Science scope and sequence chart: Grades 10 to 12 Foundation

	Grade 10	Grade 11	Grade 12
SCIENTIFIC ENQUIRY			
Methods of scientific investigation	• Identification of a focused research question with predictions related to it • Selection of appropriate equipment and materials for the investigation • Identifying and controlling variables • Working constructively and adaptively with others • Evaluating experimental design, identifying weaknesses and developing realistic strategies for improvement • Working in an ethical manner with regard to acknowledging data sources and authenticity of results and with regard to living things and the environment • Making critical use of secondary information	As Grade 10	As Grade 10
Know how scientists work	• Historical development of major scientific ideas • Dissemination of scientific ideas • Balancing the opportunities offered by science with the environmental threats	• Historical development of major scientific ideas • Handling scientific controversies; scientific value of controversy around competing models	• Historical development of major scientific ideas • Influence on science of its economic, social cultural, moral and spiritual contexts • Power and limitations of science in addressing industrial, social and environmental questions
Processing and communicating information	• Presenting and processing raw data appropriately • Drawing valid conclusions, allowing for errors and uncertainties • Communicating results and conclusions	As Grade 10	As Grade 10
Handling equipment and making measurements	• Handling equipment competently with due regard for safety of self and others • Following instructions accurately while adapting to unforeseen circumstances	As Grade 10	As Grade 10

	Grade 10	Grade 11	Grade 12
BIOLOGY			
Biological molecules	• Chemical constituents of carbohydrates, lipids and proteins • Monosaccharides as monomers of other carbohydrates • Amino acids as monomers of proteins • Structure of starch, cellulose and proteins • Structure of glucose, amino acids, glycerol and fatty acids • Composition of triglycerides and phospholipids • Primary, secondary and tertiary structure of proteins • Relationships between structure and function and size and properties of biological molecules • Identification tests for proteins, sugars and starch • Separation and identification of compounds by chromatography and electrophoresis		
Cellular structures and processes	• Structure and ultrastructure of prokaryotic and eukaryotic cells • Cell organelles (nucleus, mitochondrion, chloroplast, endoplasmic reticulum, ribosome) and their functions • Use of electron microscope and ultracentrifuge in study of cellular structures	• Structure and role of mitochondria in respiration • Fluid mosaic model of cell membrane in relation to function • Diffusion, osmosis and active transport	• Structure and role of chloroplasts in photosynthesis
Biological energetics	• Enzymes as proteins and biological catalysts • Importance of enzymes in lowering activation energies • Enzyme–substrate complex action of enzymes • Competitive and non-competitive enzyme inhibition • Effects of change in temperature, pH, substrate concentration on enzyme action • Mechanism of enzyme action in terms of their structure	• ATP as the immediate supply of energy for biological processes • Basic stages in biochemistry of aerobic respiration (glycolysis, Krebs cycle, oxidative phosphorylation) • Role of ATP in respiration	• Leaf structure in relation to photosynthesis • Limiting factors for photosynthesis • Basic stages in biochemistry of photosynthesis (light dependent reaction, light independent reaction) • Role of ATP in photosynthesis

	Grade 10	Grade 11	Grade 12
Transport systems		• Need for a transport system in multicellular animals • External and internal structure of human heart in relation to function • Human cardiac cycle • Initiation and regulation of human heart beat • Human blood system as a double closed circulation system • Major blood vessels in humans • Structure of arteries, veins and capillaries • Red blood cells as carriers of oxygen	• Need for a transport system in multicellular plants • Structure, function and distribution of phloem and xylem in roots, stems and leaves of dicotyledonous plants • Translocation • Movement of water between plant cells and between cells and their environment in terms of water potential • Transpiration
Control, coordination and homeostasis			• Organisms increase their chances of survival by responding to changes in their environment • Similarities and differences between hormonal and nervous systems • Homeostasis • Principles of negative feedback • Process of thermoregulation in mammals • Role of LH and FSH, oestrogen and progesterone in the mammalian oestrous cycle
Human health and disease	• Categories of disease and illness • Endemic, epidemic and pandemic diseases • Balanced diet • Energy and nutrient requirements • Consequences of malnutrition • Anorexia and obesity • Coronary heart disease • Diabetes	• Gaseous exchange system • Tidal volume and lung capacity • Effects of smoking and disease on gaseous exchange and cardiovascular systems • Bronchitis, emphysema, asthma and lung cancer • Blood pressure • Pulse rate and exercise	• Causes, transmission, control and significance of HIV/AIDS • Production of antibodies by the body and their mechanism of action against antigens

