Integrated Science Curriculum and Assessment Guide (Secondary 4-6)

Notes for Teachers

Introduction

This document provides supplementary notes for each of the Compulsory Modules and Elective Modules of the Integrated Science (S4-6) Curriculum for teachers' reference. It aims to enhance teachers' understanding and interpretation of the curriculum. This document is the result of a number of discussion sessions of the following committees:

- Working Group on the Review of Integrated Science (S4-6) Curriculum and Assessment
- CDC-HKEAA Committee on Integrated Science (Senior Secondary)

The supplementary notes provided for each of the modules are by no means exhaustive nor do they define the scope of learning and teaching at classroom level. Teachers are suggested to make reference to these supplementary notes alongside with the *Integrated Science Curriculum and Assessment Guide (Secondary 4-6)* published in 2007 by the Curriculum Development Council and the Hong Kong Examinations and Assessment Authority.

General Notes

(1) The supplementary notes for each of the modules present a list of learning outcomes to be achieved by students in the domain of knowledge content of the curriculum. They provide a broad framework upon which learning and teaching activities can be developed. The supplementary notes are also intended to help elaborate the knowledge content of individual modules given in the Guide, hence facilitating the understanding of the breadth and depth of the curriculum. It is suggested that teachers should read the supplementary notes in parallel with the curriculum framework of respective modules in the Guide.

(2) The learning experience of students should include but not confine to the development of science concepts and ideas covered in the supplementary notes. Activities should be arranged to help students develop an understanding of the nature of science and unifying concepts embedded in the modules, as well as to let students appreciate the interrelationship between science, technology, society & the environment and develop the relevant values and attitudes for their personal development and for contributing towards a scientific & technological world. In this connection, teachers are encouraged to refer to the 'Module highlights' in the last part of each module in the Guide for an elaboration on how these elements are manifested in the module.

Module C1 Water for Living

Section	Topics	Notes **Students should be able to:**
1.1	**The unique properties of water**	• use the concept of form and function to explain various properties of water • explain the formation of intermolecular forces in water by the shape and polarity of water molecules • explain the solvent action of water with respect to the polar nature of water molecules and their ability to form hydrogen bond [link to C4] • describe the dissociation of water and recognise its qualitative relationship with the pH value of a solution • recognise that water exists naturally in all three states and that the three states of water are interchangeable • describe what happens to water when it is heated to boil and cooled to freeze at molecular level • explain the floating of ice on water in terms of the arrangements of water molecules in ice and in water, and the densities of water at different temperatures • understand the meaning of specific heat capacity, specific latent heat of vaporisation and specific latent heat of fusion of water, and solve problems related to them • explain phenomena related to the high surface tension of water in terms of the intermolecular forces between water molecules
1.2	**Importance of water to living organisms and biological evolution**	• explain the movement of water molecules across selectively permeable membrane by osmosis using the concept of water potential • describe the roles of water in biochemical reactions, transporting materials, facilitating gas exchange, providing support and regulating body temperature in organisms, and relate them to the properties of water • recognise the importance of ice floating on water to the survival of aquatic life under icy surface • appreciate that there is evidence for and against the claim that 'Life begins in water' • describe the structure-function relationship related to the adaptations in terrestrial animals and plants that enable them to cope with life on land
1.3	**Importance of water to the physical environment**	• recognise the different processes in the water cycle • recognise the conservation of matter in the water cycle while water changes from one physical state to another • describe the influence of water on climate in terms of the relative specific heat capacities of land and water

Section	Topics	Notes **Students should be able to:**
		• recognise the contribution of water vapour to the natural greenhouse effect which helps maintain the temperature of the Earth within a suitable range for life to exist
1.4	**Effects of human activities on the balance of water distribution and water quality**	• recognise the sources of water supply in Hong Kong and the processes in ensuring clean water supply • recognise the agricultural, industrial and domestic uses of water • recognise the impact of the release of substances in domestic sewage on water systems [Link to C6] • describe the causes and effects of some water problems (drought, desertification, soil erosion, flooding) in China • develop an awareness of the impact of the uneven global water distribution on personal health and a country's development • state the measures being taken on water management in China • state the measures to conserve water resources

