Grade 8 Learning Outcomes

Below are the learning outcomes of the course stating what students are expected to know/be able to do upon completion of the course.

Schoolwide Learner Outcomes

The 5 Steps Academy students develop the following global competencies (to the extent reasonable for their age group) to thrive in the unpredictable and fast-changing:

- Courage to try and make mistakes and the ability to learn from mistakes.
- Respect people regardless of their age, gender, nationality, religion, beliefs, or opinions.
- Discipline in self-development and achievement of dreams.

Mathematics

By the end of the course students should be able to:

- Identify monomials
- Add and subtract polynomials
- Multiply and divide monomials
- Understand powers of monomials
- Find square and cube roots of monomials
- Multiply binomials
- Understand standard form
- Solve proportions
- Understand and apply transformation:
    - Identify reflections, rotations and translations
    - Translations: graph the image
    - Translations: find the coordinates
    - Reflections: graph the image
    - Reflections: find the coordinates
    - Rotations: graph the image
    - Rotations: find the coordinates
    - Dilations: graph the image
    - Dilations: find the coordinates
    - Dilations: scale factor and classification
    - Stretches
    - Combinations of transformations
- Understand and apply Pythagoras' theorem and converse Pythagoras' theorem
- Factorise out a monomial
- Factorise quadratics with leading coefficient 1
- Factorise quadratics with other leading coefficients
- Factorise quadratics: special cases
- Understand characteristics of quadratic functions
- Solve a quadratic equation by factorising
- Factorise by grouping
- Complete the square

- Solve a quadratic equation by completing the square
- Solve a quadratic equation using the quadratic formula
- Understand simultaneous equations:
    - Find out if (x, y) is a solution to the simultaneous equations
    - Solve simultaneous equations by graphing
    - Solve simultaneous equations using substitution
    - Solve simultaneous equations using elimination
- Graph an absolute value function
- Understand basic trigonometry:
    - Trigonometric ratios: sin, cos and tan
    - Find trigonometric functions of special angles
    - Find trigonometric functions using a calculator
    - Inverses of trigonometric functions
    - Trigonometric ratios: find a side length
    - Trigonometric ratios: find an angle measure
- Change the subject.
- Simplify algebraic fractions
- Solve direct and inverse proportionality word problems.
- Understand complex numbers
- Perform polynomial division
- Understand polynomial graphs
- Understand modelling
- Understand rational exponents and radicals
- Understand logarithms and solve basic logarithmic equations

English

By the end of the course students should be able to:

- read easily, fluently and with good understanding
- develop the habit of reading widely and often, for both pleasure and information
- acquire a wide vocabulary, an understanding of grammar and knowledge of linguistic conventions for reading, writing and spoken language
- appreciate our rich and varied literary heritage
- write clearly, accurately and coherently, adapting their language and style in and for a range of contexts, purposes and audiences
- use discussion in order to learn; they should be able to elaborate and explain clearly their understanding and ideas
- are competent in the arts of speaking and listening, making formal presentations, demonstrating to others and participating in debate.

Grammar and Vocabulary:

- Memorize and correctly apply the meanings of 250 core words.
- Consolidate and build on their knowledge of grammar and vocabulary through:

- extending and applying the grammatical knowledge set out in Primary programmes of study to analyse more challenging texts
- studying the effectiveness and impact of the grammatical features of the texts they read
- drawing on new vocabulary and grammatical constructions from their reading and listening, and using these consciously in their writing and speech to achieve particular effects
- knowing and understanding the differences between spoken and written language, including differences associated with formal and informal registers, and between Standard English and other varieties of English
- using Standard English confidently in their own writing and speech
- discussing reading, writing and spoken language with precise and confident use of linguistic and literary terminology.

Reading

- develop an appreciation and love of reading, and read increasingly challenging material independently through:
  - reading a wide range of fiction and non-fiction, including in particular whole books, short stories, poems and plays with a wide coverage of genres, historical periods, forms and authors. The range will include high-quality works from:
    - English literature, both pre-1914 and contemporary, including prose, poetry and drama
    - Shakespeare (two plays)
    - seminal world literature
  - choosing and reading books independently for challenge, interest and enjoyment.
  - re-reading books encountered earlier to increase familiarity with them and provide a basis for making comparisons.
- understand increasingly challenging texts through:
  - learning new vocabulary, relating it explicitly to known vocabulary and understanding it with the help of context and dictionaries
  - making inferences and referring to evidence in the text
  - knowing the purpose, audience for and context of the writing and drawing on this knowledge to support comprehension
  - checking their understanding to make sure that what they have read makes sense.
- read critically through:
  - knowing how language, including figurative language, vocabulary choice, grammar, text structure and organisational features, presents meaning
  - recognising a range of poetic conventions and understanding how these have been used
  - studying setting, plot, and characterisation, and the effects of these

- understanding how the work of dramatists is communicated effectively through performance and how alternative staging allows for different interpretations of a play
- making critical comparisons across texts
- studying a range of authors, including at least two authors in depth each year.

