
| We will know this when the students are able to:   * + demonstrate an understanding of different ways of manipulating and presenting experimental data | Students must be able to:   1. write experimental data using standard form and scientific notation 2. present result with appropriate units of measurements | **Essential mathematical skills for chemistry** | * + expressing numbers in standard form and scientific notation   + discussing guidelines for writing significant figures   + expressing the numerical results to the correct number of significant figures   + propagating units and presenting the result with appropriate units of measurements | * + demonstrations   + group discussions   + brainstorming   + written exercises   + question and answer   + tests   + practical work   + experimentations | * textbooks * scientific calculators * charts * pencils * graph paper |

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment** **resources** |
|  | 1. define accuracy and precision 2. present experimental data in a graphical form |  | * + - discussing accuracy and precision     - demonstrating precision and accuracy in measurements     - discussing different types of graphs eg bar graphs, pie charts, line graphs     - plotting graphs from given experimental data     - interpreting graphs (including extrapolation and interpolation) |  |  |

**Core element** Chemical composition of matter

**Outcome** The students will be able to appreciate the composition and properties of various natural and synthetic substances which form their environment.

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment resources** |
| We will know this when the students are able to:   * demonstrate an understanding of the particulate nature of matterand its classification | Students must be able to:   1. define matter 2. explain that matter is made up of atoms 3. give evidence of the particulate nature of matter using the concept of diffusion 4. differentiate between an element and a compound 5. name substances given their chemical formulae or symbols 6. determine the type and number of atoms in the chemical formula of a given substance 7. differentiate between a pure substance and a mixture 8. describe different types of solutions 9. state the factors that affect solubility 10. describe suitable apparatus and method for separation of mixtures | **Composition and classification of matter** | * brainstorming the definition of matter * discussing the three states of matter * investigating the existence of small particles using * bricks for building a house * breaking up some substances until one can no longer break them further * discussing the meaning of atom as the smallest particle of matter * brainstorming the meaning of diffusion * investigating the particulate nature of matter using the concept of diffusion of spread of perfumes and cooking aromas in air; and coffee grains in water as examples * defining an element * discussing and writing chemical symbols of atoms of elements * illustrating the formation of different molecules of substances using diagrams or models * discussing the differences between an element and a compound in terms of atoms presents * identifying substances from the chemical symbols of their atoms * naming substances given their chemical formulae * identifying types of atoms present in a molecule * working out the number of each type of atoms present in a given chemical formula * working out the total number of atoms present in a given chemical formula * brainstorming the meaning of pure substance and mixture * identifying a pure substance and a mixture given different substances * discussing different types of mixtures * homogeneous * heterogeneous * brainstorming the meanings of the terms solutions, solvents and solutes * discussing the meaning of an aqueous solution * explaining different types of solutions * solid in solid * liquid in liquid * solid in liquid * gas in liquid * gas in gas * discussing the difference between saturated and unsaturated solutions * conducting experiments to determine factors which affect solubility * discussing ways of making a saturated solutions unsaturated or vice versa * brainstorming separation techniques at household level * discussing different ways of separating mixtures * conducting experiments on distillation (simple and fractional), filtration, decantation, evaporation and chromatography and magnetism | * + practical work   + written exercises   + demonstration   + question and answer   + observations   + role plays   + reading assignments   + quizzes   + puzzles   + brainstorming   + experimentations   + group discussions   + field visits | * pieces of chalk * paper * water * charts * pencils * potassium permanganate * beakers/ containers * stirrings * rods * textbooks * paraffin * clamped stands * stoppers * perfume * coffee * cooking aromas (spices) * computer simulations * sugar and salt * beans and maize * molecular models * markers * naphthalene * thistle funnel * grease * cooking oil * burner * distillation apparatus * filtration apparatus * centrifuge * bar magnets * chromatograms |

**Core element** Inorganic compounds

**Outcome** The students will be able to appreciate properties of various inorganic substances, their uses in the manufacturing industry and the dangers they pose on the environment.

