YEAR 9

BLOCK 1: ENERGY

B4 Bioenergetics

Represent photosynthesis using an equation and state uses for the products
Describe and explain how factors may affect the rate of photosynthesis and explain the idea of 'limiting factors'
Interpret and explain graphs of photosynthesis rate
Represent aerobic and anaerobic respiration using equations and compare them in terms of energy release and waste products
Describe and explain changes in the body during exercise
Define metabolism and give examples of the reactions this includes

C5 Energy Changes

Describe and recognise exothermic and endothermic reactions
Describe some of the variables that can affect temperature change in endothermic and exothermic reactions
Use bond energies to determine whether a reaction will be endothermic or exothermic

P1 Energy

Name the different types of energy 'store' and describe how energy is transferred between them
Identify ways in which energy is transferred – doing work, current flowing, radiation
Identify where energy is wasted and describe where this goes
Calculate the efficiency of devices
Use Sankey diagrams to represent energy transfers or calculate efficiency
Define and calculate kinetic energy
Define and calculate gravitational potential energy
Use values for GPE to calculate maximum theoretical velocity of a raised object using KE equation
Explain why theoretical velocity will not normally be reached
Calculate the elastic potential energy in a stretched or squashed object
Use and manipulate the specific heat capacity equation to calculate energy/mass/temperature change/specific heat capacity given the others
Define specific heat capacity
Describe practical procedures to measure specific heat capacity
Calculate power using $P=E/t$ or $P=Work done/t$
Describe the relationship between watts and joules
Define a 'closed system' and explain what happens to total energy when energy transfers happen in a closed system

Describe ways to reduce unwanted energy transfers
Describe methods to investigate the effectiveness of different insulators
Describe factors that affect the thermal conductivity of a building
Describe the use, reliability and environmental impacts of renewable and non-renewable energy resources

BLOCK 2: YEAR 9 PHYSICS

P2 Electricity

Describe what is meant by an electric current and calculate it using $Q=It$
Describe what is meant by resistance and calculate values for it using Ohm's Law
Calculate current, voltage and resistance in series and parallel circuits
Recognise, describe and explain the shape of current-voltage graphs for a filament bulb, ohmic resistor and a diode
Use and recognise the symbols for all the circuit components covered
Calculate electrical power using $E=PT$, $P=I2R$, $P=VI$ and perform multi step calculations to do this
Calculate energy transferred using $E = Q \times V$
Describe and explain uses of LDRs – e.g switching on lights when it gets dark
Recognise, describe and explain the shape of IV graphs for filament lamp, diode, thermistor and LDR
Label the features and describe the safe operation of a 3 pin plug
Explain the difference between direct and alternating pd
Calculate electrical power and energy transferred for given appliances
Describe the features of the National Grid

P7 Magnetism and Electromagnetism

Describe the force between two poles of a magnet
Describe the difference between permanent and induced magnets
Explain how a current produces a magnetic field and how a solenoid can increase the strength
Explain how the interaction of a magnetic field induce by a current and a magnetic field between a horseshoe magnet can produce movement of the wire
Explain the motor effect and use Flemings left hand rule to predict direction of movement
Describe factors that can affect the size of the force acting on a wire and use F=BIl to calculate it
Explain how an electric motor can produce a turning effect

BLOCK 3: YEAR 9 CHEMISTRY

C1 Atomic Structure and the Periodic Table

Describe the structure of an atom and calculate numbers of protons, neutrons and electrons given a periodic table
Describe the development of the nuclear model of the atom from earlier models – e.g the plum pudding
Describe how mixtures can be separated using filtration, evaporation, distillation and chromatography
Compare the size of atoms to other items
Explain what is meant by an isotope and calculate the Atomic mass of an element given the percentage abundance of its isotopes
Draw the electron configuration for any of the first 20 elements in the periodic table.
Describe some of the steps in the development of the Periodic Table
Describe how atoms become ions and represent this using diagrams
Explain why group 0 do not form ions and describe the properties of group 0 elements
Describe the properties of the Group 1 metals and their reactions with oxygen and water
Explain why Group 1 reactivity increases going down the group
Describe the properties of group 7 elements.
Describe and explain the trend in reactivity of group 7 down the group
Interpret practical observations to prove reactivity in group 7 – ie displacement of less reactive halogens

