Bede Academy

Science Curriculum Map

Science Curriculum Map

Through building their key foundational knowledge and developing skills relating to scientific enquiry, students will be encouraged to be curious about the world around them. They will be able to systematically analyse new information and form logical, reasoned conclusions, that can be used to help both themselves and others.

As we identify the key knowledge that students should master in **science,** we think carefully about *how* we want students to think as a **scientist**. We want students to:

- develop their scientific knowledge through the specific disciplines of biology, chemistry and physics.
- develop their understanding of the processes involved in scientific enquiry and how this forms a framework by which they can begin to answer science specific questions relating to the world around them.
- understand that scientific knowledge is tentative and that it can change and develop over time.
- apply subject specific knowledge to recognise the social and ethical implications of scientific discoveries, today and in the future.

The **science** curriculum is sequenced around the following key concepts:

Biology	Chemistry	Physics
Cells, Tissues, Organs and Organ Systems Genetics and Inheritance Ecosystems and the Environment	Particles The Earth and our Environment Behaviour of Materials	Forces Energy Particles The Universe

Our all-through curriculum is:

…knowledge-rich with clearly defined, coherent progression which strengthens schema to enable all students to secure ambitious curriculum goals;

- Curriculum units are built around key concepts that are revisited and developed during each key stage.
- The knowledge within each curriculum unit is clearly defined and presented to students at the start of each unit and used to discuss progress throughout the unit.

…enabling as all students have access to the whole curriculum and students master fundamentals in reading, writing and mathematics;

- *Maths skills are built into each appropriate topic across all three sciences (converting units, using and rearranging equations, graph skills).*
- *Opportunities for extended writing across all three sciences to encourage fluency with scientific keywords.*
- *Themes are built upon year on year, this allows students to revisit their previous learning and build upon it.*

…responsive as assessment identifies security of learning and students are supported to achieve our curriculum goals;

- *Varied assessment types (Recall quizzes, MCQ, extended response, end of topic tests) .*
- *Assessment informs feed forward moments to fill gaps.*
- *SOW identifies prior learning to allow for checking understanding at start of new topic.*

…inspiring as it takes students beyond their own experience, offers opportunity for creativity, and enables them to understand their identity in Blyth and beyond;

- *Opportunities to engage with higher education (Oxbridge summer schools, Chemistry and Physics Olympiad, Durham University Christmas Lectures, Science Fair).*
- *Science specific house events (marble run, kitchen sink chemistry and Springwatch).*

…transformative as by developing character, we build learners who exemplify the Core Virtues and make a positive contribution to their community.

- *Showing an empathy for the views of others and yet make informed evidence-based decisions.*
- *Develop resilience in terms of applying their knowledge to novel situations in science.*

Science Curriculum Map

Primary Science

Year	Autumn 1	Autumn 2	Spring 1	Spring 2	Summer 1	Summer 2
1	Animals - Who am I?	Materials	Polar Adventures	Treasure Island	Plants on safari	Our holiday
2	Healthy me!	Materials monster	Move it!	Mini worlds	Young gardeners	Master chef
3	Rocks	Food and our bodies	We are astronauts!	Forces and Magnets	Plants on safari	Mirror Mirror
4	Sound	State of matter	Electricity	Electricity	Teeth and Eating	Living things and their habitats
5	Earth and space	Properties of changes of materials	Forces	Life cycles	Human life cycle	Properties of changes of materials
6	Classifying critters	We're evolving	Staying alive	Light	Electricity	

Biology

Year										
7	Cells and movement			Interdependence and Plant Reproduction		Human Reproduction				
8	Breathing and Digestion			Respiration and Photosynthesis		Inheritance and Evolution				
9	Cells					Organisation				
10	Infection and Response			Bioenergetics		Homeostasis				
11	Inheritance, variation and evolution					Ecology				
12	Cell Structure and membranes	Cell Division	Exchange	Transport in Animals	Transport in Plants	Biological Molecules	Enzymes	Communicable Disease	Biodiversity	Classification and Evolution
13	Communication and Homeostasis	Animal and Plant responses	Photosynthesis	Cellular Control and Inheritance	Manipulating Genomes and Cloning	Respiration	Hormonal Communication	Neuronal Communication	Population and sustainability	Ecosystems

Science Curriculum Map

Chemistry

Year										
7	Particles and Separating Mixtures			Metals Non-Metals Acids and Bases			Earths Structure and the Universe			
8	Elements and The Periodic Table			Chemical Energy and Types of Reaction			Climate and Earths Resources			
9	Atomic Structure			Bonding and Structure			Chemistry of the Atmosphere			
10	Chemical changes			Energy Changes			Quantitative			
11	Energy			Particle Model of Matter			EM Spectrum			Space
12	Atomic structure and amount of substance		Bonding and periodicity		Energetic and Kinetics	Equilibria and Redox	Periodicity Group 2 and group 7	Introduction to Organic Chemistry	Alkenes and alchols and organic analysis	Further organic Chemistry
13	Acids and Bases	Period 3	Transition Metals and Inorganic Ions	Aromatic Chemistry	Electrochemical Cells	Rates and Equilibrium	Thermodynamics	Amines and Polymers	Organic Synthesis	NMR and Chromotography

Physics

Year						
7	Voltage Resistance and Current		Contact Forces and Speed		Energy Costs and Transfers	Sound and Light
8	Pressure and Gravity		Electromagnets and Magnetism		Work and Heating and Cooling	Wave Effects and Properties
9	Energy		Particle Model of Matter		Space	
10	Atomic Structure		Electricity			Forces
11	Magnetism and Electromagnetism				Waves	
12	Mechanics and Matter	Electricity	Particles & Radiation		Waves	Further Mechanics and Thermal Physics	Nuclear Physics
13	Nuclear Physics		Fields			Turning Points

Science Curriculum Map

Early Years Links	Nursery	<u>Substantive</u> To observe the weather whilst inside and outside To enjoy taking part in cooking activities Explore the nursery indoor and outdoor environment, using all of their senses. To begin to identify same and different in things around nursery. **Early disciplinary skills and knowledge** Senses Behaviour of materials/changing states	<u>Substantive</u> To observe the weather whilst inside and outside To enjoy taking part in cooking activities Explore the nursery indoor and outdoor environment, using all of their senses. To begin to identify same and different in things around nursery. To plant seeds and water them To learn about farm animals, including the names of baby and adult animals. To know some simple ways of caring for them, e.g. feeding baby lambs with a bottle. **Early disciplinary skills and knowledge** Ecosystems and the environment Senses Behaviour of materials/changing states	<u>Substantive</u> To observe the weather whilst inside and outside To enjoy taking part in cooking activities Explore the nursery indoor and outdoor environment, using all of their senses. To begin to identify same and different in things around nursery. To plant seeds and water them To explore movement and forces To explore the beach To find out about animals that live at the beach To enjoy taking part in activities which help us to be healthy, through healthy living week. **Early disciplinary skills and knowledge** Ecosystems and the environment Forces Biology – healthy living
	Vocabulary	Sunny, raining, windy, cloudy Hot, cold	Sunny, raining, windy, cloudy Hot, cold Grow, flowers, seed, pot, water, soil Same, different Farm, animals, specifically naming farm animals, such as cow, calf, horse, foal etc, farmer, farm house, shed, barn, feeding	Sunny, raining, windy, cloudy Hot, cold, cooker, fridge, cook, cool Grow, flowers, seed, pot, water, soil Same, different Healthy, unhealthy, safe, exercise Animal names, land, sea, ocean, water, trees Rough, smooth, bumpy, fluffy

Science Curriculum Map

	Reception	<u>Substantive</u> To identify which season it is and talk about what they see outside To begin to know the impact of the changes in seasons on their day-to-day life – wearing jumpers when it's cold etc. To take part in cooking activities, talking about the changes that they see in ingredients, and how they happen – cooking in the oven, cooling in the fridge etc To find out about how doctors and nurses help us keep our bodies healthy. To find out about the skeleton inside our bodies To explore using our senses **Early disciplinary skills and knowledge** Ecosystems and the environment Biology – the body and senses	<u>Substantive</u> To identify which season it is and talk about what they see outside To begin to know the impact of the changes in seasons on their day-to-day life – beginning to feel warmer in the Spring etc. To take part in cooking activities, talking about the changes that they see in ingredients, and how they happen – cooking in the oven, cooling in the fridge etc To notice and talk about which materials build the best house for the 3 little pigs. To begin to think about recycling and how this is better for the planet. To plant potatoes and observe the changes over time as they grow. To explore the impact of surface on the speed of toy vehicles **Early disciplinary skills and knowledge** Ecosystems and the environment Behaviour of materials Forces	<u>Substantive</u> To identify which season it is and talk about what they see outside To begin to know the impact of the changes in seasons on their day-to-day life – wearing shorts and t-shirt when it's hot etc. To take part in cooking activities, talking about the changes that they see in ingredients, and how they happen – cooking in the oven, cooling in the fridge etc To plant potatoes and observe the changes over time as they grow. To find out about and observe minibeasts. To find out ways of keeping our bodies healthy through healthy living week **Early disciplinary skills and knowledge** Ecosystems and the environment Behaviour of materials Biology – healthy body
	Vocabulary	autumn, winter, spring, summer, raining, sunny, cloudy, foggy, windy (combining more that one label to the weather for more accuracy), hot, cold, Cooking, hot, cold, cool, change, sticky, firm, gooey, touch, taste, look, feel, hear Body parts – arms, legs, neck, head etc Doctor, nurse, help, hospital,	autumn, winter, spring, summer, raining, sunny, cloudy, foggy, windy (combining more that one label to the weather for more accuracy), hot, cold, Hot, cold, Cooking, hot, cold, cool, change, sticky, firm, gooey, touch, taste, look, feel, hear Recycle, planet, reuse Fast, slow, bumpy, smooth	autumn, winter, spring, summer, raining, sunny, cloudy, foggy, windy (combining more that one label to the weather for more accuracy), hot, cold, Hot, cold, Cooking, hot, cold, cool, change, sticky, firm, gooey, touch, taste, look, feel, hear Grow, roots, shoots, stem, leaves, flower, petal, soil, water, sun, planting, dark, light
	Early Learning	ELG: The Natural World Children at the expected level of development will: • Explore the natural world around them, making observations and drawing pictures of animals and plants. • Know some similarities and differences between the natural world around them and contrasting environments, drawing on their experiences and what has been read in class. • Understand some important processes and changes in the natural world around them, including the seasons and changing states of matter.		

Science Curriculum Map

Year 1	Unit	Animals – Who am I?	Materials	Polar adventures	Treasure Island	Plants on safari	On holiday
	Key Concepts	**Ecosystems and the Environment** **Biology: Cells, Tissues, Organs and Organ Systems**	**Behaviour of Materials**	**Ecosystems and the Environment**	**Ecosystems and the Environment**	**Ecosystems and the Environment**	**Ecosystems and the Environment**
	Prior Learning		The Four seasons are Autumn, Winter, Spring and Summer. Weather, plants and our environment changes during the four seasons. How to ask simple questions and recognise that they can be answered in different ways.	Objects are made from different materials. Types of materials are wood, plastic, glass, metal, water, and rock. (Identifies these) Materials can be hard or soft; smooth or rough; shiny or dull How to ask simple questions and recognise that they can be answered in different ways. How to observe closely, using simple equipment.	The Four seasons are Autumn, Winter, Spring and Summer. Materials can be hard or soft; smooth or rough; shiny or dull Weather, plants and our environment changes during the four seasons. How to ask simple questions and recognise that they can be answered in different ways. How to observe closely, using simple equipment. How to perform simple tests.	To describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets). How to ask simple questions and recognise that they can be answered in different ways. How to observe closely, using simple equipment. How to perform simple tests.	Lions and tigers are carnivores, sheep and cows are herbivores and pigs, rats and chickens are omnivores. To describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets) A habitat is a place where a plant or an animal lives. The Four seasons are Autumn, Winter, Spring and Summer. Types of materials are wood, plastic, glass, metal, water, and rock. (Identifies these) Weather, plants and our environment changes during the four seasons. How to ask simple questions and recognise that they can be answered in different ways. How to observe closely, using simple equipment. How to perform simple tests.
	Key Knowledge	**Substantive** The nose is used for the sense of smell, tongue with the sense of taste, ears with the sense of hearing, eyes with the sense of seeing and skin with the sense of touch. Weather, plants and our environment changes during the four seasons. The Four seasons are **Autumn,** Winter, Spring and Summer. **Disciplinary** How to ask simple questions and recognise that they can be answered in different ways.	**Substantive** Objects are made from different materials. Types of materials are wood, plastic, glass, metal, water, and rock. (Identifies these) Materials can be hard or soft; smooth or rough; shiny or dull. You can see through some materials which means they are transparent; like the glass in windows. Some materials are waterproof, which means that water cannot go through them. **Disciplinary** How to observe closely, using simple equipment.	**Substantive** Birds, fish and mammals are types of animals. Lions and tigers are carnivores, sheep and cows are herbivores and pigs, rats and chickens are omnivores. The Arctic and Antarctic are very cold places. Our bodies change when we are cold. We shiver, get red cheeks and nose and goose bumps. Ice is frozen water and it will melt when it gets warm. Birds have feathers. Fish live in water. Ice is water which has frozen. **Disciplinary** How to perform simple tests.	**Substantive** Amphibians and reptiles are animals. To describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets). Food keeps us healthy. A Desert Island is an area of land surrounded by sea where nobody lives. A shelter is somewhere that gives protection from the weather or from danger.	**Substantive** Plants include garden plants, wild plants and trees. Deciduous trees lose their leaves. Evergreen trees keep their leaves. Plants have roots, a stem, leaves and flowers. Flowers help to make new plants. An invertebrate is a creature without a backbone. Snails, spiders, beetles and worms are all examples of an invertebrate. A habitat is where an animal or plant lives.	**Substantive** Summer changes into autumn, spring changes in to summer, autumn changes into winter and winter changes into spring. It is colder in the autumn and winter. It is warmer in the spring and summer. There is more daylight in summer and spring than in autumn and winter. Sunburn is when the skin is damaged and goes red because of too much sunlight. Pollution is when humans leave waste in the countryside, seaside etc, which harms the habitats and living things in it.
	Next Steps						
	Enrichment /Careers	**Forest school**	**Forest school**	**Explorer's day –** **Linked to History** **Forest school**	**STEM week** **Scientist focus: William Armstrong – linked to Cragside house visit linked to History** **Forest school**	**Art** **Forest school**	**French – At the Beach** **Forest school**