Module C2 Balance within Our Body

Section	Topics	Notes **Students should be able to:**
2.1	**Homeostasis**	• recognise that homeostasis is an internal system to control change and equilibrium • understand the concept of homeostasis in terms of negative feedback mechanism and its significance in maintaining a constant internal environment • describe the roles of the components of a homeostatic control system, including receptors, coordinators and effectors
2.2	**Regulation of body temperature**	• understand the importance of body temperature regulation • recognise the nature, the role and the importance of enzymes as biological catalysts in metabolism • describe the action of enzymes and explain the effect of temperature on enzyme activity • understand the roles of different body parts in balancing heat loss and heat gain and the negative feedback mechanism involved • recognise heat stroke and hypothermia as consequences of failing to keep core temperature within tolerance range
2.3	**Regulation of blood glucose level**	• understand the importance of regulation of blood glucose level • understand how insulin and glucagon regulate the blood glucose level and the negative feedback mechanism involved • recognise that a diabetic person fails to regulate her/his blood glucose at a constant level • recognise the symptoms and the risk factors of diabetes • distinguish between type I and type II diabetes
2.4	**Coordinating systems in humans**	• recognise the functioning of the coordinating systems in terms of stimulus, receptor, coordinator, effector and response • understand the nature of hormonal coordination and that of nervous coordination • realise that a neurone consists of a cell body and nerve fibre • realise that there are three types of neurones: sensory neurone, motor neurone and interneurone • show an awareness that the nervous system consists of the central nervous system and the peripheral nervous system

Section	Topics	Notes **Students should be able to:**
		• describe the functions of different parts of the central nervous system in relation to coordination: cerebrum, cerebellum, hypothalamus, medulla, spinal cord • appreciate the role of the autonomic nervous system in the regulation of body temperature • compare and contrast hormonal coordination and nervous coordination
2.5	**Nervous coordination and mental health**	• recognise that the nerve impulse is transmitted along a nerve fibre • describe the events that occur in the nervous transmission across a synapse • understand that an imbalance of neurotransmitter production or impairment of neurotransmitter reception may lead to mental illnesses • understand the roles of psychiatric drugs through adjusting neurotransmitter levels or acting on neuro-receptors • recognise the ways that people use to manipulate the nervous coordination pathway, e.g. taking caffeine, drinking alcohol and doing exercise to induce endorphin secretion, and the effects of such manipulation

Module C3 Science in a Sprint

Section	Topics	Notes **Students should be able to:**
3.1	**Forces and sprinting**	• understand that forces can be resolved into components and can be added to give a resultant force • understand Newton's 3rd Law using the context of a crouch start with the use of starting block • understand Newton's 2nd Law as illustrated by how the sprinter accelerates • realise that the wobbling of centre of mass, frictional force and wind speed would affect the maintenance of speed in sprinting • understand Newton's 1st law (the concept of inertia) using the context of the motion of a sprinter after he/she breaks the tape • apply Newton's Laws of Motion to solve problems (limited to linear horizontal motion in one direction only)
3.2	**Analysing a sprint**	• appreciate that video-motion analysis software can be used to retrieve data for analysing the motion of a sprinter • interpret the meaning of slopes of *s*-*t* and *v*-*t* graphs and area under *v*-*t* graph • determine the average speed of a sprinter from the relevant graphs • apply the equations of uniformly accelerated motion to solve problems (limited to linear horizontal motion in one direction only) • realise how time lag in the reception of the starting signal would affect the sprinters in a race • realise how time lag in the reception of the starting signal by timekeepers and their reaction time would affect the accuracy of time measurement in a sprinting event • distinguish between systematic and random errors • identify sources of errors in the time measurement of a sprinting event • draw a best straight line for a linear relationship in a graph • realise the use of advanced technology to reduce errors in time measurement
3.3	**Impulse and impact force**	• realise that the magnitude of momentum is given by *mass* × *speed* • realise that impulse is equal to the change of momentum • interpret impact force as the rate of change of momentum • explain how impact force can be reduced by lengthening the impact time, as illustrated by the use of polypads

