

## Area of study

## Your child will ... (Knowledge)

## Your child will be able to... (Skills)

### Biology 1

### Biology 1

- The 7 life processes.
- Describe the life processes with respect to both plants and animals.
- State the meaning of: organ.
- Functions of major [human, animal, plant] organs.
- The main [parts, organs] of plant water transport system.
- The function of the plant water transport system.
- Basic parts of a light microscope and their function.
- How to use a light microscope to examine a slide.
- How to calculate total magnification using a formula.
- The scientific conventions and symbols used in communication.
- How to plan and carry out an investigation.
- Leaves have more stomata on the bottom.
- The meaning of: organelle.
- Parts (organelles) of animal and plant cells: mitochondria, nuclei, chloroplasts, vacuoles, cell wall, cell membrane, cytoplasm.
- The function of these organelles.
- The main (parts, organs) of the respiratory system.

- Justify whether something is living [an organism] or is non-living using life processes.
- Identify ways an organism shows each life process.
- Explain how organ functions link to life processes.
- Describe how water is transported around a plant (xylem).
- Evaluate the different units of measurement that could be used when measuring cells and their parts.
- Identify and solve common problems with the use of a light microscope.
- Convert units between milli and micro.
- Explain why internationally agreed symbols and conventions are necessary in science communication.
- Plan and carry out an investigation to find out which side of a leaf has the most stomata (holes).
- Determine which side of the leaf the most water is lost.
- Use a microscope to draw and measure plant/animal cell organelles.
- Produce accurate drawings.
- Use field of view and scales to estimate size of object.
- Identify organs involved in the human gaseous exchange system.

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Your child will ... (Knowledge)

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(Skills)

## Biology 1 (continued)

Biology 1  
(continued)

- The basic steps of the scientific method:
- Difference between a hypothesis and a theory.
- Main bones in the human skeleton: skull, vertebra(e), ribs, sternum, hip, thigh, shin, collar bone, knee cap, ribcage.
- Joint types and their basic parts: hinge, pivot, gliding ball and socket.
- Red blood cells, white blood cells, and platelets come from bone marrow.
- What happens when muscles contract and relax.
- Muscles and bones work together to allow movement.
- Contracting muscles produce a force, and the units are Newtons (N).
- Muscles are controlled by the nervous system.
- Muscles work in antagonistic pairs (biceps and triceps).
- Drugs can be legal, illegal, medical, or recreational.
- Effects of stimulants and depressants on reaction times.
- Effects of caffeine and other factors on human reaction time.
- Short- and long-term effects of alcohol and commonly

- Determine whether a question can be answered using science. Identify the features of a scientific and non-scientific question.
- Relate the properties of bones to their functions.
- Identify vertebrates and invertebrates.
- Describe other forms of protection and support in organisms with no skeletal structure (cell walls in plants).
- Write sentences that present ideas and opinions clearly (using ideas about clauses and conjunctions).
- Identify antagonistic muscles involved in arm movement.
- Identify which of three muscle groups is the strongest by applying force to a set of scales.
- Categorise drugs
- Describe the effects and side effects of some common drugs
- Plan and carry out an investigation into how factors affect reaction time.

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## Chemistry 1

Chemistry 1

- Materials exist in three different states of matter, which have different properties.
- A theory is a hypothesis with lots of supporting evidence.
- All matter consists of particles, and particles are arranged differently in solids, liquids and gases. This idea can help explain their properties.
- The kinetic theory can be used to explain the properties of solids, liquids and gases. It is up to you to decide if you want to introduce the term 'kinetic theory'.
- The main changes of state are melting, boiling/evaporation, condensing, freezing (you could introduce sublimation and deposition at this stage)
- The kinetic theory (students don't have to be familiar with this term) can be used to explain diffusion.
- Numeracy There are  $1 \times 10^9$  nm in a m
- The kinetic theory (students don't have to be familiar with this term) can be used to explain diffusion.

- Identify which state of matter a range of samples are in, using their properties.
- Identify adjectives, comparatives and superlatives in sentences.
- Use adjectives, comparatives and superlatives to measure and compare.
- Identify a [solid, liquid or gas] from the arrangement of particles.
- Use the particle model of matter to explain the [squashiness/ compressibility, ability to flow, ability to change shape] of [solids, liquids, gases].
- Use the kinetic theory to explain melting, boiling, condensing, freezing
- Evaluate how well kinetic theory matches evidence.
- Convert metres to nanometres and vice versa.
- Explain why the speed of diffusion in gases is faster than in liquids.
- Suggest ways in which gas pressure can be increased
- Explain some of the effects of air pressure (e.g. using a straw, collapsing can).

Identify correlations by analysis of graphs of Force vs

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Your child will ... (Knowledge)

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(Skills)

## Chemistry 1 (continued)

Chemistry 1  
(continued)

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| <ul style="list-style-type: none"> <li>• The kinetic theory can be used to explain the pressure of gases.</li> <li>• Direct and inverse proportion can be represented on a graph.</li> <li>• Scientific data can be presented in tables and graphs.</li> <li>• The differences between elements, compounds and mixtures (with reference to elements being substances that cannot be broken down into anything simpler by chemical means).</li> <li>• The difference between an atom and a molecule.</li> <li>• Chemical symbols and formulae for elements and compounds</li> <li>• Materials can be classified as metals and non-metals.</li> <li>• There is a difference between fact (scientific evidence) and opinion.</li> <li>• Metal and non-metal elements can be chemically combined to form compounds.</li> <li>• Chemical reactions involve the rearrangement of atoms.</li> </ul> | <ul style="list-style-type: none"> <li>• Plot simple graphs with given axes, using a pencil and ruler.</li> <li>• Interpret diagrams to identify [mixtures, compounds, elements].</li> <li>• Interpret diagrams to identify the different types of particles in air.</li> <li>• Classify unfamiliar substances as elements, mixtures or compounds.</li> <li>• Classify unfamiliar elements as metals or nonmetals.</li> <li>• Consider whether elements near the boundary line (e.g. carbon (graphite) and silicon) should be classified as metals or nonmetals.</li> <li>• Distinguish between examples of facts and opinions</li> <li>• Name the compound formed by a reaction between two elements.</li> <li>• Apply the knowledge of naming of compounds to less familiar situations (e.g. nitrides and carbonates) to deduce which elements a compound is made from</li> <li>• Model reactions using word and balanced equations.</li> <li>• Describe the thermal decomposition of calcium carbonate in a variety of ways (using equations/in a paragraph)</li> </ul> |
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## Physics 1