Science Curriculum Map

	Unit	Healthy me!	Materials monster!	Move it!	Mini worlds	Young gardeners	Master chef
Year 2	Key Concepts	**Biology: Cells, Tissues, Organs and Organ Systems**	**Behaviour of Materials**	**Forces**	**Ecosystems and the Environment** **Behaviour of Materials**	**Biology: Genetics and Inheritance** **Ecosystems and the Environment**	**Biology: Cells, Tissues, Organs and Organ Systems**
	Prior Learning	The nose is used for the sense of smell, tongue with the sense of taste, ears with the sense of hearing, eyes with the sense of seeing and skin with the sense of touch. How to ask simple questions and recognise that they can be answered in different ways. How to observe closely, using simple equipment. How to perform simple tests.	Objects are made from different materials. Types of materials are wood, plastic, glass, metal, water, and rock. (Identifies these) Materials can be hard or soft; smooth or rough; shiny or dull. How to use their observations and ideas to suggest answers to questions. How to ask simple questions and recognise that they can be answered in different ways. How to observe closely, using simple equipment. How to perform simple tests.	To identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses. To know some materials can be changed by squashing, bending, twisting and stretching. To know natural Materials come from plants, animals or the ground. To know man-made material goes through a process and are made by people. To know that scientists use specific language to record observations. To know that scientists record observations using tables, charts, drawings and writing. How to use their observations and ideas to suggest answers to questions. How to ask simple questions and recognise that they can be answered in different ways. How to observe closely, using simple equipment. How to perform simple tests.	To identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses. Animals and humans need water, food and air to survive. How to identify and classify. How to ask simple questions and recognise that they can be answered in different ways. How to observe closely, using simple equipment. How to perform simple tests.	Plants include garden plants, wild plants and trees. Deciduous trees lose their leaves. Evergreen trees keep their leaves. Plants have roots, a stem, leaves and flowers. How to identify and classify. How to gather and record data to help answer questions. How to ask simple questions and recognise that they can be answered in different ways. How to observe closely, using simple equipment. How to perform simple tests.	To identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses. To know that animals and humans need water, food and air to survive. To know a balanced diet keeps humans healthy. To gather and record data to help answer questions. To ask simple questions and recognise that they can be answered in different ways.
	Key Knowledge	**Substantive** To know that animals, including humans, have offspring which grow into adults. To know that animals and humans need water, food and air to survive. To know a balanced diet keeps humans healthy. To know exercise keeps us healthy by burning fat and calories. To know exercise builds muscle and pumps blood around our body. To understand germs are living things that can cause us to be sick. To know germs are so small that they are hard to notice. To understand that germs can spread from our hands and things we touch. To understand that washing hands, brushing teeth and having regular baths / showers is part of personal hygiene. **Disciplinary** How to use observations and ideas to suggest answers to questions.	**Substantive** To identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses. To know some materials can be changed by squashing, bending, twisting and stretching. To know that natural Materials come from plants, animals or the ground. To know that man-made materials go through a process and are made by people. **Disciplinary** How to identify and classify.	**Substantive** To know a force can cause something to speed up, slow down, change shape change direction To know some things are living, such as animals and plants; somethings have never been alive; such as toys, models and materials.	**Substantive** To know that some things are living, dead or have never been alive. To name a variety of plants and animals in their habitats, including micro-habitats. To know some materials are used for more than one thing, such as metal, which can be used for coins, cans, keys and cars. To know that scientists use specific language to record observations. To know that scientists record observations using tables, charts, drawings and writing. **Disciplinary** How to gather and record data to help answer questions.	**Substantive** To know that seeds don't need light to germinate. To know that plants need water, light and a suitable temperature to grow and stay healthy. To know that plants need a suitable temperature to grow. To understand that plants are a very important part of our environment because they provide us with oxygen to breathe and food to eat. To know that most plants grow from seeds. With dark conditions and the right temperature, the seed sprouts (germinates).	**Substantive** Humans need a balanced diet of a range of different food groups to stay healthy. It is important to prepare and store food correctly to keep it fresh and safe. Eating different foods will help our bodies to grow and keep us healthy. Food gives us energy to allow us to perform activities but it also helps our bones stay strong and helps our body to mend itself. Water helps us get rid of waste and clean out our bodies.
	Next Steps						
	Enrichment /Careers	Forest school Forest school - spring	Forest school	French - Animals	STEM week Famous scientist focus – Jane Goodall (1934) This anthropologist is the foremost expert on Chimpanzees in the world	Kirkley Zoo	Art – view finders – linked to fruit and veg

Science Curriculum Map

Year 3	Unit	Rocks	Food and our bodies	We are astronauts!	Forces and Magnets	Plants	Mirror Mirror
	Key Concepts	**The Earth and our Environment**	**Biology: Cells, Tissues, Organs and Organ Systems**	**The Universe** **Forces**	**Forces**	**Biology: Genetics and Inheritance** **Ecosystems and the Environment**	**Energy** **Behaviour of Materials**
	Prior Learning	Natural Materials come from plants, animals or the ground. Man-made materials go through a process and are made by people To identify and classify. To observe closely, using simple equipment. To perform simple tests. To gather and record data to help answer questions.	To know that animals and humans need water, food and air to survive. To know a balanced diet keeps humans healthy. To ask simple questions and recognise that they can be answered in different ways.	To know a force can cause something to speed up, slow down, change shape change direction. To make systematic and careful observations.	To know a force can cause something to speed up, slow down, change shape change direction. Gravity makes things fall down towards the centre of the earth. There is gravity everywhere. How to ask relevant questions and use different types of scientific enquiries to answer them. How to set up simple practical enquiries, comparative and fair test. How to make systematic and careful observations. How to gather, record, classify and present data in a variety of ways to help in answering questions	To identify and name a variety of common plants, including garden plants, wild plants and trees, and those classified as deciduous and evergreen. To describe the basic structure of a variety of common plants including roots, stem, leaves and flowers. To know that seeds don't need light to germinate. To know that plants need water, light and a suitable temperature to grow and stay healthy. To know that most plants grow from seeds. With dark conditions and the right temperature, the seed sprouts (germinates). How to ask relevant questions and use different types of scientific enquiries to answer them. How to set up simple practical enquiries, comparative and fair test. How to make systematic and careful observations. How to take accurate measurements using standard units. How to gather, record, classify and present data in a variety of ways to help in answering questions	To identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses. How to ask relevant questions and use different types of scientific enquiries to answer them. How to set up simple practical enquiries, comparative and fair test. How to make systematic and careful observations. How to take accurate measurements using standard units. How to use a range of equipment, including thermometers and data loggers. How to gather, record, classify and present data in a variety of ways to help in answering questions.
	Key Knowledge	**Substantive** To compare and group together different kinds of rocks on the basis of their appearance and simple physical properties. To describe in simple terms how fossils are formed when things that have lived are trapped within rock. To recognise that soils are made from rocks and organic matter. Rocks are used for many different purposes, including making glass, plastic, building houses, fireplace surrounds etc. Mary Anning was a famous fossil hunter. The Earth is made up of four layers. **Disciplinary** How to ask relevant questions and use different types of scientific enquiries to answer them.	**Substantive** To identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat. To identify that humans and some other animals have skeletons and muscles for support, protection and movement. Vertebrates are organisms with a backbone (spine) and invertebrates are organisms without a backbone (spine.) Humans have a number of different joints. **Disciplinary** How to set up simple practical enquiries, comparative and fair test. How to make systematic and careful observations. How to take accurate measurements using standard units.	**Substantive** The planets of the Solar System have many moons. The Earth has one moon. We always see the same side of the Moon from Earth. The Moon travels around the Earth. This is called an orbit. Neil Armstrong and Buzz Aldrin are two r famous astronauts. Gravity makes things fall down towards the centre of the earth. There is gravity everywhere. **Disciplinary** How to gather, record, classify and present data in a variety of ways to help in answering questions	**Substantive** To know objects move in different ways when on different surfaces. To know that some forces need contact between two objects, but magnetic forces can act at a distance. To know that magnets can attract or repel each other and attract some materials and not others. Magnetic materials are always made of metal, but not all metals are magnetic. Iron is magnetic, so any metal with iron in it will be attracted to a magnet. Steel contains iron, so a steel paperclip will be attracted to a magnet too. Most other metals, for example aluminium, copper and gold, are NOT magnetic. Magnets have two poles.	**Substantive** To identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers. To know that plants need air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant. Water is transported from the roots, through the tubes in the stem, to the tip of the plant. To know that the life cycle of flowering plants, includes pollination, seed formation and seed dispersal. Seed germination is when a seed begins to grow. **Disciplinary** How to use a range of equipment, including thermometers and data loggers.	**Substantive** You need light in order to see things and that dark is the absence of light. That light is reflected from surfaces. Light from the sun can be dangerous and that there are ways to protect eyes Shadows are formed when the light from a light source is blocked by a solid object. How the size of shadows can change. Light travels in straight lines and it cannot bend to travel around corners. Opaque materials form dark shadows because they do not let any light through Transparent materials can make a faint shadow because they block some light.
	Next Steps						
	Enrichment /Careers	History – stone age to iron age		Centre for Life – Planetarium and Space Workshop	STEM week Caroline Herschel German astronomer (1750-1848) Sir Isaac Newton PRS was an English mathematician, physicist, astronomer, theologian, and author who is widely recognised as one of the most influential scientists of all time and as a key figure in the scientific revolution.		

Science Curriculum Map

Year 4

	Unit	Sound	States of matter	Electricity	Electricity	Teeth and Eating	Living things and their habitats
	Key Concepts	**Energy**	**Particles** **Behaviour of Materials**	**Forces** **Energy**	**Forces** **Energy**	**Biology: Cells, Tissues, Organs and Organ Systems**	**Biology: Genetics and Inheritance** **Ecosystems and the Environment**
	Prior Learning	The nose is used for the sense of smell, tongue with the sense of taste, ears with the sense of hearing, eyes with the sense of seeing and skin with the sense of touch. How to ask relevant questions and use different types of scientific enquiries to answer them. How to set up simple practical enquiries, comparative and fair test. How to use data loggers.	To identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses How to ask relevant questions and use different types of scientific enquiries to answer them. How to set up simple practical enquiries, comparative and fair test. How to make systematic and careful observations. How to take accurate measurements using standard units. How to gather, record, classify and present data in a variety of ways to help in answering questions. How to record findings using simple scientific language, drawings, tables and bar charts.	To identify and compare the suitability of a variety of everyday materials, including wood, metal, plastic, glass, brick, rock, paper and cardboard for particular uses How to ask relevant questions and use different types of scientific enquiries to answer them. How to set up simple practical enquiries, comparative and fair test. How to gather, record, classify and present data in a variety of ways to help in answering questions How to record findings using simple scientific language, drawings, labelled diagrams, and tables. How to report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.	To identify common appliances that run on electricity. To construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers. To identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery. A complete circuit allows electricity to flow around the circuit and light a bulb or make a buzzer buzz. Plastic, rubber and glass are all insulators How to record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables. How to report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions. How to identify differences, similarities or changes related to simple scientific ideas and processes.	To identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat. To know that animals and humans need water, food and air to survive. To know a balanced diet keeps humans healthy. How to identify differences, similarities or changes related to simple scientific ideas and processes. How to make predictions for new values.	Plants include garden plants, wild plants and trees. Deciduous trees lose their leaves. Evergreen trees keep their leaves. Plants are a very important part of our environment because they provide us with oxygen to breathe and food to eat. Invertebrates do not have a back bone. Vertebrates have a back bone. Birds, fish and mammals are types of animals. How to record findings using simple scientific language, drawings, bar charts, and tables. How to report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions. How to use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions. How to use straightforward scientific evidence to answer questions or to support their findings.
	Key Knowledge	**Substantive** To know that sounds are made when something vibrates. To know that sounds can travel through solids, liquids and gases. To know that ears hear sounds. To understand that pitch is how high or low the sound is. To know that volume is how loud or quiet a sound is. To recognise that sounds get fainter as the distance from the sound source increases. Sound travels in sound waves. The smallest bone in the human body is in the ear. **Disciplinary** How to record findings using simple scientific language, drawings, tables and bar charts.	**Substantive** To identify some materials that are solids, some that are liquids and some that are gases. To know that materials change when they are heated or cooled. To know evaporation is when a liquid changes to a gas - and that this is important in the water cycle. To know that condensation is when the water vapor turns into a liquid - which is part of the water cycle. To know that evaporation increases with the increase of temperature. 0°C is the freezing point of water **Disciplinary** To report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions. To identify differences, similarities or changes related to simple scientific ideas and processes. To use research skills.	**Substantive** To identify common appliances that run on electricity. To construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers. To identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery. To know some electrical appliances are plugged into the mains electricity supply and some use batteries. To know that wind turbines produce electricity and is a renewable form of energy. To understand the importance of using renewable forms of energy in today's world. **Disciplinary** How to use results to draw simple conclusions. How to suggest improvements.	**Substantive** To recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit. To recognise some common conductors and insulators, and associate metals with being good conductors. The voltage is a kind of electrical force that makes electricity move through a wire and we measure it in volts. Plastic, rubber and glass are all insulators. **Disciplinary** How to use straightforward scientific evidence to answer questions or to support their findings. How to make predictions for new values. How to use a key.	**Substantive** The mouth has teeth to help to chew food, and it is the first part of the digestive system. Food travels down the oesophagus to the stomach. That the large intestine is the last part of the digestive system. Incisors are the front 4 teeth in your upper jaw and front 4 teeth in your lower jaw. They are used to cut and chop food up. Canines are pointy and there is 2 in the top jaw and 2 in the bottom. They rip and tear. Molar and pre-molars are in the back of the jaw and are bigger and wider than incisors and canines. They grind food. To know(and be able to create) a food chain includes a producer, predator and prey.	**Substantive** Identify and name a variety of living things in their local and wider environment. Environments can change and that this can sometimes pose dangers to living things. Organisms are living things. Animals can be classified as birds, reptiles, fish, mammals or amphibians. Insects, molluscs, and arachnids are all types of invertebrates. Non--flowering plants include conifers, ferns and mosses. Pollution can change/affect the habitats of plants and animals. Flowering plants include all other plants, including most trees, grasses and shrubs. **Disciplinary** To use a classification key.
	Next Steps						
	Enrichment /Careers	**Music**	**Geography – The water cycle (Taught Summer 2)**	Visit to Port of Blyth – Visiting the catapult – wind turbine blade test. Engineering – Buzzer Games	STEM week Famous Scientists Focus – Humphrey Davy, Thomas Edison and Joseph Swann. Linked to development of the lightbulb in Electricity.	Centre For Life visit – Digestion workshop Engineering – Food technology – making healthy pizzas.	**Local environment study – costal walk**

