Cambridge IGCSE Coordinated Science (2023-2024)

EP Curriculum Map

Biology

B1 Characteristics of living organisms

B1.1 Characteristics of living organisms

Specific Expectations	Lessons
B1.1.1 Describe the characteristics of living organisms by defining the terms: – movement as an acti...	1. Characteristics of Living Organisms
B1.1.2 Define the terms: – movement as an action by an organism or part of an organism causing a cha...	

B2 Cells

B2.1 Cell structure

Specific Expectations	Lessons
B2.1.1 State that living organisms are made of cells	1. Cell structure 2. Specialised Plant Cells 3. Specialised Animal Cells 4. Using a Microscope and Magnification
B2.1.2 Describe and compare the structure of a plant cell with an animal cell, as seen under a li...	
B2.1.3 State the functions of the structures seen under the light microscope in the plant cell an...	
B2.1.4 Relate the structure of the following to their functions: – ciliated cells – movement of m...	
B2.1.5 Calculate magnification and size of biological specimens using millimetres as units	

B2.2 Movement in and out of cells

Specific Expectations	Lessons
B2.2.1 Define diffusion as the net movement of particles from a region of their higher concentrat...	1. Passive Transport - Diffusion 2. Passive Transport: Osmosis
B2.2.2 Investigate the factors that influence diffusion, limited to	

surface area, temperature, co...	
B2.2.3 State that substances move into and out of cells by diffusion through the cell membrane	
B2.2.4 State that water diffuses through partially permeable membranes by osmosis	
B2.2.5 State that water moves in and out of cells by osmosis through the cell membrane	
B2.2.6 Define osmosis as the net movement of water molecules from a region of higher water potent...	
B2.2.7 Investigate and describe the effects on plant tissues of immersing them in solutions of di...	
B2.2.8 Explain the effects on plant tissues of immersing them in solutions of different concentra...	
B2.2.9 Explain the importance of water potential and osmosis in the uptake of water by plants	
B2.2.10 Explain the importance of water potential and osmosis on animal cells and tissues	

B3 Biological molecules

B3.1 Biological molecules

Specific Expectations	Lessons
B3.1.1 List the chemical elements that make up: – carbohydrates – fats – proteins	B3.1 Biological Molecules
B3.1.2 State that large molecules are made from smaller molecules, limited to: – starch and glyco...	
B3.1.3 Describe the use of: – iodine solution to test for starch – Benedict's solution to test fo...	
B3.1.4 State that water is important as a solvent	

B4 Enzymes

B4.1 Enzymes

Specific Expectations	Lessons
B4.1.1 Define enzymes as proteins that function as biological catalysts	1. Enzyme Structure and Uses 2. Factors Affecting Enzymes
B4.1.2 Explain enzyme action with reference to the complementary shape of the active site of an e...	
B4.1.3 Investigate and describe the effect of changes in temperature and pH on enzyme activity	

B4.1.4 Explain the effect of changes in temperature on enzyme activity in terms of kinetic energy...	
B4.1.5 Explain the effect of changes in pH on enzyme activity in terms of shape and fit and denat...	

B5 Plant nutrition

B5.1 Plant nutrition

Specific Expectations	Lessons
B5.1.1 Define photosynthesis as the process by which plants manufacture carbohydrates from raw ma...	1. Photosynthesis 2. Leaf Structure and Photosynthesis 3. Investigating Photosynthesis **Lab Activity: Photosynthesis and Starch** 1. Photosynthesis and Starch 2. Student Worksheet PDF 3. Lab Report Material PDF 4. Teacher Worksheet PDF 5. Laboratory Technician Guide PDF 6. Editable Documents - Word (.docx)
B5.1.2 State the word equation for photosynthesis: carbon dioxide + water → glucose + oxygen, in ...	
B5.1.3 State the balanced equation for photosynthesis 6 6 CO2 2 H 0 chlorophyll C H 0 0 + 6 2	
B5.1.4 Explain that chlorophyll transfers light energy into chemical energy in molecules, for the...	
B5.1.5 Outline the subsequent use and storage of the carbohydrates made in photosynthesis	
B5.1.6 Investigate the necessity for chlorophyll, light and carbon dioxide for photosynthesis, us...	
B5.1.7 Investigate and describe the effect of varying light intensity and temperature on the rate...	
B5.1.8 Identify chloroplasts, cuticle, guard cells and stomata, upper and lower epidermis, palisa...	
B5.1.9 Describe the significance of the features of a leaf in terms of functions, to include: – p...	
B5.1.10 Describe the importance of: – nitrate ions for making amino acids – magnesium ions for ma...	
B5.1.11 Explain the effects of nitrate ion and magnesium ion deficiency on plant growth	

B6 Animal nutrition

B6.1 Diet

Specific Expectations	Lessons
B6.1.1 State what is meant by the term balanced diet for humans	1. Diet and Nutrients
B6.1.2 List the principal sources of, and describe the dietary importance of: – carbohydrates – f...	
B6.1.3 Explain how age, gender and activity affect the dietary needs	

of humans including during p...	
B6.1.4 Describe the effects of malnutrition in relation to starvation, constipation, coronary hea...	
B6.1.5 Explain the causes and effects of vitamin D and iron deficiencies	
B6.1.6 Explain the causes and effects of protein-energy malnutrition, e.g. kwashiorkor and marasm...	

B6.2 Alimentary canal

Specific Expectations	Lessons
B6.2.1 Define ingestion as the taking of substances, e.g. food and drink, into the body through t...	1. Digestive System As A Whole
B6.2.2 Define digestion as the breakdown of large, insoluble food molecules into small, watersolu...	
B6.2.3 Define mechanical digestion as the breakdown of food into smaller pieces without chemical ...	
B6.2.4 Define chemical digestion as the breakdown of large, insoluble molecules into small, solub...	
B6.2.5 Define absorption as movement of digested food molecules through the wall of the intestine...	
B6.2.6 Define assimilation as the movement of digested food molecules into the cells of the body ...	
B6.2.7 Define egestion as passing out of food that has not been digested, as faeces, through the ...	
B6.2.8 Identify the main regions of the alimentary canal and associated organs, including mouth, ...	
B6.2.9 Describe the functions of the regions of the alimentary canal listed above, in relation to...	

B6.3 Digestion

Specific Expectations	Lessons
B6.3.1 Identify the types of human teeth (incisors, canines, premolars and molars)	1. Mouth and Oesophagus 2. Stomach and Small Intestine 3. Large Intestine and Rectum
B6.3.2 Describe the structure of human teeth, limited to enamel, dentine, pulp, nerves and cement...	
B6.3.3 Describe the functions of the types of human teeth in mechanical digestion of food	
B6.3.4 Describe the proper care of teeth in terms of diet and regular brushing	
B6.3.5 State the causes of dental decay in terms of a coating of bacteria and food on teeth, the ...	

B6.3.6 State the significance of chemical digestion in the alimentary canal in producing small, s...	
B6.3.7 State the functions of enzymes as follows: – amylase breaks down starch to simpler sugars ...	
B6.3.8 State where, in the alimentary canal, amylase, protease and lipase are secreted	
B6.3.9 State the functions of the hydrochloric acid in gastric juice, limited to killing bacteria...	
B6.3.10 Explain the functions of the hydrochloric acid in gastric juice, limited to the low pH: –...	
B6.3.11 Outline the role of bile in neutralising the acidic mixture of food and gastric juices en...	
B6.3.12 Outline the role of bile in emulsifying fats to increase the surface area for the chemica...	
B6.3.13 Explain the significance of villi in increasing the internal surface area of the small in...	
B6.3.14 Describe the structure of a villus	
B6.3.15 Describe the roles of capillaries and lacteals in villi	

B7 Transport

B7.1 Transport in plants

Specific Expectations	Lessons
B7.1.1 State the functions of xylem and phloem	1. Xylem and Phloem 2. Transport of Materials in Plants
B7.1.2 Identify the position of xylem as seen in sections of roots, stems and leaves, limited to ...	
B7.1.3 Identify root hair cells, as seen under the light microscope, and state their functions	
B7.1.4 Explain that the large surface area of root hairs increases the rate of absorption of wate...	
B7.1.5 State the pathway taken by water through root, stem and leaf as root hair cells, root cort...	
B7.1.6 Investigate, using a suitable stain, the pathway of water through the above-ground parts o...	
B7.1.7 State that water is transported from the roots to leaves through the xylem vessels	
B7.1.8 Define transpiration as loss of water vapour from plant leaves by evaporation of water at ...	
B7.1.9 Explain the mechanism by which water moves upwards in the xylem in terms of a transpiratio...	
B7.1.10 Investigate and describe the effects of variation of	

temperature and humidity on transpir...	
B7.1.11 Explain the effects of variation of temperature and humidity on transpiration rate	
B7.1.12 Define translocation in terms of the movement of sucrose and amino acids in phloem: – fro...	