Physics 1

- Know the unit of energy in food (KJ)
- The amount of energy in different foods can be compared by burning the foods to heat water.
- Energy can be stored and transferred in different ways.
- Energy cannot be created or destroyed but in most energy transfers some energy is lost in a form that is not useful.
- Energy resources can be renewable or non-renewable.
- Advantages and disadvantages to different energy resources.
- How fossil fuels are formed.
- How different energy resources are used.
- Fuels are used to release energy, usually by combustion.
- Some gases in the atmosphere help to keep the Earth warm.
- Some machines are more efficient than others.
- A circuit will only work if there is a complete circuit made of conducting materials.
- Current is the amount of electricity flowing around a circuit and can be measured using an ammeter.

- Compare the energy values of different foods (using food labels) and place, in order, a selection of foods based on the energy released during burning
- Look at a range of simple situations and draw simple energy transfer diagrams.
- Be able to identify Chemical store, gravitational store, kinetic store and Nuclear store
- Be able to identify some non-useful energy transfers
- Write a balanced argument discussing the pros and cons of using different energy resources in given situations.
- Summarise information and deliver it to the class.
- Write a description of the processes involved in the formation of fossil fuels and identify the sun as the source of the energy.
- Describe how fossil fuels are used to generate electricity.
- Explain how burning fossil fuels may lead to climate change.
- Identify machines as being more efficient based on labels or simple Sankey diagrams.
- Be able to construct a complete circuit when given a circuit diagram.

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## Physics 1 (continued)

Physics 1 (continued)

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| <ul style="list-style-type: none"> <li>• Circuits and the components within them can be represented using standard symbols. A current in a metal is a 'flow' of electrons, and models can be used to help us think about this.</li> <li>• Circuits with multiple components can be arranged in series or in parallel.</li> <li>• Voltage and current are divided between components in a circuit in different ways for series and parallel circuits.</li> <li>• Current is conserved at a junction.</li> <li>• Changing the number and nature of components changes the current.</li> <li>• The size of a current depends on the voltage of the cells or power pack and the components in the circuit.</li> <li>• Voltage is measured using a voltmeter.</li> <li>• Voltage is an electrical pressure.</li> <li>• Voltage and energy are linked.</li> <li>• Cables used with the mains supply have several wires inside them and these must be connected correctly to be safe.</li> <li>• A fuse is an important safety device within an electrical</li> </ul> | <ul style="list-style-type: none"> <li>• Be able to select from a list of materials which are good electrical conductors.</li> <li>• Explain why unscrewing a bulb in a series circuit causes other lamps to go out.</li> <li>• Use a model to describe how an electrical circuit works.</li> <li>• Model circuits using circuit diagrams.</li> <li>• Construct a circuit when given a circuit diagram.</li> <li>• Build series and parallel circuits when given circuit diagrams.</li> <li>• Use switches to control different parts of circuits.</li> <li>• Be able to make predictions of the brightness of lamps as more are added to both series and parallel circuits.</li> <li>• Can build series and parallel circuits with different components then use an ammeter to measure current at different points in the circuit.</li> <li>• Can predict the current at different points in a circuit based on other measurements.</li> <li>• Be able to use a voltmeter in a series and a parallel circuit.</li> <li>• Describe how voltage changes in different branches.</li> <li>• Can identify errors in the wiring of a plug.</li> </ul> |
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### Biology 2

### Biology 2

- The difference between a scientific and a non-scientific question.
- Make predictions using everyday knowledge and scientific ideas.
- Develop a hypothesis.
- How fish, birds and mammals sexually reproduce: internal or external fertilisation.
- How much aftercare different animals provide for their offspring.
- Shape and position of male and female reproductive organs.
- How sperm cells and egg cells are adapted to their functions.
- The journey of sperm cells during sexual intercourse and fertilisation.
- How sperm cells are killed and assisted on their journey to the egg.
- Stages of growth after fertilisation: zygote, embryo, foetus, baby.
- Amniotic fluid protects a developing foetus.

- Identify questions that can be tested (scientifically ) and those that cannot.
- Write a prediction using knowledge and scientific ideas.
- Compare sexual reproduction in fish, birds, and animals.
- Explain how offspring number links to the amount of aftercare provided.
- Identify parts of the human reproductive system.
- Make deductions about the reproductive process
- Describe the functions of the parts of the human reproductive system
- Explain how sperm and egg cell functions help their function.
- Explain why males produce millions of sperm cells.
- Explain how an egg cell prevents multiple sperm cells from fusing with it.
- Describe how the developing foetus is 'cared for' and protected
- Describe the role of the placenta and umbilical cord
- Write points in order to present ideas and opinions (using structured note-taking methods).
- Identify stages of growth from embryo to newborn baby using

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## Biology 2 (continued)

Biology 2 (continued)

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| <ul style="list-style-type: none"> <li>• What happens during labour and birth in humans.</li> <li>• Role of sex hormones during puberty.</li> <li>• How different parts of the body change during puberty and adolescence.</li> <li>• Stages of the menstrual cycle.</li> <li>• Definition of a life-cycle.</li> <li>• Animal life-life cycles can be short/long with different stages.</li> <li>• How to structure a paragraph to make a point.</li> <li>• Definition of a species.</li> <li>• Organisms in the same species show variation.</li> <li>• Variation can be discontinuous or continuous.</li> <li>• Definition of a hybrid animal.</li> <li>• How to present discontinuous data (bar chart with gaps), and continuous data (grouped in a bar chart with no gaps, or a scatter graph).</li> <li>• Animals have adaptations suited to their environment.</li> <li>• Variation can be inherited, environmental or both.</li> <li>• Variation can have inherited and environmental causes.</li> <li>• Organisms have both physical and behavioral</li> </ul> | <ul style="list-style-type: none"> <li>• Describe what happens during labour and birth in humans.</li> <li>• Explain the purpose of the menstrual cycle and describe what happens in the 4 main stages</li> <li>• Identify the stages in the life cycle of an animal.</li> <li>• Compare life-cycles of different animals.</li> <li>• Explain why knowing about an animal's life-cycle can help in conservation.</li> <li>• Order sentences within a paragraph to present ideas and opinions clearly.</li> <li>• Explain why organisms from different species show more variation than organisms in the same species.</li> <li>• Identify variation as continuous or discontinuous.</li> <li>• Determine the parents of a hybrid organism.</li> <li>• Collect discontinuous and continuous data.</li> <li>• Correctly draw bar charts/scatter graphs using correct axes, scaling, and titles.</li> <li>• List the adaptations of a given organism.</li> <li>• Explain how an animals adaptation increases its chance of survival.</li> <li>• Explain how [environmental, inherited] factors can cause</li> </ul> |
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(Skills)