Science Curriculum Map

Year 5

Unit	Earth and Space	Properties and changes of materials 1	Forces	Life cycles	Human life cycle	Properties and changes of materials 2
Key Concepts	**Forces** **The Universe**	**Behaviour of Materials** **Particles**	**Forces**	**Biology: Genetics and Inheritance** **Ecosystems and the Environment**	**Biology: Cells, Tissues, Organs and Organ Systems**	**Particles** **Behaviour of Materials**
Prior Learning	The planets of the Solar System have many moons. The Earth has one moon. We always see the same side of the Moon from Earth. The Moon travels around the Earth. This is called an orbit. Neil Armstrong and Buzz Aldrin are two r famous astronauts. Gravity makes things fall down towards the centre of the earth. There is gravity everywhere. How to identify differences, similarities or changes related to simple scientific ideas and processes. How to use straightforward scientific evidence to answer questions or to support their findings.	To identify some magnetic materials. To compare and group materials together, according to whether they are solids, liquids or gases. 0°C is the freezing point of water A liquid flows and can be poured. Liquids change shape to its container, but the volume does not change, examples—water, juice, oil. A gas is often invisible and always fills its container but the shape and volume change. Solids stay the same shape and can be held in your hands. They can be cut into new shapes, examples—wood, metal, rock, ice. To know evaporation is when a liquid changes to a gas - and that this is important in the water cycle. Evaporation is when a liquid becomes a gas. To know that condensation is when the water vapor turns into a liquid How to record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables. How to report on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions.	To know that some forces need contact between two objects, but magnetic forces can act at a distance. To know that magnets can attract or repel each other and attract some materials and not others. To identify some magnetic materials. To describe magnets as having two poles. Gravity makes things fall down towards the centre of the earth. There is gravity everywhere. How to use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions. How to use straightforward scientific evidence to answer questions or to support their findings. How to plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.	Seed germination is when a seed begins to grow. How to record findings using simple scientific language, drawings, labelled diagrams, keys, bar charts, and tables. How to use results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions. How to plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary. To use a classification key.	To identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat. How to plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary. How to take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate. How to record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs	To name some materials that are hard, soluble and transparent. To name some materials that are thermal conductors. Solids have a fixed shape, volume, and tightly packed molecules Liquids have no fixed shape, are able to flow and cannot be compressed. Gases have no fixed shape, have lots of space between molecules and can be compressed. Freezing is when a liquid becomes a solid. Melting is when a solid becomes a liquid. Materials change state because their molecules gain or lose energy. How to plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary. How to take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate. How to record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
Key Knowledge	**Substantive** To know that the sun is a star and is at the centre of our solar system. To know that the Earth and planets orbit the sun. To know that the Sun, Earth and Moon are approximately spherical bodies. A **day** on Earth lasts 24 hours – that is how long it takes for the planet to spin around once. To understand that when you look up into the sky the Sun seems to move around the Earth, this is an illusion: in fact, the Earth spins and causes night and day. To know that the part of the Earth that faces the Sun is in daylight, and the part that is not facing the Sun is in darkness Inside the Solar System, Earth and eight other planets (including the dwarf planet Pluto) orbit (travel round) the Sun due to its gravitational pull	**Substantive** To name some materials that are hard, soluble and transparent. To name some materials that are thermal conductors. Solids have a fixed shape, volume, and tightly packed molecules Liquids have no fixed shape, are able to flow and cannot be compressed. Gases have no fixed shape, have lots of space between molecules and can be compressed. Freezing is when a liquid becomes a solid. Melting is when a solid becomes a liquid. Materials change state because their molecules gain or lose energy. Disciplinary To plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary. . **Disciplinary** To plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.	**Substantive** To explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object. To identify the effects of air resistance, water resistance and friction that act between moving surfaces. To recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect. Mass is how much of an object there is. **Disciplinary** To take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.	**Substantive** Birth, growth, reproduction and death represent the four stages of the life cycle of all animals Amphibians begin their lives as eggs. The insect is born as an egg, hatches as a nymph (NIMF), and changes into an adult. Birds develop in eggs which hatch. Some bird life cycles involve migration. Flowers produce fruit and fruit contains seed. Seeds must be dispersed in order for new plants to grow Seeds can be dispersed by animals, wind, water or humans. Insects are attracted to flowers and pollinate them. Pollination: when pollen from one plant is transferred to another. **Disciplinary** To record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs	**Substantive** There are six stages in the human life cycle: Foetus: At this time, a baby is growing inside its mum's womb. Baby: A baby is born after spending nine months inside the womb. Childhood: At this stage, you learn to walk and talk. Adolescence: Children become teenagers. Adulthood: Your body is fully developed. Old age: The last stage in the life cycle of a human. Humans, like all mammals, give birth to live young. Smaller animals normally have a shorter gestation period than larger animals. Humans need vitamins and minerals to help them grow. Gestation is the amount of time it takes for a baby to develop.	**Substantive** To name some materials that are electrical conductors. To know that some materials will dissolve in to liquid to form a solution and describe how to recover a substance from a solution To use knowledge of solids, liquids and gases to describe how mixtures might be separated, including through filtering, sieving and evaporating To know that dissolving, mixing and changes of state are reversible changes. To know that some changes result in the formation of new materials, and that this kind of change is not usually reversible (e.g. burning) To know that when sodium bicarbonate and vinegar mix, they react with each other and one of the things that is made is carbon dioxide gas.
Next Steps						
Enrichment /Careers		Engineering – robotic hands (Tharsus)		STEM week • Famous scientist focus – Albert Einstein - developed a new theory about gravity, Dorothy Hodgkin – Female British Biochemist	‘Lovewise’ visit	Stem HUB / BN – female scientists working in labs.

Science Curriculum Map

Year 6

	Unit	Classifying critters	We're Evolving	Staying alive	Light	Electricity	Electricity
	Key Concepts	**Ecosystems and the Environment**	**Biology: Genetics and Inheritance**	**Biology: Cells, Tissues, Organs and Organ Systems**	**Energy**	**Forces** **Energy**	**Forces** **Energy**
	Prior Learning	To know how to use classification key to help group, identify and name a variety of living things in their local and wider environment. Organisms are living things. Animals can be classified as birds, reptiles, fish, mammals or amphibians. Insects, molluscs, and arachnids are all types of invertebrate. To plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary. To record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs	To describe in simple terms how fossils are formed when things that have lived are trapped within rock. To recognise that environments can change and that this can sometimes pose dangers to living things. Organisms are living things. To record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs To report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.	Humans need a balanced diet of a range of different food groups to stay healthy. Nutrition is the process by which a living organism takes in food and uses it for growth and for replacement of tissues. Eating different foods will help our bodies to grow and keep us healthy. Food gives us energy to allow us to perform activities, but it also helps our bones stay strong and helps our body to mend itself. Water helps us get rid of waste and clean out our bodies. To record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs To report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.	To know that light is reflected from surfaces To know that light from the sun can be dangerous and that there are ways to protect their eye To know that shadows are formed when the light from a light source is blocked by a solid object. Opaque materials form dark shadows because they do not let any light through Transparent materials can make a faint shadow because they block some light. To plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary. To take measurements, using a range of scientific equipment. To record data and results of increasing complexity. To report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.	To identify common appliances that run on electricity. To construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers. To identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery. Some electrical appliances are plugged into the mains electricity supply and some use batteries. Batteries convert chemical energy into electrical energy. Metals are good conductors. Plastic, rubber and glass are all insulators. To use test results to make predictions to set up further comparative and fair tests. To report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations	To know the higher the voltage the louder the bulb or louder the buzzer. To know and use the symbols for wire, cell, battery, bulb, switch, buzzer and motor. An electric current is the overall movement of charged particles in one direction. To obtain an electric current, there needs to be a continuous circuit from one terminal of a battery to the other. To use test results to make predictions to set up further comparative and fair tests. To report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations. To identify scientific evidence that has been used to support or refute ideas or arguments.
	Key Knowledge	**Substantive** To know that microorganisms, plants and animals are classified in different groups. Carl Linnaeus created the classification system that forms the basis of the one that scientists use today. Micro-organisms can be helpful or harmful to humans. **Disciplinary** To report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations.	**Substantive** To recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago. To recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents. To identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution. To know the process of evolution by natural selection was proposed by Charles Darwin. **Disciplinary** To identify scientific evidence that has been used to support or refute ideas or arguments.	**Substantive** To know that the heart, blood vessels and blood are all part of the circulatory system. The circulatory system allows blood to transport oxygen and nutrients to the body's cells, and waste products away from them. The heart acts a pump moving blood around the body. Blood travels through blood vessels which includes veins, arteries and capillaries. Diet, exercise, drugs and lifestyle affect the way our bodies function. Drugs (legal and illegal) and alcohol have positive and negative effects on the body.	**Substantive** To recognise that light appears to travel in straight lines. To use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye. To explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes. To use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them. Photon is the basic unit that makes up all light . White light is Visible light made up of the colours of the spectrum A Spectrum is a group of colours that a ray of light can be separated into including red, orange, yellow, green, blue, indigo, and violet: the colours that can be seen in a rainbow Light travels in waves. **Disciplinary** To use test results to make predictions to set up further comparative and fair tests.	**Substantive** To know the higher the voltage the louder the bulb or louder the buzzer. To know and use the symbols for wire, cell, battery, bulb, switch, buzzer and motor. An electric current is the overall movement of charged particles in one direction. To obtain an electric current, there needs to be a continuous circuit from one terminal of a battery to the other.	**Substantive** To compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches. The battery pushes the electrons in a circuit. resistance is the difficulty that the electric current has when flowing around a circuit. electrons are very small particles that travel around an electrical circuit. **Disciplinary** To use test results to make predictions to set up further comparative and fair tests. To report and present findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations. To identify scientific evidence that has been used to support or refute ideas or arguments.
	Next Steps						
	Enrichment /Careers	PPT – Simple structure of an investigation (Used from Y7) Share / model and develop this practice.			STEM week Famous scientist focus: Elizabeth Garrett Anderson – First female doctor – combatting gender bias. Elsie Widdowson - specialised in the scientific analysis of food, nutrition and the relationship between diet before and after birth and its effects on development. Links to WWII - nutrition Marie Curee – Her contribution in the fight against cancer.	Transition – Introduction to secondary laboratories – carrying out circuit investigations.	Careers Fayre – engineers and scientists from North East Community of specialist Engineers. Transition – Introduction to secondary laboratories – carrying out circuit investigations.

Science Curriculum Map

Key Stage 3 Curriculum Goals

Biology

Year 7	Year 8	Year 9
Students achieving **at** the expected standard will be able to: **DISCIPLINARY KNOWLEDGE** •Explain how to use a microscope to identify and compare cells •Use a quadrat to take measurements in an ecosystem, and describe trends observed. •Be able to produce and label a biological drawing according to the criteria **SUBSTANTIVE KNOWLEDGE** •Describe the function of cell organelles. •Explain how named animal and plant cells are adapted for their function. •Describe the interactions within a food web. •Describe the functions of the structures within the reproductive system and how different methods of contraception work.	Students achieving **at** the expected standard will be able to: **DISCIPLINARY KNOWLEDGE** •Describe a pattern in a set of data •Plan an experiment and identify the key variables and how you will control these. •Plot a bar chart and a line graph **SUBSTANTIVE KNOWLEDGE** •Explain how the shape of a cell and the number and type of organelles relate to its function. •State key differences between eukaryotic and prokaryotic cells. •Apply their knowledge of specialised cells to novel situations. •Describe how substances move in and out of cells. •Describe how the alveoli are adapted for gas exchange. •Describe the function of amylase, protease and lipase within the human body. •Describe the differences between the left and right side of the heart. •Define translocation and transpiration.	Students achieving **at** the expected standard will be able to: **DISCIPLINARY KNOWLEDGE** •Rearrange the magnification calculation •Converting units between milli- and nano-. •Describe positive tests for protein, sugar, lipids and starch. •Identify an area of the slide and produce and label a biological drawing according to the criteria. **SUBSTANTIVE KNOWLEDGE** •Explain how the shape of a cell and the number and type of organelles relate to its function. •State key differences between eukaryotic and prokaryotic cells. •Apply their knowledge of specialised cells to novel situations. •Describe how substances move in and out of cells. •Describe how the alveoli are adapted for gas exchange. •Describe the function of amylase, protease and lipase within the human body. •Describe the differences between the left and right side of the heart. •Define translocation and transpiration.

Science Curriculum Map

Key Stage 3 Curriculum Goals

Chemistry

Year 7	Year 8	Year 9
Students achieving **at** the expected standard will be able to: **DISCIPLINARY KNOWLEDGE** •Plan and carry out a scientific investigation. •Use the properties of different chemicals to justify their use. •Interpret data regarding the Earth, Solar System and Universe and make valid conclusions. **SUBSTANTIVE KNOWLEDGE** •Explain the properties of solids, liquids and gases based on the arrangement and movement of their particles and how they change with changes in energy. •Explain how different techniques use different properties for separating substances using appropriate scientific words and phrases. •Describe reactions involving acids and name the salts made. •Describe how the Earth, Solar System and Universe are linked.	Students achieving **at** the expected standard will be able to: **DISCIPLINARY KNOWLEDGE** •Devise a method to investigate some variables. •Decide on the most appropriate way to present data. **SUBSTANTIVE KNOWLEDGE** •Explain how the periodic table has developed over time. •Name compounds using their chemical formulae. •Describe different types of chemical reactions. •Explain the impact of human activities on the planet. •Describe the process of electrolysis.	Students achieving **at** the expected standard will be able to: **DISCIPLINARY KNOWLEDGE** •Apply understanding of apparatus and techniques to suggest a procedure for a specified purpose and explain why the procedure is most suitable. •Understand how scientific methods and theories develop over time. •Make estimates of the results of simple calculations •Use prefixes and powers of ten for orders of magnitude •Recognise/draw/interpret diagrams. •Make predictions / calculate quantities based on the model or show limitiations •Calculate the Area of triangles and rectangles, surface area and volumes. •Use prefixes and powers of ten for orders of magnitude •Calculate a titre **SUBSTANTIVE KNOWLEDGE** •Explain the difference between a pure element, mixture and a compound. •Compare and contrast the differences between the atomic models •Describe atoms using the atomic model. •Define an Isotope and be able to calculate Ar. •Describe trends in reactivity within groups in the periodic table. •Describe how the properties of group 1 metals compare to the transition metals. •Describe the different types of chemical bonds and how they are formed. •Explain how properties of substances are linked to bonding •Evaluate uses of materials based on their properties. •Describe and evaluate the uses of nanoparticles making links to surface area / volume ratio •Calculate the Mr for unfamiliar compounds when the formula is given. •Identify the limiting reactant in a chemical reaction. •Explain how the concentration of a solution can be changed. •Calculate %yield when actual yield and the mass of the limiting reactant is given. •Calculate the atom economy. •Describe how an indicator can be used to determine the end point.