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| **Assessment standard** | **Success criteria** | **Topic/theme** | **Suggested teaching and learning activities** | **Suggested teaching, learning and**  **assessment methods** | **Suggested teaching, learning and assessment resources** |
| We will know this when the students are able to:   * demonstrate an understanding of the structure and composition of atoms | Students must be able to:   1. describe an atom 2. state the characteristics of the particles that make up an atom 3. describe the arrangement of electrons in shells of an atom 4. use atomic and mass numbers to calculate the number of protons, neutrons or electrons in a given atom 5. explain, with relevant examples, the meaning of an isotope | **Atomic structure** | * discussing the composition of an atom in terms of protons, neutrons and electrons * drawing the structure of an atom * discussing the mass and charge of a proton, neutron and an electron * discussing the location of particles (ie protons, neutrons and electrons) in an atom * discussing the filling in of electrons in shells of an atom * discussing the meaning of electron configuration * discussing the meaning of mass number (A) and atomic number (Z) * interpreting and using nuclide symbols in the form X   A  Z   * working out the number of sub-atomic particles in an atom given relevant information * discussing the meaning of isotopes * writing nuclide symbols of different isotopes * calculating the average mass of an element given masses of its isotopes | * written exercises * question and answer * demonstrations * group work * observations * written reports * role plays * tests * reading assignments | * molecular models * charts * posters * textbooks * activity sheets * periodic table * scientific calculators * mathematical instrument * round coins bottle tops |

**Core element** Inorganic compounds

**Outcome** The students will be able to appreciate properties of various inorganic substances, their uses in the manufacturing industry and the dangers they pose to the environment.

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| **Assessment standard** | **Success criteria** | **Topic/theme** | **Suggested teaching and learning activities** | **Suggested teaching, learning and**  **assessment methods** | **Suggested teaching, learning and assessment resources** |
| We will know this when the students are able to:   * demonstrate an understanding of the periodic table as an arrangement of elements according their characteristic properties | Students must be able to:   1. describe the periodic table 2. relate the electron configuration to periods and groups of the periodic table 3. state the family name of elements in the periodic table | **The periodic table** | * brainstorming the meaning of periodic table * discussing main features of the periodic table: * groups * periods * discussing the general distribution of the elements in the periodic table * metals * non-metals * writing electron configurations of 20 elements from the periodic table * discussing the relationship between number of electrons in the outermost shell (valence electrons) and group number of the element * establishing the relationship between periods and number of shells * discussing special names of some groups like.   + alkali metals   + alkaline earth metals   + halogens   + noble gases |  | * molecular models * charts * posters * textbooks * internet * activity sheets * periodic tables * scientific calculators * mathematical instruments * computer simulations * round coins/ bottle tops |

**Core element** Chemical reactions

**Outcome** Thestudents will be able to demonstrate an understanding of reaction dynamics and chemical energetics essential for the advancement of the chemical and manufacturing industry.

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment resources** |
| We will know this when the students are able to:   * demonstrate an understanding of physical and chemical changes and the law of conservation of matter | Students must be able to:   1. explain the difference between physical and chemical changes 2. define chemical reaction 3. express a chemical reaction in form of an equation 4. determine masses of reactants and products in a chemical reaction 5. work out the percentage composition by mass of elements in a compound | **Physical and chemical changes** | * investigating the changes that take place during * the heating and cooling of candle wax * the burning of wood and paper * the dissolving of sugar in water * discussing properties of physical and chemical changes * brainstorming the meaning of a chemical reaction * demonstrating examples of chemical reactions such as burning of magnesium ribbon in air and reacting sodium metal with water * discussing the reactants and products of a chemical reaction * expressing simple chemical reactions using word and chemical equations * balancing simple chemical equations * calculating formula masses of given substances in a balanced chemical equation * comparing masses of reactants to those of product(s) * discussing the law of conservation of matter * calculating the percentage by mass of a particular element in a given compound | * practical work * demonstration * experimentation * group discussion * brainstorming * written exercises * question and answer * reading assignments * observations * tests | * candle wax * matches * pieces of wood * molecular models * paper * posters * activity sheets * burners * magnesium ribbons * sodium metal * water * charts * glass ware * textbooks * sugar * computer simulations * periodic table * scientific calculators * internet |

**Core element** Organic chemistry

**Outcome** The students will be able to demonstrate creative use of knowledge and skills on the composition and reactivity of organic compounds for safe and efficient utilization of resources around them.