Section	Topics	Notes Students should be able to:
		at the finishing line in a 60 metre race for stopping • realise that a sprinter jumps immediately before impacting with the polypads to help reduce his/her speed (changing some of the kinetic energy to potential energy) • apply the concept of impulse and impact force to solve problems (limited to linear horizontal completely inelastic collision)
3.4	**Efficient movement in sprinting**	• understand the roles of skeleton, skeletal muscles, tendons, ligaments and joints in movement • recognise the structure of a typical movable joint • identify hinge joints and ball-and-socket joints and compare their degrees of movement • recognise that the movements are brought about by the lever system formed by skeletal muscles, joints and bones • describe the movement of limbs brought about by the action of opposing muscle pairs • relate the muscle size and fibre content of slow twitch fibre and fast twitch fibre to muscle performance
3.5	**Energy production for sprinting**	• understand ATP as a carrier of energy in our body • understand how the three energy systems (ATP/PC system, lactic acid system, aerobic system) work to produce ATP in skeletal muscles • recognise the relative contribution of the three energy systems in different sports • understand how anaerobic respiration leads to lactic acid accumulation in skeletal muscles and the importance of repayment of oxygen debt • recognise the roles of different energy systems in sprinting
3.6	**Enhancing performance**	• describe how training (for increasing aerobic capacity and reducing reaction time) helps improve sport performance • recognise that sportswear is designed for offering better protection and for enhancing performance in different sports • describe how some drugs (e.g. AAS, stimulants and creatine) help enhance performance and their side effects

Module C4 Chemical Patterns

Section	Topics	Notes Students should be able to:
4.1	**Elements in order**	• appreciate that there are different hypotheses on the nature of matter in different cultures • appreciate that alchemists are the pioneers of experimentation • appreciate the work of Mendeleev and his predecessors in the development of the empirical periodic table • recognise the periodic table as an organiser resulting from pattern seeking and logical thinking to organise our understanding of elements
4.2	**The periodic table**	• understand the basic features of the periodic table • identify the trends in physical properties (e.g. boiling point, melting point, atomic size and electronegativity) of elements within Groups I, VII and O • identify the trends of reactivity of Group I metals (in terms of reaction with water) • identify the trends of reactivity of Group VII elements (in terms of bleaching property) • predict the properties of unfamiliar elements based on trends revealed in the periodic table • compare the reactivity between Group I & Group II metals
4.3	**Looking into an atom**	• appreciate the development of the atomic model (a conceptual model) through systematic observations and much imagination (e.g. Rutherford's experiment) • realise the evidence in support of the atomic model • describe the basic structure of an atom in terms of protons, neutrons and electrons
4.4	**Atomic number and the modern periodic table**	• understand what is meant by atomic number and mass number • understand what isotopes are • perform calculations involving relative atomic masses and the natural abundance of various isotopes • deduce the electronic arrangement of atoms and ions from atomic numbers and successive ionisation energies, and draw the corresponding electron diagrams • identify the relationship between the position of elements in the periodic table and their electronic arrangements • relate the electronic arrangement to the chemical properties of the elements in Groups I, VII and O