Writing

- write accurately, fluently, effectively and at length for pleasure and information through:
  - writing for a wide range of purposes and audiences, including:
    - well-structured formal expository and narrative essays
    - stories, scripts, poetry and other imaginative writing
    - notes and polished scripts for talks and presentations
    - a range of other narrative and non-narrative texts, including arguments, and personal and formal letters
  - summarising and organising material, and supporting ideas and arguments with any necessary factual detail
  - applying their growing knowledge of vocabulary, grammar and text structure to their writing and selecting the appropriate form
  - drawing on knowledge of literary and rhetorical devices from their reading and listening to enhance the impact of their writing
- plan, draft, edit and proof-read through:
  - considering how their writing reflects the audiences and purposes for which it was intended
  - amending the vocabulary, grammar and structure of their writing to improve its coherence and overall effectiveness
  - paying attention to accurate grammar, punctuation and spelling; applying the spelling patterns and rules set out in Primary programmes of study for English.

Public Speaking

- Speak coherently and with ease in front of a large audience.
- speak confidently and effectively, including through:
  - using Standard English confidently in a range of formal and informal contexts, including classroom discussion
  - giving short speeches and presentations, expressing their own ideas and keeping to the point
  - participating in formal debates and structured discussions, summarising and/or building on what has been said
  - improvising, rehearsing and performing play scripts and poetry in order to generate language and discuss language use and meaning, using role, intonation, tone, volume, mood, silence, stillness and action to add impact.

Students must meet the following standards:

- **Multimedia Proficiency:** Student knows how to use PowerPoint or other presentation software effectively. Students should understand how to use appropriate backgrounds and the right font size for headings. Headings on each page capture the main point; bullet points are to be used to aid comprehension. Students should understand how to use images in a way that doesn't distract from the presentation.

- **Coherence:** Presentation has discernible parts and transitions. There is a build-up from start to finish. Organization improves ease of understanding.

- **Projection/Articulation:** Every word is clearly heard. Pace is even and agreeable.

- **Preparation:** Sufficient research has been done such that the presentation is of substance rather than comprising mostly of general statements and guesswork.

Physics

By the end of the course students should be able to:

2 Thermal physics

2.1 Simple kinetic molecular model of matter

2.1.1 States of matter

Core

- State the distinguishing properties of solids, liquids and gases

2.1.2 Molecular model

Core

- Describe qualitatively the molecular structure of solids, liquids and gases in terms of the arrangement, separation and motion of the molecules
- Interpret the temperature of a gas in terms of the motion of its molecules
- Describe qualitatively the pressure of a gas in terms of the motion of its molecules
- Show an understanding of the random motion of particles in a suspension as evidence for the kinetic molecular model of matter
- Describe this motion (sometimes known as Brownian motion) in terms of random molecular bombardment

Supplement

- Relate the properties of solids, liquids and gases to the forces and distances between molecules and to the motion of the molecules
- Explain pressure in terms of the change of momentum of the particles striking the walls creating a force
- Show an appreciation that massive particles may be moved by light, fast-moving molecules

2.1.3 Evaporation

Core

- Describe evaporation in terms of the escape of more-energetic molecules from the surface of a liquid
- Relate evaporation to the consequent cooling of the liquid

Supplement

- Demonstrate an understanding of how temperature, surface area and draught over a surface influence evaporation
- Explain the cooling of a body in contact with an evaporating liquid

2.1.4 Pressure changes

Core

- Describe qualitatively, in terms of molecules, the effect on the pressure of a gas of:
  - a change of temperature at constant volume
  - a change of volume at constant temperature

Supplement

- Recall and use the equation

pV= constant for a fixed mass of gas at constant temperature

2.2 Thermal properties and temperature

2.2.1 Thermal expansion of solids, liquids and gases

Core

- Describe qualitatively the thermal expansion of solids, liquids, and gases at constant pressure
- Identify and explain some of the everyday applications and consequences of thermal expansion

Supplement

- Explain, in terms of the motion and arrangement of molecules, the relative order of the magnitude of the expansion of solids, liquids and gases

2.2.2 Measurement of temperature

Core

- Appreciate how a physical property that varies with temperature may be used for the measurement of temperature, and state examples of such properties
- Recognise the need for and identify fixed points
- Describe and explain the structure and action of liquid-in-glass thermometers

Supplement

- Demonstrate understanding of sensitivity, range and linearity

- Describe the structure of a thermocouple and show understanding of its use as a thermometer for measuring high temperatures and those that vary rapidly
- Describe and explain how the structure of a liquid-in-glass thermometer relates to its sensitivity, range and linearity

