Grade 7 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:

- Understand coordinate plane
- Find highest common factor and least common multiple
- Evaluate exponents and square roots
- Identify arithmetic and geometric sequences
- Understand number sequences
- Evaluate variable expressions for number sequences
- Write variable expressions for arithmetic sequences
- Add and subtract like terms.
- Identify terms and coefficients
- Add, subtract and multiply linear expressions
- Solve two-step equations
- Find out if (x, y) satisfy the equation
- Identify independent and dependent variables
- Find a value using two-variable equations
- Solve word problems involving two-variable equations
- Solve equations with variables on both sides
- Solve multi-step equations
- Solve multi-step inequalities
- Find the gradient from a graph
- Find the gradient from two points
- Find a missing coordinate using gradient
- Find the gradient from an equation
- Graph a line using gradient
- Write a linear function
- Graph a line from an equation in y=mx+c form
- Convert a linear equation in standard form to y=mx+c form
- Graph a line from an equation in standard form
- Find gradients of parallel and perpendicular lines
- Construct an angle bisector and a perpendicular bisector
- Calculate area, circumference, radius and diameter of a circle

- Calculate area, perimeter, radius and diameter of a circumference
- Calculate area, perimeter and radius of a quarter circles
- Find area between two shapes
- Find area of composite figures with triangles, semicircles and quarter circles
- Find volume and surface area of all basic 3d shapes:
    - Prisms and cylinders
    - Pyramids and cones
    - Spheres
- Find volume and surface area of similar solids
- Understand Data and Graphs:
    - Create pictographs
    - Interpret tables
    - Create line plots
    - Create stem-and-leaf plots
    - Create bar graphs
    - Create histograms
    - Create frequency charts
    - Interpret pie charts
    - Relate pie charts and central angles
    - Create line graphs
    - Choose the best type of graph
- Calculate mean, median, mode and range
- Interpret charts to find mean, median, mode and range
- Given mean, median, mode and range, find the missing number
- Evaluate changes in mean, median, mode and range
- Calculate simple interest
- Calculate compound interest
- Understand significant figures
- Understand irrational numbers
- Understand functions
- Understand exponential growth and decay

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:

1 General physics

1.1 Length and time

Core
- Use and describe the use of rules and measuring cylinders to find a length or a volume
- Use and describe the use of clocks and devices, both analogue and digital, for measuring an interval of time
- Obtain an average value for a small distance and for a short interval of time by measuring multiples (including the period of a pendulum)

Supplement
- Understand that a micrometer screw gauge is used to measure very small distances

1.2 Motion

Core
- Define speed and calculate average speed from total distance

Supplement

- Distinguish between speed and velocity
- Define and calculate acceleration using
total time
- Plot and interpret a speed–time graph or a distance–time graph
- Recognise from the shape of a speed–time graph when a body is
– at rest
– moving with constant speed
– moving with changing speed
- Calculate the area under a speed–time graph to work out the distance travelled for motion with constant acceleration
- Demonstrate understanding that acceleration and deceleration are related to changing speed including qualitative analysis of the gradient of a speed–time graph
- State that the acceleration of free fall for a body near to the Earth is constant
change of velocity time taken
- Calculate speed from the gradient of a distance–time graph
- Calculate acceleration from the gradient of a speed–time graph
- Recognise linear motion for which the acceleration is constant
- Recognise motion for which the acceleration is not constant
- Understand deceleration as a negative acceleration
- Describe qualitatively the motion of bodies falling in a uniform gravitational field with and without air resistance (including reference to terminal velocity)

1.3 Mass and weight

Core
- Show familiarity with the idea of the mass of a body
- State that weight is a gravitational force
- Distinguish between mass and weight
- Recall and use the equation W = mg
- Demonstrate understanding that weights (and hence masses) may be compared using a balance

Supplement
- Demonstrate an understanding that mass is a property that ‘resists’ change in motion
- Describe, and use the concept of, weight as the effect of a gravitational field on a mass

1.4 Density

Core
- Recall and use the equation $\rho = m/V$
- Describe an experiment to determine the density of a liquid and of a regularly shaped solid and make the necessary calculation