Section	Topics	Notes Students should be able to:
4.5	**Electrolysis and the ionic theory**	• recognise electrolysis as the decomposition of substances by electricity • understand that electrolysis provides evidence for the presence of ions • distinguish between cations and anions • understand that some metals can be obtained from their compounds by electrolysis • write half equations to describe the reactions occurred at cathode and anode during electrolysis of some molten simple ionic compounds
4.6	**Chemical bonding and structure**	• realise the tendency of atoms to achieve stability by attaining the electronic arrangement of the nearest noble gas (octet rule) • predict the formation of ionic and covalent substances and write their chemical formulae • draw electron diagrams of ionic and simple molecular substances • write balanced chemical equations for the formation of ionic and covalent compounds • understand the bonding, structure and general properties of metals, ionic substances (e.g. NaCl), simple molecular substances (e.g. H_2O, O_2, CO_2) and giant covalent substances (e.g. diamond and graphite) • distinguish different intermolecular forces: van der Waals' forces, dipole-dipole attractions and hydrogen bonds

Module C5 Electrical Enlightenment

Section	Topics	Notes Students should be able to:
5.1	**Volta and the chemical cell**	• appreciate Volta's discovery of producing electric current from chemical reactions • recognise the basic structure of a simple chemical cell and understand how it works (limited to cells with a pair of metal electrodes only) • describe the reactions that occur at the electrodes in simple chemical cells using half equations • recognise redox reactions as the basic principle of chemical cells • recognise the working principles and implications of fuel cells
5.2	**The development of electrolysis**	• appreciate the first decomposition of water by electricity in 1800 • recognise the products of electrolysis of water formed at the electrodes • understand how electrolysis can be applied in extracting reactive metals, purifying metals and electroplating
5.3	**The work of Oersted and Ampere**	• appreciate Oersted's discovery of the magnetic effect of a current • appreciate Ampere's investigation of the magnetic fields produced by current-carrying wires, as well as his invention of solenoid • realise how the pattern, direction and the strength of magnetic fields are represented by magnetic field lines • apply right hand grip rule to find the direction of the magnetic field of current-carrying straight wire and solenoid • recognise the factors affecting the magnitude of the magnetic field of an electromagnet
5.4	**Ohm's contribution to current electricity**	• appreciate Ohm's contribution to the understanding of the relationship among voltage, current and resistance • recognise the factors affecting the resistance of metal wires • determine the equivalent resistance of resistors in series and in parallel • apply Ohm's Law to solve problems involving resistance • identify circuit components in a simple circuit and draw simple circuit diagrams • measure voltage and current using voltmeters and ammeters respectively • determine resistance from a linear *V*-*I* graph • understand the working principle of a variable resistor (rheostat) and its use in controlling current in a circuit

Section	Topics	Notes **Students should be able to:**
5.5	**The great experimenter: Faraday**	• appreciate Faraday's discovery of electromagnetic rotation • apply Fleming's left hand rule to find the direction of the magnetic force acting on a current-carrying wire in a magnetic field • understand the turning effect of a current-carrying coil in a magnetic field • understand the working principle of a simple d.c. motor • recognise other applications of magnetic force (e.g. moving-coil loudspeaker) • appreciate Faraday's discovery of electromagnetic induction • recognise the factors affecting the magnitude of induced voltage • apply Fleming's right hand rule to find the direction of induced current in a simple a.c. generator • recognise other applications of electromagnetic induction (e.g. microphone)
5.6	**Joule and the consumption of electricity**	• appreciate Joule's discovery of energy conservation in electrical circuits and the establishment of Joule's Law • apply the equation *Electrical Energy* = I^2Rt to solve problems (limited to the consumption of electrical energy by circuit components due to their resistance) • realise the reasons behind the quest for high temperature superconductors and their potential applications
5.7	**Domestic electricity**	• distinguish the direction of direct current (d.c.) and alternating current (a.c.) • recognise the functions of live, neutral and earth wires in the mains circuit • understand the proper connection of household wiring and the functions of ring circuits • realise the safe use of electricity • understand how overloaded circuits and short circuits may lead to danger • understand how fuses and circuit breakers work to prevent fire due to electrical faults