Science Curriculum Map

Key Stage 3 Curriculum Goals

Physics

Year 7	Year 8	Year 9
Students achieving **at** the expected standard will be able to: **DISCIPLINARY KNOWLEDGE** •Build circuits to be able to measure the current and potential difference at different places in a circuit. •Compare different energy resources. •Use the results of experiments to describe the behaviour of light in different situations. **SUBSTANTIVE KNOWLEDGE** •Explain how forces can combine and affect the motion of an object. •Illustrate a journey with changing speed on a distance-time graph, and label changes in motion. •Draw circuit diagrams and recognise how the current and potential difference can vary in different circuits. •Describe different types of energy transfer. •Differentiate renewable and non-renewable energy resources. •Describe the differences between transverse and longitudinal waves.	Students achieving **at** the expected standard will be able to: **DISCIPLINARY KNOWLEDGE** •Plan and carry out a scientific investigation and draw conclusions based upon the results obtained. •Plan and carry out an investigation based upon some variables. •Decide on the most appropriate way to present data including derived values. **SUBSTANTIVE KNOWLEDGE** •Describe the components of an electromagnet. •Carry out calculations involving pressure, force and area. •Carry out calculations involving mass and weight. •Calculate work done. •Describe the different ways heat energy can be transferred. •Describe the properties of transverse and longitudinal waves. •Describe how different objects and organs produce and use waves for a purpose.	Students achieving **at** the expected standard will be able to: **DISCIPLINARY KNOWLEDGE** •Explain transfers between energy stores using practical examples. •Investigate heat energy transfers for different materials. •Determine the SHC for various materials. •Relate use of energy resources to everyday examples. •Balancing moments using a ruler and hanging masses. •Calculating the gradient of and area under a graph to determine distance, velocity and acceleration. **SUBSTANTIVE KNOWLEDGE** •Describe the transfer of energy between energy stores. •Apply the energy equations. •Describe heat transfer by conduction, convection and radiation. •Apply the equation for SHC. •Describe the various energy resources available. •Calculate the resultant force from a force diagram. •Apply Newton's laws to the motion of an object. •Apply the principle of moments. •Determine the position of the centre of mass of an object. •Describe the motion of an object using distance/time and velocity/time graphs. •Recall and use the equation for acceleration.

Science Curriculum Map

Year 7 & 8 Biology

Unit	Cells and Movement	Interdependence and Plant Reproduction	Human Reproduction	Breathing and Digestion	Respiration and Photosynthesis	Inheritance and Evolution
Key Concepts	Cells, tissues, organs and organ systems.	Cells, Tissues, Organs and Organ Systems Ecosystems and the Environments	Cells, tissues, organs and organ systems.	Cells, Tissues, Organs and Organ Systems	Cells, Tissues, Organs and Organ Systems	Genetics and Inheritance
Prior Learning	**Year 3: Food and our bodies** To identify that humans and some other animals have skeletons and muscles for support, protection and movement. Vertebrates are organisms with a backbone(spine) and invertebrates are organisms without a backbone(spine). Humans have a number of different joints.	**Year 5: Life Cycles** Seeds must be dispersed in order for new plants to grow. Seeds can be dispersed by animals, wind, water or humans. Insects are attracted to flowers and pollinate them. Pollination: when pollen from one plant is transferred to another.	**Year 5: Life Cycles** There are six stages in the human life cycle. Gestation is the amount of time it takes for a baby to develop	**Year 7: Cells and Movement** Be able to give examples of how cells, tissues and organs work together to form organ systems	**Year 7: Cells and Movement** Describe the functions of mitochondria and chloroplasts	**Year 7: Cells and Movement** The nucleus of a cell contains DNA The nucleus controls the cell
Key Knowledge	**Substantive** Describe the structure of animal and plant cells. Explain how named animal and plant cells are adapted for their function. Apply knowledge of specialised cells to novel situations. Describe the function of cell organelles. **Disciplinary** Describe and explain how a microscope works. Use a simple equation to calculate the size of an object viewed under a light microscope.	**Substantive** Be able to draw a food chain from given information. Describe the interactions within a food web. Interpret and explain information from a food web. Describe the process of pollination. Describe the process of fertilisation in plants. **Disciplinary** Use a quadrat to record data from an ecosystem. Use a quadrat to take measurements in an ecosystem, and describe trends observed. Plan and evaluate a method for using a quadrat to sample an ecosystem. Identify the main parts of a flower during a dissection.	**Substantive** Describe the functions of the structures within the male and female reproductive system. Explain the function of the amniotic sac and fluid, umbilical cord, placenta, and uterus Describe how different methods of contraception work. **Disciplinary** Use data to compare the effectiveness of different methods of contraception	**Substantive** Identify the parts of the digestive and respiratory systems and give their functions Describe the difference between mechanical and chemical digestion Explain the adaptations of each part of the digestive system. Explain how each part of the respiratory system works together to facilitate gas exchange. **Disciplinary** Define the terms dependent and independent variable Identify the dependent and independent variables in an experimental method Produce a balanced argument, explaining why different people may be for or against a particular issue. Explain how their views have influenced your own.	Substantive State the word equations for photosynthesis, aerobic respiration, and anaerobic respiration in animals. Describe how a leaf is adapted for photosynthesis State the limiting factors for photosynthesis. Describe adaptations of plants to living in dry conditions Describe and explain the changes in the body that happen during exercise. Disciplinary Use scientific terminology to describe trends and conclusions. Find and use suitable websites to answer scientific questions.	Substantive Be able to state where DNA is found within animal and plant cells. Explain why offspring from the same parents look similar but not identical. Describe the structure of DNA. Describe the process of natural selection Disciplinary Know when to use a bar chart and when to use a line graph and explain the patterns observed. Identify anomalies and calculate a mean that omits such anomalies.
Next Steps	Year 8: Breathing and Digestion Year 9: Cells.	Year 11: Ecology	Year 10: Homeostasis	Year 9: Organisation	Year 9: Organisation	Year 11: Inheritance

Science Curriculum Map

Year 9 Biology	Unit	Cells	Organisation
	Key Concepts	Cells, Tissues, Organs and Organ Systems	Cells, Tissues, Organs and Organ Systems
	Prior Learning	**Year 7: Cells and movements** Describe the structure of animal and plant cells. Explain how named animal and plant cells are adapted for their function. Apply knowledge of specialised cells to novel situations. Describe the function of cell organelles.	**Year 8: Breathing and Digestion** Identify the parts of the digestive and respiratory systems and give their functions Describe the difference between mechanical and chemical digestion Explain the adaptations of each part of the digestive system. Explain how each part of the respiratory system works together to facilitate gas exchange. **Year 9: Cells** Explain how the shape of a cell and the number and type of organelles relate to its function. State key differences between eukaryotic and prokaryotic cells. Apply knowledge of specialised cells to novel situations. Describe how substances move in and out of cells. Describe what a stem cell is and why they are necessary. Explain why some organisms need specialised exchange surfaces.
	Key Knowledge	**Substantive** Explain how the shape of a cell and the number and type of organelles relate to its function. State key differences between eukaryotic and prokaryotic cells. Apply knowledge of specialised cells to novel situations. Describe how substances move in and out of cells. Describe what a stem cell is and why they are necessary. Explain why some organisms need specialised exchange surfaces. **Disciplinary** Rearrange and use the magnification equation Be able to convert units in the range of kilo- to nano-. Produce and label a biological drawing according to standard criteria. Can calculate SA:Vol ratio	**Substantive** State where digestive enzymes are found, their role and the products of breakdown. Describe the different tissues found in the stomach and their roles. Label a diagram of the heart, describing the flow of blood through the heart and any adaptations to function. Describe the main components of blood and the different types of blood vessels in the body. Explain how the structure of the different blood vessels is adapted to their function. State the function of the xylem and the phloem and how they contribute to the processes of translocation and transpiration **Disciplinary** Follow a method to test foodstuffs for protein, sugar, lipids and starch. Correctly identify positive and negative tests for protein, sugar, lipids and starch. Evaluate a range of different treatments for heart conditions.
	Next Steps	Year 9: Organisation	Year 10: Bioenergetics

Science Curriculum Map

Year 10 & 11 Biology

Unit	Bioenergetics	Homeostasis and response	Ecology	Inheritance, variation and evolution
Key Concepts	Cells, Tissues, Organs and Organ Systems	Cells, Tissues, Organs and Organ Systems	Ecosystems and the environment	Genetics and Inheritance
Prior Learning	**Year 8: Photosynthesis and Respiration** Recognise the word equations for photosynthesis, aerobic respiration and anaerobic respiration in animals. Describe how a leaf is adapted for photosynthesis State the limiting factors for photosynthesis. Describe adaptations of plants to living in dry conditions Describe and explain the changes in the body that happen during exercise.	**Year 7: Reproduction** Describe the main structures in the female reproductive system and how they are adapted to their function. Describe the main stages of the menstrual cycle and their timings Describe how chemical and barrier methods of contraception prevent pregnancy Identify a nerve cell from diagrams and state how it is adapted to its function.	**Year 7: Interdependence and plant reproduction** Be able to draw a food chain from given information. Describe the interactions within a food web. Interpret and explain information from a food web.	**Year 8: Inheritance and evolution** Be able to state where DNA is found within animal and plant cells. Explain why offspring from the same parents look similar but not identical. Describe the structure of DNA. Describe the process of natural selection
Key Knowledge	**Substantive** State the chemical equations for photosynthesis, aerobic and anaerobic respiration Be able to draw a sketch graph of how each of the limiting factors affects photosynthesis State what is meant by hydroponics State the uses of glucose in a plant Compare aerobic and anaerobic respiration in animals, plants and micro-organisms **Disciplinary** Be able to evaluate a method used to investigate the effect of temperature or light intensity on rate of photosynthesis.	**Substantive** Describe the events of a reflex arc and what happens at a synapse Describe the differences in the causes and treatment of Type I and II diabetes Describe the roles of FSH, LH and Oestrogen in the Menstrual Cycle Give examples of how barrier, chemical and surgical methods of contraception prevent pregnancy Explain the steps that happen during IVF *Describe the functions of the cerebrum, cerebellum, hypothalamus and medulla oblongata (Biology ONLY)* *Describe how body temperature is monitored and controlled (Biology ONLY)* *Explain the role of the kidneys in maintaining body water content (Biology ONLY)* *Describe how the eye focuses light and explain how defect sin sight can be treated (Biology ONLY)* **Disciplinary** Analyse and evaluate data on the success rates of either different contraceptives or different fertility treatments Be able to give reasons why people may be for or against fertility treatment or pre-implantation genetic testing	**Substantive** List resources that animals and plants compete for Describe some ways that air, water, and land are polluted and the effects of deforestation and peat bog destruction. Define the terms community, population, habitat, ecosystem, abiotic factor, biotic factor Describe the events in the carbon and water cycle. *Define sustainable food production and describe how it could help increase food security. (Biology Only)* *Describe the events of the decay cycle (Biology Only)* **Disciplinary** Explain how to use a quadrat and a transect to estimate population sizes. Evaluate sampling methodologies to estimate population sizes. *Draw a pyramid of biomass (Biology Only)*	**Substantive** State the sex chromosomes in males and females. Describe the advantages and disadvantages of sexual and asexual reproduction. Describe the processes of genetic modification and selective breeding Describe what is meant by extinction and give examples Describe what is meant by an antibiotic resistant bacteria Describe how organisms are classified. Describe how fossils are formed. *Describe the process of adult cell cloning and the production of clones by embryo transplant (Biology Only).* *Describe the work of Mendel, Darwin, Wallace and Lamarck in developing our understanding of inheritance (Biology Only)* *Describe the steps involved in producing a protein inside the cell (Biology only)* **Disciplinary** Use given information to complete a Punnett square Give reasons why some people are for and some are against the use of genetic modification in farming.
Next Steps	Year 13: Respiration and Photosynthesis	Year 13: Hormonal Communication Year 13: Neuronal Communication	Year 12: Biodiversity	Year 12: Classification and Evolution

Science Curriculum Map

Year 12 Biology

	Unit	Cell Structure and membranes	Cell Division	Exchange	Transport in Animals	Transport in Plants
	Key Concepts	Cells, Tissues, Organs and Organ Systems	Genetics and Inheritance	Cells, Tissues, Organs and Organ Systems	Cells, Tissues, Organs and Organ Systems	Cells, Tissues, Organs and Organ Systems
	Prior Learning	**Year 9: Cells** Describe the structure of animal, plant and prokaryotic cells. Manipulate and use the magnification equation. Describe the functions of cell parts including the cell membrane and describe transport mechanisms i.e. diffusion, osmosis and active transport.	**Year 11: Inheritance** **Describe the** processes of mitosis and meiosis. State the events in the cell cycle and evaluate the benefits of different reproduction strategies (sexual and asexual) Describe how names specialised cells are adapted to their function Define the term stem cell and describe their role and uses	**Year 9: Organisation** Describe the structure of the respiratory system in humans Discuss the features of specialised exchange surfaces in humans and fish. Calculate surface area: volume ratio. Describe the mechanism of inhalation and exhalation.	**Year 9: Organisation** Describe the structure of the heart Compare the structure and function of arteries, veins and capillaries Describe the components of blood and their function	**Year 10: Bioenergetics** Describe the role of xylem and phloem Define the terms transpiration and translocation. Label the structure of a leaf and describe how plants are adapted to minimise water loss.
	Key Knowledge	**Substantive** Describe the different methods of microscopy and staining Describe the cell ultrastructure in eukaryote animal and plant cells and prokaryote cells, including the functions of all organelles Explain the methods of secretion of proteins and the role of the cytoskeleton Compare similarities and differences between prokaryotic and eukaryotic cells Describe the structure and function of the plasma membrane and the fluid mosaic model Describe the processes of transport across membranes including osmosis, diffusion and active transport Discuss factors that affect the permeability and structure of the plasma membrane **Disciplinary** Prepare light microscope sample slides and make detailed, labelled drawings of specimens Determining cell ultrastructure from photomicrographs Calculate values using the magnification equation on samples and photomicrographs Calculate values for microscope calibration Investigate factors affecting cell permeability Investigate and plot data on the effects of solutions of different water potential	***Substantive*** Describe the stages of the cell cycle and its regulation Describe the processes of mitosis and meiosis and their significance in life cycles Describe how cells are organised into tissues, organ and organ systems and how multi-cellar organisms have cells that are adapted to a particular function. Describe the features of stem cells and explain and evaluate their potential uses in medicine and research Describe the production of specialised cells from stem cells/meristems in plants and animals ***Disciplinary*** To perform a root tip squash and describe and draw the stages of mitosis	***Substantive*** The need for specialised exchange surfaces and their general features. The structures and functions of the components of the mammalian gaseous exchange system and the mechanism of ventilation. The mechanisms of ventilation and gas exchange in bony fish and insects ***Disciplinary*** Interpret the graphical output from a spirometer Calculate SA:Volume The dissection, examination and drawing of the gaseous exchange system of a bony fish and/or insect trachea Using prepared slides and a light microscope to draw biological diagrams following standard conventions	**Substantive** Describe the need for transport systems in animals. Compare the structure and function of arteries, arterioles, veins, venules and capillaries. Describe the structure of the mammalian heart, the sequence of events that make up the cardiac cycle and how the cardiac cycle is controlled. Explain how tissue fluid is formed Describe the role of haemoglobin in transporting oxygen and carbon dioxide. **Disciplinary** Interpret ECG traces Safely dissect and produce biological drawings of the heart (internal and external structure) Interpret oxygen dissociation curves (fetal and adult haemoglobin)	***Substantive*** Describe the need for a transport system in plants. Describe the processes of transpiration and translocation. Give examples of the adaptations shown by different plants to water availability in their environment (to include examples from xerophytes and hydrophytes). Be able to describe practical methodologies used to measure rates of transpiration. Be able to explain evidence that has contributed to our understanding of the mechanisms behind transpiration and translocation. ***Disciplinary*** Safely dissect and stain plant tissue to enable xylem and phloem to be seen under the light microscope.
	Next Steps	Year 12: Cell Division	Year 13: Cellular Control and inheritance		Year 13: Responses in Animals and Plants	Year 13: Photosynthesis