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment resources** |
| We will know this when the students are able to:   * demonstrate an understanding of organic compounds as sources of fuels | Students must be able to:   1. define organic compounds 2. describe the use of organic compounds as fuels 3. describe the composition of petroleum 4. state the uses of fractions of petroleum | **Organic compounds** | * brainstorming the definition of organic compound * discussing the historical background to the current understanding of organic compounds * discussing natural sources of organic compounds (plants, animals and fossils) * naming different substances used as fuels in homes * discussing uses of organic compounds as fuels * bio fuels (biogas, ethanol, and biodiesel) * fossil fuels (coal, petroleum, and natural gas) * discussing the composition of petroleum as a mixture of organic compounds (hydrocarbons) * discussing separation of petroleum into useful fractions by fractional distillation * discussing uses of fractions of petroleum * petrol * diesel * bitumen * paraffin * lubricants | * question and answer * written exercises * reading assignments * written reports * brainstorming * tests * field trips * demonstration * group discussion | * pictures * charts * activity sheets * textbooks * petroleum jelly * paraffin * coal * crude oil * diesel * grease * fractional distillation apparatus * methylated spirits |

**Form 2**

**Core element** Inorganic compounds

**Outcome** The **s**tudents will be able to appreciate properties of various inorganic substances, their uses in the manufacturing industry and the dangers they pose on the environment.

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment resources** |
| We will know this when the students are able to:   * demonstrate an understanding of properties and uses of elements in the periodic table | Students must be able to:   1. describe the patterns in properties of elements in the periodic table 2. state uses of group I, II, VII and VIII elements in the periodic table | **Elements and the periodic table** | * identifying blocks of elements in the periodic table (metals, metalloids and non-metals) * discussing the trends in the periodic table in terms of: * radii of atoms * ionisation energy * electron affinity * eletronegativity * discussing, using specific examples, the patterns in physical and chemical properties of elements in group I, II, VII and VIII * discussing the uses of elements of group I, II, VII and VIII * listing products that uses the elements | * written exercises * question and answer * group discussion * reading assignments * observations * demonstration * experimentation * tests * brainstorming | * charts * pictures * posters * toothpaste * text books * molecular models * activity sheets * students’ experiences * water * sodium |

**Core element** Chemical composition of matter

**Outcome** The students will be able to appreciate the composition and properties of various natural and synthetic substances which form their environment.

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment resources** |
| We will know this when the students are able to:   * demonstrate an understanding of how atoms chemically combine to form new substances | Students must be able to:   1. define a chemical bond 2. name the three types of chemical bonds 3. describe ionic bonding 4. describe covalent bonding 5. draw cross and dot structures showing ionic and covalent bonding 6. describe metallic bonding | **Chemical bonding** | * defining a chemical bond as combination of atoms to attain stability * illustrating bonding using molecular models * stating the three types of bonds as ionic, covalent and metallic * explaining the formation of ions by losing/gaining electrons to obtain an inert character * discussing the formation of ionic bonds between metals and non metals using NaCl, MgCl2, and CaO as examples * writing formulae for ionic compounds from given symbols and ionic charges * discussing the formation of covalent bonds between non-metallic elements using H2, Cl2, O2, N2, H2O and CO2 as examples * writing formulae for simple covalent compounds using valencies * writing cross and dot diagrams to illustrate bonding for:   + ionic compounds eg NaCl, CaO, and MgCl2   + diatomic molecules eg H2, and Cl2   + compound molecules eg H2O, NH3 and CH4 * explaining bonding in metals resulting from electrostatic attraction between positive ions and delocalised electrons | * role play * group discussion * brainstorming * written exercises * demonstration * question and answer * practical work * observation * experimentation | * textbooks * internet * activity sheets * computers * molecular models * bottle tops of different colours * charts * posters * mathematical instruments * common salt (NaCl) * magnesium oxide (MgO), * calcium chloride (CaCl2) |