Module C6 Balance in Nature

Section	Topics	Notes Students should be able to:
6.1	**The Earth as a system**	• appreciate that the Earth is a single big system comprising different spheres interacting with each other • appreciate that the Gaia hypothesis provides a conceptual model for viewing the Earth as a single system in which all things are interconnected
6.2	**Energy flow in the ecosphere**	• recognise that the ultimate source of energy of the ecosphere is from the Sun and the ecosphere is an open system in terms of energy flow • describe the 2-stage process of photosynthesis (chemical equation is not required) and understand how different factors affect photosynthesis • understand the one-way energy flow in the ecosphere as shown in food chains and food webs • understand that energy transfer between trophic levels is inefficient as shown in ecological pyramids (including pyramid of energy, pyramid of biomass, and pyramid of number) • recognise the meaning of biological productivity • appreciate that the first and second laws of thermodynamics explain the transfer of energy
6.3	**Cycling of materials in the ecosphere**	• recognise that matter exists in different chemical forms when cycling among different spheres of the Earth • understand the ecosphere as a closed system within which matter is conserved via biogeochemical cycling • describe the cycling of materials in the carbon cycle and in the nitrogen cycle • understand the role of decomposers in the cycling of materials
6.4	**Disturbances and restoration**	• realise that Nature as a complex and balanced system and that ecological succession as a natural restoration and recovery of damaged lands • understand the concept of ecological succession in a natural habitat (e.g. hillsides affected by fire) • discuss the effects of human activities on the ecosystems (algal bloom due to chemical fertilisers and domestic sewage, bioaccumulation of heavy metals, global warming due to the overuse of fossil fuels and deforestation, reduction in biodiversity due to human activities) • recognise some possible ways of artificial restoration of disturbed ecosystem (e.g. artificial reef and reforestation) and the costs involved

Section	Topics	Notes **Students should be able to:**
6.5	**The hunt for balance**	• understand the importance of resource management in balancing the demand and supply of natural resources (e.g. minerals, forest and energy) • discuss the different ways of environmental protection (e.g. pollution control at the source, integrated waste management) • discuss the importance of balancing economic development and ecological sustainability

Module C7 Radiation and Us

Section	Topics	Notes Students should be able to:
7.1	**The electromagnetic spectrum**	• state the components of the electromagnetic (EM) spectrum (γ-rays, X-rays, ultraviolet, visible light, infrared, microwaves and radio waves) and recognise their general properties • recognise the approximate wavelength ranges of γ-rays, X-rays, ultraviolet, visible light, infrared, microwaves and radio waves • realise the wave nature of EM radiation (e.g. interference) • recognise that EM radiation can be represented by rays, waves and photons • describe waves in terms of waveform, crest, trough, amplitude, period, frequency, wavelength and wave speed • recognise the relationship between frequency, wavelength and wave speed • apply the equation $c = f\lambda$ to solve problems involving EM radiation
7.2	**EM radiation as a carrier of energy**	• realise that EM radiation delivers energy in 'packets' called photons and the photon energy (E) is given by the equation $E = hf$ • recognise that the energy of a beam of EM radiation is given by number of photons $\times$ energy per photon • understand how the intensity of radiation varies with the distance from its source • describe how radiation of a particular frequency is produced by the transition of electrons between different energy levels as illustrated by the flame test • understand the phenomena of reflection, absorption and transmission of EM radiation • describe the applications of UV radiation (e.g. sterilisation and material identification) and recognise the risks of UV radiation (e.g. sun burns, air pollution caused by photochemical smog) • discuss the benefits and risks of using EM radiation in everyday life
7.3	**Ionising radiations**	• realise that high energy EM radiation (e.g. high frequency UV, X-rays and γ-rays) can ionise atoms • describe the nature of nuclear radiations (α, β and γ radiations) and recognise that they originate from unstable nuclei • recognise how α, β and γ radiations can be detected • compare the penetrating power, range in air and ionising power of α, β and γ radiations