- Describe the determination of the density of an irregularly shaped solid by the method of displacement
- Predict whether an object will float based on density data

1.5 Forces

1.5.1 Effects of forces

Core

- Recognise that a force may produce a change in size and shape of a body
- Plot and interpret extension–load graphs and describe the associated experimental procedure
- Describe the ways in which a force may change the motion of a body
- Find the resultant of two or more forces acting along the same line
- Recognise that if there is no resultant force on a body it either remains at rest or continues at constant speed in a straight line
- Understand friction as the force between two surfaces which impedes motion and results in heating
- Recognise air resistance as a form of friction

Supplement

- State Hooke's Law and recall and use the expression $F = k x$, where k is the spring constant
- Recognise the significance of the 'limit of proportionality' for an extension–load graph
- Recall and use the relationship between force, mass and acceleration (including the direction), $F = ma$
- Describe qualitatively motion in a circular path due to a perpendicular force ($F = mv^2 / r$ is not required)

1.5.2 Turning effect

Core

- Describe the moment of a force as a measure of its turning effect and give everyday examples
- Understand that increasing force or distance from the pivot increases the moment of a force
- Calculate moment using the product force × perpendicular distance from the pivot
- Apply the principle of moments to the balancing of a beam about a pivot

Supplement

- Apply the principle of moments to different situations

1.5.3 Conditions for equilibrium

Core

- Recognise that, when there is no resultant force and no resultant turning effect, a system is in equilibrium

Supplement

- Perform and describe an experiment (involving vertical forces) to show that there is no net moment on a body in equilibrium

1.5.4 Centre of mass

Core

- Perform and describe an experiment to determine the position of the centre of mass of a plane lamina
- Describe qualitatively the effect of the position of the centre of mass on the stability of simple objects

1.5.5 Scalars and vectors

Supplement

- Understand that vectors have a magnitude and direction
- Demonstrate an understanding of the difference between scalars and vectors and give common examples
- Determine graphically the resultant of two vectors

1.6 Momentum

Supplement

- Understand the concepts of momentum and impulse
- Recall and use the equation momentum = mass × velocity, p= mv
- Recall and use the equation for impulse

Ft = mv – mu

- Apply the principle of the conservation of momentum to solve simple problems in one dimension

1.7 Energy, work and power

1.7.1 Energy

Core

- Identify changes in kinetic, gravitational potential, chemical, elastic (strain), nuclear and internal energy that have occurred as a result of an event or process
- Recognise that energy is transferred during events and processes, including examples of transfer by forces (mechanical working), by electrical currents (electrical working), by heating and by waves
- Apply the principle of conservation of energy to simple examples

Supplement

- Recall and use the expressions kinetic energy = $\frac{1}{2}mv^2$ and change in gravitational potential energy = $mg\Delta h$

- Apply the principle of conservation of energy to examples involving multiple stages
- Explain that in any event or process the energy tends to become more spread out among the objects and surroundings (dissipated)

1.7.2 Energy resources

Core

- Describe how electricity or other useful forms of energy may be obtained from:
  - chemical energy stored in fuel
  - water, including the energy stored in waves, in tides, and in water behind hydroelectric dams
  - geothermal resources
  - nuclear fission
  - heat and light from the Sun (solar cells and panels)
  - wind
- Give advantages and disadvantages of each method in terms of renewability, cost, reliability, scale and environmental impact
- Show a qualitative understanding of efficiency

Supplement

- Understand that the Sun is the source of energy for all our energy resources except geothermal, nuclear and tidal
- Show an understanding that energy is released by nuclear fusion in the Sun
- Recall and use the equations:

efficiency = useful energy output/energy input × 100%

efficiency = useful power output/energy input × 100%

1.7.3 Work

Core

- Demonstrate understanding that work done = energy transferred
- Relate (without calculation) work done to the magnitude of a force and the distance moved in the direction of the force

Supplement

- Recall and use W = Fd = ΔE

1.7.4 Power

Core

- Relate (without calculation) power to work done and time taken, using appropriate examples

Supplement

- Recall and use the equation P = ΔE / t in simple systems

1.8 Pressure

Core

- Recall and use the equation p = F / A
- Relate pressure to force and area, using appropriate examples
- Describe the simple mercury barometer and its use in measuring atmospheric pressure
- Relate (without calculation) the pressure beneath a liquid surface to depth and to density, using appropriate examples
- Use and describe the use of a manometer