2.2.3 Thermal capacity (heat capacity)

Core
- Relate a rise in the temperature of a body to an increase in its internal energy
- Show an understanding of what is meant by the thermal capacity of a body

Supplement
- Give a simple molecular account of an increase in internal energy
- Recall and use the equation thermal capacity mc
- Define specific heat capacity
- Describe an experiment to measure the specific heat capacity of a substance
- Recall and use the equation change in energy = $mc\Delta T$

2.2.4 Melting and boiling

Core
- Describe melting and boiling in terms of energy input without a change in temperature
- State the meaning of melting point and boiling point
- Describe condensation and solidification in terms of molecules

Supplement
- Distinguish between boiling and evaporation
- Use the terms latent heat of vaporisation and latent heat of fusion and give a molecular interpretation of latent heat
- Define specific latent heat
- Describe an experiment to measure specific latent heats for steam and for ice
- Recall and use the equation energy = ml

2.3 Thermal processes

2.3.1 Conduction

Core
- Describe experiments to demonstrate the properties of good and bad thermal conductors

Supplement
- Give a simple molecular account of conduction in solids including lattice vibration and transfer by electrons

2.3.2 Convection

Core
- Recognise convection as an important method of thermal transfer in fluids
- Relate convection in fluids to density changes and describe experiments to illustrate convection

2.3.3 Radiation

Core
- Identify infrared radiation as part of the electromagnetic spectrum
- Recognise that thermal energy transfer by radiation does not require a medium
- Describe the effect of surface colour (black or white) and texture (dull or shiny) on the emission, absorption and reflection of radiation

Supplement
- Describe experiments to show the properties of good and bad emitters and good and bad absorbers of infrared radiation
- Show understanding that the amount of radiation emitted also depends on the surface temperature and surface area of a body

2.3.4 Consequences of energy transfer

Core
- Identify and explain some of the everyday applications and consequences of conduction, convection and radiation

3 Properties of waves, including light and sound

3.1 General wave properties

Core
- Demonstrate understanding that waves transfer energy without transferring matter
- Describe what is meant by wave motion as illustrated by vibration in ropes and springs and by experiments using water waves
- Use the term wavefront
- Give the meaning of speed, frequency, wavelength and amplitude
- Distinguish between transverse and longitudinal waves and give suitable examples
- Describe how waves can undergo:
  - reflection at a plane surface
  - refraction due to a change of speed
  - diffraction through a narrow gap
- Describe the use of water waves to demonstrate reflection, refraction and diffraction

Supplement

- Recall and use the equation $v = f\lambda$
- Describe how wavelength and gap size affects diffraction through a gap
- Describe how wavelength affects diffraction at an edge

3.2 Light

3.2.1 Reflection of light

Core

- Describe the formation of an optical image by a plane mirror, and give its characteristics
- Recall and use the law

angle of incidence = angle of reflection

Supplement

- Recall that the image in a plane mirror is virtual
- Perform simple constructions, measurements and calculations for reflection by plane mirrors

3.2.2 Refraction of light

Core

- Describe an experimental demonstration of the refraction of light
- Use the terminology for the angle of incidence i and angle of refraction r and describe the passage of light through parallel-sided transparent material
- Give the meaning of critical angle
- Describe internal and total internal reflection

Supplement

- Recall and use the definition of refractive index n

in terms of speed

- Recall and use the equation $\sin i / \sin r = n$
- Recall and use $n=1/\sin c$
- Describe and explain the action of optical fibres particularly in medicine and communications technology

3.2.3 Thin converging lens

Core

- Describe the action of a thin converging lens on a beam of light
- Use the terms principal focus and focal length
- Draw ray diagrams for the formation of a real image by a single lens
- Describe the nature of an image using the terms enlarged/same size/diminished and upright/ inverted

Supplement

- Draw and use ray diagrams for the formation of a virtual image by a single lens
- Use and describe the use of a single lens as a magnifying glass
- Show understanding of the terms real image and virtual image

3.2.4 Dispersion of light

Core

- Give a qualitative account of the dispersion of light as shown by the action on light of a glass prism including the seven colours of the spectrum in their correct order

Supplement

- Recall that light of a single frequency is described as monochromatic

3.3 Electromagnetic spectrum

Core

- Describe the main features of the electromagnetic spectrum in order of wavelength
- State that all electromagnetic waves travel with the same high speed in a vacuum
- Describe typical properties and uses of radiations in all the different regions of the electromagnetic spectrum including:
  - radio and television communications (radio waves)
  - satellite television and telephones (microwaves)
  - electrical appliances, remote controllers for televisions and intruder alarms (infrared)
  - medicine and security (X-rays)
- Demonstrate an awareness of safety issues regarding the use of microwaves and X-rays

Supplement

- State that the speed of electromagnetic waves in a vacuum is 3.0×10^8 m / s and is approximately the same in air