B7.2 Transport in mammals

Specific Expectations	Lessons
B7.2.1 Describe the circulatory system as a system of blood vessels with a pump and valves to ens...	1. Introduction to the Circulatory System 2. Structure and Function of the Heart 3. Blood Vessels 4. Coronary Heart Disease 5. Exercise 6. Blood
B7.2.2 Describe double circulation in terms of circulation to the lungs and circulation to the bo...	
B7.2.3 Explain the advantages of a double circulation	
B7.2.4 Name and identify the structures of the mammalian heart, limited to the muscular wall, the...	
B7.2.5 State that blood is pumped away from the heart into arteries and returns to the heart in v...	
B7.2.6 Describe the functioning of the heart in terms of the contraction of muscles of the atria ...	
B7.2.7 Name the main blood vessels to and from the: – heart, limited to vena cava, aorta, pulmona...	
B7.2.8 Describe coronary heart disease in terms of the blockage of coronary arteries and state th...	
B7.2.9 Investigate and state the effect of physical activity on pulse rate	
B7.2.10 Explain the effect of physical activity on the heart rate	
B7.2.11 Describe the structure and functions of arteries, veins and capillaries	
B7.2.12 Explain how the structures of arteries, veins and capillaries are adapted for their funct...	
B7.2.13 List the components of blood as red blood cells, white blood cells, platelets and plasma	
B7.2.14 Identify red and white blood cells, as seen under the light microscope, on prepared slide...	
B7.2.15 State the functions of the following components of blood: – red blood cells in transporti...	

B8 Gas exchange and respiration

B8.1 Gas exchange

Specific Expectations	Lessons
B8.1.1 Name and identify the lungs, diaphragm, ribs, intercostal muscles, larynx, trachea, bronch...	1. Introduction to the Respiratory System 2. Breathing 3. Breathing and Gas Exchange
B8.1.2 List the features of gas exchange surfaces in humans, limited to large surface area, thin ...	
B8.1.3 State the differences in composition between inspired and expired air limited to oxygen, c...	
B8.1.4 Explain the differences in composition between inspired and expired air	
B8.1.5 Use limewater as a test for carbon dioxide to investigate the differences in composition b...	
B8.1.6 Investigate and describe the effects of physical activity on rate and depth of breathing	
B8.1.7 Explain the effects of physical activity on rate and depth of breathing in terms of the in...	
B8.1.8 Explain the role of goblet cells, mucus and ciliated cells in protecting the gas exchange ...	
B8.1.9 State that tobacco smoking can cause chronic obstructive pulmonary disease (COPD), lung ca...	
B8.1.10 Describe the effects on the gas exchange system of tobacco smoke and its major toxic comp...	

B8.2 Respiration

Specific Expectations	Lessons
B8.2.1 State the uses of energy in the body of humans limited to: muscle contraction, protein syn...	1. Aerobic Respiration 2. Anaerobic Respiration
B8.2.2 Define aerobic respiration as the chemical reactions in cells that use oxygen to break dow...	
B8.2.3 State the word equation for aerobic respiration as glucose + oxygen → carbon dioxide + wat...	
B8.2.4 State the balanced chemical equation for aerobic respiration as $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2$...	
B8.2.5 Define anaerobic respiration as the chemical reactions in cells that break down nutrient m...	
B8.2.6 State the word equation for anaerobic respiration in muscles during vigorous exercise (glu...	
B8.2.7 State that lactic acid builds up in muscles and blood during	

vigorous exercise causing an ...	
B8.2.8 State the word equation for anaerobic respiration in microorganism yeast (glucose → alcoho...	
B8.2.9 Describe the role of anaerobic respiration in yeast during bread-making	
B8.2.10 State that anaerobic respiration releases much less energy per glucose molecule than aero...	

B9 Coordination and response

B9.1 Nervous control in humans

Specific Expectations	Lessons
B9.1.1 Describe a nerve impulse as an electrical signal that passes along nerve cells called neur...	1. The Human Nervous System 2. The Reflex Arc **Lab Activity: Testing Reflexes** 1. Testing Reflexes 2. Student Worksheet PDF 3. Teacher Guide PDF 4. Laboratory Technician Guide PDF 5. Editable Documents - Word (.docx)
B9.1.2 Describe the human nervous system in terms of: – the central nervous system consisting of ...	
B9.1.3 Distinguish between voluntary and involuntary actions	
B9.1.4 Identify motor (effector), relay (connector) and sensory neurones from diagrams	
B9.1.5 Describe a simple reflex arc in terms of receptor, sensory neurone, relay neurone, motor n...	
B9.1.6 Describe a reflex action as a means of automatically and rapidly integrating and coordinat...	

B9.2 Sense organs

Specific Expectations	Lessons
B9.2.1 Identify the structures of the eye, limited to cornea, iris, pupil, lens, retina, optic ne...	1. The Eye **Lab Activity: Eye Dissection** 1. Eye Dissection 2. Student Worksheet PDF 3. Teacher Guide PDF 4. Laboratory Technician Guide PDF 5. Editable Documents - Word (.docx)
B9.2.2 Describe the function of each part of the eye, limited to: – cornea – refracts light – iri...	
B9.2.3 Explain the pupil reflex in terms of light intensity and antagonistic action of circular a...	
B9.2.4 Explain accommodation to view near and distant objects in terms of the contraction and rel...	

B9.3 Hormones

Specific Expectations	Lessons
B9.3.1 Define a hormone as a chemical substance, produced by a gland, carried by the blood, which...	1. Introduction to the Endocrine System 2. Control Systems - Nervous vs Endocrine
B9.3.2 Describe adrenaline as the hormone secreted in 'fight or	

flight' situations and its effect...	
B9.3.3 Give examples of situations in which adrenaline secretion increases	
B9.3.4 Discuss the role of the hormone adrenaline in the chemical control of metabolic activity, ...	
B9.3.5 Compare nervous and hormonal control systems in terms of speed and longevity of action	

B9.4 Homeostasis

Specific Expectations	Lessons
B9.4.1 Define homeostasis as the maintenance of a constant internal environment	1. Basics of Homeostasis 2. Modelling Human Thermoregulation 3. Regulating Blood Sugar
B9.4.2 Explain that homeostasis is the control of internal conditions within set limits	
B9.4.3 Explain the concept of control by negative feedback	
B9.4.4 Describe the control of the glucose content of the blood by the liver and the roles of ins...	
B9.4.5 Name and identify on a diagram of the skin: hairs, hair erector muscles, sweat glands, rec...	
B9.4.6 Describe the maintenance of a constant internal body temperature in humans in terms of ins...	
B9.4.7 Describe the maintenance of a constant internal body temperature in humans in terms of vas...	

B9.5 Tropic responses

Specific Expectations	Lessons
B9.5.1 Define gravitropism as a response in which parts of a plant grow towards or away from grav...	1. Tropisms 2. Investigation: Tropic Responses
B9.5.2 Define phototropism as a response in which parts of a plant grow towards or away from the ...	
B9.5.3 Explain phototropism and gravitropism of a shoot as examples of the chemical control of pl...	
B9.5.4 Investigate gravitropism and phototropism in shoots and roots	
B9.5.5 Explain the role of auxin in controlling shoot growth, limited to: – auxin made in shoot t...	

B10 Reproduction

B10.1 Asexual and sexual reproduction

Specific Expectations	Lessons
B10.1.1 Define asexual reproduction as a process resulting in the production of genetically ident...	1. Asexual Reproduction 2. Sexual Reproduction
B10.1.2 Discuss the advantages and disadvantages of asexual reproduction to a population of a spe...	
B10.1.3 Identify examples of asexual reproduction from information provided	
B10.1.4 Define sexual reproduction as a process involving the fusion of the nuclei of two gametes...	
B10.1.5 State that the nuclei of gametes are haploid and that the nucleus of a zygote is diploid	
B10.1.6 Discuss the advantages and disadvantages of sexual reproduction to a population of a spec...	

B10.2 Sexual reproduction in plants

Specific Expectations	Lessons
B10.2.1 Identify and draw, using a hand lens if necessary, the sepals, petals, stamens, filaments...	1. Sexual Reproduction in Plants 2. Pollination 3. Investigation: Seed Germination
B10.2.2 Use a hand lens to identify and describe the anthers and stigmas of a wind-pollinated flo...	
B10.2.3 State the functions of the sepals, petals, anthers, stigmas and ovaries	
B10.2.4 Distinguish between the pollen grains of insectpollinated and wind-pollinated flowers	
B10.2.5 Define pollination as the transfer of pollen grains from the anther to the stigma	
B10.2.6 Name the agents of pollination	
B10.2.7 State that fertilisation occurs when a pollen nucleus fuses with a nucleus in an ovule	
B10.2.8 Describe the structural adaptations of insectpollinated and wind-pollinated flowers	
B10.2.9 Investigate and state the environmental conditions that affect germination of seeds, limi...	