Supplement

- Recall and use the equation p=hρg

Chemistry

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

1 The particulate nature of matter

Core

- State the distinguishing properties of solids, liquids and gases
- Describe the structure of solids, liquids and gases in terms of particle separation, arrangement and types of motion

· Describe changes of state in terms of melting, boiling, evaporation, freezing, condensation and sublimation

· Describe qualitatively the pressure and temperature of a gas in terms of the motion of its particles

· Show an understanding of the random motion of particles in a suspension (sometimes known as Brownian motion) as evidence for the kinetic particle (atoms, molecules or ions) model of matter

· Describe and explain diffusion

Supplement

· Explain changes of state in terms of the kinetic theory

· Describe and explain Brownian motion in terms of random molecular bombardment

· State evidence for Brownian motion

· Describe and explain dependence of rate of diffusion on molecular mass

2 Experimental techniques

Core

· Name appropriate apparatus for the measurement of time, temperature, mass and volume, including burettes, pipettes and measuring cylinders

2.2.1 Criteria of purity

Core

· Demonstrate knowledge and understanding of paper chromatography

· Interpret simple chromatograms

· Identify substances and assess their purity from melting point and boiling point information

· Understand the importance of purity in substances in everyday life, e.g. foodstuffs and drugs

Supplement

· Interpret simple chromatograms, including the use of R_f values

· Outline how chromatography techniques can be applied to colourless substances by exposing chromatograms to substances called locating agents. (Knowledge of *specific* locating agents is **not** required.)

2.2.2 Methods of purification

Core

· Describe and explain methods of purification by the use of a suitable solvent, filtration, crystallisation and distillation (including use of a fractionating column).

· Suggest suitable purification techniques, given information about the substances involved

3 Atoms, elements and compounds

Core

· State the relative charges and approximate relative masses of protons, neutrons and electrons

- · Define *proton number* (atomic number) as the number of protons in the nucleus of an atom
- · Define *nucleon numbe*r (mass number) as the total number of protons and neutrons in the nucleus of an atom
- · 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 number 1 to 20
- · Define *isotopes* as atoms of the same element which have the same proton number but a different nucleon number
- · State the two types of isotopes as being radioactive and non-radioactive

Supplement

· Understand that isotopes have the same properties because they have the same number of electrons in their outer shell

Core

· State one medical and one industrial use of radioactive isotopes

- · 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.)

3.2.1 Bonding: the structure of matter

Core

- Describe the differences between elements, mixtures and compounds, and between metals and non-metals
- Describe an alloy, such as brass, as a mixture of a metal with other elements

3.2.2 Ions and ionic bonds

Core

- Describe the formation of ions by electron loss or gain
- Describe the formation of ionic bonds between elements from Groups I and VII

Supplement

- Describe the formation of ionic bonds between metallic and non-metallic elements
- Describe the lattice structure of ionic compounds as a regular arrangement of alternating positive and negative ions

3.2.3 Molecules and covalent bonds

Core

- Describe the formation of single covalent bonds in H_2, Cl_2, H_2O, CH_4, NH_3 and HCl as the sharing of pairs of electrons leading to the noble gas configuration
- Describe the differences in volatility, solubility and electrical conductivity between ionic and covalent compounds

Supplement

- Describe the electron arrangement in more complex covalent molecules such as N_2, C_2H_4, CH_3OH and CO_2
- Explain the differences in melting point and boiling point of ionic and covalent compounds in terms of attractive forces

3.2.4 Macromolecules

Core

- Describe the giant covalent structures of graphite and diamond

· Relate their structures to their uses, e.g. graphite as a lubricant and a conductor, and diamond in cutting tools

Supplement

· Describe the macromolecular structure of silicon(IV) oxide (silicon dioxide)

· Describe the similarity in properties between diamond and silicon(IV) oxide, related to their structures

3.2.5 Metallic bonding

Supplement

· 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

Biology

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

1 Characteristics and classification of living organisms

Core

• Describe the characteristics of living organisms by defining the terms:

– movement as an action by an organism causing a change of position or place

– respiration as the chemical reactions in cells that break down nutrient molecules and release energy

– sensitivity as the ability to detect and respond to changes in the environment

– growth as a permanent increase in size

– reproduction as the processes that make more of the same kind of organism

– excretion as removal from organisms of toxic materials and substances in excess of requirements

– nutrition as taking in of materials for energy, growth and development

Supplement

• Define the terms:

– movement as an action by an organism or part of an organism causing a change of position or place

– respiration as the chemical reactions in cells that break down nutrient molecules and release energy for metabolism

– sensitivity as the ability to detect or sense stimuli in the internal or external environment and to make appropriate responses

– growth as a permanent increase in size and dry mass by an increase in cell number or cell size or both
– excretion as removal from organisms of the waste products of metabolism (chemical reactions in cells including respiration), toxic materials, and substances in excess of requirements
– nutrition as taking in of materials for energy, growth and development; plants require light, carbon dioxide, water and ions; animals need organic compounds and ions and usually need water

Core
• State that organisms can be classified into groups by the features that they share
• Define species as a group of organisms that can reproduce to produce fertile offspring
• Define and describe the binomial system of naming species as an internationally agreed system in which the scientific name of an organism is made up of two parts showing the genus and species

Supplement
• Explain that classification systems aim to reflect evolutionary relationships
• Explain that classification is traditionally based on studies of morphology and anatomy
• Explain that the sequences of bases in DNA and of amino acids in proteins are used as a more accurate means of classification
• Explain that organisms which share a more recent ancestor (are more closely related) have base sequences in DNA that are more similar than those that share only a distant ancestor

Core
• List the features in the cells of all living organisms, limited to cytoplasm, cell membrane and DNA as genetic material
• List the main features used to place animals and plants into the appropriate kingdoms
• List the main features used to place organisms into groups within the animal kingdom, limited to:
– the main groups of vertebrates: mammals, birds, reptiles, amphibians, fish
– the main groups of arthropods: myriapods, insects, arachnids, crustaceans

Supplement
• List the features in the cells of all living organisms, limited to ribosomes for protein synthesis and enzymes involved in respiration
• List the main features used to place all organisms into one of the five kingdoms: Animal, Plant, Fungus, Prokaryote, Protoctist
• List the main features used to place organisms into groups within the plant kingdom, limited to ferns and flowering plants (dicotyledons and monocotyledons)

- List the features of viruses, limited to protein coat and genetic material

Core
- Construct and use simple dichotomous keys based on easily identifiable features

2 Organisation of the organism

Core
- Describe and compare the structure of a plant cell with an animal cell, as seen under a light microscope, limited to cell wall, nucleus, cytoplasm, chloroplasts, vacuoles and location of the cell membrane
- State the functions of the structures seen under the light microscope in the plant cell and in the animal cell

Supplement
- State that the cytoplasm of all cells contains structures, limited to ribosomes on rough endoplasmic reticulum and vesicles
- State that almost all cells, except prokaryotes, have mitochondria and rough endoplasmic reticulum
- Identify mitochondria and rough endoplasmic reticulum in diagrams and images of cells
- State that aerobic respiration occurs in mitochondria
- State that cells with high rates of metabolism require large numbers of mitochondria to provide sufficient energy

Core
- Relate the structure of the following to their functions:
  - ciliated cells – movement of mucus in the trachea and bronchi
  - root hair cells – absorption
  - xylem vessels – conduction and support
  - palisade mesophyll cells – photosynthesis
  - nerve cells – conduction of impulses
  - red blood cells – transport of oxygen
  - sperm and egg cells – reproduction
- Define tissue as a group of cells with similar structures, working together to perform a shared function
- Define organ as a structure made up of a group of tissues, working together to perform specific functions
- Define organ system as a group of organs with related functions, working together to perform body functions
- State examples of tissues, organs and organ systems from sections 6 to 16

- Identify the different levels of organisation in drawings, diagrams and images of familiar material

Supplement
- Identify the different levels of organisation in drawings, diagrams and images of unfamiliar material

Core
- Calculate magnification and size of biological specimens using millimetres as units