C3 Quantitative Chemistry

Explain what is meant by 'conservation of mass' and apply it to chemical equations
Calculate relative formula mass
Know that a mole represents 6.02 x 10^{23} atoms or molecules and is equal to the atomic or formula mass in grams
Use the equation Mass = Mr x moles to work out number of moles, mass or formula mass, given the other two
Calculate the mass of reactants and products in a symbol equation and use these to predict the masses of reactants needed or products expected
Use moles to balance symbol equations
Calculate the mass of a given solid in a specified volume of a solution of a given concentration

C4 Chemical Change

Define the terms oxidation and reduction in terms of reactions with oxygen
Identify which substances have been oxidised or reduced in a given equation in terms of gain or loss of oxygen
Evaluate metal extraction methods given appropriate information
Describe the reactions of K, Na, Li, Ca, Mg, Zn, Fe and Cu with dilute acids and water
Derive the reactivity series for metals given information about displacement reactions

Explain reactivity in terms of a metal's tendency to form ions
Identify which species has been oxidised and which has been reduced in terms of gain or loss of electrons in given equations
Write half equations for oxidation and reduction
Describe the test for hydrogen gas
Describe the formation of a soluble salt by neutralising acids with metal oxides or metal carbonates
Explain why the reactions of acids and metals are redox reactions
Describe the reactions of acids and alkalis and the use of indicators
Explain the meaning of the terms 'strong' and 'weak' acids
Explain the process of electrolysis in terms of movement of ions to the electrodes and the loss or gain of electrons
Describe the extraction of Aluminium from its oxide using electrolysis
Predict the products from the electrolysis of solutions and explain why hydrogen is often given off at the cathode
Write half equations for the reactions at the electrodes

BLOCK 4: YEAR 9 BIOLOGY

B2 Organisation

Name the organs in the digestive system
Use the 'lock and key' model to explain how enzymes work
Name the three digestive enzymes, what they act on and what the products are
Explain why digestion of food is necessary
Explain the functions of bile and hydrochloric acid in digestion
Describe the chemical tests for sugar, starch, fat and protein and their results
Label a diagram of the major structures of the heart
Label a diagram of the major structures of the lungs
Describe how the heart rate is normally regulated and the use of artificial pacemakers
Describe the features of arteries, veins and capillaries
Name and describe the functions of the four components of blood
Describe what 'coronary heart disease' is, describe and evaluate treatment options
Describe some of the diseases linked with lifestyle factors
Describe the causes of cancer and what is meant by 'benign' and 'malignant' tumours
Name the different plant tissues and describe how they are adapted for their function
Explain how transpiration happens and describe factors that can affect the rate
Explain what is meant by 'translocation'

B3 Infection and Response

Define the term 'pathogen'

Describe the spread and symptoms of viral diseases such as measles, HIV and Tobacco Mosaic Virus (TMV)

Describe the spread and symptoms of the bacterial infections Salmonella and Gonorrhoea

Describe the symptoms, spread and treatment of the fungal disease rose black spot

Describe the spread of and the prevention of malaria by protists

Describe the main physical barriers humans have to infection

Describe how white cells fight pathogens that do get into the body

Explain how vaccinations prevent disease

Explain the use of antibiotics and other medicines in treating diseases

Describe the origins of many drugs and how new drugs are developed, including the use of placebos

YEAR 10

BLOCK 1: YEAR 10 BIOLOGY

B1 Cells & Microscopy

Label the major features of animal, plant and bacterial cells
Describe differences between animal and plant cells
Describe the functions of all the parts – e.g nucleus, ribosomes etc
Use Magnification=Image/Actual to calculate size of cells or magnification
Use prefixes centi, milli, micro and nano and change numbers between units
Describe what is meant by 'differentiation' or specialisation
Relate a cells specialised features to its function
Describe how microscopy has developed over time and give advantages of the electron microscope over the light microscope
Describe the stages in the cell cycle
Recognise & define mitosis and give examples where it may occur
Define the term 'stem cells'
Name sources of stem cells and describe their use – adult, embryo and meristem
Evaluate the use of stem cells in medical research and treatments
Describe diffusion and the factors that can affect the rate
Describe how organs and surfaces are specialised for effective diffusion – lungs, gills in fish, roots and leaves in plants
Define the term osmosis and give examples of where it happens
Define the term 'Active Transport' and explain why it is necessary