	Grade 10	Grade 11	Grade 12
Biological basis of inheritance	• Structure and replication of DNA • Roles of DNA, mRNA and tRNA in protein synthesis • DNA as genetic code controlling sequence of amino acids in polypeptides • Changes in base sequence of DNA can change the amino acid sequence of a polypeptide and consequent function of a protein • DNA as vehicle of inheritance • Chromosomes as carriers of DNA • Structure and function of chromosomes • Diploid and haploid numbers • Sexual reproduction as a mechanism of passing genetic material from one generation to the next • How male and female gametes differ in size, number and motility	• Homologous chromosomes • Stages of mitosis • Mitosis as a mechanism to enable a constant number of chromosomes to be passed from cell to cell • Stages of meiosis • Meiosis as mechanism to enable a constant number of chromosomes to be passed from generation to generation • Genes and alleles as sections of DNA • Changes in structure of DNA as a source of genetic variation • Causes of mutation • Mutation as a change in DNA • Mutations can reduce the efficiency of or block enzyme action	• Random assortment and crossing over creates genetic variation • Genetic basis of sex determination in humans • Sex linkage • Dominant and recessive alleles • Monohybrid crosses
Diversity, selection and evolution	• Causes of variation within populations • Continuous and discontinuous variation	• Species are classified into groups with shared features • The kingdom, phylum, class, order, family, genus, species classification system • Key features of the five kingdoms and of the major phyla of animals and plants	• Evolution over a long period of time has given rise to the diversity of living organisms • Species are adapted to survive in particular environmental conditions • Predation, disease and competition result in differential survival and reproduction • Organisms with a selective advantage are more likely to survive and pass on genes to next generation • Natural selection and isolation can lead to new species
Ecological relationships	• Relationship of pyramids of numbers, biomass and energy to food chains and webs • Energy flow through ecosystems	• Interactions between organisms can cause changes in the size of population • Inter- and intra-specific competition for food and space, predation and disease limit the size of populations • Ecosystems are dynamic and subject to change • Impact of human activities on the environment	

	Grade 10	Grade 11	Grade 12
Microbiology and biotechnology	• Role of micro-organisms in recycling • Carbon cycle • Nitrogen cycle • Mutualistic relationships in nitrogen fixation	• Features of viruses, bacteria and fungi • Culture techniques for micro-organisms and cells	• Genetic engineering • Moral and ethical issues of genetic engineering • Use of micro-organisms in food production • Treatment of waste water
CHEMISTRY			
Matter	• Atomic structure • Relative atomic and molecular mass • Isotopes • Ionic, covalent and metallic bonding • Ionic and covalent giant structures • Bonding and physical properties • Write balanced molecular and ionic equations • Main characteristics of the three states of matter • Ceramics and composites		• Induced dipole intermolecular forces • Hydrogen bonding • Dative bonding • Relationship between physical properties and bond types • Calculations of reacting quantities using the mole concept, molarity and molar volume • Empirical and molecular formulae calculations
Industrial processes	• Purification techniques • Properties and uses of the main gases of the air • Fractionation of liquid air • Fractionation of petroleum • Hardness of water • Distillation of water • Electrolysis of electrolytes, both molten and in solution, and commercial applications • Manufacture of steel, copper, aluminium • Environmental issues related to chemical production • Recycling	• Haber process for making ammonia, its oxidation to nitric acid and manufacture of fertilisers • Sulfur and the contact process for making sulfuric acid • Limestone and its products; cement	