B10.3 Sexual reproduction in humans

Specific Expectations	Lessons

B10.3.1 Identify and name on diagrams of the male reproductive system: the testes, scrotum, sperm...	1. Male Reproduction 2. Female Reproduction 3. Pregnancy 4. Sexual Health (HIV & AIDS)
B10.3.2 State the function of the parts of the male reproductive system limited to: – testes – pr...	
B10.3.3 Identify and name on diagrams of the female reproductive system: the ovaries, oviducts, u...	
B10.3.4 State the function of the parts of the female reproductive system limited to: – ovaries –...	
B10.3.5 Describe fertilisation as the fusion of the nuclei from a male gamete (sperm) and a femal...	
B10.3.6 Compare male and female gametes in terms of size, structure, motility and numbers	
B10.3.7 State the adaptive features of sperm, limited to flagellum and the presence of enzymes	
B10.3.8 State the adaptive features of egg cells, limited to energy stores and a jelly coating th...	
B10.3.9 Describe the menstrual cycle in terms of changes in the uterus and ovaries (knowledge of ...	
B10.3.10 State that in early development, the zygote forms an embryo which is a ball of cells tha...	
B10.3.11 State the functions of the umbilical cord, placenta, amniotic sac and amniotic fluid	
B10.3.12 Describe the function of the placenta and umbilical cord in relation to exchange of diss...	
B10.3.13 State that human immunodeficiency virus (HIV) infection may lead to acquired immune defi...	
B10.3.14 Describe the methods of transmission of HIV	
B10.3.15 Explain how the spread of sexually transmitted infections (STIs) is controlled	

B11 Inheritance

B11.1 Chromosomes and genes

Specific Expectations	Lessons
B11.1.1 Define inheritance as the transmission of genetic information from generation to generati...	1. Genes and Genetic Information
B11.1.2 Define chromosome as a thread-like structure of DNA, carrying genetic information in the ...	
B11.1.3 Define gene as a length of DNA that codes for a protein	
B11.1.4 Define allele as a version of a gene	
B11.1.5 Describe the inheritance of sex in humans with reference to	

XX and XY chromosomes	
B11.1.6 Define a haploid nucleus as a nucleus containing a single set of unpaired chromosomes, e....	
B11.1.7 Define a diploid nucleus as a nucleus containing two sets of chromosomes, e.g. in body ce...	
B11.1.8 State that in a diploid cell, chromosomes are arranged in pairs and in a human diploid ce...	

B11.2 Cell division

Specific Expectations	Lessons
B11.2.1 Define mitosis as nuclear division giving rise to genetically identical cells (details of...	1. DNA Replication 2. Mitosis 3. Meiosis 4. Gametes and Fertilisation 5. Review: Mitosis vs. Meiosis
B11.2.2 State that the exact duplication of chromosomes occurs before mitosis	
B11.2.3 State the role of mitosis in growth, repair of damaged tissues, replacement of cells and ...	
B11.2.4 Define meiosis as reduction division in which the chromosome number is halved from diploi...	
B11.2.5 State that meiosis is involved in the production of gametes	

B11.3 Monohybrid inheritance

Specific Expectations	Lessons
B11.3.1 Define genotype as the genetic make-up of an organism in terms of the alleles present	1. Mendel 2. Alleles 3. Inheriting Alleles and Punnett Squares 4. Dominant/Recessive Interactions 5. Punnett Squares 6. Pedigrees
B11.3.2 Define phenotype as the observable features of an organism	
B11.3.3 Define homozygous as having two identical alleles of a particular gene	
B11.3.4 State that two identical homozygous individuals that breed together will be pure-breeding	
B11.3.5 Define heterozygous as having two different alleles of a particular gene	
B11.3.6 State that a heterozygous individual will not be pure-breeding	
B11.3.7 Define dominant as an allele that is expressed if it is present	
B11.3.8 Define recessive as an allele that is only expressed when there is no dominant allele of ...	
B11.3.9 Use genetic diagrams to predict the results of monohybrid crosses and calculate phenotypi...	
B11.3.10 Use Punnett squares in crosses which result in more than one genotype to work out and sh...	

B11.3.11 Interpret pedigree diagrams for the inheritance of a given characteristic	

B11.4 Variation and selection

Specific Expectations	Lessons
B11.4.1 Define variation as differences between individuals of the same species	1. Variation 2. Mechanisms of Evolution 3. Natural Selection 4. Artificial Selection
B11.4.2 Distinguish between phenotypic variation and genetic variation	
B11.4.3 State that phenotypic variation is caused by both genetic and environmental factors	
B11.4.4 State that continuous variation results in a range of phenotypes between two extremes, e....	
B11.4.5 State that discontinuous variation is mostly caused by genes alone, e.g. A, B, AB and O b...	
B11.4.6 State that discontinuous variation results in a limited number of phenotypes with no inte...	
B11.4.7 Record and present the results of investigations into continuous and discontinuous variat...	
B11.4.8 Define mutation as a change in a gene or chromosome	
B11.4.9 State that ionising radiation and some chemicals increase the rate of mutation	
B11.4.10 Describe natural selection with reference to: – variation within populations – productio...	
B11.4.11 Describe evolution as the change in adaptive features of a population over time as the r...	
B11.4.12 Define the process of adaptation as the process, resulting from natural selection, by wh...	
B11.4.13 Describe the development of strains of antibiotic resistant bacteria as an example of ev...	
B11.4.14 Describe selective breeding with reference to: – selection by humans of individuals with...	
B11.4.15 State the differences between natural and artificial selection	
B11.4.16 Outline how selective breeding by artificial selection is carried out over many generati...	

B12 Organisms and their environment

B12.1 Organisms and their environment

Specific Expectations	Lessons

B12.1.1 State that the Sun is the principal source of energy input to biological systems	1. Producers 2. Food Chains and Food Webs 3. Trophic Levels
B12.1.2 Define the terms: – food chain as showing the transfer of energy from one organism to the...	
B12.1.3 Define the terms: – ecosystem as a unit containing all of the organisms and their environ...	
B12.1.4 Describe how energy is transferred between trophic levels	
B12.1.5 Explain why food chains usually have fewer than five trophic levels	
B12.1.6 Construct simple food chains	
B12.1.7 Interpret food chains and food webs in terms of identifying producers and consumers	
B12.1.8 State that consumers may be classed as primary, secondary and tertiary according to their...	
B12.1.9 Identify producers, primary consumers, secondary consumers, tertiary consumers and quater...	

B13 Human influences on ecosystems

B13.1 Human influences on ecosystems

Specific Expectations	Lessons
B13.1.1 Describe the carbon cycle, limited to photosynthesis, respiration, feeding, decomposition...	1. The Carbon Cycle 2. Deforestation 3. Water Pollution
B13.1.2 Discuss the effects of the combustion of fossil fuels and the cutting down of forests on ...	
B13.1.3 List the undesirable effects of deforestation as an example of habitat destruction, to in...	
B13.1.4 Explain the undesirable effects of deforestation on the environment	
B13.1.5 State the sources and effects of pollution of water (rivers, lakes and the sea) by chemic...	
B13.1.6 Explain the process of eutrophication of water in terms of: – increased availability of n...	

Chemistry

C1 The particulate nature of matter

C1.1 The particulate nature of matter

Specific Expectations	Lessons
C1.1.1 State the distinguishing properties of solids, liquids and gases	1. Introduction to Particles 2. Particle Model of Matter 3. Solids, Liquids and Gases 4. Changing States: The Particulate Nature of Matter 5. Atoms, Molecules and Compounds 6. Diffusion
C1.1.2 Describe the structure of solids, liquids and gases in terms of particle separation, arrangement and types of motion	
C1.1.3 Describe the changes of state in terms of melting, boiling, evaporation, freezing and condensation	
C1.1.4 Demonstrate understanding of the terms atom, molecule and ion	
C1.1.5 Explain changes of state in terms of particle theory and the energy changes involved	
C1.1.6 Describe and explain diffusion in terms of the movement of particles (atoms, molecules or ions)	
C1.1.7 Describe and explain dependence of rate of diffusion on molecular mass	

C2 Experimental techniques

C2.1 Measurement

Specific Expectations	Lessons
C2.1.1 Name and suggest appropriate apparatus for the measurement of time, temperature, mass and volume, including burettes, pipettes and measuring cylinders	1. Equipment Types and Measurement 2. Safety Equipment

C2.2 Criteria of purity

Specific Expectations	Lessons
C2.2.1 Demonstrate knowledge and understanding of paper chromatography	1. Chromatography 2. Purity of Substances
C2.2.2 Interpret simple chromatograms	
C2.2.3 Interpret simple chromatograms, including the use of Rf values	
C2.2.4 Understand the importance of purity in substances for use in everyday life, e.g. in the manufacture of compounds to use in drugs	

and food additives	
C2.2.5 Recognise that mixtures melt and boil over a range of temperatures	
C2.2.6 Identify substances and assess their purity from melting point and boiling point information	

C2.3 Methods of purification

Specific Expectations	Lessons
C2.3.1 Describe and explain methods of separation and purification by the use of a suitable solvent, filtration, crystallisation, distillation, fractional distillation and paper chromatography	1. Distillation 2. Filtration
C2.3.2 Suggest suitable separation and purification techniques, given information about the substances involved	

C3 Atoms, elements and compounds

C3.1 Physical and chemical changes

Specific Expectations	Lessons
C3.1.1 Identify physical and chemical changes, and understand the differences between them	1. Chemical and Physical Changes
C3.1.2 Understand that some chemical reactions can be reversed by changing the reaction conditions (Limited to the effects of heat and water on hydrated and anhydrous copper(II) sulfate and cobalt(II) chloride.) (Concept of equilibrium is not required.)	

C3.2 Elements, compounds and mixtures

Specific Expectations	Lessons
C3.2.1 Describe the differences between elements, mixtures and compounds, and between metals and non-metals	1. Introduction to Elements, Compounds and Mixtures 2. Purity of Substances (see 2.2 Criteria of purity)
C3.2.2 Define the terms solvent, solute, solution and concentration	

C3.3 Atomic structure and the Periodic Table

Specific Expectations	Lessons
C3.3.1 Describe the structure of an atom in terms of a central nucleus, containing protons and neutrons, and 'shells' of electrons	1. The Structure of an Atom 2. Atomic Symbols 3. Electron Configurations of Atoms 4. The Periodic Table 5. What are Isotopes?
C3.3.2 Describe the build-up of electrons in 'shells' and understand the significance of the noble gas electronic structures and of the outer-shell electrons (The ideas of the distribution of electrons in s and p orbitals and in d-block elements are not required.)	