Supplement
- Calculate magnification and size of biological specimens using millimetres and micrometres as units

3 Movement in and out of cells

Core
- Define diffusion as the net movement of particles from a region of their higher concentration to
a region of their lower concentration down a concentration gradient, as a result of their random movement
- Describe the importance of diffusion of gases and solutes
- State that substances move into and out of cells by diffusion through the cell membrane

Supplement
- State that the energy for diffusion comes from the kinetic energy of random movement of molecules and ions
- Investigate the factors that influence diffusion, limited to surface area, temperature, concentration gradients and distance

Core
- State that water diffuses through partially permeable membranes by osmosis
- State that water moves in and out of cells by osmosis through the cell membrane
- Investigate and describe the effects on plant tissues of immersing them in solutions of different concentrations
- State that plants are supported by the pressure of water inside the cells pressing outwards on the cell wall

Supplement
- Define osmosis as the net movement of water molecules from a region of higher water potential (dilute solution) to a region of lower water potential (concentrated solution), through a partially permeable membrane

- Explain the effects on plant tissues of immersing them in solutions of different concentrations
by using the terms turgid, turgor pressure, plasmolysis and flaccid
- Explain the importance of water potential and osmosis in the uptake of water by plants
- Explain the importance of water potential and osmosis on animal cells and tissues
- Explain how plants are supported by the turgor pressure within cells, in terms of water pressure acting against an inelastic cell wall

Core
- Define active transport as the movement of particles through a cell membrane from a region of lower concentration to a region of higher concentration using energy from respiration

Supplement
- Discuss the importance of active transport as a process for movement across membranes:
– e.g. ion uptake by root hairs and uptake of glucose by epithelial cells of villi and kidney tubules
- Explain how protein molecules move particles across a membrane during active transport

4 Biological molecules

Core
- List the chemical elements that make up:
– carbohydrates
– fats
– proteins
- State that large molecules are made from smaller molecules, limited to:
– starch and glycogen from glucose
– cellulose from glucose
– proteins from amino acids
– fats and oils from fatty acids and glycerol
- Describe the use of:
– iodine solution to test for starch
– Benedict’s solution to test for reducing sugars
– biuret test for proteins
– ethanol emulsion test for fats and oils
– DCPIP test for vitamin C

Supplement

- Explain that different sequences of amino acids give different shapes to protein molecules
- Relate the shape and structure of protein molecules to their function, limited to the active site of enzymes and the binding site of antibodies

continued

Core

- State that water is important as a solvent

Supplement

- Describe the structure of DNA as:
  - two strands coiled together to form a double helix
  - each strand contains chemicals called bases
  - cross-links between the strands are formed by pairs of bases
  - the bases always pair up in the same way: A with T, and C with G (full names are not required)
- Describe the roles of water as a solvent in organisms with respect to digestion, excretion and transport

5 Enzymes

Core

- Define the term catalyst as a substance that increases the rate of a chemical reaction and is not changed by the reaction
- Define enzymes as proteins that function as biological catalysts
- Describe why enzymes are important in all living organisms in terms of reaction speed necessary to sustain life
- Describe enzyme action with reference to the complementary shape of an enzyme and its substrate and the formation of a product (knowledge of the term active site is not required)
- Investigate and describe the effect of changes in temperature and pH on enzyme activity

Supplement

- Explain enzyme action with reference to the active site, enzyme-substrate complex, substrate and product
- Explain the specificity of enzymes in terms of the complementary shape and fit of the active site with the substrate
- Explain the effect of changes in temperature on enzyme activity in terms of kinetic energy, shape and fit, frequency of effective collisions and denaturation
- Explain the effect of changes in pH on enzyme activity in terms of shape and fit and denaturation

6 Plant nutrition

Core

- Define photosynthesis as the process by which plants manufacture carbohydrates from raw materials using energy from light
- State the word equation for photosynthesis: carbon dioxide + water -> glucose + oxygen, in the presence of light and chlorophyll

Supplement

- State the balanced chemical equation for photosynthesis

$$6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{light}} C_6H_{12}O_6 + 6O_2$$