Science Curriculum Map

Year 12 Biology

Unit	Biological Molecules	Enzymes	Communicable Disease	Biodiversity	Classification and Evolution
Key Concepts	Cells, Tissues, Organs, Organ Systems Genetics and Inheritance	Cells, Tissues, Organs and Organ Systems	Cells, Tissues, Organs and Organ Systems	Ecosystems and the Environment	Genetics and Inheritance
Prior Learning	**Year 9: Organisation,** Describe the structure of animal, plant and prokaryotic cells. Recall the products that carbohydrates, proteins and lipids are broken down into. Describe experimental methods used to test foods for sugars, starch, lipids and proteins **Year 11: Inheritance** Describe structure of DNA Describe how proteins are synthesised (students that studied separate sciences at GCSE only)	**Year 9: Organisation** Where digestive enzymes are found, their role and the products of breakdown. The factors that affect the rate of enzyme activity (temperature, pH, enzyme concentration).	**Year 10: Infection and Response** Describe how named bacterial, fungal, viral and protist diseases are spread Describe how white blood cells protect us against pathogens Describe how vaccination works Describe the difference between painkillers and antibiotics Explain what is meant by antibiotic resistance and how we can prevent it	**Year 11: Ecology** Explain how to use a quadrat and a transect to estimate population sizes. Evaluate sampling methodologies to estimate population sizes. Describe some ways that air, water, and land are polluted and the effects of deforestation and peat bog destruction. Define the terms community, population, habitat, ecosystem, abiotic factor, biotic factor	**Year 11: Inheritance** Describe how organisms are classified. Describe the process of natural selection Describe the work of Mendel, Darwin, Wallace and Lamarck in developing our understanding of inheritance (Biology Only)
Key Knowledge	**Substantive** Discuss the importance of water and the importance of its properties for living organisms Compare the chemical components of biological molecules and describe the hydrolysis reaction for the formation of biological polymers Describe the role of inorganic ions in biological processes Describe the structure of monosaccharides and how they join to make complex carbohydrates with different structures and functions. Describe the structure and properties of triglycerides and how they are joined through ester bonds Describe the structure and properties of phospholipids and cholesterol Describe the structure of amino acids and how these can be joined through peptide bonds to make globular and fibrous proteins with different properties Describe the structure of nucleotides and how they are joined to form DNA and RNA through the formation of phosphodiester bonds Explain the process of DNA replication, the genetic code and how polypeptides are synthesised through transcription and translation Describe the structure and function of ATP and ADP and compare to the structure of DNA and RNA **Disciplinary** Investigate and test for biological molecules; biuret test for protein, Benedict's test for sugars, iodine test for starch, emulsion test for lipids Use a colorimeter to accurately determine the concentration of a chemical substance Using paper chromatography to separate biological molecules Purify DNA using DNA precipitation	**Substantive** Describe how enzymes catalyse reactions that affect metabolism at a cellular and whole organism level. Describe the mechanism for enzyme action and the effects of pH, temperature, enzyme concentration and substrate concentration on enzyme activity. Explain the need for coenzymes, cofactors and prosthetic groups in some enzyme-controlled reactions. Explain the effects of inhibitors on the rate of enzyme controlled reactions **Disciplinary** Plan an investigation into the effect of a named factor on the rate of an enzyme controlled reaction. Suggest suitable control variables for an investigation into enzyme activity and recognise those variables that cannot be controlled in a school laboratory environment.	**Substantive** State the different types of pathogen that can cause communicable diseases in plants and animals and the means of transmission for specific diseases. Describe how plants defend themselves against pathogens Describe both the primary non-specific defence against pathogens and the structure and mode of action of phagocytes. Describe the structure, different roles and modes of action of B and T lymphocytes in the specific immune response. Describe the structure and general functions of antibodies. Outline the role of opsonins, agglutinins and anti-toxins Compare active and passive immunity, and natural and artificial immunity. Outline what is meant by an autoimmune diseases and give specific examples. Describe the principles of vaccination and the role of vaccination programmes in the prevention of epidemics State possible sources of medicines. **Disciplinary** Demonstrate the correct use of aseptic technique to grow microorganisms safely in a school laboratory setting. Understand why serial dilution is often used when growing microorganisms Calculate the number of microorganisms in the original sample, when grown using a method involving serial dilution	**Substantive** Define the terms habitat biodiversity, species biodiversity and genetic biodiversity Describe the factors affecting biodiversity Describe how sampling is used in measuring the biodiversity of a habitat and the importance of sampling Describe the ecological, economic, and aesthetic reasons for maintain biodiversity Describe and evaluate in-situ and ex-situ conservation as methods for maintaining biodiversity Explain how international and local agreements can be used to protect species and habitats **Disciplinary** Use and interpret the results from Simpson's Index of Diversity (D) to calculate the biodiversity of a habitat. Calculate genetic biodiversity using the number of polymorphic gene loci Plan and demonstrate how sampling can be used to estimate populations (include both random and non-random sampling methods)	**Substantive** Describe how species have been classified and how this has changed over time. Describe the binomial system of naming species and its advantages. State the features used to classify organisms into the five kingdoms Describe the evidence that has led to new classification systems, such as the three domains of life Describe the evidence for the theory of evolution by natural selection Describe the different types of adaptations of organisms to their environment Be able to calculate the standard deviation of a data set. **Disciplinary** Use students t-test or Spearman's rank correlations to compare data and comment on its statistical significance.
Next Steps	Year 13: Manipulating Genomes	Year 13: Communication, Homeostasis and Excretion		Year 13: Ecosystems	Year 13: Populations and Sustainability

Science Curriculum Map

Year 13 Biology

Unit	Communication and Homeostasis	Animal and Plant responses	Photosynthesis	Cellular Control and Inheritance	Manipulating Genomes and Cloning
Key Concepts	Cells, Tissues, Organs and Organ Systems	Cells, Tissues, Organs and Organ Systems	Cells, Tissues, Organs and Organ Systems	Genetics and Inheritance	Genetics and Inheritance
Prior Learning	**Year 10 Homeostasis** Describe what is meant by homeostasis State examples of where homeostasis happens in the human body Students that studied separate sciences will be able to describe how body temperature is monitored and controlled Describe the function of the liver in relation to the production of bile Students that have studied separate sciences will be able to explain the role of the kidneys in maintaining body water content	**Year 10 Homeostasis (separate scientists only)** Describe the functions of the cerebrum, cerebellum, hypothalamus and medulla oblongata Explain how the production and diffusion of auxin affects the growths of shoots and roots	**Prior Knowledge: Year 12 Transport in plants** Describe the need for a transport system in plants. Describe the processes of transpiration and translocation. Be able to explain evidence that has contributed to our understanding of the mechanisms behind transpiration and translocation.	**Prior Learning: Year 11 Inheritance** Describe variation and its causes. Interpret data from genetic crosses for dominant and recessive phenotypes. Describe mitosis and meiosis, protein synthesis and DNA replication. Describe cell structure and the role of stem cells.	**Prior Learning: Year 13 Cellular control and inheritance** Describe the types of gene mutation and their effects on protein function. Discuss the regulation of gene expression at transcriptional, post-transcriptional, translational and post-translational level. Explain the control of the development of body plan in an organism and the importance of mitosis and apoptosis in this process. Discuss the contribution of environmental and genetic variation in a species Describe the factors that influence evolution and speciation.
Key Knowledge	**Substantive** Describe the need for communication systems in multicellular organism Describe how cells communicate with each other through cell signalling Explain why homeostasis is necessary in the body Describe the physiological and behavioural responses involved in temperature control in ectotherms and endotherms Describe the structure and functions of the mammalian liver Describe the structure, mechanisms of action and functions of the mammalian kidney Describe how the water potential of the blood is controlled Discuss the effects of kidney failure and its potential treatments Describe how excretory products can be used in medical diagnosis **Disciplinary** Safely dissect, examine and draw the external and internal structure of the kidney Use a light microscope to examine the histology of the kidney nephrons	**Substantive** Describe the organisation of the mammalian nervous system Describe the structure of the human brain and the functions of its parts Describe how the nervous and endocrine systems interact to coordinate responses Describe the effects of hormones and nervous mechanisms on heart rate Describe the structure of mammalian muscle and the mechanism of muscular contraction Describe the roles of plant hormones Discuss the commercial uses of plant hormones **Disciplinary** Discuss and evaluate the experimental evidence for the role of auxins in the control of apical dominance and the role of gibberellin in the control of stem elongation and seed germination Identify and label key features of mammalian skeletal muscle under the light microscope.	**Substantive** Label the structure of a chloroplast and describe its adaptations for photosynthesis. Describe the importance of photosynthetic pigments in photosynthesis Describe the events of the light-dependent stage of photosynthesis Describe the fixation of carbon dioxide and the light independent stage of photosynthesis State the uses of triose phosphate Explain the factors affecting the rate of photosynthesis **Disciplinary** Demonstrate the use of thin layer chromatography (TLC) to separate photosynthetic pigments and interpret the results. Plan a practical investigation into the effect of a named factor on the rate of photosynthesis. Evaluate the validity of the method.	***Substantive*** Describe he types of gene mutation and their effects on protein function Discuss the regulation of gene expression at transcriptional, post-transcriptional, translational and post-translational level Explain the control of the development of body plan in an organism and the importance of mitosis and apoptosis in this process Discuss the contribution of environmental and genetic variation in a species Describe the factors that influence evolution and speciation ***Disciplinary*** Construct genetic diagrams to show patterns of inheritance including dominant, recessive, codominance, dihybrid crosses, linkage and epistasis Calculate phenotypic ratios Use and interpret the chi-squared test to determine significance of variation in offspring Use and interpret the Hardy-Weinberg principle to calculate allele frequencies	***Substantive*** Explain the principles, uses and methods of DNA technology including; DNA sequencing, gel electrophoresis, DNA profiling, polymerase chain reaction, gene therapy and genetic engineering Describe the use of biotechnology in genome-wide analysis and the development of synthetic biology Discuss the ethical considerations of genetic manipulation of plants and animals. Describe the methods and uses of cloning in animals and plants including; taking plant cuttings, micro-propagation, artificial embryo twinning and somatic cell nuclear transfer Discuss the use of microorganisms in biotechnology, their growth curve, types of culture and fermentation, adapting growth conditions to maximise yield and the advantages and disadvantages of their use Describe the uses of immobilised enzymes in biotechnology and evaluate the different methods of immobilisation. ***Disciplinary*** Interpret data from gel electrophoresis and DNA profiling Calculate and carry out serial dilutions on bacterial cultures
Next Steps	N/A	N/A	N/A	Year 13 – Manipulating Genes and Cloning	N/A

Science Curriculum Map

Year 13 Biology

Unit	Respiration	Hormonal Communication	Neuronal Communication	Population and sustainability	Ecosystems
Key Concepts	**Cells, Tissues, Organs, Organ Systems**	**Cells, Tissues, Organs and Organ Systems**	**Cells, Tissues, Organs and Organ Systems**	Ecosystems and the Environment	Ecosystems and the Environment
Prior Learning	**Prior Knowledge: Year 10 Bioenergetics** State the chemical equations for aerobic and anaerobic respiration Compare aerobic and anaerobic respiration in animals, plants and micro-organisms	**Prior learning: Year 10 Homeostasis** Define the term hormone Locate the major endocrine glands in the body and name the hormones that they release Describe the differences in the causes and treatment of Type I and II diabetes	**Prior Learning:** Year 10 Homeostasis Describe the events of a reflex arc Describe how an impulse travels across a synapse	**Prior Learning: Year 11 Ecology** Define sustainable food production and describe how it could help increase food security (students that studied separate sciences at GCSE only).	**Year 12 Biodiversity** Explain how to use a quadrat and a transect to estimate population sizes. Evaluate sampling methodologies to estimate population sizes. Describe how sampling is used in measuring the biodiversity of a habitat and the importance of sampling.
Key Knowledge	***Substantive*** Describe the need for cellular respiration Label the structure of the mitochondrion Describe the processes and sites of glycolysis, the link reaction, the Krebs cycle and oxidative phosphorylation. Describe the importance of coenzymes in cellular respiration Describe the process of anaerobic respiration in eukaryotes Discuss the difference in relative energy values of carbohydrates, lipids and proteins as respiratory substrates ***Disciplinary*** Plan a practical investigation to assess the effect of a named factor on respiration rates in yeast Calculate RQ values for respiratory substrates and interpret data from practical investigations.	**Substantive** Describe the structure and function of the adrenal glands Describe how the structure of the pancreas relates to its function Describe how blood glucose concentration is regulated Compare the differences between type I and type II diabetes mellitus Describe the potential treatments for diabetes melllitus **Disciplinary** Using a light microscope, examine and produce a biological drawing of stained sections of the pancreas – following standard conventions.	**Substantive** Describe the roles of mammalian sensory receptors in converting different types of stimuli into nerve impulses Describe the structure and functions of sensory, relay and motor neurones Describe the generation and transmission of nerve impulses in mammals including the events of depolarisation, repolarisation and hyperpolarisation Describe the structure of a synapse and explain its role in neurotransmission **Disciplinary** Use graphical data to calculate the speed that an impulse is travelling along a neurone	**Substantive** State the factors that determine the size of a population. Define the term carrying capacity Describe interactions between populations including predator–prey relationships, interspecific and intraspecific competition. Discuss the reasons for, and differences between, conservation and preservation. Describe how the management of an ecosystem can provide resources in a sustainable way. Evaluate how ecosystems can be managed to balance the conflict between conservation/ preservation and human needs (to include the Masai Mara region in Kenya and the Terai region of Nepal) Describe the effects of human activities on animal and plant populations and how these are controlled in environmentally sensitive ecosystems (the Galapagos Islands, Antarctica, Snowdonia National Park, the Lake District). **Disciplinary** Evaluate the economic and ecological arguments for conserving or preserving an ecosystem.	**Substantive** State examples of abiotic and biotic factor that affect ecosystems Describe how biomass transfers between trophic levels and the efficiency of this transfer Discuss how human activities can manipulate the transfer of biomass through ecosystems Describe the events of the Nitrogen and Carbon cycles and their importance in ecosystems Describe the process of successions from pioneer species to climax communities Describe how the distribution and abundance of organisms in an ecosystem can be measured **Disciplinary** Demonstrate how sampling methods can be used to determine the distribution and abundance of organisms in an ecosystem Evaluate the validity of methods used to assess the distribution and abundance of organisms in an ecosystem
Next Steps	N/A	Year 13 – Animal and Plant Responses	Year 13 – Animal and Plant Responses	N/A	N/A