C3.3.3 State the charges and approximate relative masses of protons, neutrons and electrons	
C3.3.4 Define and use proton number (atomic number) as the number of protons in the nucleus of an atom	
C3.3.5 Define and use nucleon number (mass number) as the total number of protons and neutrons in the nucleus of an atom	
C3.3.6 Use proton number and the simple structure of atoms to explain the basis of the Periodic Table, with special reference to the elements of proton numbers 1 to 20	
C3.3.7 Define isotopes as atoms of the same element which have the same proton number but a different nucleon number	
C3.3.8 Understand that isotopes have the same properties because they have the same number of electrons in their outer shell	

C3.4 Ions and ionic bonds

Specific Expectations	Lessons
C3.4.1 Describe the formation of ions by electron loss or gain	1. Introduction to Ions 2. Electron Configuration of Ions 3. Ions and Ion Formation 4. Ionic Bonds and Ionic Compounds 5. Ionic Bonding 6. Ionic Compounds
C3.4.2 Use dot-and-cross diagrams to describe the formation of ionic bonds between Group I and Group VII	
C3.4.3 Describe the formation of ionic bonds between metallic and non-metallic elements to include the strong attraction between ions because of their opposite electrical charges	
C3.4.4 Describe the lattice structure of ionic compounds as a regular arrangement of alternating positive and negative ions, exemplified by the sodium chloride structure	

C3.5 Molecules and covalent bonds

Specific Expectations	Lessons
C3.5.1 State that non-metallic elements form simple molecules with covalent bonds between atoms	1. Covalent Bonding 2. Covalent Compounds 3. Electron Dot Diagrams of Atoms
C3.5.2 Describe the formation of single covalent bonds in H2, Cl 2, H2O, CH4, NH3 and HCl as the sharing of pairs of electrons leading to the noble gas configuration including the use of dot-and-cross diagrams	
C3.5.3 Use and draw dot-and-cross diagrams to represent the bonding in the more complex covalent molecules such as N2, C2H4, CH3OH, and CO2	
C3.5.4 Describe the differences in volatility, solubility and electrical conductivity between ionic and covalent compounds	
C3.5.5 Explain the differences in melting point and boiling point of ionic and covalent compounds in terms of attractive forces	

C3.6 Macromolecules

Specific Expectations	Lessons
C3.6.1 State that there are several different forms of carbon, including diamond and graphite	1. Covalent Network Substances 2. Allotropes of Carbon
C3.6.2 Describe the giant covalent structures of graphite and diamond	
C3.6.3 Relate the structures of diamond and graphite to their uses, e.g. graphite as a lubricant and a conductor and diamond in cutting tools	
C3.6.4 Describe the macromolecular structure of silicon(IV) oxide (silicon dioxide, SiO2)	

C4 Stoichiometry

C4.1 Stoichiometry

Specific Expectations	Lessons
C4.1.1 Use the symbols of the elements and write the formulae of simple compounds	1. Chemical Reactions and Equations 2. Writing Chemical Equations 3. Balancing Chemical Equations 4. Reaction Equations 5. Ar and Mr
C4.1.2 Determine the formula of an ionic compound from the charges on the ions present	
C4.1.3 Deduce the formula of a simple compound from the relative numbers of atoms present	
C4.1.4 Deduce the formula of a simple compound from a model or a diagrammatic representation	
C4.1.5 Construct and use word equations	
C4.1.6 Interpret and balance simple symbol equations	
C4.1.7 Construct and use symbol equations, with state symbols, including ionic equations	
C4.1.8 Deduce the balanced equation for a chemical reaction, given relevant information	
C4.1.9 Define relative atomic mass, Ar , as the average mass of naturally occurring atoms of an element on a scale where the 12C atom has a mass of exactly 12 units	
C4.1.10 Define relative molecular mass, Mr , as the sum of the relative atomic masses (relative formula mass or Mr will be used for ionic compounds)	

C4.2 The mole

Specific Expectations	Lessons
C4.2.1 Define the mole in terms of a specific number of particles called Avogadro's constant	1. Stoichiometry
C4.2.2 Use the molar gas volume, taken as 24dm3 at room temperature and pressure	
C4.2.3 Calculate stoichiometric reacting masses, volumes of gases and solutions, and concentrations of solutions expressed in g /dm3 and mol/dm3 . (Calculations involving the idea of limiting reactants may be set.)	

C5 Electricity and chemistry

C5.1 Electricity and chemistry

Specific Expectations	Lessons
C5.1.1 Define electrolysis as the breakdown of an ionic compound when molten or in aqueous solution by the passage of electricity	1. Introduction to Electrolysis 2. Electrolysis: What is Produced in Electrolysis? 3. Electrolysis: Uses of Electrolysis (see 10.3 Extraction of metals from their ores)
C5.1.2 Use the terms inert electrode, electrolyte, anode and cathode	
C5.1.3 Describe electrolysis in terms of the ions present and the reactions at the electrodes, in terms of gain of electrons by cations and loss of electrons by anions to form atoms	
C5.1.4 Describe the electrode products and the observations made, using inert electrodes (platinum or carbon), in the electrolysis of: – molten lead(II) bromide – concentrated aqueous sodium chloride – dilute sulfuric acid	
C5.1.5 State the general principle that metals or hydrogen are formed at the negative electrode (cathode), and that non-metals (other than hydrogen) are formed at the positive electrode (anode)	
C5.1.6 Relate the products of electrolysis to the electrolyte and electrodes used, exemplified by the specific examples in the Core together with aqueous copper(II) sulfate using carbon electrodes and using copper electrodes (as used in the refining of copper)	
C5.1.7 Construct simple ionic half-equations for the formation of elements at the cathode	
C5.1.8 Describe electroplating with copper	
C5.1.9 Predict the products of the electrolysis of a specified molten binary compound	
C5.1.10 Describe, in outline, the chemistry of the manufacture of: – aluminium from pure aluminium oxide in molten cryolite – chlorine, hydrogen and sodium hydroxide from concentrated aqueous	

sodium chloride (Starting materials and essential conditions should be given but not technical details or diagrams.)	

C6 Energy changes in chemical reactions

C6.1 Energy changes in chemical reactions

Specific Expectations	Lessons
C6.1.1 Describe the meaning of exothermic and endothermic reactions	1. Exothermic and Endothermic Processes 2. Energy Level Diagrams
C6.1.2 Describe bond breaking as an endothermic process and bond forming as an exothermic process	
C6.1.3 Draw and label energy level diagrams for exothermic and endothermic reactions using data provided	
C6.1.4 Interpret energy level diagrams showing exothermic and endothermic reactions and the activation energy of a reaction	

C7 Chemical reactions

C7.1 Rate (speed) of reaction

Specific Expectations	Lessons
C7.1.1 Describe practical methods for investigating the rate of a reaction which produces a gas	1. Introduction to Rates of Reaction 2. Temperature and Reaction Rate 3. Concentration and Reaction Rate 4. Surface Area and Reaction Rate 5. Catalysts and Reaction Rate 6. Collision Theory 7. Collision Theory and Reaction Rate
C7.1.2 Interpret data obtained from experiments concerned with rate of reaction	
C7.1.3 Suggest suitable apparatus, given information, for experiments, including collection of gases and measurement of rates of reaction	
C7.1.4 Describe the effect of concentration, particle size, catalysts and temperature on the rate of reactions	
C7.1.5 Describe and explain the effect of changing concentration in terms of frequency of collisions between reacting particles	
C7.1.6 Describe and explain the effect of changing temperature in terms of the frequency of collisions between reacting particles and more colliding particles possessing the minimum energy (activation energy) to react	
C7.1.7 Describe how concentration, temperature and surface area create a danger of explosive combustion with fine powders (e.g. flour mills) and gases (e.g. methane in mines)	
C7.1.Note: Candidates should be encouraged to use the term rate rather than speed.	