- Investigate the necessity for chlorophyll, light and carbon dioxide for photosynthesis, using appropriate controls
- Investigate and describe the effects of varying light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis, e.g. in submerged aquatic plants
- Explain that chlorophyll transfers light energy into chemical energy in molecules, for the synthesis of carbohydrates
- Outline the subsequent use and storage of the carbohydrates made in photosynthesis
- Define the term limiting factor as something present in the environment in such short supply that it restricts life processes
- Identify and explain the limiting factors of photosynthesis in different environmental conditions
- Describe the use of carbon dioxide enrichment, optimum light and optimum temperatures in glasshouses in temperate and tropical countries
- Use hydrogencarbonate indicator solution to investigate the effect of gas exchange of an aquatic plant kept in the light and in the dark

Core

- Identify chloroplasts, cuticle, guard cells and stomata, upper and lower epidermis, palisade mesophyll, spongy mesophyll, vascular bundles, xylem and phloem in leaves of a dicotyledonous plant

Supplement

- Explain how the internal structure of a leaf is adapted for photosynthesis

Core

- Describe the importance of:
  - nitrate ions for making amino acids
  - magnesium ions for making chlorophyll

Supplement

- Explain the effects of nitrate ion and magnesium ion deficiency on plant growth

7 Human nutrition

Core

- State what is meant by the term balanced diet for humans
- Explain how age, gender and activity affect the dietary needs of humans including during pregnancy and whilst breast-feeding
- Describe the effects of malnutrition in relation to starvation, constipation, coronary heart disease, obesity and scurvy
- List the principal sources of, and describe the dietary importance of:
  - carbohydrates
  - fats
  - proteins
  - vitamins, limited to C and D
  - mineral salts, limited to calcium and iron
  - fibre (roughage)
  - water

Supplement

- Explain the causes and effects of vitamin D and iron deficiencies
- Explain the causes and effects of protein-energy malnutrition, e.g. kwashiorkor and marasmus

Core

- Define ingestion as the taking of substances, e.g. food and drink, into the body through the mouth
- Define mechanical digestion as the breakdown of food into smaller pieces without chemical change to the food molecules
- Define chemical digestion as the breakdown of large, insoluble molecules into small, soluble molecules
- Define absorption as the movement of small food molecules and ions through the wall of the intestine into the blood
- Define assimilation as the movement of digested food molecules into the cells of the body where they are used, becoming part of the cells
- Define egestion as the passing out of food that has not been digested or absorbed, as faeces, through the anus
- Describe diarrhoea as the loss of watery faeces
- Outline the treatment of diarrhoea using oral rehydration therapy
- Describe cholera as a disease caused by a bacterium
- Identify the main regions of the alimentary canal and associated organs, limited to mouth, salivary glands, oesophagus, stomach, small intestine (duodenum and ileum), pancreas, liver, gall bladder and large intestine (colon, rectum, anus)

• Describe the functions of the regions of the alimentary canal listed above, in relation to ingestion, digestion, absorption, assimilation and egestion of food

Supplement

• Explain that the cholera bacterium produces a toxin that causes secretion of chloride ions into the small intestine, causing osmotic movement of water into the gut, causing diarrhoea, dehydration and loss of salts from blood

Core

• Identify the types of human teeth (incisors, canines, premolars and molars)
• Describe the structure of human teeth, limited to enamel, dentine, pulp, nerves and cement, as well as the gums
• Describe the functions of the types of human teeth in mechanical digestion of food
• State the causes of dental decay in terms of a coating of bacteria and food on teeth, the
bacteria respiring sugars in the food, producing acid which dissolves the enamel and dentine
• Describe the proper care of teeth in terms of diet and regular brushing

Core

• State the significance of chemical digestion in the alimentary canal in producing small, soluble molecules that can be absorbed
• State the functions of enzymes as follows:
– amylase breaks down starch to simpler sugars
– protease breaks down protein to amino acids
– lipase breaks down fats to fatty acids and glycerol
• State where, in the alimentary canal, amylase, protease and lipase are secreted
• State the functions of the hydrochloric acid in gastric juice, limited to killing bacteria in food and giving an acid pH for enzymes