Science Curriculum Map

Year 7 & 8 Chemistry

Unit	Particles and Separating Mixtures	Metals Non Metals Acids and Bases	Earths Structure and the Universe	Elements and The Periodic Table	Chemical Energy and Types of Reaction	Climate and Earths Resources
Key Concepts	Particles	Behaviour of Materials	The Earth and our Environment and The Universe	Particles	Behaviour of materials	The environment
Prior Learning	**Year 5: Properties and Changes of Material** Know that some materials will dissolve into a liquid to form a solution and describe how to recover a substance from a solution Use knowledge of solids, liquids and gases to describe how mixtures might be separated, including through filtering, sieving and evaporating. State that dissolving, mixing and changes of state are reversible changes. State that some changes result in the formation of new materials, and that this kind of change is not usually reversible. Identify some materials that are solids, some that are liquids and some that are gases. State that materials change when they are heated or cooled. State that evaporation is when a liquid changes to a gas - and that this is important in the water cycle. State that condensation is when the water vapor turns into a liquid - which is part of the water cycle. State that evaporation increases with the increase of temperature. State that 0°C is the freezing point of water	**Year 5:** To name some materials that are electrical conductors	**Year 5: Earth and Space** To know that the sun is a star and is at the centre of our solar system. To know that the Earth and planets orbit the sun. To know that the Sun, Earth and Moon are approximately spherical bodies. A day on Earth lasts 24 hours – that is how long it takes for the planet to spin around once. To understand that when you look up into the sky the Sun seems to move around the Earth, this is an illusion: in fact, the Earth spins and causes night and day. To know that the part of the Earth that faces the Sun is in daylight, and the part that is not facing the Sun is in darkness Inside the Solar System, Earth and eight other planets (including the dwarf planet Pluto) orbit (travel round) the Sun due to its gravitational pull	**Year 7: Particles and separating mixtures** **Substantive** Describe the arrangement and movement of particles in solids, liquids and gases and how they change with changes in energy. Explain the properties and how to classify substances which behave unusually as solids, liquids or gases. Describe and explain how different techniques use different properties for separating substances using appropriate scientific words and phrases. **Disciplinary** Plan and carry out a scientific investigation, suggesting improvements. Use the properties of different chemicals to justify their use.	**Year 7. Metals, nonmetals, acids and bases** **Substantive** Describe acids and bases in terms of their pH number and the colour they turn universal indicator. Describe reactions involving acids and name the salts made. **Disciplinary** Plan and carry out a scientific investigation. Use the properties of different chemicals to justify their use. Deduce rules from observations and data about which reactions will occur or not, based on the reactivity series.	**Year 7. Earth and the Universe** **Substantive** Describe the structure of the Earth, Solar System and Universe. Describe how the Earth, Solar System and Universe are linked. Explain how the properties and features of planets are linked to their place in the Solar System. **Disciplinary** Compare different geological features. Interpret data regarding the Earth, Solar System and Universe and make valid conclusions. Compare explanations from different periods in history about the motion of objects and structure of the Universe.
Key Knowledge	**Substantive** Describe the arrangement and movement of particles in solids, liquids and gases and how they change with changes in energy. Explain the properties and how to classify substances which behave unusually as solids, liquids or gases. Describe and explain how different techniques use different properties for separating substances using appropriate scientific words and phrases. **Disciplinary** Plan and carry out a scientific investigation, suggesting improvements. Use the properties of different chemicals to justify their use.	**Substantive** Describe acids and bases in terms of their pH number and the colour they turn universal indicator. Describe reactions involving acids and name the salts made. **Disciplinary** Plan and carry out a scientific investigation. Use the properties of different chemicals to justify their use. Deduce rules from observations and data about which reactions will occur or not, based on the reactivity series.	**Substantive** Describe the structure of the Earth, Solar System and Universe. Describe how the Earth, Solar System and Universe are linked. Explain how the properties and features of planets are linked to their place in the Solar System. **Disciplinary** Compare different geological features. Interpret data regarding the Earth, Solar System and Universe and make valid conclusions. Compare explanations from different periods in history about the motion of objects and structure of the Universe.	**Substantive** Explain how the periodic table has developed over time. Name compounds using their chemical formulae. Explain how the position of an element in the periodic table can be linked to its properties. **Disciplinary** Decide on the most appropriate way to present data.	**Substantive** Identify independent, dependent and control variables and be able to devise a method to investigate some variables Discuss the limitations of a method **Disciplinary** Recognise and be able to name compounds from their chemical formulae Construct formulae equations Describe different types of chemical reactions and be able to explain why a reaction can be classified as a certain type	**Substantive** Know that our resources are obtained from the Earth, Oceans and atmosphere. Understand and explain how human impact effects the Earth. Be able to evaluate the impact of human activity on the Earth and make suggestions on changes that can be made. **Disciplinary** Interpret data to make valid conclusions. Use data from experiments or observations to describe and explain models. Compare explanations from different sources.
Next Steps	Year 8: Particles - Elements and the Periodic Table Year 9: Separating Mixtures - Atomic Structure	Year 9: Atomic Structure and the Periodic Table	Year 9: Space Year 10: Atmosphere	Year 9: Atomic structure and the periodic table	Year 10. Chemical Change	Year 10. Atmosphere

Science Curriculum Map

Year 9 Chemistry

Unit	Atomic Structure	Bonding and Structure	Chemistry of the Atmosphere
Key Concepts	Particles	Behaviour of materials	Earth and our environment
Prior Learning	**Year 8: Elements and the periodic table** **Substantive** Explain how the periodic table has developed over time. Name compounds using their chemical formulae. Explain how the position of an element in the periodic table can be linked to its properties. **Disciplinary** Decide on the most appropriate way to present data.	**Year 9: Atomic structure** **Substantive** Explain the difference between a pure element, mixture and a compound. Identify models of the atom and compare the differences between them Describe atoms using the atomic model including the subatomic particles. Describe trends in reactivity within groups in the periodic table. Describe how the properties of group 1 metals compare to the transition metals. Define an Isotope and be able to calculate Ar. Construct chemical formulae for a range of chemical substances. **Disciplinary** Use models of elements, compound and mixtures in explanations. Understand how scientific methods and theories develop over time relating to the periodic table. Explain the limitations of using models to represent substances.	**Year 8: Climate and Earth's resources** **Substantive** Know that our resources are obtained from the Earth, Oceans and atmosphere. Understand and explain how human impact effects the Earth. Be able to evaluate the impact of human activity on the Earth and make suggestions on changes that can be made. **Disciplinary** Interpret data to make valid conclusions. Use data from experiments or observations to describe and explain models. Compare explanations from different sources.
Key Knowledge	**Substantive** Explain the difference between a pure element, mixture and a compound. Identify models of the atom and compare the differences between them Describe atoms using the atomic model including the subatomic particles. Describe trends in reactivity within groups in the periodic table. Describe how the properties of group 1 metals compare to the transition metals. Define an Isotope and be able to calculate Ar. Construct chemical formulae for a range of chemical substances. **Disciplinary** Use models of elements, compound and mixtures in explanations. Understand how scientific methods and theories develop over time relating to the periodic table. Explain the limitations of using models to represent substances.	**Substantive** Identify different types of chemical bonds and describe how they are formed Know some properties of each type of substance and be able to explain how properties of substances are linked to their type of bonding. Evaluate uses of materials based on their properties. Predict the properties of unfamiliar substances State definition of nanoscience Explain the relationship between surface area to volume ratio and particle size and its effect on properties, linked specifically to nanoscience **Disciplinary** Recognise, draw and interpret diagrams. Visualise and represent substances in 2D and 3D models Make predictions / calculate quantities based on the model and explain the model's limitations Use SI Units Calculate the area of triangles and rectangles, surface area and volumes. Use prefixes and powers of ten for orders of magnitude Recognise and use expressions in standard form.	**Substantive** State the composition, including formulae, of the Earth's early and current atmosphere. Describe a theory for the development of the Earth's atmosphere. Explain the greenhouse effect. Explain how human activity can change the proportion of greenhouse gases and other pollutants in the atmosphere. Explain possible methods to reduce greenhouse gas emissions. **Disciplinary** Appreciate the power and limitations of science and consider any ethical issues which may arise. Explain why not all scientists agree on what is causing global warming. Use ratios, fractions and percentages
Next Steps	Year 9: Bonding	Year 10: Chemical change	Year 11: Using resources

Science Curriculum Map

Year 10 Chemistry

Unit	Chemical changes	Energy Changes	Quantitative
Key Concepts	Behaviour of materials	Behaviour of materials	Particles
Prior Learning	**Year 8: Chemical energy and reactions** **Substantive** Identify independent, dependent and control variables and be able to devise a method to investigate some variables Discuss the limitations of a method **Disciplinary** Recognise and be able to name compounds from their chemical formulae Construct formulae equations Describe different types of chemical reactions and be able to explain why a reaction can be classified as a certain type	**Prior learning. Year 8: Chemical energy and reactions** **Substantive** Identify independent, dependent and control variables and be able to devise a method to investigate some variables Discuss the limitations of a method **Disciplinary** Recognise and be able to name compounds from their chemical formulae Construct formulae equations Describe different types of chemical reactions and be able to explain why a reaction can be classified as a certain type	**Year 9: Atomic structure** **Substantive** Describe atoms using the atomic model including the subatomic particles. Define an isotope and be able to calculate Ar. Construct chemical formulae for a range of chemical substances. **Disciplinary** Use models of elements, compound and mixtures in explanations.
Key Knowledge	**Substantive** Recall the reactivity series. Recognise acids, alkalis and bases, and recall the difference between the terms, ‘strong’, ‘weak’ and ‘neutral’. Describe the pH Scale and be able to use an indicator correctly. Prepare a sample of a soluble salt from an insoluble oxide or carbonate. Define oxidation and reduction in terms of oxygen and electron transfer and be able to identify these in chemical reactions. Define and describe how electrolysis is carried out to separate a variety of substances. Identify the products formed during electrolysis. **Disciplinary** Use general and symbol equations, including state symbols to describe the reactions of metals. Use the reactivity series to predict reactions and the extraction method of different metals Describe a practical procedure for a specified purpose and suggest / select the technique/instrument/apparatus needed. Explaining why this is suitable. Be able to write balanced symbol equations using state symbols. Use data from experiments or observations to describe and explain them. Use standard form when looking at pH. Use ratios, fractions and percentages.	**Substantive** Define and classify exothermic and endothermic reactions Know that energy is conserved in chemical reactions (link to Physics) Sketch and describe key features of a reaction profile diagram. Explain a chemical reaction in terms of energy transfer. Calculate energy changes for a reaction Know the differences between batteries, cells and fuel cells List the advantages and disadvantages of using hydrogen fuels cells compared to rechargeable cells and batteries. Determine which species is oxidised and reduced in an electrochemical cell. **Disciplinary** Use SI Units Describe a practical procedure for a specified purpose and suggest / select the technique/instrument/apparatus needed, explaining why this is suitable Recognise/draw/interpret diagrams of energy changes. Be able to write balanced symbol equations using state symbols. Use data from experiments or observations about energy changes to describe and explain them.	**Substantive** Define Atomic Number, Mass Number and Mr Calculate the Mr for unfamiliar compounds when the formula is given. Calculate the concentration of a solution in g/dm3 Define and calculate atom economy. Identify the limiting reactant in a chemical reaction. Calculate percentage yield when actual yield and the mass of the limiting reactant is given. Calculate the number of moles or mass of a substance from data supplied. Use balanced symbol equations to calculate reacting masses. Calculate the volume of gaseous reactants and products from a balanced equation and volumes. **Disciplinary** Accurately read the volume on a burette to 1d.p. Identify concordant results and calculate a titre Make predictions / calculate quantities based on the model or show limitations Use prefixes and powers of ten for orders of magnitude
Next Steps	Year 10: Energy changes	Year 12: Energetics	Year 12: Amount of substance