3.4 Sound

Core

- Describe the production of sound by vibrating sources
- Describe the longitudinal nature of sound waves
- State that the approximate range of audible frequencies for a healthy human ear is 20 Hz to 20 000 Hz
- Show an understanding of the term ultrasound
- Show an understanding that a medium is needed to transmit sound waves
- Describe an experiment to determine the speed of sound in air
- Relate the loudness and pitch of sound waves to amplitude and frequency
- Describe how the reflection of sound may produce an echo

Supplement
- Describe compression and rarefactio
- State typical values of the speed of sound in gases, liquids and solids

Chemistry

By the end of the course students should be able to:

4 Stoichiometry

Core
- Use the symbols of the elements and write the formulae of simple compounds
- Deduce the formula of a simple compound from the relative numbers of atoms present
- Deduce the formula of a simple compound from a model or a diagrammatic representation
- Construct word equations and simple balanced chemical equations
- 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
- Define relative molecular mass, Mr, as the sum of the relative atomic masses. (Relative formula mass or Mr will be used for ionic compounds.)
(Calculations involving reacting masses in simple proportions may be set. Calculations will not involve the mole concept.)

Supplement
- Determine the formula of an ionic compound from the charges on the ions present
- Construct equations with state symbols, including ionic equations
- Deduce the balanced equation for a chemical reaction, given relevant information

4.2 The mole concept
Supplement
- Define the mole and the Avogadro constant
- Use the molar gas volume, taken as 24 dm3 at room temperature and pressure
- 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. Questions on the gas laws and the conversion of gaseous volumes to different temperatures and pressures will not be set.)
- Calculate empirical formulae and molecular formulae
- Calculate percentage yield and percentage purity

5 Electricity and chemistry

5.1 Electricity and chemistry

Core

- Define electrolysis as the breakdown of an ionic compound, molten or in aqueous solution, by the passage of electricity
- Describe the electrode products and the observations made during the electrolysis of:
  - molten lead(II) bromide
  - concentrated hydrochloric acid
  - concentrated aqueous sodium chloride
  - dilute sulfuric acid

  between inert electrodes (platinum or carbon)
- 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)
- Predict the products of the electrolysis of a specified binary compound in the molten state
- Describe the electroplating of metals
- Outline the uses of electroplating

Supplement

- 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)
- Describe electrolysis in terms of the ions present and reactions at the electrodes in the examples given
- Predict the products of electrolysis of a specified halide in dilute or concentrated aqueous solution
- Construct ionic half-equations for reactions at the cathode

continued

5.1 Electricity and chemistry continued

Core

- Describe the reasons for the use of copper and (steel-cored) aluminium in cables, and why plastics and ceramics are used as insulators

Supplement

- Describe the transfer of charge during electrolysis to include:
  - the movement of electrons in the metallic conductor
  - the removal or addition of electrons from the external circuit at the electrodes
  - the movement of ions in the electrolyte
- Describe the production of electrical energy from simple cells, i.e. two electrodes in an electrolyte.
- Describe, in outline, the manufacture of:

– aluminium from pure aluminium oxide in molten cryolite
– chlorine, hydrogen and sodium hydroxide from concentrated aqueous sodium chloride

6 Chemical energetics

6.1 Energetics of a reaction

Core
- Describe the meaning of exothermic and endothermic reactions
- Interpret energy level diagrams showing exothermic and endothermic reactions

Supplement
- Describe bond breaking as an endothermic process and bond forming as an exothermic process
- Draw and label energy level diagrams for exothermic and endothermic reactions using data provided
- Calculate the energy of a reaction using bond energies

6.2 Energy transfer

Core
- Describe the release of heat energy by burning fuels
- State the use of hydrogen as a fuel
- Describe radioactive isotopes, such as 235U, as a source of energy

Supplement
- Describe the use of hydrogen as a fuel reacting with oxygen to generate electricity in a fuel cell. (Details of the construction and operation of a fuel cell are not required.)

7 Chemical reactions

7.1 Physical and chemical changes

Core
- Identify physical and chemical changes, and understand the differences between them

7.2 Rate (speed) of reaction

Core

- Describe and explain the effect of concentration, particle size, catalysts (including enzymes) and temperature on the rate of reactions
- Describe the application of the above factors to the danger of explosive combustion with fine powders (e.g. flour mills) and gases (e.g. methane in mines)
- Demonstrate knowledge and understanding of a practical method for investigating the rate of a reaction involving gas evolution
- Interpret data obtained from experiments concerned with rate of reaction

Note: Candidates should be encouraged to use the term rate rather than speed.