Section	Topics	Notes **Students should be able to:**
		• recognise that eV is commonly used as a unit of energy in describing EM radiation and nuclear radiations
7.4	**The decay, half-life and uses of radioisotopes**	• realise the random nature of radioactive decay • understand that unstable radioisotopes decay to form stable substances through a decay series • understand the meaning of half-life and determine the half-life of a radioactive substance from its decay-curve • recognise some uses of radioisotopes in industrial field, medical field and dating • determine an appropriate source for a specific application with reference to penetrating power, ionising power and half-life • compare the effects of α, β and γ radiations on humans • realise the existence and the origins of background radiation • apply the ALARA (as low as reasonably achievable) principle in making decision related to the use of radiation • recognise sievert (Sv) as a unit in measuring radiation dose • describe ways to ensure safe use of radiation (e.g. safe operational procedure, protective clothing, screen and special badge for monitoring radiation dosage) • perform risk-benefit assessment on the diagnostic and therapeutic uses of radioisotopes
7.5	**Nuclear energy**	• recognise nuclear fission and fusion reactions • realise the applications of fission (nuclear reactor and atomic bomb) • realise the relationship between mass (m) and energy (E) in nuclear reactions as given by the equation $E = mc^2$ • recognise the safety measures related to the structures in a nuclear power plant including control rods in the nuclear reactor, cooling systems with water as coolant and shielding • realise the impact of nuclear waste on the environment and the importance of its proper disposal

Module C8 From Genes to Life

Section	Topics	Notes Students should be able to:
8.1	**Genetic information flow that controls life phenomena**	• understand the relationship between chromosomes, DNA and genes • recognise that genes are the tools to maintain continuity as well as to allow changes and evolution in living organisms • realise DNA replication as a process of genetic information transmission • describe the process of DNA replication, including complementary base-pairing and the role of enzyme • understand that transcription and translation are involved in the expression of genetic information to control life phenomena • describe the process of transcription and translation, including how genetic code can be converted into protein
8.2	**DNA as the genetic material**	• appreciate the work of scientists in the discovery of DNA as the genetic material (in particular the work of Avery) and in building the hypothesis of the double helical structure of DNA • understand the structural features of DNA which enable it to serve as a carrier of genetic information • understand the principles of Mendel's Laws of Inheritance and apply them to solve genetic problems involving monohybrid and dihybrid inheritance, including the use of Punnett square • understand the significance of mitosis and meiosis • recognise that meiosis and the chromosomal theory provide the physical basis of Mendel's Laws
8.3	**Genetic basis of biodiversity, evolution and genetic diseases**	• state the factors contributing to variations between individuals within a species • recognise the genetic basis of variation and its relationship with the claim of evolution by natural selection • outline the mechanism of evolution by natural selection • understand how mutations can lead to genetic diseases (e.g. sickle-cell anemia due to gene mutation, Down syndrome due to an extra chromosome) • recognise that mutation can be induced or enhanced by mutagens and it also occurs spontaneously in Nature
8.4	**Applications of DNA technology**	• outline the basic principle and describe the process of recombinant DNA technology • recognise some applications of recombinant DNA technology (e.g. production of insulin, gene therapy, production of genetically-modified crops)

Section	Topics	Notes **Students should be able to:**
		• realise DNA fingerprinting as a generalised term to describe the methods of identifying individuals based on his/her DNA patterns • recognise how DNA patterns are used in forensic science, parentage testing and diagnosis of genetic diseases • outline the principle of organism cloning and appreciate its potential use • recognise the impact of Human Genome Project on our society • recognise the potential benefits, risks and ethical issues of DNA technology