### Biology 2 (continued)

Biology 2  
(continued)

- There is competition between organisms for limited resources.
- The distribution of an organism can be investigated using a belt transect.
- Population size can be estimated using random sampling.
- Human activity can damage ecosystems.
- Feeding relationships can be described in terms of energy flow

- Explain why organisms are in competition in a given habitat.
- Describe how the distribution of organisms is controlled by the availability of resources.
- Explain how changes in a population or community in an ecosystem affect other populations.
- Collect and use belt transect data to make a conclusion about the distribution of an organism.
- Estimate a population size using random sampling.
- Explain the effects of persistent pesticides on ecosystems.
- Interpret models of energy transfer in food chains (pyramids of number, biomass).

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(Skills)

Chemistry 2

## Chemistry 2

- Some solids can dissolve in some liquids to make a solution, which is a reversible change. A solid that can dissolve is said to be soluble. Mass is conserved in a physical change.
  - Mixtures are made of different substances jumbled up together which can be separated using a variety of techniques. Some solids do not dissolve in liquids. A pure substance has a fixed composition and doesn't contain anything else mixed with it.
  - knowledge can be presented into clear points written in a logical sequence in writing, using a combination of text, diagrams, charts and graphs.
  - Some solids can dissolve in some liquids to make a solution, which is a reversible change. Evaporation can be used as a separation technique for solutions. Changes of state are an example of a reversible, physical change. Evaporation can occur below the boiling point. Evaporation is changing a liquid into a vapour / gas.
  - Different methods are needed to separate miscible and immiscible liquids. Miscible liquids are when two or more
- Identify the solvent and solute in a solution. Use knowledge of solutions to decide how a solution should be separated. Apply this to explain what is meant by a saturated solution and conservation of mass
  - Explain why filtration can be used to separate an insoluble solid from the liquid of a suspension.
  - Write practical methods as sets of instructions following scientific conventions.
  - Predict the state of a substance at a given temperature.
  - Suggest and justify an appropriate method to separate the substances in different mixtures / solutions.
  - Identify potential hazards during practical work and plan how to reduce the risk of these hazards causing harm.
  - Explain what happens to the particles during each stage of distillation. Explain how distillation can be used to produce pure water from sea water. Label the equipment used in distillation and understand its role in the process.
  - Explain how chromatography works, and be able to interpret a chromatogram.
  - Use and calculate R<sub>f</sub> values to identify substances from chromatograms

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## Chemistry 2 (continued)

Chemistry 2 (continued)

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| <ul style="list-style-type: none"> <li>• Chromatography can be used to separate and analyse a mixture</li> <li>• of solutes. Rf values can be used to identify substances.</li> <li>• Chromatography can be used to separate and analyse a mixture</li> <li>• of solutes. Rf values can be used to identify substances.</li> <li>• The testing of scientific ideas should be safe.</li> <li>• Bases are substances that react with acids. Some are soluble and these are called alkalis.</li> <li>• Indicators are substances that will change colour when added to substances that are acids or alkalis.</li> <li>• The pH scale is a measure of acidity.</li> <li>• People will often decide whether they want to read a report based on the title.</li> <li>• Bases are substances that react with acids in neutralisation reactions.</li> <li>• Some bases are soluble and these are called alkalis.</li> <li>• Chemical reactions can be represented by word</li> </ul> | <ul style="list-style-type: none"> <li>• Use chromatography to separate the different dyes in an ink and use Rf values to interpret the resulting chromatogram.</li> <li>• Recognise different hazard symbols.</li> <li>• Recognise a range of risks and plan appropriate safety precautions.</li> <li>• Plan to reduce risks by using a risk assessment.</li> <li>• Justify chosen methods of risk reduction.</li> <li>• Identify whether a substance is an acid or an alkali from the reaction with indicators.</li> <li>• Describe the pH scale in detail and use it to classify solutions as strong or weak acids or alkalis.</li> <li>• Use Universal Indicator to measure the pH of a solution.</li> <li>• Identify key points in a text.</li> <li>• Develop clear titles in order to present ideas and opinions.</li> <li>• Describe the reactions of acids with bases.</li> <li>• Model simple reactions using word equations.</li> <li>• Suggest how to treat a bee and wasp sting.</li> </ul> |
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(Skills)

## Physics 2

Physics 2

- Forces can be represented by arrows of different sizes and directions.
- Forces are measured in Newtons.
- Forces can change the shape, speed and/or direction of travel of an object.
- How to take effective notes from a video or presentation.
- Using abbreviations when note taking saves time..
- Friction is a force which resists motion,
- Friction can be reduced or increased in different situations.
- Pressure is a measure of how much force is acting upon a certain area. ( $P=F/A$ ).
- Pressure can be measured in Pascals (Pa) or Newtons per square metre.
- Standard (SI) units are used by scientists all over the world.
- We must convert measurements into the same units in order to compare them.
- Forces can be balanced or unbalanced.