Supplement

- Devise and evaluate a suitable method for investigating the effect of a given variable on the rate of a reaction
- Describe and explain the effects of temperature and concentration in terms of collisions between reacting particles. (An increase in temperature causes an increase in collision rate and more of the colliding molecules have sufficient energy (activation energy) to react whereas an increase in concentration only causes an increase in collision rate.)
- Describe and explain the role of light in photochemical reactions and the effect of light on the rate of these reactions. (This should be linked to section 14.4.)
- Describe the use of silver salts in photography as a process of reduction of silver ions to silver; and photosynthesis as the reaction between carbon dioxide and water in the presence of chlorophyll and sunlight (energy) to produce glucose and oxygen

7.3 Reversible reactions

Core

- 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.)

Supplement

- Predict the effect of changing the conditions (concentration, temperature and pressure) on other reversible reactions
- Demonstrate knowledge and understanding of the concept of equilibrium

7.4 Redox

Core

- Define oxidation and reduction in terms of oxygen loss/gain. (Oxidation state limited to its use to name ions, e.g. iron(II), iron(III), copper(II), manganate(VII).)

Supplement

- Define redox in terms of electron transfer

- Identify redox reactions by changes in oxidation state and by the colour changes involved when using acidified potassium manganate(VII), and potassium iodide. (Recall of equations involving $KMnO_4$ is not required.)
- Define oxidising agent as a substance which oxidises another substance during a redox reaction. Define reducing agent as a substance which reduces another substance during a redox reaction.
- Identify oxidising agents and reducing agents from simple equations

8 Acids, bases and salts

Core
- Describe the characteristic properties of acids as reactions with metals, bases, carbonates and effect on litmus and methyl orange
- Describe the characteristic properties of bases as reactions with acids and with ammonium salts and effect on litmus and methyl orange
- Describe neutrality and relative acidity and alkalinity in terms of pH measured using universal indicator paper (whole numbers only)
- Describe and explain the importance of controlling acidity in soil

Supplement
- Define acids and bases in terms of proton transfer, limited to aqueous solutions
- Describe the meaning of weak and strong acids and bases

Biology

By the end of the course students should be able to:

Supplement
- Define translocation in terms of the movement of sucrose and amino acids in phloem:
  – from regions of production (source)
  – to regions of storage OR to regions where they are used in respiration or growth (sink)
- Explain that some parts of a plant may act as a source and a sink at different times during the life of a plant

9 Transport in animals

Core
- Describe the circulatory system as a system of blood vessels with a pump and valves to ensure one-way flow of blood

Supplement
- Describe the single circulation of a fish

- Describe the double circulation of a mammal
- Explain the advantages of a double circulation

Core

- Name and identify the structures of the mammalian heart, limited to the muscular wall, the septum, the left and right ventricles and atria, one-way valves and coronary arteries
- State that blood is pumped away from the heart into arteries and returns to the heart in veins
- State that the activity of the heart may be monitored by ECG, pulse rate and listening to sounds of valves closing
- Investigate and state the effect of physical activity on the pulse rate
- Describe coronary heart disease in terms of the blockage of coronary arteries and state the possible risk factors as diet, stress, smoking, genetic predisposition, age and gender

Supplement

- Name and identify the atrioventricular and semilunar valves in the mammalian heart
- Explain the relative thickness:
  – of the muscle wall of the left and right ventricles
  – of the muscle wall of the atria compared to that of the ventricles
- Explain the importance of the septum in separating oxygenated and deoxygenated blood
- Describe the functioning of the heart in terms of the contraction of muscles of the atria and ventricles and the action of the valves
- Explain the effect of physical activity on the heart rate
- Discuss the roles of diet and exercise in the prevention of coronary heart disease
- Describe ways in which coronary heart disease may be treated, limited to drug treatment with aspirin and surgery (stents, angioplasty and by- pass)

Core

- Describe the structure and functions of arteries, veins and capillaries
- Name the main blood vessels to and from the:
  – heart, limited to vena cava, aorta, pulmonary artery and pulmonary vein
  – lungs, limited to the pulmonary artery and pulmonary vein
  – kidney, limited to the renal artery and renal vein

Supplement

- Explain how the structures of arteries, veins and capillaries are adapted for their functions
- State the function of arterioles, venules and shunt vessels
- Outline the lymphatic system in terms of lymphatic vessels and lymph nodes
- Describe the function of the lymphatic system in the circulation of body fluids and the protection of the body from infection

Core

- List the components of blood as red blood cells, white blood cells, platelets and plasma
- Identify red and white blood cells, as seen under the light microscope, on prepared slides and in diagrams and photomicrographs
- State the functions of the following components of blood:
  - red blood cells in transporting oxygen, including the role of haemoglobin
  - white blood cells in phagocytosis and antibody production
  - platelets in clotting (details are not required)
  - plasma in the transport of blood cells, ions, soluble nutrients, hormones and carbon dioxide

Supplement

- Identify lymphocyte and phagocyte white blood cells, as seen under the light microscope, on prepared slides and in diagrams and photomicrographs
- State the functions of:
  - lymphocytes – antibody production
  - phagocytes – phagocytosis
- Describe the process of clotting as the conversion of fibrinogen to fibrin to form a mesh
- State the roles of blood clotting as preventing blood loss and preventing the entry of pathogens
- Describe the transfer of materials between capillaries and tissue fluid (details of the roles of water potential and hydrostatic pressure are not required)