Science Curriculum Map

Year 11 Chemistry

	Unit	Rate and Extent of Chemical Change	Organic Chemistry	Chemical Analysis	Using Resources
	Key Concepts	Particles	Behaviour of Materials	Behaviour and materials Particles	Earth and our environment
	Prior Learning	**Year 10 Energy changes** Define and classify exothermic and endothermic reactions Know that energy is conserved in chemical reactions **Year 10 Quantitative** Know that the concentration of a solution can be measured by the mass of solute in a given volume of solution, such as g/dm3. Be able to use the concentration to calculate the mass of a solute in a given volume.	**Year 9 – Bonding Structures and Properties** Visualise and represent substances in 2D and 3D models Know some properties of each type of substance dependant on type of bonding Explain how properties of substances are linked to bonding Describe how covalent bonds form Explain how different techniques use different properties for separating substances using appropriate scientific words and phrases	**Year 8: Chemical energy and reactions** Identify the products of complete combustion **Year 9: Atomic structure** Have the skills to carry out chromatography to separate a mixture of inks.	**Year 8: Climate and Earth resources** **Substantive** Know that our resources are obtained from the Earth, Oceans and atmosphere. Understand and explain how human impact effects the Earth. Be able to evaluate the impact of human activity on the Earth and make suggestions on changes that can be made. **Disciplinary** Interpret data to make valid conclusions. Use data from experiments or observations to describe and explain models. Compare explanations from different sources.
	Key Knowledge	**Substantive** Define key terms; 'rate of reaction', 'concentration', 'catalyst', 'activation energy', 'reversible reaction', 'equilibrium', 'dynamic equilibrium'. Calculate the mean rate of a reaction or the rate at a given time and explain how there can be different units for measuring rate of reaction. Describe how surface area, temperature, concentration, pressure and catalysts affect the rate of a reaction, making links to collision theory. Use a reaction profile diagram to explain the effect of adding a catalyst. Describe a reversible reaction using balanced symbol equations Justify the use of reversible reactions in everyday life. Describe Le Chateliers' Principle and apply it to explain the effects of changing conditions on the rate of forwards and backwards reactions (Triple Only) **Disciplinary** Describe a practical procedure for determining the rate of a reaction and suggest / select the technique/instrument/apparatus needed. Explaining why this is suitable Recognise/draw/interpret diagrams on rates of reaction. Be able to write balanced symbol equations using state symbols. Evaluate the effect of errors during practical work. Use graphs and tables to calculate gradients and means to explain what is happening in a reaction.	**Substantive Knowledge** Draw displayed formulae of different organic molecules. Describe the trends in viscosity, flammability, boiling point and volatility of the alkanes and how their properties make it suitable for a use. Describe how fractional distillation is carried out to separate crude oil into fractions. Describe incomplete and complete combustion using word and symbol equations to represent them. Describe 'cracking' and the chemical test for alkenes using word and symbol equations. *Describe the reactions of alkenes, alcohols, carboxylic acids and predict word and symbol equations for complete combustion reactions.* *Describe the difference between addition and condensation polymerisation.* *Be able to draw the monomers or polymers formed from information provided (both natural and man-made).* *Be able describe the importance of DNA for living structures* **Disciplinary Knowledge** Use models in explanations of different molecules.. Recognise/draw/interpret diagrams of molecules. Be able to write balanced symbol equations using state symbols for reactions of organic molecules.	**Substantive** Define the term pure and be able to explain how melting point is linked to purity. Explain what a formulation is. Describe and explain the process of Chromatography and be able to calculate Rf values. Describe the tests for oxygen, hydrogen, chlorine and carbon dioxide Explain why limewater turns 'cloudy' when carbon dioxide is bubbled through it. *Describe how to carry out a flame test* *Describe the chemical tests and observations for various metal ions and negative ions* **Disciplinary** Rearrange equations to find the subject when calculating Rf values. Describe a practical procedure for a specified purpose and be able to identify hazards and methods to reduce risk when identifying gases or ions. Make and record observations, including being able to read measurements off a scale in a practical and use these to identify unknown substances. *Explain why various metals produce different coloured flames.* *Explain the advantages and disadvantages of instrumental analysis.* *Explain how flame emission spectroscopy works be able to use results to identify metal ions.*	**Substantive** Define the use of natural, sustainable, and finite resources, with examples. Describe the processes of using Phyto mining and bioleaching to extract copper. Recall methods used to extract metals from ores. Evaluate extraction and processing techniques for raw materials, environmental impacts and cost. Define and compare alloys as mixtures of metals. Describe corrosion and how prevented. experiment for rusting and how corrosion is prevented. Describe and compare the properties of polymers, why they are dependent on their monomers. Explain the differences between thermosetting and thermo softening polymers. Compare and evaluate the physical properties alloys / polymers and their different applications. Explain and interpret a life cycle assessment of materials or products using appropriate information. Consider the environmental impact of a product of a material. Explain and compare methods of treating water. Explain and define the Haber process, applying the knowledge of reversible reactions and dynamic equilibrium. Explain that NPK fertilisers contain Nitrogen, Phosphorus and Potassium. Explain and evaluate how the raw materials are treated and extracted. Explain how ammonia can be neutralised by acids to make fertilisers. Explain how to prepare a fertiliser in the lab. **Disciplinary** Evaluate, interpret, translate, compare and draw conclusions consistent with information provided from graphs, charts, tables, and prose and evaluate the validity of the data, weighing up the advantages and disadvantages to reach conclusion. Recognise and use expressions in decimal form. Use ratio, fractions and percentages
	Next Steps	**Year 12: Kinetics**	**Year 12: Introduction to Organic**	Year 12:. Organic analysis	**Year 12: Equilibria**

Science Curriculum Map

Year 12 Chemistry

Unit	Atomic structure and amount of substance	Bonding and periodicity	Energetic and Kinetics	Equilibria and Redox
Key Concepts	Particles	Particles and Behaviour of materials	Particles	Behaviour of Matter
Prior Learning	**Year 10: Quantitative Chemistry** **Substantive** Define Atomic Number, Mass Number and Mr Calculate the Mr for unfamiliar compounds when the formula is given. Calculate the concentration of a solution in g/dm3 Define and calculate atom economy. Identify the limiting reactant in a chemical reaction. Calculate percentage yield when actual yield and the mass of the limiting reactant is given. Calculate the number of moles or mass of a substance from data supplied. Use balanced symbol equations to calculate reacting masses. Calculate the volume of gaseous reactants and products from a balanced equation and volumes. **Disciplinary** Make predictions / calculate quantities based on the model or show limitations Use prefixes and powers of ten for orders of magnitude	**Year 9: Bonding** **Substantive** Identify different types of chemical bonds and describe how they are formed Know some properties of each type of substance and be able to explain how properties of substances are linked to their type of bonding. Evaluate uses of materials based on their properties. Predict the properties of unfamiliar substances **Disciplinary** Recognise, draw and interpret diagrams. Visualise and represent substances in 2D and 3D models Make predictions / calculate quantities based on the model and explain the model's limitations	**Year 10. Energy changes** **Substantive** Define and classify exothermic and endothermic reactions Know that energy is conserved in chemical reactions (link to Physics) Sketch and describe key features of a reaction profile diagram. Explain a chemical reaction in terms of energy transfer. Calculate energy changes for a reaction **Year 11. Rate and extent of chemical change** **Substantive** Define key terms; 'rate of reaction', 'concentration', 'catalyst', 'activation energy', 'reversible reaction', 'equilibrium', 'dynamic equilibrium'. Calculate the mean rate of a reaction or the rate at a given time and explain how there can be different units for measuring rate of reaction. Describe how surface area, temperature, concentration, pressure and catalysts affect the rate of a reaction, making links to collision theory. Use a reaction profile diagram to explain the effect of adding a catalyst. **Disciplinary** Describe a practical procedure for determining the rate of a reaction and suggest / select the technique/instrument/apparatus needed. Explaining why this is suitable	**Year 11: Rates and Extent of Chemical Change** **Year 10: Using Resources** **Year 10: Chemical Changes – Electrolysis** **Substantive Knowledge** Define key terms; 'rate of reaction', 'concentration', 'catalyst', 'activation energy', 'reversible reaction', 'equilibrium', 'dynamic equilibrium'. Describe how surface area, temperature, concentration, pressure and catalysts affect the rate of a reaction, making links to collision theory. Describe a reversible reaction using balanced symbol equations Justify the use of reversible reactions in everyday life. Describe Le Chateliers' Principle and apply it to explain the effects of changing conditions on the rate of forwards and backwards reactions. Explain and define the Haber process, applying the knowledge of reversible reactions and dynamic equilibrium. Define oxidation and reduction in terms of oxygen and electron transfer and be able to identify these in chemical reactions. **Disciplinary** Be able to write balanced symbol equations using state symbols. Interpret information to make qualitative predictions about the effect of changes on systems at equilibrium when given appropriate information. Write balanced half equations and ionic equations where appropriate Write ionic equations for displacement reactions Identify in a given reaction, symbol equation or half equation which species are oxidised and which are reduced.
Key Knowledge	**Substantive** Determine the number of fundamental particles in atoms and ions using mass number, atomic number and charge Explain the existence of isotopes Interpret simple mass spectra of elements and calculate the relative atomic mass from isotopic abundance Define first ionisation energy and write equations for first and successive ionisation energies Explain how first and successive ionisation energies in period 3 (Na-Ar) and in group 2 (Be-Ba) give evidence for electron configuration in sub-shells and in shells Carry out calculations using the Avogadro constant, mass of substance, Mr, amount in moles, concentration, volume, amount of substance in a solution and use the ideal gas equation pV = nRT. Calculate empirical formula from data State the economic, ethical and environmental advantages for society and for industry for developing chemical reactions with high atom economy **Disciplinary** Analyse, interpret and evaluate scientific information to link atomic and electronic structure of elements to their properties. Apply knowledge and understanding of scientific ideas to carry out calculations. Evaluate how scientific models change over time.	**Substantive** Predict the charge on a simple ion using the position of the element in the Periodic Table and construct formulas for ionic compounds. Describe how covalent and dative covalent bonds form and how these give a molecule shape. Define electronegativity and explain how a bond can be polar. Explain the existence of: permanent dipole-dipole forces; induced dipole-dipole (van der Waals, dispersion, London) forces; hydrogen bonding **Disciplinary** Interpret data to draw valid conclusions about the shapes of molecules. Link the type of bonding in a compound to its physical properties.	**Substantive** Define enthalpy change (ΔH), standard enthalpy change of combustion (ΔcHθ) and standard enthalpy change of formation (ΔfHθ) Use the equation q=mcΔT to calculate the molar enthalpy change Use Hess's law to perform calculations, including calculation of enthalpy changes for reactions from enthalpies of combustion or from enthalpies of formation Define the term mean bond enthalpy and use it to calculate an approximate value of ΔH for reactions in the gaseous state Define the term activation energy and explain why most collisions do not lead to a reaction Draw and explain Maxwell-Boltzmann distribution curves for different temperatures. Explain how a change in concentration or a change in pressure influences the rate of a reaction. Define the term catalyst and explain how they work **Disciplinary** Use knowledge of Hess' cycles to calculate enthalpy changes for unknown reactions. Use collision theory and/or Maxwell distribution curves to explain how changes in conditions affect reactions rates.	**Substantive** Explain what is happening in a reversible reaction at equilibrium Use Le Chatelier's principle to describe the effect of changes in temperature, pressure and concentration on the position of equilibrium and why in industry other conditions may be used. Describe the terms oxidation and reduction in terms of electrons **Disciplinary** Construct an expression for Kc for a homogeneous system in equilibrium and calculate a value for Kc from the equilibrium concentrations. Use Le Chatelier's principle to predict qualitatively the effect of changes in temperature, pressure and concentration on the position of equilibrium and why in industry other conditions may be used. Work out the oxidation state of an element in a compound or ion from the formula Write half equations identifying the oxidation and reduction processes in redox reactions and be able to combine half equations to give an overall redox equation.
Next Steps	Year 12: Periodicity, group 2 and 7	Year 12: Introduction to organic chemistry	Year 13 Thermodynamics	Year 13: Transition metals Year 13: Acids, Bases and Buffers Year 13: Rates and Equilibrium

Science Curriculum Map

Year 12 Chemistry

Unit	Periodicity (Group 2 & 7)	Introduction to Organic Chemistry	Alkenes, Alcohols and Organic Analysis	Further Organic
Key Concepts	Behaviour of materials	Behaviour of materials	Behaviour of materials	Behaviour of materials
Prior Learning	**Year 12: Atomic structure and amount of substance.** **Substantive** Define first ionisation energy and write equations for first and successive ionisation energies Explain how first and successive ionisation energies in period 3 (Na-Ar) and in group 2 (Be-Ba) give evidence for electron configuration in sub-shells and in shells **Disciplinary** Analyse, interpret and evaluate scientific information to link atomic and electronic structure of elements to their properties.	**Year 11: Organic chemistry** **Substantive** Draw displayed formulae of different organic molecules. Describe the trends in viscosity, flammability, boiling point and volatility of the alkanes and how their properties make it suitable for a use. Describe how fractional distillation is carried out to separate crude oil into fractions. Describe incomplete and complete combustion using word and symbol equations to represent them. Describe 'cracking' and the chemical test for alkenes using word and symbol equations. **Disciplinary** Use models in explanations of different molecules. Recognise/draw/interpret diagrams of molecules. Be able to write balanced symbol equations using state symbols for reactions of organic molecules.	**Year 12: Introduction to organic** **Substantive** Explain the different types of formulae that can be used to represent a compound and apply IUPAC rules for nomenclature. Describe the properties of alkanes, fractional distillation and the problems with combustion. Describe mechanisms by drawing the structures of the species involved and curly arrows to represent the movement of electron pairs **Disciplinary** Outline mechanisms by drawing the structures of the species involved and curly arrows to represent the movement of electron pairs	**Year 12: Introduction to organic** **Substantive** Explain the different types of formulae that can be used to represent a compound and apply IUPAC rules for nomenclature. Define the term structural and stereoisomers and be able to identify the different types. **Disciplinary** Outline mechanisms by drawing the structures of the species involved and curly arrows to represent the movement of electron pairs
Key Knowledge	**Substantive** Explain the trends in atomic radius first ionisation energy and melting point.(Mg-Ba) Describe the reactions of elements Mg-Ba with water and the relative solubilities of the hydroxides and sulfates of the elements Mg-Ba in water. Recall the uses of Mg, $Mg(OH)_2$, $Ca(OH)_2$, CaO or $CaCO_3$, acidified $BaCl_2$ and $BaSO_4$ Explain why $BaCl_2$ solution is used to test for sulfate ions and why it is acidified Explain the trend in electronegativity, boiling point and oxidising ability for the elements in Group VII Know the trend in reducing ability of the halide ions, including the reactions of solid sodium halides with concentrated sulfuric acid Explain why silver nitrate solution is used to identify and distinguish between halide ions, why it is acidified and why ammonia solution is added Recall the reaction of chlorine with water to form chloride ions and chlorate(I) ions; chloride ions and oxygen and its uses in water treatment. **Disciplinary** Carry out simple test-tube reactions to identify: NH_4^+; OH^-, CO_3^{2-}, SO_4^{2-} Explain what the result of each test shows using equations.	**Substantive** Explain the different types of formulae that can be used to represent a compound and apply IUPAC rules for nomenclature. Define the term structural and stereoisomers and be able to identify the different types. Describe the properties of alkanes, fractional distillation and the problems with combustion. Describe the reaction mechanism for free-radical substitution. Describe how haloalkanes are formed, how they react and their role in the depletion of the ozone layer. Describe mechanisms by drawing the structures of the species involved and curly arrows to represent the movement of electron pairs **Disciplinary** Predict products and write equations for thermal and catalytic cracking reactions. Outline mechanisms by drawing the structures of the species involved and curly arrows to represent the movement of electron pairs	**Substantive** Know general equations and mechanisms for reactions of alkenes. Describe the primary, secondary and tertiary structures of alcohols and their reactions Describe chemical tests to distinguish aldehydes and ketones. Describe how an infrared spectra can be used to identify particular bonds and therefore functional groups, and also identify impurities. **Disciplinary** Deduce equations and mechanisms for reactions of alkenes and explain the potential formation of major and minor products in these reactions. Use chemical tests to distinguish aldehydes and ketones. Use infrared spectra and the Chemistry Data sheet to identify particular bonds and therefore functional groups, and also identify impurities Use precise atomic masses and precise molecular mass from mass spectrometry to determine the molecular formula of a compound	**Substantive knowledge** Define the terms optical isomerism and racemic mixtures Describe the structure of and the reactions to form carboxylic acids, esters and amines. Describe the importance of some of these molecules. **Disciplinary knowledge** Identify chiral centres in complex molecules. Explain how different nucleophiles will react with compounds containing a carbonyl group. Construct mechanisms to show how different nucleophiles will react with compounds containing a carbonyl group.
Next Steps	Year 13: Period 3 and their oxides	Year 12: Alkenes, alcohols and organic analysis	Year 12: Further organic	Year 13: Organic synthesis