C7.2 Redox

Specific Expectations	Lessons
C7.2.1 Describe oxidation and reduction in chemical reactions in terms of oxygen loss/ gain (Oxidation state limited to its use to name ions, e.g. iron(II), iron(III), copper(II).)	1. Introduction to Oxidation-Reduction Reactions
C7.2.2 Define redox in terms of electron transfer, and identify such reactions from given information, which could include simple equations	
C7.2.3 Define and identify an oxidising agent as a substance which oxidises another substance during a redox reaction and a reducing agent as a substance which reduces another substance during a redox reaction	

C8 Acids, bases and salts

C8.1 The characteristic properties of acids and bases

Specific Expectations	Lessons
C8.1.1 Describe neutrality and relative acidity and alkalinity in terms of pH (whole numbers only) measured using universal indicator	1. Acids 2. Bases 3. pH and Indicators 4. Neutralisation Reactions
C8.1.2 Describe the characteristic properties of acids (exemplified by dilute hydrochloric acid and dilute sulfuric acid) including their effect on litmus paper and their reactions with metals, bases and carbonates	
C8.1.3 Describe the characteristic properties of bases including their effect on litmus paper and their reactions with acids and ammonium salts	
C8.1.4 Describe and explain the importance of controlling acidity in soil	
C8.1.5 Define acids and bases in terms of proton (H+) transfer, limited to aqueous solutions	

C8.2 Types of oxides

Specific Expectations	Lessons
C8.2.1 Classify oxides as either acidic or basic, related to metallic and non-metallic character	1. Types of Oxides
C8.2.2 Further classify other oxides as neutral or amphoteric	

C8.3 Preparation of salts

Specific Expectations	Lessons
C8.3.1 Describe the preparation, separation and purification of salts	1. Preparation of Salts

using techniques specified in Section C2 and the reactions specified in Section C8.1	
C8.3.2 Suggest a method of making a given salt from suitable starting material, given appropriate information, including precipitation	

C8.4 Identification of ions and gases

Specific Expectations	Lessons
C8.4.1 Describe and use the following tests to identify: aqueous cations: ammonium, calcium, copper(II), iron(II), iron(III) and zinc, using aqueous sodium hydroxide and aqueous ammonia as appropriate (formulae of complex ions are not required) cations: flame tests to identify lithium, sodium, potassium and copper(II) anions: carbonate (by reaction with dilute acid and then limewater), chloride and bromide (by reaction under acidic conditions with aqueous silver nitrate), nitrate (by reduction with aluminium) and sulfate (by reaction under acidic conditions with aqueous barium ions) gases: ammonia (using damp red litmus paper), carbon dioxide (using limewater), chlorine (using damp litmus paper), hydrogen (using a lighted splint), oxygen (using a glowing splint)	1. Tests for Ions

C9 The Periodic Table

C9.1 The Periodic Table

Specific Expectations	Lessons
C9.1.1 Describe the Periodic Table as a method of classifying elements and its use to predict properties of elements	1. The Periodic Table

C9.2 Periodic trends

Specific Expectations	Lessons
C9.2.1 Describe the change from metallic to nonmetallic character across a period	1. Organisation of the Periodic Table 2. Trends in the Periodic Table
C9.2.2 Describe the relationship between group number, number of outer-shell electrons and metallic/ non-metallic character	

C9.3 Group properties

Specific Expectations	Lessons
C9.3.1 Describe lithium, sodium and potassium in Group I as a collection of relatively soft metals showing a trend in melting point, density and reaction with water	Trends in the Periodic Table (see 9.2 Periodic Trends) 1. Groups 1 and 2 2. Group 17
C9.3.2 Predict the properties of other elements in Group I, given	

data, where appropriate	
C9.3.3 Describe the halogens, chlorine, bromine and iodine in Group VII, as a collection of diatomic non-metals showing a trend in colour and physical state	
C9.3.4 State the reaction of chlorine, bromine and iodine with other halide ions	
C9.3.5 Predict the properties of other elements in Group VII, given data where appropriate	
C9.3.6 Identify trends in other groups, given data about the elements concerned	

C9.4 Transition elements

Specific Expectations	Lessons
C9.4.1 Describe the transition elements as a collection of metals having high densities, high melting points and forming coloured compounds, and which, as elements and compounds, often act as catalysts	1. Transition Metals

C9.5 Noble gases

Specific Expectations	Lessons
C9.5.1 Describe the noble gases, in Group VIII or 0, as being unreactive, monoatomic gases and explain this in terms of electronic structure	1. Noble Gases
C9.5.2 State the uses of the noble gases in providing an inert atmosphere, i.e. argon in lamps, helium for filling balloons	

C10 Metals

C10.1 Properties of metals

Specific Expectations	Lessons
C10.1.1 Describe the general physical properties of metals as solids with high melting and boiling points, malleable and good conductors of heat and electricity	1. Physical Properties of Metallic Substances 2. Alloys
C10.1.2 Describe metallic bonding as a lattice of positive ions in a 'sea of electrons' and use this to describe the electrical conductivity and malleability of metals	
C10.1.3 Describe alloys, such as brass, as mixtures of a metal with other elements	
C10.1.4 Explain in terms of their properties why alloys are used instead of pure metals	
C10.1.5 Describe how the properties of iron are changed by the	

controlled use of additives to form steel alloys, such as mild steel and stainless steel	
C10.1.6 Identify representations of alloys from diagrams of structure	

C10.2 Reactivity series

Specific Expectations	Lessons
C10.2.1 Place in order of reactivity: potassium, sodium, calcium, magnesium, aluminium, (carbon), zinc, iron, (hydrogen) and copper, by reference to the reactions, if any, of the elements with: – water or steam – dilute hydrochloric acid – reduction of their oxides with carbon	1. Displacement Reactions
C10.2.2 Describe the reactivity series in terms of the tendency of a metal to form its positive ion, illustrated by its reaction, if any, with: – aqueous ions of other listed metals – the oxides of other listed metals	
C10.2.3 Deduce an order of reactivity from a given set of experimental results	

C10.3 Extraction of metals from their ores

Specific Expectations	Lessons
C10.3.1 Describe the use of carbon in the extraction of some metals from their ores	1. Electrolysis: Uses of Electrolysis
C10.3.2 Describe and explain the essential reactions in the extraction of iron from hematite in the blast furnace, including the removal of acidic impurities as slag $C + O2 \rightarrow CO2$ $C + CO2 \rightarrow 2CO$ $Fe2O3 + 3CO \rightarrow 2Fe + 3CO2$ $CaCO3 \rightarrow CaO + CO2$ $CaO + SiO2 \rightarrow CaSiO3$	
C10.3.3 Know that aluminium is extracted from the ore bauxite by electrolysis	
C10.3.4 Relate the method of extraction of a metal from its ore to its position in the reactivity series for the metals listed in section C10.2 and for other metals, given information	
C10.3.5 Describe metal ores as a finite resource and hence the need to recycle metals	

C10.4 Uses of metals

Specific Expectations	Lessons
C10.4.1 Describe the uses of aluminium: – in aircraft parts because of its strength and low density – in food containers because of its resistance to corrosion	
C10.4.2 Describe and explain the apparent unreactivity of aluminium in terms of the oxide layer which adheres to the metal	

C10.4.3 State the uses of mild steel (car bodies and machinery) and stainless steel (chemical plant and cutlery)	
C10.4.4 Explain the uses of zinc for galvanising steel and for making brass	

C11 Air and water

C11.1 Water

Specific Expectations	Lessons
C11.1.1 Describe a chemical test for water using copper(II) sulfate and cobalt(II) chloride	1. Water Tests
C11.1.2 Describe, in outline, the treatment of the water supply in terms of filtration and chlorination	

C11.2 Air

Specific Expectations	Lessons
C11.2.1 State the composition of clean air as being a mixture of 78% nitrogen, 21% oxygen and small quantities of noble gases, water vapour and carbon dioxide	1. Air and Pollution
C11.2.2 Name the common pollutants in air as being carbon monoxide, sulfur dioxide and oxides of nitrogen	
C11.2.3 State the adverse effect of these common air pollutants on buildings and on health	
C11.2.4 State the source of each of these pollutants: – carbon monoxide from the incomplete combustion of carbon-containing substances – sulfur dioxide from the combustion of fossil fuels which contain sulfur compounds (leading to acid rain) – oxides of nitrogen from car engines	
C11.2.5 Describe some approaches to reducing emissions of sulfur dioxide, including the use of low sulfur petrol and flue gas desulfurisation by calcium oxide	
C11.2.6 Describe, in outline, how a catalytic converter removes nitrogen monoxide and carbon monoxide from exhaust emissions by reaction over a hot catalyst $2CO + O_2 \rightarrow 2CO_2$ $2NO + 2CO \rightarrow N_2 + 2CO_2$ $2NO \rightarrow N_2 + O_2$	
C11.2.7 State the conditions required for the rusting of iron (presence of oxygen and water)	
C11.2.8 Describe and explain barrier methods of rust prevention, including paint and other coatings	
C11.2.9 Describe and explain sacrificial protection in terms of the reactivity series of metals and galvanising as a method of rust prevention	

C11.3 Carbon dioxide and methane

Specific Expectations	Lessons
C11.3.1 State the formation of carbon dioxide: – as a product of complete combustion of carbon-containing substances – as a product of respiration – as a product of the reaction between an acid and a carbonate – as a product of thermal decomposition of calcium carbonate	1. Carbon Dioxide and Methane
C11.3.2 State that carbon dioxide and methane are greenhouse gases	
C11.3.3 State that increased concentrations of greenhouse gases cause an enhanced greenhouse effect, which may contribute to climate change	

C11.4 Nitrogen and fertilisers

Specific Expectations	Lessons
C11.4.1 Describe the need for nitrogen-, phosphorus- and potassium-containing fertilisers	1. Nitrogen and Fertilisers
C11.4.2 Describe the displacement of ammonia from its salts	
C11.4.3 Describe and explain the essential conditions for the manufacture of ammonia by the Haber process including the sources of the hydrogen (reaction of methane/natural gas with steam) and nitrogen (from the air)	

C12 Sulfur

C12.1 Sulfur

Specific Expectations	Lessons
C12.1.1 Name the use of sulfur in the manufacture of sulfuric acid	1. Sulfur
C12.1.2 Describe the manufacture of sulfuric acid by the Contact process, including essential conditions and reactions $S + O2 \rightarrow SO2$ $2SO2 + O2 \rightleftharpoons 2SO3$ $H2SO4 + SO3 \rightarrow H2S2O7$ $H2S2O7 + H2O \rightarrow 2H2SO4$	