- Draw diagrams showing the magnitude and direction of forces acting on various bodies.
- Identify key information from a presentation and make effective notes.
- Identify ways in which friction can be increased or reduced for mechanical systems.
- Apply knowledge of friction to road safety.
- Use the formula relating pressure, force and area giving the answer to a given number of significant figures.
- Record data using a suitable unit and convert units where data is given in alternate units.
- Evaluate the effects of balanced/unbalanced forces in unfamiliar situations. Calculate the resultant force from two forces acting in the same plane.
- Collect data by investigating the extension of a spring and use the data to produce a line graph.
- Relate the size/ length of a source of sound to the pitch of the sound it produces. Relate the volume/intensity of a sound to the size of the vibrations producing it.
- Be able to explain how sounds propagate in terms of the

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Your child will ... (Knowledge)

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(Skills)

### Physics 2 (continued)

- Sound can be described in terms of their pitch and volume.
- Sounds are produced by vibrations.
- Sound requires a material through which it can travel.
- Sound travels at different speeds in different materials.
- Sound travels away from a source becoming quieter the further it travels..
- Different types of charts and graphs may be used to present information.
- The vibrations of sound waves can be detected by the ear,
- Different animals hear different ranges of sound.
- Microphones convert sound into electrical signals.
- Sound can be used for communication and echolocation.
- Sound transfers energy and sounds may be transmitted through materials, absorbed or reflected.
- Waves can be longitudinal or transverse but all waves share certain characteristics.

- Identify line graphs and scatter graphs, and extract simple information from them. Present data in line graphs and scatter graphs. Identify patterns using scatter graphs.
- Be able to correctly describe the workings of the ear and explain how hearing can be damaged by sound.
- Be able to use the formula linking speed, distance and time. Be able to explain how ultrasound is used in medicine.
- To be able to compare longitudinal and transverse waves giving examples.
- Select an appropriate method to be able to remember key information from a lesson or topic

Physics 2  
(continued)

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### Physics 2 (continued)

- Waves travelling in different directions can pass through each other and add together or cancel each other out - called superposition.
- There are many techniques we can use to help us remember the things we have learned.

- Determine whether a question can be answered using science. Identify the features of a scientific and non-scientific question.
- Relate the properties of bones to their functions.
- Identify vertebrates and invertebrates.
- Describe other forms of protection and support in organ

Physics 2  
(continued)

### Area of study

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### Biology 3

#### Biology 3)

- The amount of energy and the substances in foods are shown on nutrition information labels.
- Different nutrients in the diet have different purposes.
- Humans need to eat a balanced diet.
- Information may be presented to persuade an audience.
- Health is defined by the WHO.
- Scientific evidence helps make decisions.
- Scientists use different methods study health in our communities
- The advantages of taking part in scientific research.
- What is the balance of their own diet?
- Possible risks to health
- Different factors that might influence an individual's health
- Factors that are important to health
- Lifestyle choice is important to health
- The components of a scientific investigation.
- The components of a scientific scientific research poster.
- Record and present results as a scientific research poster

- Use food labels to identify the nutrients in food.
- Calculate energy content or amounts of nutrients in foods/meals/ diets.
- Explain how deficiency diseases are caused.
- Describe the differences in energy requirements of different individuals.
- Recall that if a person's energy intake is different from the amount of energy that we need, their mass will change.
- Calculate the energy requirements for daily needs and activities.
- Describe the relationships between diet, exercise, age, sex and energy.
- Distinguish between points that are supported
- by evidence and those that are not.
- Describe different methods used by scientists to study health.
- Relate evidence to decisions that need to be made.
- Compare their diet to the Eatwell Plate and consider whether changes need to be made.
- Identify factors that might cause an effect on individuals

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### Biology 3 (continued)

Biology 3 (continued)

- Malnutrition is caused by a lack of or excess of one or more nutrients.
- The parts of the digestive system and their roles.
- An enzyme is a biological catalyst in digestion and what happens in basic enzyme action. Carbohydrases, proteases and lipases are enzymes.
- The meanings of ingestion, absorption and egestion.
- The gut contains bacteria.
- What happens in absorption
- The features of the small intestine wall for efficient absorption of soluble products of digestion.
- Respiration is one of the life processes.
- Oxygen and glucose are used in respiration to make carbon dioxide and water and release energy.
- How burning (combustion) and respiration are similar and different.
- The passage of air into the alveolus.
- How oxygen diffuses into the blood and carbon dioxide out.
- Calculate means.

- Use / interpret data from various sources to analyse the risk to health in the future.
- Consider factors that affect our decisions on what we eat.
- Formulate own question to investigate health
- Design and construct a plan for the investigation
- Safely carry out the investigation
- Record reliable, precise and accurate data
- Make a conclusion based on the data
- Complete a scientific research poster on their group's investigation findings.
- Provide advice on how to have a healthy diet.
- Describe what happens in digestion at various points along the digestive system.
- Identify how carbohydrate/protein/ fat is broken down in the gut including enzyme action.
- Consider the importance of gut bacteria in digestion.
- Explain how the structures of the small intestine increase absorption of food.
- Calculate surface area and relate it to its importance in the digestive system.



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### Biology 3 (continued)

Biology 3  
(continued)

- Peak flow is a measurement of how quickly air can be removed from the lungs.
- Nicotine, Tar and Carbon Monoxide are found in tobacco smoke and can reduce gas exchange.
- Asthma can reduce gas exchange.
- Limewater or hydrogen carbonate indicators can detect carbon dioxide.
- Plants exchange gases.
- Aerobic and anaerobic respiration occur in humans at the same time.
- Anaerobic respiration releases less energy than aerobic respiration.

- Explain how specialised cells keep the lungs clean (mucus production and ciliated epithelial cells). Describe how substances transfer from the alveoli to the blood and vice versa. Describe how substances reach respiring cells from the blood and how waste products are returned to the blood.
- Explain why data with a small range is of good quality.
- Calculate means and explain their use.
- Write an explanation of the effects of smoking on the body, using the idea of cause and effect.
- Write an explanation of the effects of exercise on the body using the idea of cause and effect.
- Explain how we can show respiration has occurred.
- Compare gas exchange in plants and animals.
- Model anaerobic respiration using a word equation.
- Describe how lactic acid is removed from tissues.
- Explain why anaerobic activity cannot be sustained.
- Compare anaerobic and aerobic respiration and link to their uses.