**Core element** Chemical reactions

**Outcome** The students will be able to demonstrate an understanding of aspects of reaction dynamics and chemical energetics essential for the advancement of the chemical and manufacturing industry.

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment resources** |
| We will know this when the students are able to:   * demonstrate an understanding of the basic concepts of acids and bases and how they are applied in real life situations | Students must be able to:   1. describe the properties of acids and bases 2. prepare acid –base indicators from local materials 3. determine the strength of an acid and a base using universal indicator and pH scale 4. describe the uses of acids and bases 5. describe neutralization reaction 6. explain the applications of neutralization reaction | **Acids and bases** | * investigating the properties of acids and bases * tasting given samples of food stuffs * corrosion * conductivity * changing colour of indicators * reaction with metals * preparing different acid-base indicators from selected leaves and flowers * tomatoes leaves * hibiscus flowers * acacia leaves * discussing how a universal indicator chart is used to determine the pH value of an acid or a base * distinguishing acids and bases using universal indicator and noting their strength * comparing strength of acids of the same concentration by reacting with Magnesium ribbon * discussing the uses of * acids * bases * brainstorming neutralization reaction * conducting experiments to show neutralization reaction * discussing applications of neutralization reaction eg * drinking of milk by people with ulcers * taking of anti-acid * such as milk of magnesia and sodium bicarbonate (soda) * addition of lime to acidic soils * insect bite neutralisation * use of tooth paste for mouth cleaning | * experimentations * demonstrations * group discussions * brainstorming * written exercises * question and answer * practical work * tests * reading assignments * observations | * citrus fruits * tamarind *(bwemba)* * *malambe* * conductivity apparatuses * litmus paper * litmus solution * universal indicator and pH charts * Sodium bicarbonate (soda) * water * mortars * pestles * strainers/sieves * phenolphthalein indicator * textbooks * sulphuric acid * hydrochloric acid * magnesium ribbon * *chidulo* * sodium chloride * aluminium foil * sodium hydroxide * lime * tomato leaves * hibiscus flowers * acacia leaves |

**Core element** Organic chemistry

**Outcome** The students will be able to demonstrate creative use of knowledge and skills on the composition and reactivity of organic compounds for safe and efficient utilization of resources around them.

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment resources** |
| We will know this when the students are able to:   * demonstrate an understanding of the sources, properties and uses of hydrocarbons | Students must be able to:   1. classify organic compounds 2. name and draw the formulae of alkanes and alkenes up to ten carbon atoms 3. write the molecular and condensed formulae of alkanes and alkenes given the number of carbon atoms 4. explain sources of alkanes and alkenes 5. describe physical properties of alkanes and alkenes 6. describe combustion of alkanes and alkenes 7. describe substitution reactions of alkanes 8. describe the addition reactions of alkenes 9. state the uses of alkanes and alkenes | **Hydrocarbons** | * discussing families of organic compounds (hydrocarbons and oxycarbons) * discussing the two homologous series of hydrocarbons (alkanes and alkenes) * naming alkanes and alkenes containing up to ten carbon atoms * drawing structural and skeletal formulae of alkanes and alkenes * discussing the difference between saturated and unsaturated hydrocarbons * writing the molecular and condensed formulae of alkanes and alkenes * deducing the general formulae of alkanes and alkenes * discussing how to use the general formulae to come up with a molecular formula of any alkane or alkene given the number of carbons * discussing sources of alkanes and alkenes * fossil fuels (fractional distillation of petroleum) * cracking of long-chain alkanes * natural gas * investigating the physical properties of alkanes and alkenes * solubility in water * melting points and boiling points * density * viscosity * electrical conductivity * discussing types of combustion * writing balanced equations for the combustion * investigating the combustion of alkanes and alkenes of different chain sizes * discussing the meaning of substitution reaction * discussing the reaction of methane with bromine and chlorine in the presence of heat and ultra-violet light * discussing the following addition reactions of alkenes: * bromination * catalytic hydrogenation * hydration * discussing the uses of alkanes and alkenes * alkenes (fruit ripening, flower maturation, seed germination, production of alkanols, polymer synthesis) * alkanes (fuels for automobiles, lubricants, surfacing roads, heating , lighting, storage of reactive metals) | * question and answer * written exercises * reading assignments * written reports * brainstorming * demonstrations * experimentation * tests * field trips * **g**roup discussions * **o**bservations * role plays | * pictures * charts * posters * activity sheets * textbooks * candles * paraffin * gas burners * petroleum jelly * bromine solution * distilled water * glassware * internet * molecular models * cyclohexene * cooking oil * computer simulations * **c**onductivity apparatus |