C13 Carbonates

C13.1 Carbonates

Specific Expectations	Lessons
C13.1.1 Describe the manufacture of lime (calcium oxide) from limestone (calcium carbonate) in terms of the chemical reactions involved, and the use of limestone in treating acidic soil and	1. Carbonates

neutralising acidic industrial waste products	
C13.1.2 Describe the thermal decomposition of calcium carbonate (limestone)	

C14 Organic chemistry

C14.1 Names of compounds

Specific Expectations	Lessons
C14.1.1 Name and draw the structures of methane, ethane, ethene and ethanol	1. Introduction to Organic Chemistry 2. Naming Alkanes 3. Naming Alkenes 4. Naming Alcohols 5. Homologous Series (see 14.3 Homologous series)
C14.1.2 State the type of compound present, given a chemical name ending in -ane, -ene and -ol, or a molecular structure	
C14.1.3 Name and draw the structures of the unbranched alkanes and alkenes (not cis-trans), containing up to four carbon atoms per molecule	

C14.2 Fuels

Specific Expectations	Lessons
C14.2.1 State that coal, natural gas and petroleum are fossil fuels that produce carbon dioxide on combustion	1. Fractional Distillation
C14.2.2 Name methane as the main constituent of natural gas	
C14.2.3 Describe petroleum as a mixture of hydrocarbons and its separation into useful fractions by fractional distillation	
C14.2.4 Describe the properties of molecules within a fraction	
C14.2.5 Name the uses of the fractions as: – refinery gas for bottled gas for heating and cooking – gasoline fraction for fuel (petrol) in cars – naphtha fraction as a feedstock for making chemicals – diesel oil/ gas oil for fuel in diesel engines – bitumen for road surfaces	

C14.3 Homologous series

Specific Expectations	Lessons
C14.3.1 Describe the homologous series of alkanes and alkenes as families of compounds with the same general formula and similar chemical properties	1. Homologous Series

C14.4 Alkanes

Specific Expectations	Lessons
C14.4.1 Describe alkanes as saturated hydrocarbons whose molecules contain only single covalent bonds	1. Alkanes

C14.4.2 Describe the properties of alkanes (exemplified by methane) as being generally unreactive, except in terms of burning	
C14.4.3 Describe the complete combustion of hydrocarbons to give carbon dioxide and water	

C14.5 Alkenes

Specific Expectations	Lessons
C14.5.1 Describe alkenes as unsaturated hydrocarbons whose molecules contain one double covalent bond	1. Alkenes
C14.5.2 State that cracking is a reaction that produces alkenes	
C14.5.3 Describe the formation of smaller alkanes, alkenes and hydrogen by the cracking of larger alkane molecules and state the conditions required for cracking	
C14.5.4 Recognise saturated and unsaturated hydrocarbons: – from molecular structures – by their reaction with aqueous bromine	
C14.5.5 Describe the properties of alkenes in terms of addition reactions with bromine, hydrogen and steam, exemplified by ethene	

C14.6 Alcohols

Specific Expectations	Lessons
C14.6.1 State that ethanol may be formed by fermentation and by reaction between ethene and steam	1. Alcohols
C14.6.2 Describe the formation of ethanol by fermentation and the catalytic addition of steam to ethene	
C14.6.3 Describe the complete combustion of ethanol to give carbon dioxide and water	
C14.6.4 State the uses of ethanol as a solvent and as a fuel	

C14.7 Polymers

Specific Expectations	Lessons
C14.7.1 Define polymers as long chain molecules formed from small units (monomers)	1. Introduction to Polymers
C14.7.2 Understand that different polymers have different monomer units and/or different linkages	

C14.8 Synthetic polymers

Specific Expectations	Lessons
C14.8.1 Describe the formation of poly(ethene) as an example of addition polymerisation of monomer units	1. Polymerisation Reactions

C14.8.2 Deduce the structure of the polymer product from a given alkene and vice versa	
C14.8.3 Explain the differences between addition and condensation polymerisation	
C14.8.4 Describe the formation of a simple condensation polymer exemplified by nylon, the structure of nylon being represented as:	

Physics

P1. Motion

P1.1 Length and time

Specific Expectations	Lessons
P1.1.1 Use and describe the use of rules and measuring cylinders to find a length or a volume	1. Measuring Length, Volume and Time
P1.1.2 Understand that a micrometer screw gauge is used to measure very small distances	
P1.1.3 Use and describe the use of clocks and devices, both analogue and digital, for measuring a...	
P1.1.4 Obtain an average value for a small distance and for a short interval of time by measuring...	

P1.2 Motion

Specific Expectations	Lessons
P1.2.1 Define speed and calculate average speed from total distance total time	1. Speed 2. Acceleration 3. Distance-Time Graphs 4. Speed-Time Graphs
P1.2.2 Distinguish between speed and velocity	
P1.2.3 Define and calculate acceleration using change of velocity total time	
P1.2.4 Plot and interpret a speed–time graph and a distance–time graph	
P1.2.5 Calculate acceleration from the gradient of a speed–time graph	
P1.2.6 Recognise from the shape of a speed–time graph when a body is: – at rest – moving with con...	
P1.2.7 Recognise linear motion for which the acceleration is constant and calculate the accelerat...	
P1.2.8 Calculate the area under a speed–time graph to work out the distance travelled for motion ...	
P1.2.9 Recognise motion for which the acceleration is not constant	
P1.2.10 Demonstrate an understanding that acceleration and deceleration are related to changing s...	
P1.2.11 State that the acceleration of free fall g for a body near to the Earth is constant	

P1.3 Mass and weight

Specific Expectations	Lessons
P1.3.1 Distinguish between mass and weight	1. Weight and Mass
P1.3.2 Know that the Earth is the source of a gravitational field	
P1.3.3 Describe, and use the concept of, weight as the effect of a gravitational field on a mass	
P1.3.4 Recognise that g is the gravitational force on unit mass and is measured in N/ kg	
P1.3.5 Recall and use the equation W = mg	
P1.3.6 Demonstrate understanding that weights (and hence masses) may be compared using a balance	

P1.4 Density

Specific Expectations	Lessons
P1.4.1 Recall and use the equation ρ = V m	1. Density
P1.4.2 Describe an experiment to determine the density of a liquid and of a regularly-shaped soli...	
P1.4.3 Describe the determination of the density of an irregularly shaped solid by the method of ...	

P1.5 Forces

P1.5.1 Effects of forces

Specific Expectations	Lessons
P1.5.1.1 Describe how forces may change the size, shape and motion of a body	
P1.5.1.2 Plot and interpret extension–load graphs and describe the associated experimental proced...	
P1.5.1.3 State Hooke's law and recall and use the expression F = k x, where k is the spring const...	
P1.5.1.4 Recognise the significance of the term limit of proportionality for an extension–load gr...	
P1.5.1.5 Recall and use the relationship between resultant force, mass and acceleration, F = ma	
P1.5.1.6 Understand friction as the force between two surfaces which impedes motion and results i...	
P1.5.1.7 Recognise air resistance as a form of friction	
P1.5.1.8 Find the resultant of two or more forces acting along the same line	1. Introduction to Forces 2. Friction as a Force 3. Hooke's Law Lab Activity

P1.5.1.9 Recognise that if there is no resultant force on a body it either remains at rest or con...	

P1.5.2 Turning effect

Specific Expectations	Lessons
P1.5.2.1 Describe the moment of a force as a measure of its turning effect, and give everyday exa...	1. The Turning Effect
P1.5.2.2 Calculate moment using the product force × perpendicular distance from the pivot	
P1.5.2.3 Recognise that, when there is no resultant force and no resultant turning effect, a syst...	
P1.5.2.4 Apply the principle of moments to the balancing of a weightless beam about a pivot	
P1.5.2.5 Apply the principle of moments to different situations	

P1.5.3 Centre of mass

Specific Expectations	Lessons
P1.5.3.1 Perform and describe an experiment to determine the position of the centre of mass of a ...	1. Centre of Mass
P1.5.3.2 Describe qualitatively the effect of the position of the centre of mass on the stability...	