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Chemistry 3

### Chemistry 3)

- In a chemical reaction, mass is conserved. The total mass of all reactants will equal the total mass of all products.
- Metals react with oxygen to form metal oxides.
- Fuels are used to transfer energy, usually using combustion.
- A hydrocarbon is a chemical compound that contains carbon and hydrogen only.
- The complete combustion of hydrocarbons produces carbon dioxide and water.
- Limewater will turn cloudy in the presence of carbon dioxide.
- Incomplete combustion occurs when the supply of oxygen is poor.
- The products of the incomplete combustion of hydrocarbons include carbon monoxide, carbon (soot), and water.
- The products of incomplete combustion can cause health problems.
- Pollutants such as sulfur dioxide and nitrogen oxides are

- Predict the products of a chemical reaction between metals and oxygen.
- Use knowledge of the composition of the atmosphere to explain the change in mass observed in chemical reactions.
- Model simple chemical reactions using word and symbol equations.
- State the meaning of the word hydrocarbon and identify examples of hydrocarbon compounds.
- Write word equations to show the complete combustion of hydrocarbons.
- Describe how you can test for the presence of carbon dioxide.
- Explain the products formed by the incomplete combustion of hydrocarbons.
- Explain the problems caused by incomplete combustion.
- Describe how sulfur dioxide and nitrogen oxides are produced.
- Explain how sulfur dioxide and nitrogen oxides can cause acid rain.
- Explain how neutralisation can be used to reduce pollution from fossil fuel combustion.

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## Chemistry 3 (continued)

Chemistry 3 (continued)

- The effects of pollutants can be reduced using catalytic converters.
- The temperature on the Earth varies over time, which can affect climate.
- Some gases in the atmosphere help to keep the Earth warm, including carbon dioxide.
- Human activity can influence the levels of carbon dioxide in the atmosphere.
- All matter is made up of tiny particles called atoms.
- Elements are made up of one type of atom.
- Compounds are made up of two or more different types of atoms chemically bonded together.
- Differences in atoms give elements distinct properties.
- Atoms have protons and neutrons in a central nucleus and electrons in 'orbits' around the nucleus.
- The ratio of the different types of atoms within a compound can be represented by a chemical formula.
- Chemical reactions are usually observable and irreversible changes.

- Explain the greenhouse effect.
- Explain how human activity affects the levels of carbon dioxide in the atmosphere.
- Explain how methods of controlling the levels of carbon dioxide work.
- Describe an element and a compound in terms of Dalton's atomic theory.
- Use the idea of atoms to explain why different elements have different physical properties.
- Use chemical symbols to represent different atoms, elements, and compounds.
- Use observations to decide whether a chemical reaction has taken place.
- Identify reactants and products using a word equation.
- Interpret chemical formulae to identify the types of and ratio of atoms in a compound.
- Identify the alkali metals, halogens, and noble gases in the Periodic Table.

Explain how Mendeleev arranged his Periodic Table

Area of study

Your child will ... (Knowledge)

Your child will be able to... (Skills)

### Chemistry 3 (continued)

Chemistry 3 (continued)

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>• During a chemical reaction, bonds between atoms are broken and reformed.</li> <li>• Mendeleev arranged his Periodic Table by atomic mass and grouped the elements based on their properties.</li> <li>• Mendeleev left gaps in his Periodic Table to place elements not known at the time and could make predictions about their properties.</li> <li>• Elements in the same group of the modern Periodic Table share similar properties.</li> <li>• Outliers are results that lie outside of the rest of the data.</li> <li>• Anomalous results do not fit with the pattern of the other results in an experiment.</li> <li>• Metals and non-metals can be identified based on their physical properties.</li> <li>• The physical state of a substance at a particular temperature can be identified using the melting and boiling point of the substance.</li> <li>• As you descend groups of the Periodic Table, there is typically a regular gradation in the physical properties of the elements.</li> </ul> | <ul style="list-style-type: none"> <li>• State the meaning of the terms anomalous result and outlier.</li> <li>• Identify outliers/anomalous results in a set of data.</li> <li>• Suggest scientific reasons for anomalous results or outliers.</li> <li>• Identify metals and non-metals based on their physical properties.</li> <li>• Predict the physical state of a substance at a set temperature using its melting and boiling point.</li> <li>• Use data to identify trends in physical properties within a group of the Periodic Table.</li> <li>• Identify trends in chemical properties using the Periodic Table.</li> <li>• Describe the reaction and predict the products when an alkali metal reacts with water.</li> <li>• Make predictions about the chemical properties of elements using the Periodic Table.</li> </ul> |
|--|---|

Metals react with water to produce a metal hydroxide

Area of  
study

Your child will ... (Knowledge)

Your child will be able to...  
(Skills)

### Chemistry 3 (continued)

- The reactivity of the alkali metals increases as you descend Group 1.
- The oxides of elements become more acidic as you go from left to right across the Periodic Table.

Chemistry 3  
(continued)

Area of  
study

Your child will ... (Knowledge)

Your child will be able to...  
(Skills)

## Physics 3

Physics 3

- All matter consists of particles, and particles are arranged differently in solids, liquids and gases. This idea can help explain their properties.
- The [kinetic theory, particle model] can be used to explain the expansion and contraction of solids, liquids and gases.
- The kinetic theory can be used to explain diffusion.
- The density of an object depends on its mass and volume.
- The [kinetic theory, particle model] can be used to explain what happens during changes of state.
- Energy is transferred during changes of state.
- When a pure substance changes state its temperature remains constant.
- States of matter can be changed reversibly because they are physical changes.
- The kinetic theory can be used to explain atmospheric pressure and pressure in gases.
- Pressure is exerted by fluids.
- Pressure is a way of saying how concentrated a force is.

- Use the particle model of matter to explain the properties of solids, liquids and gases (including density qualitatively), and how their movement changes with temperature.
- State what is meant by diffusion, contraction and expansion.
- Use the particle model of matter to explain how and why the volume of a solid changes when it is a) heated; b) cooled.
- Describe how to measure the volume of regular and irregular objects (using a displacement can).
- Complete calculations using the equation  $\text{density} = \frac{\text{mass}}{\text{volume}}$ .
- Change the subject of a simple mathematical formula.
- Describe how the volumes and densities of substances change at different temperatures.
- Explain how chemical changes are different from physical changes.
- Recall that a change of state of a pure substance takes place at a constant temperature.
- Explain what happens to particles and temperature of a substance during changes of state, in terms of energy and forces.