10 Diseases and immunity

Core

- Define pathogen as a disease-causing organism
- Define transmissible disease as a disease in which the pathogen can be passed from one host to another
- State that the pathogen for a transmissible disease may be transmitted either through direct contact, e.g. through blood or other body fluids, or indirectly, e.g. from contaminated surfaces or food, from animals, or from the air
- State that the body has defences:
  - mechanical barriers, limited to skin and hairs in the nose
  - chemical barriers, limited to mucus and stomach acid
  - cells, limited to phagocytosis and antibody production by white blood cells
  - which can be enhanced by vaccination

Supplement

- State that antibodies lock on to antigens leading to direct destruction of pathogens, or marking of pathogens for destruction by phagocytes
- Explain how each pathogen has its own antigens, which have specific shapes, so specific antibodies which fit the specific shapes of the antigens are needed

- Define active immunity as defence against a pathogen by antibody production in the body
- Explain that active immunity is gained after an infection by a pathogen, or by vaccination
- Explain the process of vaccination:
  - harmless pathogen given which has antigens
  - antigens trigger an immune response by lymphocytes which produce antibodies
  - memory cells are produced that give long-term immunity

Core

- Explain the importance of hygienic food preparation, good personal hygiene, waste disposal and sewage treatment in controlling the spread of disease

Supplement

- Explain the role of vaccination in controlling the spread of diseases
- Explain that passive immunity is short-term defence against a pathogen by antibodies acquired from another individual, e.g. mother to infant
- State that memory cells are not produced in passive immunity
- Explain the importance of passive immunity for breast-fed infants
- State that some diseases are caused by the immune system targeting and destroying body cells, limited to Type 1 diabetes

11 Gas exchange in humans

Core

- List the features of gas exchange surfaces in humans, limited to large surface area, thin surface, good blood supply and good ventilation with air
- Name and identify the lungs, diaphragm, ribs, intercostal muscles, larynx, trachea, bronchi, bronchioles, alveoli and associated capillaries
- State the differences in composition between inspired and expired air, limited to oxygen, carbon dioxide and water vapour
- Use limewater as a test for carbon dioxide to investigate the differences in composition between inspired and expired air
- Investigate and describe the effects of physical activity on rate and depth of breathing

Supplement

- Name and identify the internal and external intercostal muscles
- State the functions of the cartilage in the trachea
- Explain the role of the ribs, the internal and external intercostal muscles and the diaphragm in producing volume and pressure changes in the thorax leading to the ventilation of the lungs
- Explain the differences in composition between inspired and expired air

- Explain the link between physical activity and rate and depth of breathing in terms of the increased carbon dioxide concentration in the blood, detected by the brain, causing an increased rate of breathing
- Explain the role of goblet cells, mucus and ciliated cells in protecting the gas exchange system from pathogens and particles

12 Respiration

Core
- State the uses of energy in the body of humans: muscle contraction, protein synthesis, cell division, active transport, growth, the passage of nerve impulses and the maintenance of a constant body temperature
- State that respiration involves the action of enzymes in cells

Core
- Define aerobic respiration as the chemical reactions in cells that use oxygen to break down nutrient molecules to release energy
- State the word equation for aerobic respiration as glucose + oxygen carbon dioxide + water
- Investigate the uptake of oxygen by respiring organisms, such as arthropods and germinating seeds

Supplement
- State the balanced chemical equation for aerobic respiration as C6H12O6 = 6O2 -> 6CO2 + 6H2O
- Investigate the effect of temperature on the rate of respiration of germinating seeds

Core
- Define anaerobic respiration as the chemical reactions in cells that break down nutrient molecules to release energy without using oxygen
- State the word equations for anaerobic respiration in muscles during vigorous exercise (glucose lactic acid) and
the microorganism yeast
(glucose alcohol + carbon dioxide)
- State that anaerobic respiration releases much less energy per glucose molecule than aerobic respiration

Supplement
- State the balanced chemical equation for anaerobic respiration in the microorganism yeast as C6H12O6 -> 2C2H5OH + 2CO2
- State that lactic acid builds up in muscles and blood during vigorous exercise causing an oxygen debt
- Outline how the oxygen debt is removed during recovery, limited to:
– aerobic respiration of lactic acid in the liver
– continuation, after exercise, of fast heart rate to transport lactic acid in blood from muscles to the liver

– continuation, after exercise, of deeper breathing supplying oxygen for aerobic respiration of lactic acid

13 Excretion in humans

Core
- State that urea is formed in the liver from excess amino acids
- State that carbon dioxide is excreted through the lungs
- State that the kidneys excrete urea and excess water and salts
- Explain that the volume and concentration of urine produced is affected by water intake, temperature and exercise
- Identify on drawings, diagrams and images, the ureters, bladder and urethra