**Core element** Environmental chemistry

**Outcome** The students will be able to demonstrate an understanding of the applications of chemistry in solving real life problems and the potential harmful effects of chemicals and chemical processes on the environment and human health.

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment resources** |
| We will know this when students are able to:   * demonstrate an understanding of the important gases in air and the effects of air pollution on human health and the environment | Students must be able to:   1. describe the composition of gases present in dry air 2. state the uses of the gases present in dry air 3. describe the importance of oxygen 4. describe common atmospheric pollutants and their sources 5. explain the effects of pollutants on human health and the environment | **Air** | * discussing the major components of dry air and their percentage composition * explaining how the components of dry air can be separated by fractional distillation * discussing the uses of nitrogen, carbon dioxide and the noble gases * discussing the physical properties of oxygen * discussing the chemical properties of oxygen * reaction with metals and non metals * test for oxygen * discussing uses of oxygen * naming some common pollutants (eg CO, CH4, NO2, SO2, O3, NO, and unburned hydrocarbon) * discussing sources of common indoor and outdoor air pollutants * discussing the reactions of the common atmospheric pollutants * describing effects of pollutants on health and the environment | * written exercises * written reports * observations * demonstrations * field trips * group discussion * reading assignments * experiments * brainstorming * question and answer * tests | * computer simulations * resource persons * videos * charts * textbooks * activity sheets * pictures * posters * internet * MBS brochures/booklets * World Health Organisation * (WHO) booklets * WHO website * MBS website |

**Core element** Environmental chemistry

**Outcome** The students will be able to demonstrate an understanding of the applications of chemistry in solving real life problems and the potential harmful effects of chemicals and chemical processes on the environment and human health.

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| **Assessment standard** | **Success criteria** | **Theme/topic** | **Suggested teaching and learning activities** | **Suggested teaching, learning and assessment methods** | **Suggested teaching, learning and assessment resources** |
| We will know this when the students are able to:   * demonstrate an understanding of composition, properties and pollution of soil | Students must be able to:   1. describe the components of soil 2. describe the chemical properties of soil 3. describe sources of soil pollutants and their effects 4. explain ways of preventing soil pollution | **Soil** | * discussing the composition of soil (air, water, organic and inorganic matter) * discussing chemical properties of soil (ion exchange capacity, soil pH, salinity, organic matter) and their importance * discussing the importance of controlling acidity of soil * defining soil pollution * discussing sources of soil pollutants and their effects * discussing ways of preventing soil pollution | * question and answer * written exercises * tests * group discussions * demonstrations * experimentations * observations * written reports * role plays * reading assignment | * activity sheet * textbooks * charts * chemicals and reagents * glassware * plastic containers * scientific calculators * samples of soil * balances * pH meters * computer simulations * conductivity apparatuses * protective wear |