Area of study

Your child will ... (Knowledge)

Your child will be able to... (Skills)

## Physics 3 (continued)

Physics 3 (continued)

- Upthrust is a force that acts in liquids and gases.
- The density of an object depends on its mass and volume.
- How an object behaves will depend on the interaction of the forces upon it.
- There are different types of forces that resist motion.
- Forces can be balanced or unbalanced.
- Moving objects have a top speed.
- The average energy in the kinetic store of the particles in a gas depends on the temperature.
- The internal energy of an object depends on its mass, temperature and the material it is made of.
- The direction in which energy is transferred by heating depends on the relative temperatures of different objects or materials.
- Energy can be transferred by evaporation from a surface.
- Energy can be transferred by conduction, convection and radiation in different circumstances.
- Energy transfers by conduction, convection, radiation

- Describe the ways in which the volume and density changes during the water–ice transition are different from other materials.
- Use the particle model of matter to describe the causes of pressure in a liquid or gas.
- Explain some effects caused by air or water pressure using ideas about forces, including atmospheric pressure.
- Explain why pressure in a fluid increases with depth.
- Use prepositional phrases in writing.
- Explain why an object floats.
- Explain how the upthrust depends on the weight of fluid displaced.
- Use densities of materials to predict whether different objects will float in water.
- Use ideas about density changes to explain how a hot air balloon flies/how the depth of a submarine is controlled.
- Explain, in terms of particles, what causes water and air resistance.
- Describe the ways in which size of drag forces can be changed.

Area of study

Your child will ... (Knowledge)

Your child will be able to... (Skills)

## Physics 3 (continued)

Physics 3 (continued)

- Energy transfers by conduction can be reduced by using insulating materials.
- Power is the rate at which work is done.
- Energy transfers can be shown using Sankey diagrams.
- Energy cannot be created or destroyed, but in most energy transfers some energy is transferred to a store that is not useful.
- Energy used has to be paid for.
- Energy cannot be created or destroyed, but in most energy transfers some energy is transferred to a store that is not useful.
- Energy can be transferred by conduction, convection and radiation in different circumstances.

- Explain how internal energy and temperature are different.
- Identify the direction in which energy will be transferred in given circumstances.
- Describe the factors that determine the temperature of an object.
- Describe the factors that affect the rate of transfer of energy by heating.
- Convert between the Kelvin and Celsius scales.
- Use the particle model of matter to explain energy transfers by conduction and convection.
- Describe how energy is transferred by radiation.
- Compare conduction in thermal conductors and thermal insulators.
- Compare conduction, convection, radiation and evaporation as methods of heat energy transfer.
- Recall ways of reducing energy transfer by conduction, convection and evaporation.
- Explain why particular materials (conductors/insulators) are used for given purposes.
- Apply the idea of different colours being good or poor emitters



Area of  
study

Your child will ... (Knowledge)

Your child will be able to...  
(Skills)

Physics 3 (continued)

Physics 3  
(continued)

- Follow instructions to complete an investigation safely.
- Investigate how changing thickness of insulation around a beaker of hot water affects the water temperature over time.
- Write a conclusion using a given set of data for a scientific investigation.
- Describe what power means and the relationship between watts and joules/second.
- State the meaning of efficiency and recall some advantages of efficient appliances.
- Identify useful and wasteful energy transfers.
- Use Sankey diagrams to compare appliances or processes.
- Calculate energy efficiencies.
- Explain why efficiency can never be greater than 100%.
- Recall that electricity and mains gas are charged for on the basis of the energy transferred.
- Explain why power companies use the kWh as a measure of energy.
- Recall some advantages of low-energy appliances.
- Calculate the energy transferred by different appliances in one year in kWh.

## Area of study

## Your child will ... (Knowledge)

## Your child will be able to... (Skills)

### Biology 4

#### Biology 4

- Every organism is classified into one of five kingdoms, and each kingdom contains a series of smaller and smaller groupings or subsets.
- It is important to maintain biodiversity
- Samples can be used to calculate an estimate of population size.
- Variation can have inherited and environmental causes.
- Some plants can reproduce asexually.
- Pollination and fertilisation occur differently in different flowering plants.
- In the reproduction of many plants, pollen has to be carried from one flower to another.
- Fruit and seed formation occurs differently in different flowering plants.
- Sexual reproduction involves the fusion of specialised [sex cells, gametes] to form cells that grow into embryos.
- Pollination and fertilisation occur differently in different flowering plants.
- Paragraphs are structured to make ideas clear.
- Seeds remain dormant until germination when an embryo grows from a seed into a seedling.

- Explain why biodiversity is important.
- Able to classify living organisms into their kingdoms.
- Extension: Use simple calculations (e.g. biodiversity index) to compare biodiversity.
- Calculate a population size.
- Explain the effects of too small and too big a sample size.
- Identify and explain how different plants reproduce asexually.
- Evaluate the advantages and disadvantages of sexual and asexual reproduction in plants in different conditions.
- Describe the functions of different parts of the flower.
- Evaluate different methods of pollination (wind and animal) and identify unknown plants that might do either.
- Name the parts and the functions of the different parts of a seed.
- State the methods of seed dispersal and explain the importance of seed dispersal.
- Describe how fertilisation happens.
- Explain what structures of the flower turn to what parts of the seed.

Area of  
study

Your child will ... (Knowledge)

Your child will be able to...  
(Skills)

## Biology 4 (continued)

Biology 4  
(continued)

- The importance of pollination for the production of foods.
- Microorganisms can be classified based on their cell structure, which at its most basic level classifies them as prokaryotes and eukaryotes.
- Unicellular organisms do not require the efficient transport systems used by multicellular organisms.
- Some organisms contain only one cell; others contain many millions.
- Microorganisms may respire aerobically or anaerobically.
- Microorganisms can increase quickly in number
- Modal verbs can be used in scientific writing to express different degrees of certainty.
- Bacterial cells share certain features.
- Microorganisms may respire aerobically or anaerobically.
- Microorganisms can increase quickly in number.
- Data can be presented in pie charts.
- Protist/protocist cells have a wide variety of features.