Supplement
- Describe the role of the liver in the assimilation of amino acids by converting them to proteins, including plasma proteins, e.g. fibrinogen
- Define deamination as the removal of the nitrogen-containing part of amino acids to form urea
- Explain the need for excretion, limited to toxicity of urea and carbon dioxide
- Outline the structure of the kidney, limited to the cortex, medulla and ureter
- Outline the structure and functioning of a kidney tubule, including:

– the role of the glomerulus in the filtration from the blood of water, glucose, urea and salts

– the role of the tubule in the reabsorption of all of the glucose, most of the water and some salts back into the blood, leading to
the concentration of urea in the urine as well as loss of excess water and salts (details of these processes are not required)
- Explain dialysis in terms of salt balance, the maintenance of glucose concentration and the removal of urea
- Describe the use of dialysis in kidney machines
- Discuss the advantages and disadvantages of kidney transplants, compared with dialysis

14 Coordination and response

Core
- Describe a nerve impulse as an electrical signal that passes along nerve cells called neurones
- Describe the human nervous system in terms of:

– the central nervous system consisting of brain and spinal cord

– the peripheral nervous system

– coordination and regulation of body functions
- Identify motor (effector), relay (connector) and sensory neurones from diagrams
- Describe a simple reflex arc in terms of receptor, sensory neurone, relay neurone, motor neurones and effector

- Describe a reflex action as a means of automatically and rapidly integrating and coordinating stimuli with the responses of effectors (muscles and glands)
- Define a synapse as a junction between two neurones

Supplement
- Distinguish between voluntary and involuntary actions
- Describe the structure of a synapse, including the presence of neurotransmitter containing vesicles, the synaptic cleft and neurotransmitter receptor molecules
- Describe how an impulse triggers the release of a neurotransmitter from vesicles into the synaptic gap and how the neurotransmitter diffuses across to bind with receptor molecules, in the membrane of the neurone after the synaptic gap, causing the impulse to continue
- State that in a reflex arc the synapses ensure that impulses travel in one direction only
- State that many drugs, e.g. heroin, act upon synapses

Core
- Define sense organs as groups of receptor cells responding to specific stimuli: light, sound, touch, temperature and chemicals
- Identify the structures of the eye, limited to cornea, iris, pupil, lens, retina, optic nerve and blind spot
- Describe the function of each part of the eye, limited to:
  - cornea – refracts light
  - iris – controls how much light enters pupil
  - lens – focuses light onto retina
  - retina – contains light receptors, some sensitive to light of different colours
  - optic nerve – carries impulses to the brain
- Explain the pupil reflex in terms of light intensity and pupil diameter only

Supplement

- Explain the pupil reflex in terms of light intensity and antagonistic action of circular and radial muscles in the iris
- Explain accommodation to view near and distant objects in terms of the contraction and relaxation of the ciliary muscles, tension in the suspensory ligaments, shape of the lens and refraction of light
- State the distribution of rods and cones in the retina of a human
- Outline the function of rods and cones, limited to greater sensitivity of rods for night vision and three different kinds of cones absorbing light of different colours for colour vision
- Identify the position of the fovea

Core
- Define a hormone as a chemical substance, produced by a gland and carried by the blood, which alters the activity of one or more specific target organs

- Identify specific endocrine glands and their secretions, limited to adrenal glands and adrenaline, pancreas and insulin, testes and testosterone and ovaries and oestrogen
- Describe adrenaline as the hormone secreted in ‘fight or flight’ situations and its effects,
limited to increased breathing and pulse rate and widened pupils
- Give examples of situations in which adrenaline secretion increases
- State the functions of insulin, oestrogen and testosterone

Supplement

- Discuss the role of the hormone adrenaline in the chemical control of metabolic activity, including increasing the blood glucose concentration and pulse rate
- Compare nervous and hormonal control systems in terms of speed and longevity of action

Core
- Define homeostasis as the maintenance of a constant internal environment
- Name and identify on a diagram of the skin: hairs, hair erector muscles, sweat glands, receptors, sensory neurones, blood vessels and fatty tissue
- Describe the maintenance of a constant internal body temperature in humans in terms of insulation, sweating, shivering and the role of the brain (limited to blood temperature receptors and coordination)

Supplement
- Explain that homeostasis is the control of internal conditions within set limits
- Explain the concept of control by negative feedback
- Describe the control of the glucose concentration of the blood by the liver and the roles of insulin and glucagon from the pancreas
- Outline the symptoms and treatment of
Type 1 diabetes (detail of β cells is not required)

- Describe the maintenance of a constant internal body temperature in humans in terms of vasodilation and vasoconstriction of arterioles supplying skin surface capillaries