B5 Homeostasis and Response

Define homeostasis and explain why it is important
Give examples of conditions that are maintained in the body
Name the different types of receptor humans have and describe how they react to a stimulus
Know what the words receptor, sensory neurone, relay neurone, motor neurone, effector and synapse refer to and use them to describe a response
Describe how nerve impulses travel and how they cross the synapse
Explain what a reflex is and be able to label a diagram of a reflex arc
Describe how the parts of the nervous system are adapted for their function
Explain the importance of reflexes
Describe a method to test reaction time, identifying variables and processing data obtained
Describe the functions of the cortex, cerebellum and medulla and label these on a diagram of the brain
Explain some of the difficulties involved in studying brain function and treating brain disease
Label the parts of the eye and describe their functions
Describe how the eye adapts to focus on near and far objects

Describe common defects of the sight and how they are corrected (short sightedness and long sightedness)

State that body temperature is monitored and controlled using vasoconstriction and vasodilation

Explain how body temperature is monitored and controlled, including vasoconstriction and vasodilation

Describe the structure and function of the endocrine system, identifying major endocrine glands in the human body

Describe what a hormone is and explain the main differences between hormonal and nervous responses

Describe how blood sugar varies and is normally controlled by insulin

Describe the role of glucagon in maintaining blood sugar levels, including negative feedback

Describe and compare Type 1 and Type 2 diabetes in terms of problems in the control of sugar and treatments

Name and describe the effects of the hormones involved in controlling the female menstrual cycle

Describe the interaction of FSH, LH, oestrogen and progesterone in the menstrual cycle and interpret graphs of hormone levels

Describe and evaluate forms of contraception (pill, injection, condom, IUD, spermidical agents, sterilisation, diaphragm etc)

Describe the use of fertility treatments & IVF and evaluate them in terms of cost, ethics, medical/health, success rates, stress on the parents,

Define negative feedback

Describe the roles of adrenaline and thryroxine in the body and explain how thyroxine levels are controlled by negative feedback

B7 Ecology

Describe and explain adaptations for animals and plants – especially ones that live in extreme conditions – deserts, poles etc

Explain what 'extremophiles' are and give examples

Define biotic and abiotic factors and explain how they can affect the organisms in a community

Describe the flow of energy through food chains

Describe methods of determining abundance of organisms within a habitat – using quadrats.

Name the processes involved in the cycling of carbon and water and describe the importance of this

Explain how waste, pollution, deforestation and global warming have impacted biodiversity

Describe some of the biological consequences of global warming

Describe measures to restore biodiversity and evaluate them

BLOCK 2: YEAR 10 CHEMISTRY

C8 Chemical Analysis

Define a pure substance and a formulation
Describe how purity can be checked using melting and boiling points
Give some examples of formulations
Describe how soluble substances can be separated using paper chromatography
Interpret chromatograms
Calculate Rf values for given chromatograms
Describe the test and positive results for chlorine gas, hydrogen, oxygen and carbon dioxide

C2 Bonding, Structure, and the Properties of Matter

Describe the particle arrangement in solids, liquids and gases and explain how changes of state occur
Describe the formation of ionic bonds between metal and non-metal atoms and represent this in diagrams and models
Use dot and cross diagrams to show the transfer of electrons in ionic bonding
Describe the properties of ionic compounds
Represent covalent bonds using dot and cross diagrams
Describe the properties of simple and giant covalent substances
Describe the structure and bonding of carbon in the forms of diamond, graphite and fullerenes and relate their properties to the bonding
Represent the bonding in polymers using diagrams and explain why most polymers are solids at room temperature
Describe the bonding in metals and relate the properties of metals to the bonding
Define nanoparticles and explain why their properties are different than the substance in bulk
Describe some concerns about the use of nanoparticles

C7 Organic Chemistry

Define a hydrocarbon
Describe the structure of crude oil
Describe uses of crude oil – fuels, feedstock for petrochemicals etc
Name and draw the first five alkanes
Describe how the properties of alkanes change with increasing chain length
Describe how the different chain lengths are separated using fractional distillation
Describe complete and incomplete combustion of alkanes and represent and recognise equations showing this
Explain why cracking is necessary
Describe different methods for cracking
State the products of cracking
Represent cracking using equations