P1.5.4 Pressure

Specific Expectations	Lessons
P1.5.4.1 Relate qualitatively pressure to force and area, using appropriate examples	1. Pressure
P1.5.4.2 Recall and use the equation p = F /A	

P2 Work, energy and power

P2.1 Work

Specific Expectations	Lessons
P2.1.1 Relate (without calculation) work done to the magnitude of a force and distance moved in t...	1. Energy, Work, and Power (see P2.1-3 Work, energy and power)
P2.1.2 Recall and use W = Fd = ΔE	

P2.2 Energy

Specific Expectations	Lessons
P2.2.1 Demonstrate an understanding that work done = energy	1. Energy, Work, and Power (see P2.1-3

transferred	Work, energy and power) 2. Kinetic Energy 3. Gravitational Potential Energy 4. Calculating Energy Efficiency
P2.2.2 Demonstrate understanding that an object may have energy due to its motion (kinetic energy...	
P2.2.3 Give and identify examples of changes in kinetic, gravitational potential, chemical potent...	
P2.2.4 Recall and use the expressions KE = ½mv 2 and gravitational potential energy (GPE) = mgh o...	
P2.2.5 Recognise that energy is transferred during events and processes, including examples of tr...	
P2.2.6 Apply the principle of conservation of energy to simple examples	
P2.2.7 Show a qualitative understanding of efficiency	

P2.3 Power

Specific Expectations	Lessons
P2.3.1 Relate (without calculation) power to work done and time taken, using appropriate examples	1. Energy, Work, and Power (see P2.1-3 Work, energy and power)
P2.3.2 Recall and use the equation P = ΔE /t in simple systems, including electrical circuits	

P2.4 Energy resources

Specific Expectations	Lessons
P2.4.1 Distinguish between renewable and nonrenewable sources of energy	1. Sources of Energy Calculating Energy Efficiency (see P2.1-3 Work, energy and power) 2. Fossil Fuels as a Resource 3. Nuclear Fuel as a Resource 4. Living Things as a Resource 5. Solar Energy 6. Wind as a Resource 7. Wind Turbines 8. Geothermal Energy 9. Water Power
P2.4.2 Describe how electricity or other useful forms of energy may be obtained from: – chemical ...	
P2.4.3 Give advantages and disadvantages of each method in terms of renewability, cost, reliabili...	
P2.4.4 Understand that the Sun is the source of energy for all our energy resources except geothe...	
P2.4.5 Understand that the source of tidal energy is mainly the moon	
P2.4.6 Show an understanding that energy is released by nuclear fusion in the Sun	
P2.4.7 Recall and use the equations: efficiency = useful energy output energy input × 100% effici...	

P3 Thermal physics

P3.1 Simple kinetic molecular model of matter

Specific Expectations	Lessons
P3.1.1 State the distinguishing properties of solids, liquids and gases	1. Simple Kinetic Model 2. Solids 3. Liquids 4. Gases Measurement of Temperature (see P3.4 Measurement of temperature) 5. Changing State
P3.1.2 Relate the properties of solids, liquids and gases to the forces and distances between the...	
P3.1.3 Describe qualitatively the molecular structure of solids, liquids and gases in terms of th...	
P3.1.4 Describe qualitatively the pressure of a gas and the temperature of a gas, liquid or solid...	
P3.1.5 Describe qualitatively the pressure of a gas in terms of the motion of its molecules and t...	
P3.1.6 Show an understanding of Brownian motion (the random motion of particles in a suspension) ...	
P3.1.7 Show an appreciation that massive particles may be moved by light, fast-moving molecules	
P3.1.8 Use and describe the use of thermometers to measure temperature on the Celsius scale	
P3.1.9 Describe melting and boiling in terms of energy input without a change in temperature	
P3.1.10 State the meaning of melting point and boiling point, and recall the melting and boiling ...	
P3.1.11 Distinguish between boiling and evaporation	
P3.1.12 Describe condensation and solidification	
P3.1.13 Explain evaporation in terms of the escape of more-energetic molecules from the surface o...	
P3.1.14 Relate evaporation to the consequent cooling of the liquid	
P3.1.15 Demonstrate an understanding of how temperature, surface area and draught over a surface ...	

P3.2 Pressure changes

Specific Expectations	Lessons
P3.2.1 Describe qualitatively, in terms of molecules, the effect on the pressure of a gas of: – a...	1. Pressure and Thermal Expansion (see P3.2-3 Pressure changes and Matter and thermal properties)

P3.3 Matter and thermal properties

Specific Expectations	Lessons

P3.3.1 Describe qualitatively the thermal expansion of solids, liquids and gases at constant pres...	1. Pressure and Thermal Expansion (see P3.2-3 Pressure changes and Matter and thermal properties)
P3.3.2 Explain in terms of the motion and arrangement of molecules, the relative order of the mag...	
P3.3.3 Identify and explain some of the everyday applications and consequences of thermal expansi...	

P3.4 Measurement of temperature

Specific Expectations	Lessons
P3.4.1 Describe how a physical property that varies with temperature may be used for the measurem...	1. Measurement of Temperature
P3.4.2 Demonstrate understanding of sensitivity, range and linearity	
P3.4.3 Describe the structure of a thermocouple and show understanding of its use as a thermomete...	
P3.4.4 Recognise the need for and identify fixed points	
P3.4.5 Describe and explain how the structure of a liquid-in-glass thermometer relates to its sen...	
P3.4.6 Describe and explain the structure and action of liquid-in-glass thermometers	

P3.5 Thermal processes

P3.5.1 Conduction

Specific Expectations	Lessons
P3.5.1.1 Recognise and name typical good and bad thermal conductors	1. Conduction
P3.5.1.2 Describe experiments to demonstrate the properties of good and bad thermal conductors	
P3.5.1.3 Explain conduction in solids in terms of molecular vibrations and transfer by electrons	

P3.5.2 Convection

Specific Expectations	Lessons
P3.5.2.1 Recognise convection as the main method of energy transfer in fluids	1. Convection
P3.5.2.2 Relate convection in fluids to density changes	
P3.5.2.3 Interpret and describe experiments designed to illustrate convection in liquids and gase...	

P3.5.3 Radiation

Specific Expectations	Lessons
P3.5.3.1 Recognise radiation as the method of energy transfer that does not require a medium to t...	1. Radiation
P3.5.3.2 Identify infrared radiation as the part of the electromagnetic spectrum often involved i...	
P3.5.3.3 Describe the effect of surface colour (black or white) and texture (dull or shiny) on th...	
P3.5.3.4 Interpret and describe experiments to investigate the properties of good and bad emitter...	

P3.5.4 Consequences of energy transfer

Specific Expectations	Lessons
P3.5.4.1 Identify and explain some of the everyday applications and consequences of conduction, c...	1. Consequences of Energy Transfer

P4 Properties of waves, including light and sound

P4.1 General wave properties

Specific Expectations	Lessons
P4.1.1 Demonstrate understanding that waves transfer energy without transferring matter	1. Introduction to Waves 2. Transverse and Longitudinal Waves 3. Introduction to Reflection, Refraction and Diffraction
P4.1.2 Describe what is meant by wave motion as illustrated by vibration in ropes and springs and...	
P4.1.3 Use the term wavefront	
P4.1.4 State the meaning of speed, frequency, wavelength and amplitude	
P4.1.5 Distinguish between transverse and longitudinal waves and give suitable examples	
P4.1.6 Describe how waves can undergo: – reflection at a plane surface – refraction due to a chan...	
P4.1.7 Recall and use the equation $v = f \lambda$	
P4.1.8 Understand that refraction is caused by a change in speed as a wave moves from one medium ...	
P4.1.9 Describe how waves can undergo diffraction through a narrow gap	
P4.1.10 Describe the use of water waves to demonstrate diffraction	

P4.2 Light

P4.2.1 Reflection of light

Specific Expectations	Lessons
P4.2.1.1 Describe the formation of an optical image by a plane mirror and give its characteristic...	1. Light as a Wave
P4.2.1.2 Recall and use the law: angle of incidence i = angle of reflection r recognising these a...	
P4.2.1.3 Perform simple constructions, measurements and calculations for reflection by plane mirr...	

P4.2.2 Refraction of light

Specific Expectations	Lessons
P4.2.2.1 Interpret and describe an experimental demonstration of the refraction of light	1. Refraction
P4.2.2.2 Recall and use the definition of refractive index n in terms of speed	
P4.2.2.3 Use the terminology for the angle of incidence i and angle of refraction r and describe ...	
P4.2.2.4 Recall and use the equation for refractive index sin i sin r = n	
P4.2.2.5 Describe internal and total internal reflection using ray diagrams	
P4.2.2.6 Give the meaning of critical angle	
P4.2.2.7 Describe and explain the action of optical fibres particularly in medicine and communica...	

P4.2.3 Thin converging lens

Specific Expectations	Lessons
P4.2.3.1 Describe the action of a thin converging lens on a beam of light	1. Lenses 2. Drawing Ray Diagrams
P4.2.3.2 Use the terms principal focus and focal length	
P4.2.3.3 Draw ray diagrams for the formation of a real image by a single lens	
P4.2.3.4 Describe the nature of an image using the terms enlarged/same size /diminished and uprig...	
P4.2.3.5 Describe the difference between a real image and a virtual image	
P4.2.3.6 Use and describe the use of a single lens as a magnifying glass	

P4.3 Electromagnetic spectrum

Specific Expectations	Lessons
P4.3.1 Describe the main features of the electromagnetic spectrum in order of frequency, from rad...	1. The Electromagnetic Spectrum 2. Extension: You, Me and UV 3. Extension: Electromagnetic Radiation and Medicine
P4.3.2 State that all electromagnetic waves travel with the same high speed in a vacuum and appro...	
P4.3.3 State that the speed of electromagnetic waves in a vacuum is 3.0 × 108m/s	
P4.3.4 Describe typical properties and uses of radiations in all the different regions of the ele...	
P4.3.5 Demonstrate an understanding of safety issues regarding the use of microwaves and X-rays	
P4.3.6 State the dangers of ultraviolet radiation, from the Sun or from tanning lamps	

P4.4 Sound

Specific Expectations	Lessons
P4.4.1 Describe the production of sound by vibrating sources	1. Sound
P4.4.2 Describe the longitudinal nature of sound waves	
P4.4.3 Describe the transmission of sound waves in air in terms of compressions and rarefactions	
P4.4.4 State that the approximate range of audible frequencies for a healthy human ear is 20Hz to...	
P4.4.5 Show an understanding that a medium is needed to transmit sound waves	
P4.4.6 Describe and interpret an experiment to determine the speed of sound in air, including cal...	
P4.4.7 Recognise that sound travels faster in liquids than gases and faster in solids than in liq...	
P4.4.8 Relate the loudness and pitch of sound waves to amplitude and frequency	
P4.4.9 Describe how the reflection of sound may produce an echo	

P5 Electricity and magnetism

P5.1 Simple phenomena of magnetism

Specific Expectations	Lessons
P5.1.1 Describe the forces between magnets, and between magnets and magnetic materials	1. Magnetism 2. Magnetic Fields 3. Examples of Magnetic Fields **Subfolder:** **Lab Activity: Building an Electromagnet** 1. Building an Electromagnet 2. Student Worksheet PDF 3. Lab Report Material PDF 4. Teacher Guide PDF 5. Editable Documents - Word (.docx) 6. Laboratory Technician Guide PDF
P5.1.2 Give an account of induced magnetism	
P5.1.3 Draw and describe the pattern and direction of magnetic field lines around a bar magnet	
P5.1.4 Distinguish between the magnetic properties of soft iron and steel	
P5.1.5 Distinguish between the design and use of permanent magnets and electromagnets	
P5.1.6 Describe methods of magnetisation to include stroking with a magnet, use of direct current...	