Module E1 Energy, Weather and Air Quality

Section	Topics	Notes Students should be able to:
1.1	**Solar energy and the Earth's atmosphere**	• recognise the composition of the atmosphere • recognise the influence of water vapour, carbon dioxide and ozone on weather • realise that incoming solar energy is the major driving force behind various weather phenomena • describe the process of heat transfer by means of conduction, convection and radiation • understand the balancing act of the atmosphere in terms of the absorption, reflection and scattering of radiation by the atmosphere and the Earth's surface • describe the roles of water vapour, carbon dioxide and infrared radiation in the atmospheric greenhouse effect • relate the stability of air in the troposphere and the stratosphere to the temperature profiles of these layers
1.2	**The weather machine**	• understand that weather can be described by major atmospheric parameters: temperature, pressure and humidity • relate the thermal characteristics of land and sea with their specific heat capacities • explain the seasonal and diurnal variation of temperature • recognise that scientists use air parcel as a model in studying the convection of air • describe the temperature-volume relationship of an air parcel on heating and cooling • describe how the pressure of an air parcel changes when it expands and when it contracts • relate the vertical variation of atmospheric pressure to gravity • relate wind speed to pressure gradient • determine wind direction with reference to pressure gradient and the Coriolis effect • understand the meaning of relative humidity and describe the formation of clouds and precipitation
1.3	**Hong Kong's weather patterns and weather forecasting**	• appreciate that scientists investigate, describe and explain weather phenomena in terms of systems (e.g. the atmosphere, a cyclone) • understand the formation of monsoon, land-sea breeze, cold front, trough and cyclone, and their effects on weather (e.g. temperature, wind speed and direction, pressure, and precipitation) • recognise the structure of a cyclone and the weather in different parts (eye, rain band and subsidence)

Section	Topics	Notes **Students should be able to:**
		• extract information about direction and strength of wind from weather maps • identify some weather systems (monsoon, cold front, trough and cyclone) on weather maps • appreciate how scientists make weather forecast through mathematical modelling based on known relationships between wind speed and direction, temperature, pressure and humidity • realise the limitations of weather forecasting
1.4	**Air pollution in Hong Kong**	• recognise the Air Quality Health Index (AQHI) as a numerical indicator of air quality and its health implications for the general public • state the air pollutants used in the calculation of AQHI [sulphur dioxide, nitrogen dioxide, ozone, respirable suspended particulates (RSP)] • state some other common air pollutants which pose important environmental and health issues [e.g. carbon monoxide, volatile organic compounds (VOCs) and dioxins] • state the sources and describe the formation of some common air pollutants and their effects on health and the environment
1.5	**Transportation and stagnation of air pollutants**	• describe how some weather factors (wind, rainfall, intensity of sunlight and temperature inversion) affect the transportation and stagnation of air pollutants • relate the seasonal air quality pattern in Hong Kong to its position in the Pearl River Delta and weather phenomena (monsoon and land-sea breeze) • describe how typhoon and rainfall affect the air quality in Hong Kong • understand how the topography and urbanisation affect the air quality in Hong Kong
1.6	**Energy use and air quality**	• recognise that while the use of fossil fuels can drive the economy of Hong Kong, it inevitably produces pollutants that threaten the public health • describe some measures for reducing air pollution, such as energy saving and enhancing energy efficiency, clean production of energy and control of emission, and the conduct of environmental impact assessment in town planning and regional zoning

Module E2 Keeping Ourselves Healthy

Section	Topics	Notes Students should be able to:
2.1	**Health**	• understand the meaning of 'health' • discuss the factors affecting personal health
2.2	**Diseases**	• distinguish between infectious and non-infectious diseases • appreciate the different approaches to understanding diseases: clinical, pathological and epidemiological • use the 2x2 table as an epidemiological tool to determine the risk factors of diseases
2.3	**Infectious diseases**	• recognise that the germ theory contributed to the understanding of infectious diseases • realise the evidence supporting the germ theory of diseases • state the major types of pathogens (viruses, bacteria and fungi) that cause infectious diseases • understand the different modes of transmission of infectious diseases (including water or food borne, air borne, blood borne, vector borne, and direct contact) • relate the prevention and control of infectious diseases to the cause and mode of disease transmission with reference to the chain of infection • explain the development of antibiotic resistance in bacteria resulting from the indiscriminate use of antibiotics and the consequences of it
2.4	**Non-infectious diseases**	• outline the roles of epidemiological studies in the understanding of non-infectious diseases • understand the processes involved in epidemiological studies • understand what cancer and cardiovascular diseases are and recognise how we can reduce the risks of developing these diseases by changing our diet and lifestyle • realise that there are different treatments for major cancer types in Hong Kong • understand what degenerative diseases are, using osteoporosis as an example, and how we can reduce the risks of developing the disease by changing our diet and lifestyle • understand what genetic diseases are and recognise the importance of different screening tests (e.g. prenatal screening, neonatal screening and genetic counselling)