C10 Using Resources

Explain the difference between finite and renewable resources
Evaluate the extraction of finite resources – jobs, economy, energy use, pollutants such as CO_2
Define the term 'sustainable development'
Define the term 'low grade ore'
Explain how phytomining and bioleaching can be used to extract metals such as copper from low grade ore sites
Explain the benefits of recycling or reusing metals, glass and plastics
Explain what a 'life cycle assessment' is and why they may be biased
Explain what 'potable' water is
Describe how water can be made potable using distillation, filtration and sterilisation and desalination
Evaluate the production of potable water using distillation and desalination
Label the equipment used to distil water and explain the processes involved
Explain the stages in sewage water treatment

BLOCK 3: YEAR 10 PHYSICS

P3 Particle Model of Matter

Describe density in terms of particle arrangement
Use Density = mass/volume to calculate values and use the correct units
Explain the term 'internal energy'
Describe differences in particle arrangement and energy in solids, liquids and gases
Explain what happens to particles during a change of state
Use the equation E=mL to calculate mass, specific latent heat or energy
Distinguish between specific heat capacity and specific latent heat
Define the terms specific latent heat, latent heat of fusion, latent heat of vaporisation
Explain the term 'gas pressure' and explain how temperature affects this

P4 Atomic Structure

Label the parts of an atom and state approximate sizes of the atom and the nucleus
Explain what might cause changes in distance of electrons from the nucleus
(Review the plum pudding model of the atom and how the atomic model has changed over time – e.g Rutherford's scattering experiment; Review how the plum pudding model compares with the modern model of the atom)
Describe what is meant by an isotope and compare given isotopes
Describe the properties and origins of alpha, beta and gamma radiation
Describe how radiation levels are measured and give the unit
Complete nuclear equations for alpha and beta decay

Describe what is meant by the half-life of a radioactive isotope and obtain values for this from a decay curve
Choose an appropriate source for a particular purpose, given some information
Explain the difference between contamination and irradiation and compare the hazards of each

P5a Forces

Name contact and non-contact forces and describe their interaction
Define scalar and vector quantities and give examples of each
Calculate resultant forces
Define weight and use w=mxg to calculate any one of those values
Define 'centre of mass'
Draw free body diagrams to scale including resolving forces at different angles
Know the equation to calculate work done and apply this to find work done, force or distance
Describe the relationship between joules and newton-metres and convert between them
Give examples of forces involved in stretching or compression and explain the difference between elastic deformation and inelastic deformation
Describe the features of a graph of force applied versus the extension of a spring
Know Hooke's Law (f = ke) and apply it in stretching or compression scenarios
Calculate work done during stretching or compressing using e= ½ k x e2

P6 Waves

Describe the origin and properties of longitudinal and transverse waves and give examples
Calculate frequency of waves using frequency = number of waves/time and use Hz as the unit
Use the wave equation to calculate wave speed, frequency or wavelength including using standard form
Describe properties of all EM waves
Name the 7 EM waves and describe their uses and dangers
Link uses of EM waves to their properties
Describe three things that can happen to waves when they meet an object
Explain what happens to waves as they travel into more or less dense materials
Label a diagram to show refraction of light, including the normal and angles of incidence and refraction
Describe ways of measuring wave speed– e.g ripple tank, waves on a string
Describe how to measure the speed of sound and know it's approximate value in air
Explain how radio waves are generated by oscillating charges in the transmitter and how this generates a current in the receiver
Explain how microwaves can be used to communicate with satellites and how microwaves of a different wavelength can be used to cook food
Explain how IR radiation emission and absorption is affected by surface and describe an investigation to measure this
Explain some of the dangers of EM waves and how the radiation dose is measured