- Describe how seeds can be dispersed and identify the method used for unknown plants. Explain why dispersal is important.
- Carry out an experiment to quantitatively analyse seed dispersal.
- Write in paragraphs which show unity, cohesion and order.
- Explain what a seed needs to germinate.
- Explain why plants produce lots of seeds.
- Identify parts of the plant's life-cycle.
- Describe examples of interdependence and explain how changes in a population or community in an ecosystem affect other populations.
- Explain the importance of pollinators to food security.
- Extension: Link to accumulation of toxins in the environment.
- Identify unicellular organisms from their cell structures.
- Explain why multicellular organisms need efficient transport systems.
- Explain the importance of surface area: volume ratio for organisms.
- Describe what happens in budding.
- Explain how yeast can be used in the food industry.

Area of study

Your child will ... (Knowledge)

Your child will be able to... (Skills)

### Biology 4 (continued)

- Plants make their own food using photosynthesis.
- Feeding relationships can be described in terms of energy flow.
- Carbon is recycled in an ecosystem.
- There are many different types of interaction between the organisms in an ecosystem.
- Some microorganisms are useful.

- Describe what a growth curve shows. Use graphs to calculate population growth rates.
- Plan a bacterial investigation to find out if using soap to wash your hands is more effective at killing bacteria than just water.
- Identify a range of modal verbs and what they are trying to convey in terms of certainty.
- Use a range of modal verbs in their writing to express different degrees of certainty.
- How can bacteria be used in the food industry?
- Identify different types of bacteria.
- Identify the parts of a bacterial cell.
- Describe how bacteria multiply by binary fission.
- Explain how bacteria are used in the production of yoghurt .
- Use keys to identify different types of bacteria.
- Describe what a certain pie chart shows.
- Extract simple information from pie charts.
- Present data in pie charts.
- Identify when to use a pie chart.
- Identify features of protoctists (compare to other unicellular organisms as appropriate)

Biology 4  
(continued)

Area of  
study

Your child will ... (Knowledge)

Your child will be able to...  
(Skills)

Biology 4 (continued)

Biology 4  
(continued)

- Can explain the importance of algae / other photosynthetic protists as a producer in the food chain.
- Can interpret pyramids of numbers.
- Model photosynthesis with a word equation.
- Identify processes in the carbon cycle.
- Explain the role of decomposers in the carbon cycle.
- Make predictions about how changes in physical and biological factors will affect carbon supply in an ecosystem.
- Model the recycling of carbon in an ecosystem using the carbon cycle.

Area of  
study

Your child will ... (Knowledge)

Your child will be able to...  
(Skills)

Chemistry 4

## Chemistry 4

- Metal and nonmetal elements can be chemically combined to form compounds.
- Chemical reactions can take place at a great variety of speeds.
- Chemical reactions can be represented by word equations.
- Metals can react with oxygen.
- Metals can react with water.
- Adjectives can be used to describe substances.
- Metals can react with water.
- Chemical reactions can be represented by symbol or formula equations.
- Good quality evidence needs to be both accurate and reliable.
- Acids can react with metals, bases and carbonates.
- Pure elements are often alloyed with others to make their properties more useful.
- The purity of a single substance can be determined by its melting point and boiling point.

- Use evidence to classify unfamiliar materials as being [metal elements, metallic, non-metal elements, nonmetallic].
- Name simple compounds formed by a reaction between two elements.
- Describe how catalysts affect the [speed, rate] of a reaction.
- Model simple chemical reactions using word equations.
- Identify the products formed by the oxidation of metals.
- Compare the corrosion of iron with the corrosion of other metals.
- Recall ways in which iron can be prevented from rusting.
- Use adjectives correctly, both before and after the noun in a sentence, to describe substances accurately.
- Use information on the reactions of metals with water to place them in an order of reactivity.
- Model simple reactions using balanced symbol equations.
- Use state symbols in equations.
- Identify data that is repeatable, not repeatable, reproducible, not reproducible, reliable and not reliable.
- Suggest a simple way to improve an investigation.
- Model simple reactions using balanced symbol equations.

Area of  
study

Your child will ... (Knowledge)

Your child will be able to...  
(Skills)

### Chemistry 4 (continued)

Chemistry 4  
(continued)

- |   |  |
|---|--|
| <ul style="list-style-type: none"> <li>• Different rocks are made up of different types of grains.</li> <li>• Rocks have a great many uses.</li> <li>• Igneous rocks are formed when molten rock freezes.</li> <li>• The reliability of a source is related to the publisher, evidence provided and the peer review process.</li> <li>• Physical, chemical and biological weathering breaks down rocks.</li> <li>• Erosion moves weathered rocks.</li> <li>• Sedimentary rocks are formed by the compaction of deposited layers of sediment.</li> <li>• Metamorphic rocks are formed by the action of pressure and heat on igneous and sedimentary rocks.</li> <li>• In some sciences it is difficult to carry out experiments, and most of the data used to test hypotheses is collected by observation.</li> <li>• There are different ways of extracting metals from compounds in their ores depending on their positions in the reactivity series.</li> </ul> | <ul style="list-style-type: none"> <li>• Use state symbols in equations.</li> <li>• Use information on the reactions of metals with acids to place them in an order of reactivity.</li> <li>• Identify a pure substance from its melting or boiling point.</li> <li>• Use models to explain why converting pure metals into alloys often increases the strength of the product.</li> <li>• Explain why certain rocks are [porous, usually permeable].</li> <li>• Explain why certain rocks are used for certain applications.</li> <li>• Describe how igneous rocks are formed.</li> <li>• Explain how the size of crystals is evidence for the speed of cooling.</li> <li>• Describe some factors that affect the rate at which lava or magma cools down.</li> <li>• Identify the use of emotive language in media reports.</li> <li>• Evaluate the information contained in media reports.</li> <li>• Describe the effect of physical, chemical and biological weathering on rocks.</li> </ul> |
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Area of study

Your child will ... (Knowledge)

Your child will be able to... (Skills)

## Chemistry 4 (continued)

Chemistry 4 (continued)

- Some scientific investigations are concerned with the relation between an independent variable and a dependent variable. The emphasis is on identifying one independent variable to be manipulated independently of other factors, which must be controlled. Systematic changes in the independent variable are compared with changes in the outcome, or dependent variable. All other relevant variables are controlled.
- All measurements have a degree of accuracy.