Core
- Define gravitropism as a response in which parts of a plant grow towards or away from gravity
- Define phototropism as a response in which parts of a plant grow towards or away from the direction from which light is coming
- Investigate gravitropism and phototropism in shoots and roots

Supplement
- Explain phototropism and gravitropism of a shoot as examples of the chemical control of plant growth
- Explain the role of auxin in controlling shoot growth, limited to:

– auxin made in shoot tip (only)
– auxin spreads through the plant from the shoot tip
– auxin is unequally distributed in response to light and gravity
– auxin stimulates cell elongation
• Describe the use in weedkillers of the synthetic plant hormone 2,4-D

15 Drugs

Core
• Define a drug as any substance taken into the body that modifies or affects chemical reactions in the body

Core
• Describe the use of antibiotics for the treatment of bacterial infection
• State that some bacteria are resistant to antibiotics which reduces the effectiveness of antibiotics
• State that antibiotics kill bacteria but do not affect viruses

Supplement

• Explain how development of resistant bacteria such as MRSA can be minimised, limited to using antibiotics only when essential and ensuring treatment is completed
• Explain why antibiotics kill bacteria, but do not affect viruses

Core
• Describe the effects of excessive alcohol consumption and abuse of heroin, limited to:
– powerful depressant drugs
– effect on reaction times and self-control
– addiction and withdrawal symptoms
– negative social implications, e.g. crime
• State that injecting heroin can cause infections such as HIV
• State that excessive alcohol consumption can cause liver damage
• State that tobacco smoking can cause chronic obstructive pulmonary disease (COPD), lung cancer and coronary heart disease
• Describe the effects on the gas exchange system of tobacco smoke and its major toxic components, limited to carbon monoxide, nicotine and tar
• State that the liver is the site of break down of alcohol and other toxins

Supplement
• Explain how heroin affects the nervous system, limited to its effect on the function of synapses
• Discuss the evidence for the link between smoking and lung cancer
• Discuss the use of hormones to improve sporting performance, limited to testosterone and anabolic steroids

World History

By the end of the course students should be able to answer the following questions:

By the end of the course students are expected to develop the following skills

- making historical connections,
- chronological reasoning (causation),
- creating and supporting a historical argument.
- recall, select, organise and deploy knowledge of the syllabus

content.

- construct historical explanations using an understanding of:

• cause and consequence, change and continuity, similarity and difference

• the motives, emotions, intentions and beliefs of people in the past.

- understand, interpret, evaluate and use a range of sources as

evidence, in their historical context.

and should be able to demonstrate an understanding of the following content areas:

4 1350 - 1800 Renaissance, Reformation, Exploration

The Renaissance Begins

The Reformation

Europe Sets Sail

Europe Explores Asia (or Tries to)

American Colonies

5 1500 -1914 Enlightenment, Revolution, Imperialism

The Scientific Revolution and the Enlightenment

Monarchies Rise in Europe

The American Revolution

The French Revolution

Nationalism Across Europe and Independence Movements in South America and Haiti

The American Civil War

The Industrial Revolution

The Women's Movement

European Imperialism

The Scramble for Africa

Japan Modernizes

The Spanish-American War

Reactions to Colonization

6 The 20th century

Beginning of World War I

Other fronts of World War I

Western and Eastern fronts of World War I

Blockades and American entry

World War I shapes the Middle East

Aftermath of World War I

Rise of Hitler and the Nazis

Rise of Mussolini and Fascism

Overview of Chinese history 1911-1949

Overview of World War II

The Cold War

Human rights

Literature

By the end of the course students should be able to demonstrate the following:

• knowledge of the content of the text – through reference to detail and use of quotations from the text

• understanding of characters, relationships, situations and themes

• understanding of the writer's intentions and methods – response to the writer's use of language

• personal response – sometimes directly (answering questions such as 'What do you think?', 'What are your feelings about...?') and sometimes by implication (answering questions such as 'Explore the ways in which...')

Geography

By the end of the course students should be able to demonstrate the knowledge and understanding of the following content areas:

3 PRACTICAL GEOGRAPHY
What is practical geography?
Continents and oceans
Countries and nations
Political map of the world
Capitals and major cities
Hemispheres and latitude
Longitude, time zones, and coordinates
Distance and relative distance
Geopolitics
Types of maps
How a map works
Globes
Topographic maps
Atlases
Geographic Information Systems (GIS)
Fieldwork
Quantitative data
Qualitative data
Graphicacy
Using photography
Geographical inquiry

and develop the following skills:

- interpret and analyse geographical data
- use and apply geographical knowledge and understanding to maps and in numerical, diagrammatic, pictorial, photographic and graphical form
- use geographical data to recognise patterns in such data and to deduce relationships
- select and show understanding of techniques for observing and collecting data
- select and use techniques for organising and presenting data.
- reason and make judgements and decisions, including evaluation and conclusions, which demonstrate, where appropriate