YEAR 11

BLOCK 1

B6 Inheritance, Variation and Evolution

Explain what is meant by the terms 'sexual' and 'asexual' reproduction and the differences between them.
Describe the main stages of the production of gametes by meiosis
Explain the differences between mitosis and meiosis in terms of daughter cells
Describe the importance of understanding the genome
Define key genetic terms – allele, heterozygous, homozygous, dominant, recessive, genotype and phenotype
Complete punnett squares to show the possibilities for offspring of a genetic cross and interpret them using direct proportion and ratios
Describe the chromosome make up of men and women and use genetic crosses to show how gender is inherited
Use and interpret family tree diagrams
Construct genetic diagrams and use theory of probability to interpret results
Describe the inheritance of the diseases polydactyly and cystic fibrosis
Evaluate the use of embryo screening to prevent these and other inherited diseases
Describe the work of Mendel and interpret data about his results
Explain why Darwin's theory of natural selection was not well accepted at first and contrast his theory with that of Lamarck
Define the reasons for variation within a species and across species
Explain the role of mutations in variation
Describe the theory of evolution
Apply the theory of natural selection to explain how organisms have changed over time
Explain how different species arise over time
Describe the work of Wallace in developing our understanding of evolution by natural selection
Describe 'selective breeding' and give examples of where it is used
Give the disadvantages of selective breeding in terms of the gene pool
Describe how plants, animals and bacteria can be genetically engineered and evaluate this – e.g +/- of genetically modified foods, production of insulin by GM bacteria
Describe the main steps in genetic engineering of crops and bacteria
Describe the evidence for evolution – fossils, antibiotic resistant bacteria etc
Explain what fossils show, how they were formed and why the fossil record is incomplete
Interpret evolutionary trees and explain why organisms may go extinct
Explain how antibiotic resistant bacteria form and how we can try to prevent this
Describe Linnaeus' classification system
Describe the more recent 'three-domain' system

C6 The rate and extent of chemical change

Describe ways of measuring rates of reaction – e.g mass/volume of product in a specific amount of time

Use collision theory to explain why rates of reaction slow down as they progress

Describe and explain patterns in graphs showing rates of reaction

Calculate rates of reaction given data or graphs, using change/time, including drawing tangents to a curve

Describe and explain how reactions are affected by temperature, concentration, surface area, pressure (gaseous reactions) & catalysts

Explain what is meant by a reversible reaction and know how to represent them in equations

Define the terms 'closed system', 'yield' and 'dynamic equilibrium'

Predict the energy change in a reversible reaction given information about one of the reactions

Describe factors that can affect the position of equilibrium

Apply Chatelier's principle to any given reaction to predict the effects on yield of changing temperature, pressure or concentration of reactants

Predict optimum yield conditions given some information about a reversible reaction

Explain why the conditions chosen industrially are often 'compromise' conditions

C9 Chemistry of the Atmosphere

Give the approximate composition of Earth's atmosphere today

Describe the likely composition of Earth's early atmosphere

Describe and explain how Earth's atmosphere has changed – condensation, sedimentation, photosynthesis etc

Name the two greenhouse gases and explain why their concentration in the atmosphere is increasing

Explain the 'greenhouse effect' and how this is linked to climate change

Describe some of the consequences of climate change

Define 'carbon footprint' and give ways of reducing it

Describe how carbon monoxide, soot, sulphur dioxide and nitrogen oxides are made

Explain the environmental problems linked to soot, sulphur dioxide, nitrogen oxides and carbon monoxide

P5b Motion

Interpret distance-time graphs to calculate velocity and total distance moved

Explain the difference between distance and displacement

Know typical values for speed for walking, running, cycling and sensible values for car, train and airplane speeds

Describe the difference between velocity and speed and calculate them using s=d/t

Describe circular motion in terms of speed and direction

Interpret distance time graphs to find speed, **including drawing a tangent if the object is accelerating**

Describe what is meant by acceleration

Calculate the acceleration or deceleration of an object using a=v-u/t, using negative values to represent deceleration

Use uniform acceleration equation to calculate acceleration, velocity or distance

Know that acceleration under gravity is 9.8 m/s²

Interpret velocity-time graphs to calculate acceleration and total distance/displacement

Describe the change in forces that occur during free fall of an object through a fluid

Define terminal velocity

Apply Newton's first law to predict the effect of balanced and unbalanced forces on stationary and moving objects

Use Newton's second law (f=ma) to calculate force, mass or acceleration

Apply Newton's third law to equilibrium situations – ie describe how forces exerted by two objects interacting are equal and opposite

Define the terms stopping distance, thinking distance and braking distance and know how speed affects overall stopping distance

Explain how reaction time can affect thinking distance and how this can be measured

Describe physical factors that can affect braking distance – condition of tyres, road etc

Explain why large decelerations are dangerous **and estimate values forces involved in deceleration of road vehicles**

Describe what is meant by momentum and calculate values from an equation

Explain what is meant by 'conservation of momentum' and apply this in calculations

BLOCK 2: REVISION / MOCK EXAMS

BLOCK 3: EXAM SKILLS / REVISION PROGRAMME