Section	Topics	Notes Students should be able to:
2.5	**Body defence against pathogens**	• describe how the non-specific defence mechanisms in the body offer protection against pathogens • describe specific immunity: the role of B cells and the production of antibodies in response to antigens; the actions of antibodies; the role and action of T cells; the importance of memory cells • understand the principle of vaccination • develop an awareness of the pros and cons of vaccination
2.6	**Government's role in public health**	• develop an awareness of the public services on disease prevention and control, as well as the public facilities on improving environmental hygiene • develop an awareness of the role of government in promoting personal hygiene and healthy lifestyles • understand the role of government in promoting public health (e.g. vaccination programme)

Module E3 Chemistry for World Needs

Section	Topics	Notes **Students should be able to:**
3.1	**From Laboratory to Industry**	• understand how the rate of a chemical reaction can be measured • explain how different factors (surface area of solid reactants, reaction temperature, concentration of reactants, and pressure of gas reactants) affect the rate of a chemical reaction using collision theory • understand the basic working principle of catalysts • understand the concept of dynamic equilibrium of a reversible reaction • explain how different factors (concentration change, temperature change, pressure change, and presence of catalyst) affect the equilibrium position of a reversible reaction, and hence the product yield • state the factors to consider in scaling up a chemical production
3.2	**Chemicals for personal, household and public hygiene**	Detergent • realise that soap is produced from oils (or fats) and alkali • describe how detergent serves as a wetting agent and an emulsifying agent • relate the molecular structures of soap and soapless detergents to their cleansing properties • state the limitation of soap in terms of the formation of scum in hard water • realise the use of additives in detergent • describe the environmental problems associated with the use of detergents Chlorine and chlorine bleach • recognise the importance of chlorination in water treatment and the use of chlorine bleach in public hygiene • describe the production of chlorine gas by electrolysis of brine • describe the production of chlorine bleach from chlorine gas • understand the appropriate and safe use of chlorine bleach for household cleaning • state the limitations of the use of chlorine and chlorine bleach for disinfection in terms of its toxic and irritating nature
3.3	**Chemicals for agriculture**	Solving the nitrogen problem for enhancing plant growth • state the sources of nitrogen for healthy plant growth • appreciate that natural fertiliser and synthetic fertiliser help replenish nutrients in the soil

Section	Topics	Notes **Students should be able to:**
		• describe the process involved in the production of ammonia in the Haber Process • explain how different factors affect the product yield in Haber Process • describe the environmental problems caused by the excessive use of synthetic fertilisers Solving the pest problem • appreciate that pesticides are developed to protect crops from pests • discuss the pros and cons of using pesticides, using DDT and organophosphate as examples • state the qualities of an ideal pesticide for sustainable agriculture
3.4	**Man-made polymers fit for different purposes**	• recognise polymers as large molecules made up of the same repeating unit • recognise that monomers can be produced from petroleum refining process • distinguish between addition polymerisation and condensation polymerisation • relate the structure of polymers to their properties (e.g. thermal and mechanical properties) • describe different ways for modifying the properties of polymers • discuss the environmental issues related to the use of plastics • state the responsible ways of using plastics • appreciate the development and applications of degradable plastics