	Grade 10	Grade 11	Grade 12
Patterns in chemical reactivity	• Periodicity in physical properties • Trends in chemical properties across the third period • Trends down groups I, II, VII and VIII • Common characteristics of transition metals • Strong and weak acids and alkalis, pH • Neutralisation, indicators, salts, buffer solutions	• Metal reactivity series • Alloys, their properties and uses • Oxidation and reduction in terms of oxygen transfer and in terms of electron transfer • Relating cell potentials to metal reactivity series • Environmental issues related to rechargeable cells	• Chemistry of oxygen and sulfur • Chemistry of nitrogen, including ammonia and its compounds • Chemistry of carbon and silicon • Chemistry of the transition metals
Environmental chemistry	• Carbon, nitrogen and water cycles • Pollution from the combustion of hydrocarbons • Atmospheric warming and climate change • Measures to reduce atmospheric pollution • Purification of water • Water pollution, eutrophication • Disposal of waste heat in industrial complexes		
Reaction kinetics and energetics	• Conditions affecting reaction rate • Explanation of kinetics in terms of kinetic particle model • Catalysis • Bimolecular reaction in terms of particle collisions and energy • Reversible reactions and dynamic equilibria	• Exothermic and endothermic changes • Activation energy and energy profiles • Effect of a catalyst on the activation energy • Energy considerations associated with bond breaking and making	
Organic chemistry		• Nomenclature, structure, bonding and shape • Alkanes and alkenes • Sources of organic compounds • Aliphatic electrophilic and nucleophilic addition and substitution reactions • Alcohols, halogen compounds, aldehydes and ketones, carboxylic acids and derivatives	• Arenes, phenol and bromobenzene; comparison with aliphatic compounds
Macromolecules			• Addition and condensation polymerisation reactions • Fats and oils, unsaturation, soap • Natural polymers: proteins, cellulose and nucleic acids

	Grade 10	Grade 11	Grade 12
PHYSICS			
Measurement	• SI units • Standard form • Precision and accuracy • Simplifying assumptions in problem solving • Vectors and scalars		
Mechanics and kinematics	• Displacement, speed, velocity and acceleration, equations of motion • Effects of forces • Dynamic and static friction	• Newton's laws of motion and their application • Gravitational and inertial mass, weight • Conservation of momentum • Centre of gravity • Principle of moments and its applications	• Potential and kinetic energy • Work, energy and power
Matter and energy	• Kinetic particle theory of matter • Properties of solids and liquids, expansion, deformation and surface tension • Anomalous expansion of water • Pressure and density, floating and sinking	• Heat and temperature • Transmission of heat by conduction, convection and radiation • Ocean and atmospheric convection currents and weather • Specific heat capacity and specific latent heat	
Waves and oscillations, light and optics, sound	• Waves as a way of transmitting energy; longitudinal and transverse waves • Wave frequency, wavelength, velocity, period, displacement, amplitude and phase • Determination of velocity of sound and its dependence on the medium • The ear and limits of hearing	• Reflection, refraction and dispersion of light and their consequences and applications • Mirrors and lenses and their applications • Total internal reflection and its applications • The eye and sight correction	• Reflection, refraction, superposition, interference and diffraction of waves • Electromagnetic spectrum • Diffraction and interference of electromagnetic waves
Electricity and magnetism	• Conductors, semiconductors and insulators • Charging by friction, rules of electrostatics • Electric force fields • Making magnets; properties of magnets; rules of magnetism • Magnetic fields • Magnetic flux patterns due to a wire, a coil and a solenoid, and their many applications	• Use of $Q = It$, $V = W/Q$ and $V = IR$ • Resistors in series and parallel • Voltage, e.m.f. and internal resistance • Use of different kinds of resistors as potential dividers • Function and use of capacitors • The transistor • Logic gates • Bistable and astable switching and memory	• Electromagnetic induction; factors affecting induced e.m.f., • AC generation • Transformers and AC transmission

	Grade 10	Grade 11	Grade 12
Quantum and nuclear physics			• Nuclear atom and subatomic particles • Radioactive decay, half-life, properties of α-, β-and γ-radiation • Background radiation • Radioisotopes and some of their uses • Nuclear fission and fusion: occurrence and uses • Properties of the electron and applications of electron beams