P5.2 Electrical quantities

P5.2.1 Electric charge

Specific Expectations	Lessons
P5.2.1.1 State that there are positive and negative charges	1. Electric Charge
P5.2.1.2 State that unlike charges attract and that like charges repel	
P5.2.1.3 Describe and interpret simple experiments to show the production and detection of electr...	
P5.2.1.4 State that charging a body involves the addition or removal of electrons	
P5.2.1.5 Describe an electric field as a region in which an electric charge experiences a force	
P5.2.1.6 Distinguish between electrical conductors and insulators and give typical examples	

P5.2.2 Current, potential difference and electromotive force (e.m.f.)

Specific Expectations	Lessons
P5.2.2.1 Demonstrate understanding of current, potential difference, e.m.f. and resistance	1. Electrical Quantities in Circuits
P5.2.2.2 State that current is related to the flow of charge	
P5.2.2.3 Show understanding that a current is a rate of flow of charge and recall and use the equ...	

P5.2.2.4 State that current in metals is due to a flow of electrons	
P5.2.2.5 State that the potential difference (p.d.) across a circuit component is measured in vol...	
P5.2.2.6 Use and describe the use of an ammeter and a voltmeter, both analogue and digital	
P5.2.2.7 State that the electromotive force (e.m.f) of an electrical source of energy is measured...	
P5.2.2.8 Show understanding that e.m.f. is defined in terms of energy supplied by a source in dri...	

P5.2.3 Resistance

Specific Expectations	Lessons
P5.2.3.1 State that resistance = p.d./ current and understand qualitatively how changes in p.d. o...	1. Resistance
P5.2.3.2 Sketch and explain the current–voltage characteristic of an ohmic resistor and a filamen...	
P5.2.3.3 Recall and use the equation R = V/ I	
P5.2.3.4 Recall and use quantitatively the proportionality between resistance and length, and the...	

P6 Electric circuits

P6.1 Circuit diagrams

Specific Expectations	Lessons
P6.1.1 Draw and interpret circuit diagrams containing sources, switches, resistors (fixed and var...	1. Circuits

P6.2 Series and parallel circuits

Specific Expectations	Lessons
P6.2.1 Understand that the current at every point in a series circuit is the same	1. Circuits in Series 2. Circuits in Parallel 3. Comparing Circuits 4. Class Experiment: Designing Simple Circuits
P6.2.2 Calculate the combined resistance of two or more resistors in series	
P6.2.3 Recall and use the fact that the sum of the p.d.s across the components in a series circui...	
P6.2.4 State that, for a parallel circuit, the current from the source is larger than the current...	
P6.2.5 Recall and use the fact that the current from the source is the sum of the currents in the...	
P6.2.6 State that the combined resistance of two resistors in	

parallel is less than that of eithe...	
P6.2.7 Calculate the combined resistance of two resistors in parallel	
P6.2.8 State the advantages of connecting lamps in parallel in a circuit	
P6.2.9 Draw and interpret circuit diagrams containing NTC thermistors and light-dependent resisto...	
P6.2.10 Describe the action of NTC thermistors and LDRs and show understanding of their use as in...	

P6.3 Electrical energy

Specific Expectations	Lessons
P6.3.1 Recall and use the equations P = IV and E = IVt	1. Electrical Energy

P6.4 Dangers of electricity

Specific Expectations	Lessons
P6.4.1 Identify electrical hazards including: – damaged insulation – overheating of cables – damp...	1. Dangers of Electricity
P6.4.2 State that a fuse protects a circuit	
P6.4.3 Explain the use of fuses and choose appropriate fuse ratings	

P7 Electromagnetic effects

P7.1 Magnetic effect of an electric current

Specific Expectations	Lessons
P7.1.1 Describe the pattern of the magnetic field (including direction) due to currents in straig...	1. Electromagnetic Effects (see P7.1-2 Magnetic effect of an electric current and Force on a current-carrying conductor)
P7.1.2 Describe the effect on the magnetic field of changing the magnitude and direction of the c...	

P7.2 Force on a current-carrying conductor

Specific Expectations	Lessons
P7.2.1 Describe an experiment to show that a force acts on a current-carrying conductor in a magn...	1. Electromagnetic Effects (P7.1-2 Magnetic effect of an electric current and Force on a current-carrying conductor)
P7.2.2 State and use the relative directions of force, field and current	

P7.3 d.c. motor

Specific Expectations	Lessons

P7.3.1 State that a current-carrying coil in a magnetic field experiences a turning effect and th...	1. Motors
P7.3.2 Relate this turning effect to the action of an electric motor including the action of a sp...	

P7.4 Electromagnetic induction

Specific Expectations	Lessons
P7.4.1 Show understanding that a conductor moving across a magnetic field or a changing magnetic ...	1. Electromagnetic Induction
P7.4.2 State the factors affecting the magnitude of an induced e.m.f.	

P7.5 a.c. generator

Specific Expectations	Lessons
P7.5.1 Distinguish between direct current (d.c) and alternating current (a.c)	1. Generators 2. Alternating Current
P7.5.2 Describe and explain the operation of a rotatingcoil generator and the use of slip rings	
P7.5.3 Sketch a graph of voltage output against time for a simple a.c. generator	

P7.6 Transformer

Specific Expectations	Lessons
P7.6.1 Describe the construction of a basic transformer with a soft-iron core, as used for voltag...	1. Transformers
P7.6.2 Describe the principle of operation of a transformer	
P7.6.3 Use the terms step-up and step-down	
P7.6.4 Recall and use the equation (V p /Vs) = (N p /Ns) (for 100% efficiency)	
P7.6.5 Describe the use of the transformer in high voltage transmission of electricity	
P7.6.6 Recall and use the equation I p V p = IsVs (for 100% efficiency)	
P7.6.7 Explain why power losses in cables are lower when the voltage is high	

P8 Atomic physics

P8.1 The nuclear atom

Specific Expectations	Lessons

P8.1.1 Describe the composition of the nucleus in terms of protons and neutrons	1. The Nuclear Atom
P8.1.2 Use the terms proton number Z and nucleon number A	
P8.1.3 Use and explain the term isotope	
P8.1.4 Use and interpret the term nuclide and use the nuclide notation A ZX	

P8.2 Radioactivity

P8.2.1 Characteristics of the three kinds of emission

Specific Expectations	Lessons
P8.2.1.1 Describe the random nature of radioactive emission	1. What is Radioactivity? 2. Types of Radiation 3. Properties of Radiation Deflection of Particles and Rays (see P8.2.2 Detection of radioactivity)
P8.2.1.2 Identify alpha (α)-, beta (β)- and gamma (γ)- emissions by recalling – their nature – th...	
P8.2.1.3 Describe the deflection of α-particles, β-particles and γ-rays in electric fields and in...	
P8.2.1.4 Recognise the general term ionising radiation can be used to describe radioactive emissi...	
P8.2.1.5 Describe and explain examples of practical applications of α-, β- and γ-emissions	

P8.2.2 Detection of radioactivity

Specific Expectations	Lessons
P8.2.2.1 Demonstrate understanding of background radiation	1. Deflection of Particles and Rays
P8.2.2.2 Describe the detection of α-particles, β-particles and γ-rays	

P8.2.3 Radioactive decay

Specific Expectations	Lessons
P8.2.3.1 State the meaning of radioactive decay	What is Radioactivity? (see P8.2.1 Characteristics of the three kinds of emission) 1. Writing Nuclear Equations 2. Balancing Nuclear Equations
P8.2.3.2 Use word equations to represent changes in the composition of the nucleus when particles...	
P8.2.3.3 Use nuclide notation in equations to show α- and β-decay	

P8.2.4 Half-life

Specific Expectations	Lessons
P8.2.4.1 Use the term half-life in simple calculations which may involve information in tables or...	1. Half-life

P8.2.5 Safety precautions

Specific Expectations	Lessons
P8.2.5.1 Recall the effects of ionising radiations on living things	1. Effects of Radiation on Humans
P8.2.5.2 Describe how radioactive materials are handled, used and stored in a safe way	