- Apply knowledge of [particles, expansion, contraction] to explain how rocks are broken up by [freeze–thaw action, onion skin weathering (exfoliation)].
- Use a simple model to explain how bits of rock are transported, abraded and deposited.
- Describe how different limestones were formed.
- Explain why sedimentary rocks [may contain fossils, are susceptible to erosion].
- Describe how metamorphic rocks are formed.
- Use the rock cycle model to link the formation of igneous, sedimentary and metamorphic rocks.
- Outline the basic scientific method and how it is modified for largely observational sciences such as geology.
- Identify hypotheses and some of the evidence that supports/refutes them.
- Describe how metals are extracted from their ores by [heating with carbon, electrolysis].
- Explain why the method used to extract a metal is related to its position in the reactivity series and the cost of the extraction process.



## Area of study

## Your child will ... (Knowledge)

## Your child will be able to... (Skills)

### Physics 4

#### Physics 4

- Waves can be longitudinal or transverse but all waves share certain characteristics.
- We see things when light reflected from them enters our eyes.
- Light travels in straight lines and can pass through empty space.
- We see things when light reflected from them enters our eyes.
- Light travels in straight lines.
- Waves are reflected at the boundary between different materials according to a physical law.
- We see things when light reflected from them enters our eyes.
- The nature of the image formed by a plane mirror can be worked out using ray diagrams.
- Waves travel at different speeds in different materials, which means that the waves can be refracted.
- Lenses have different uses based on how they bend light.
- Style practical questions – Angle of refraction with different materials

- Describe the difference between light waves and sound waves (compare longitudinal and transverse waves)
- Use ray diagrams to explain image formation in pinhole cameras.
- Use the ray model of light to explain how we see things that are not sources of light.
- Explain how a shadow is formed.
- Use ray diagrams to model and explain the effect of hole size on the image formed by a pinhole camera.
- Describe the characteristics of the image formed by a plane mirror.
- Use ray diagrams to explain the law of reflection.
- Use a ray diagram to describe the differences in light reflected from smooth and from rough surfaces
- Use the ray model of light to explain how a periscope works.
- Explain why refraction occurs.
- State the meaning of: convex lens, concave lens, converging lens, diverging lens, focal length, focus, and principal axis.
- Describe the effects of convex and concave lenses on parallel beams of light.

State the meaning of: angle of incidence, incident

Area of study

Your child will ... (Knowledge)

Your child will be able to... (Skills)

## Physics 4 (continued)

Physics 4 (continued)

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>• Waves travel at different speeds in different materials, which means that the waves can be refracted.</li> <li>• Our eyes use refraction to help us to see.</li> <li>• Cameras work in a similar way to eyes.</li> <li>• Computer presentations can be used as visual aids when communicating ideas and scientific findings.</li> <li>• Presentations need to be planned carefully based on their purpose, audience, length and key ideas.</li> <li>• Coloured light can be mixed to produce other colours.</li> <li>• The appearance of objects changes in different coloured light.</li> <li>• There have been different models of the solar system.</li> <li>• The Solar System contains the Sun and the Earth, the Moon and other planets.</li> <li>• All the planets in the Solar System orbit the Sun, revolving as they do so.</li> <li>• All the planets in the Solar System orbit the Sun, revolving as they do so.</li> </ul> | <ul style="list-style-type: none"> <li>• Investigate the effect of refraction using different shaped glass blocks</li> <li>• Measure angles accurately using a protractor</li> <li>• State the functions of the parts of the eye.</li> <li>• Describe similarities and differences between cameras and eyes. This would include the movement of the lens to focus as opposed to changing the shape of the lens.</li> <li>• Explain how different types of lens are used to correct long-sight and short-sight.</li> <li>• Prepare a presentation using a mixture of text, diagrams, charts and graphs.</li> <li>• Explain that some of the colours we perceive are a mixture of different [wavelengths, frequencies] of light.</li> <li>• Explain why objects look different in light of different colours.</li> <li>• Explain how filters can be used to make coloured light.</li> <li>• Compare the geocentric and heliocentric models of the Solar System.</li> <li>• Explain why the heliocentric model is our current model of the Solar System.</li> <li>• Describe the positions and orbits of the Earth and planets in the Solar system.</li> </ul> |
|--|---|

Area of study

Your child will ... (Knowledge)

Your child will be able to... (Skills)

## Physics 4 (continued)

Physics 4 (continued)

- The seasons are caused by the movement of the Earth.
- Magnetism is a non-contact force that affects the space around it.
- Magnetism is a force that is a property of some materials.
- Magnets can push and pull.
- The strength of gravity is affected by factors.
- Gravity affects planets, natural satellites and stars.
- Weight and mass are not the same.
- The strength of gravity is affected by factors.
- Weight and mass are not the same.
- The Solar System is part of the Milky Way, which is just one galaxy in the Universe.
- Other galaxies are moving relative to our own.
- Humans can explore the Solar System in different ways.

- Explain the changes in day length and height of the Sun in terms of the tilt of the Earth's axis.
- Explain the effect of the tilt of the Earth's axis on the energy transferred from the Sun to a unit area of the Earth's surface.
- Describe the Earth's magnetic field.
- Explain how a plotting compass can be used to show the shape and direction of a magnetic field.
- Explain how to arrange two magnets so that they attract or repel each other.
- Describe the difference between mass and weight and use gravitational field strength to calculate weights.
- Explain why the weight of an object changes if taken to the Moon but not its mass.
- Describe how gravity affects bodies in space.
- Calculate and compare the diameter and gravitational field strength of the planets using ratios and percentages.
- Use gravitational field strength to calculate weights.
- Recognise the light year as a measurement of distance and use it to compare the distances of distant objects.

Describe the shape of different galaxies

Area of  
study

Your child will ... (Knowledge)

Your child will be able to...  
(Skills)

Physics 4 (continued)

Physics 4  
(continued)

- Describe some ways of investigating planets.
- Explain how technological developments have increased our knowledge of the Solar System.
- Produce a balanced argument on/debate whether we should spend money on studying space.

Your child will ...

KS4

Physics 4  
(continued)

- Describe some ways of investigating planets.
- Explain how technological developments have increased our knowledge of the Solar System.
- Produce a balanced argument on/debate whether we should spend money on studying space.