Supplement

• Describe the digestion of starch in the alimentary canal:
– amylase is secreted into the alimentary canal and breaks down starch to maltose
– maltose is broken down by maltase to glucose on the membranes of the epithelium lining the small intestine
• Describe pepsin and trypsin as two protease enzymes that function in different parts of the alimentary canal:
– pepsin in the stomach
– trypsin in the small intestine
• Explain the functions of the hydrochloric acid in gastric juice, limited to the low pH:
– denaturing enzymes in harmful microorganisms in food
– giving the optimum pH for pepsin activity
• Outline the role of bile in neutralising the acidic mixture of food and gastric juices entering the duodenum from the stomach, to provide a suitable pH for enzyme action
• Outline the role of bile in emulsifying fats to increase the surface area for the chemical

digestion of fat to fatty acids and glycerol by lipase

Core
- Identify the small intestine as the region for the absorption of digested food
- State that water is absorbed in both the small intestine and the colon, but that most absorption of water happens in the small intestine

Supplement
- Explain the significance of villi and microvilli in increasing the internal surface area of the small intestine
- Describe the structure of a villus
- Describe the roles of capillaries and lacteals in villi

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:

1 Beginnings - 600 BCE

The origin of humans and early human societies

The Neolithic Revolution and the birth of agriculture

Ancient Mesopotamia

Ancient Egypt

Ancient art and artifacts

Ancient India

Shang China

Ancient Americas

Human innovation and the environment

2 600 BCE - 600 CE Second-Wave Civilizations

Ancient Persia

Classical Greece

The rise and fall of empires

Empire of Alexander the Great

Rise of Rome

From Roman Republic to Roman Empire

The Roman Empire

Ancient and Imperial China

Early Judaism

Early Christianity

Early Americas

Empires in India

Early Hinduism

Early Buddhism

Syncretism

Women and families

Transregional Trade: the Silk Road

	Survey of second-wave civilizations
3	600 - 1450 Regional and interregional interactions
	Byzantine Empire
	European Middle Ages: feudalism and serfdom
	Origins of Islam
	Spread of Islam
	Sunni and Shia Islam
	Golden Age of Islam
	The Great Schism
	The Crusades
	The Mongols
	Song China
	Medieval Japan
	Maya, Aztec, and Inca
	Environment and trade
	Human migration
	Development of new trading cities
	Cultural interactions along trade routes
	Development of financial institutions
	Disease and demography
	Social institutions in the Islamic world

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:

1 PHYSICAL GEOGRAPHY
What is physical geography?
Earth s history and geological time
Earth's structure
Moving plates and boundaries
Shifting continents
Earthquakes and tsunamis
Mountain building
Volcanoes and hot springs
Physical map of the world
Rocks and minerals
Igneous rocks
Weathering and erosion
Sedimentary rocks and fossils
Metamorphic rocks
The rock cycle
Soil
Mountain streams
Rivers
Ice ages
Glacial erosion
Glacial deposition
Coastal erosion
Coastal deposition
Erosion in deserts
The atmosphere
Seasons
Climate zones

The hydrological cycle
Global winds
Ocean currents
Weather systems
Weather forecasting
Cloud and fog
Precipitation
Hurricanes and tornadoes
Biomes
Distribution of species
Ecosystems
Tropical grasslands and rain forests
Deserts
Temperate forests and grasslands
Boreal forests and tundra
Oceans and seas map
Oceans, seas, and lakes

2 HUMAN GEOGRAPHY
What is human geography?
Where people live
Demography
Migration
Population change
Human settlements
Cities
Megacities
Rural settlements
Urbanization
The spread of cultures
Health
Economic activity
Food and farming
Extracting fossil fuels
Manufacturing industry
The service industry
Tourism
Transportation and distribution
Technology
Uneven development
Globalization
Urban housing
Human impact
Pollution
The changing landscape
Deforestation
Climate change
Preservation and conservation

Managing natural hazards
Sources of energy
Sustainability
Plastic pollution
Big geographical issues
Global and local interdependence
Food security
Water security
Conflict and resolution

and make judgements and decisions and recognise how these are made within a geographical context as affected and constrained by

- the physical and human contexts in which decisions are made
- the values and perceptions of differing groups or individuals
- the choices available to decision-makers
- the increasing level of global interdependence and the need for sustainable development.