Science Curriculum Map

Year 13 Chemistry

Unit	Acids and Bases	Properties of Period 3 elements and their oxides	Transition Metals and Inorganic Ions	Aromatic Chemistry	Electrochemical Cells
Key Concepts	Particles Behaviour of materials	Behaviour of materials	Behaviour of materials	Behaviour of matter	Behaviour of materials Particles
Prior Learning	**Year 11. Chemical change** **Substantive** Know the definitions of acids and bases. Recall the pH scale. Recognise the difference between strong and weak acids and bases. Apply the concentration of H^+ ions and pH and know that altering the concentration of H^+ ions by a factor of 10 alters pH. **Disciplinary** Carry out a titration and calculate concentration using practical measurements.	**Year 12: Periodicity** **Substantive** Predict the charge on a simple ion using the position of the element in the Periodic Table and construct formulas for ionic compounds. Describe how covalent and dative covalent bonds form and how these give a molecule shape. Define electronegativity and explain how a bond can be polar. Explain the existence of permanent dipole-dipole forces; induced dipole-dipole (van der Waals, dispersion, London) forces; hydrogen bonding **Disciplinary** Interpret data to draw valid conclusions about the shapes of molecules. Link the type of bonding in a compound to its physical properties.	**Year 12 Bonding** **Substantive** Know the transition metals form a block in the periodic table between the s block and the p block elements. Recall the electronic structures of transition elements and the general properties of the transition metals. Recall bonding types; focussing on co-ordinate bond (dative bonds). Understand electronegativity and bond polarity across covalent bonds. **Disciplinary** Determine the shape of molecules using knowledge of valence shell electron repulsion theory	**Year 12: Alkenes, alcohol, and organic analysis** **Substantive** Know general equations and mechanisms for reactions of alkenes. Describe how an infrared spectrum can be used to identify particular bonds and therefore functional groups, and also identify impurities. **Disciplinary** Deduce equations and mechanisms for reactions of alkenes and explain the potential formation of major and minor products in these reactions.	**Year 10: Energy Changes** **Substantive** Describe the terms oxidation and reduction in terms of electrons. Describe advantages and disadvantages of the different types of fuel cell and the reactions that occur. **Disciplinary** Work out the oxidation state of an element in a compound or ion from the formula Write half equations identifying the oxidation and reduction processes in redox reactions and be able to combine half equations to give an overall redox equation
Key Knowledge	**Substantive** Recall the BrØnsted-Lowry definitions of an acid and base and describe what happens in their reactions. State the expression for the ionic product of water K_w. Define pH and use it to find the concentration of $H^+_{(aq)}$ and $OH^-_{(aq)}$. Describe how pH is determined experimentally. Describe the shapes of the pH curves for acid-base titrations, identifying key features 'equivalence, half-neutralisation and end point'. Describe how pH curves can be used to select a suitable indicator. State the definition of a buffer and describe its use. **Disciplinary** Calculate the pH of mixtures of solutions. Work out the resulting solution after a chemical reaction to see if a buffer is formed and calculate its pH. Work out pH of a buffer solution after small additions of acid or alkalis.	**Substantive** State the reactions and conditions needed for Na and Mg to react with water and how elements from Na to S react with oxygen. Describe how the physical properties of the oxides are explained in terms of their structure and bonding and how the oxides react with water and with acids and bases, using equations. Describe the reactions of period 3 elements with chlorine and describe the trend in bonding structure, pH and solubility in water of the chlorides. **Disciplinary** Interpret information about the period 3 elements and their oxides to deduce their properties. Relate the knowledge of period 3 elements and their oxides to other periods.	**<u>Substantive</u>** Describe the characteristic properties of the elements titanium to copper and explain these in terms of electronic structure. Define terms; ligand, co-ordinate bond (dative) and co-ordination number; bidentate and multi-dentate ligands. Describe the origin of the colour of a transition metal complex ion and explain which factors determine the colour. Define the terms 'heterogeneous, homogeneous' catalyst and describe their role within chemical processes. Describe reactions of metal aqua ions in aqueous solutions the acidity of these ions. **<u>Disciplinary</u>** Perform calculations for the redox titrations of Fe^{2+} and $C_2O_4^{2-}$ with MnO^{4-} Deduce the formula of transition metal complexes based on information given. Explain the changes in co-ordination numbers and charges of complexes when different ligands are substituted. Explain why complexes formed with multi-dentate ligands are more stable than those with mono-dentate ligands.	**Substantive knowledge** Describe the nature of the bonding in a benzene ring and explain the evidence for its structure. Outline the reactions and mechanisms for the reactions of benzene. **Disciplinary knowledge** Use thermochemical evidence from enthalpies of hydrogenation to account for the stability of benzene Explain why substitution reactions occur in preference to addition reactions	**Substantive** Know the IUPAC convention for writing half-equations for electrode reactions. Be able to describe an electrochemical cell and how to calculate the EMF. Know that standard electrode potentials can be listed as an electrochemical series and the values can be used to predict the direction of simple redox reactions. Describe the reactions in fuel cells and batteries. **Disciplinary** Measure the EMF of electrochemical cells Deduce the voltage from a theoretical electrochemical cell. Recognise limitations of electrochemical cells.
Next Steps	Year 13 Period 3 and their oxides	Year 13: Transition metals and Inorganic ions.	**Year 13. Acid, bases and buffers**	Year 13: Organic Analysis	

Science Curriculum Map

Year 13 Chemistry

Unit	Rates and Equilibrium	Thermodynamics	Amines and Polymers	Organic Synthesis	NMR and Chromatography
Key Concepts	Behaviour of materials	Particles	Behaviour of materials	Behaviour of materials	Behaviour of materials
Prior Learning	**Year 12: Energetics and kinetics** Be able to analyse Maxwell-Boltzmann distribution curves to predict the effect of changing temperature / adding a catalyst has on the fraction of reactant molecules that have enough energy to react. Explain what is happening in a reversible reaction at equilibrium Use Le Chatelier's principle to predict qualitatively the effect of changes in temperature, pressure and concentration on the position of equilibrium Explain why, for a reversible reaction used in an industrial process, a compromise temperature and pressure may be used Construct an expression for K_c for a homogeneous system in equilibrium (using [X] for a species X of mol dm^{-3} concentration) Calculate a value for K_c from the equilibrium concentrations for a homogeneous system at constant temperature Perform calculations involving K_c and predict the qualitative effects of changes of temperature on the value of K_c	**Year 12 Energetics and kinetics** **Substantive** Define enthalpy change (ΔH), standard enthalpy change of combustion (Δ_cH^θ) and standard enthalpy change of formation (Δ_fH^θ) Use the equation q=mcΔT to calculate the molar enthalpy change Use Hess's law to perform calculations, including calculation of enthalpy changes for reactions from enthalpies of combustion or from enthalpies of formation Define the term mean bond enthalpy and use it to calculate an approximate value of ΔH for reactions in the gaseous state Define the term activation energy and explain why most collisions do not lead to a reaction Draw and explain Maxwell-Boltzmann distribution curves for different temperatures. Explain how a change in concentration or a change in pressure influences the rate of a reaction. Define the term catalyst and explain how they work **Disciplinary** Use knowledge of Hess' cycles to calculate enthalpy changes for unknown reactions. Use collision theory and/or Maxwell distribution curves to explain how changes in conditions affect reactions rates.	**Year 12: Alkenes, alcohols, and organic analysis** Describe the uses of different polymers Explain the difference between high and low density polythene Describe the issues associated with polymers Identify monomers from polymers Draw polymers from monomers **Year 13: Acids and bases** Recall the Bronsted-Lowry definitions of an acid and base and describe what happens in their reactions. State the expression for the ionic product of water K_w. Define pH and use it to find the concentration of $H^+_{(aq)}$ and $OH^-_{(aq)}$.	Year 12: Unit 6 – Introduction to Organic Chemistry, Alkanes and Haloalkanes. Unit 7 – Alkenes, Alcohols and Organic Analysis Unit 14 – Further Organic Chemistry Unit 15 – Aromatic Chemistry Unit 16 – Polymers All content from Organic units needs to be known focussing especially on mechanisms, conditions and reagents required.	**Year 11 Chemical analysis** **Substantive knowledge** Explain how paper chromatography separates mixtures. Suggest how chromatographic methods can be used for distinguishing pure substances from impure substances **Disciplinary knowledge** Interpret chromatograms and determine Rf values from chromatograms.
Key Knowledge	**Substantive** Define the rate of a reaction, the expressions order of a reaction of reaction, overall order of reaction, the expression rate equation and rate constant of a rate equation. Describe how the order of a reaction with respect to a reagent is found experimentally Describe how changes in concentration and temperature affects the value of the rate constant. Be able to describe the connection between the rate equation and the rate determining step. Be able to derive partial pressures from mole fractions and total pressure. Know that the equilibrium constant, k_p, is deduced from the equation for a reversible reaction occurring in the gas phase. Understand that, whilst a catalyst can affect the rate of attainment on an equilibrium, it does not affect the value of the equilibrium constant. **Disciplinary** Be able to perform calculation involving, K_p. Predict the qualitative effects of changes in temperature and pressure on the position of equilibrium Predict the qualitative effects if changes in temperature on the value of K_p. Be able to construct an expression for K_p for a homogeneous system in equilibrium.	**Substantive** Define enthalpy changes that are relevant to the formation of ionic compounds. Complete and describe Born-Haber cycles to predict enthalpy changes for the formation of theoretical compounds. Describe how to find the enthalpy of hydration. Describe the evidence that theoretical calculations for lattice enthalpies provide about bonding. Explain why endothermic/exothermic reactions occur. Explain how temperature changes affects feasibility using ΔG=ΔH-TΔS. Understand how the above equation can be used to perform calculations using straight line graphs. Disciplinary Use temperature changes affects feasibility using ΔG=ΔH-TΔS. Use the above equation can be used to perform calculations using straight line graphs. Comment on experimental design and evaluate scientific methods Present data about Gibbs Free energy in appropriate ways to work out missing quantities. Evaluate results and draw conclusions with reference to measurement uncertainties and errors Identify variables including those that must be controlled	**Substantive** Draw the repeating units of condensation polymers. Describe the properties of different condensation polymers Describe the structure of amino acids and proteins. Describe the structure of DNA **Disciplinary** Explain the link between the structure of the polymers and their properties. Understand the principle of a drug acting as an enzyme inhibitor. Explain why such drugs can have adverse effects. Understand the cost/ benefit implications of such drugs.	**Substantive knowledge** Explain why chemists aim to design production methods with fewer steps with a high percentage atom economy **Disciplinary knowledge** Explain why chemists aim to design processes that do not require a solvent and that use non-hazardous starting materials Devise a synthesis, with up to four steps, for an organic compound	**Substantive knowledge** Explain why TMS is a suitable standard Describe what the chemical shift, integration and splitting of a peak in a NMR spectrum tells us about the molecule. Describe TLC, CC and GC. Explain how chromatography separates substances **Disciplinary knowledge** Use NMR spectra and data booklet to suggest possible structures or part structures for molecules Use the n+1 rule to deduce the spin-spin splitting patterns of adjacent, non-equivalent protons (Aliphatic compounds) Compare retention times and Rf values with standards to identify different substances
Next Steps		Year 13: Rates and equilibrium Kp	Year 13: Organic synthesis	Year 13: NMR and Chromatography	

Science Curriculum Map

Year 7 Physics	Unit	Voltage Resistance and Current	Contact Forces and Speed	Energy Costs and Transfers	Sound and Light
	Key Concepts	**Energy**	Forces	Energy	Energy
	Prior Learning	**Year 6 Electricity** Name and recognise the symbols for simple circuit components An electrical current is the overall movement of charged particles in one direction To obtain an electrical current, there needs to be a continuous circuit from one terminal of a battery to the other. Give reasons for variations in how components function e.g. brightness of bulbs, position of switches	**Year 5: Forces** Identify effects of air resistance, water resistance and friction on moving objects. Recognise that forces act between objects that are touching and some act between objects at a distance. Understand that due to gravity unsupported objects will fall towards the Earth.	**Year 4: Electricity** Understand the importance of using renewable forms of energy in today's world **Year 5: properties and changes of materials** Name some materials that are thermal conductors	**Year 4: Sound** Know that sound is made when something vibrates Understand that pitch is how high or low the sound is Know that volume is how quiet or loud the sound is Sound travels in sound waves **Year 6: Light** Recognise that light appears to travel in straight lines Explain that we see things because light travels from light sources to our eyes White light is visible light made up of the colours of the spectrum Light travels in waves is required to see objects and that it can be reflected. Know that light from the sun can be dangerous and that shadows are formed when the path of light is blocked.
	Key Knowledge	**Substantive** Draw circuit diagrams and recognise how the current and potential difference can vary in different circuits. Compare the use of different components and different designs of circuits. **Disciplinary** Build circuits to be able to measure the current and potential difference at different places in a circuit. Identify and draw common circuit components. Calculate resistance using R = V ÷ I	**Substantive** Describe how different forces act on different objects. Describe what happens when forces are balanced and unbalanced. Calculate the speed and acceleration of an object. Explain how forces can combine and affect the motion of an object. Determine the resultant force acting on an object **Disciplinary** Illustrate a journey with changing speed on a distance-time graph, and label changes in motion.	**Substantive** Describe different types of energy transfer. Differentiate renewable and non-renewable energy resources. Understand the concept of conservation of energy in a closed system **Disciplinary** Compare reliability, sustainability and environmental impact of different energy resources. Calculate the energy in different foods from practical data. Calculate energy and power in different scenarios. Draw and interpret Sankey diagrams.	**Substantive** Explain that sound is caused by the vibration of objects. Explain how sound is transferred through materials. Describe the differences between transverse and longitudinal waves. Understand that waves can reflect and refract. **Disciplinary** Use the results of experiments to describe the behaviour of light
	Next Steps	Year 8 Electromagnets and magnetism Year 10 Electricity	Year 8: Pressure and Gravity, Magnets and electromagnets	Year 8: work and heating	Year 8: Waves

Science Curriculum Map

Year 8 Physics	Unit	**Pressure and Gravity**	**Electromagnets and Magnetism**	**Work and Heating and Cooling**	**Wave Effects and Properties**
	Key Concepts	Forces	Forces	Energy	Energy
	Prior Learning	**Year 5 Forces** Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the falling object and the Earth. **Year 7 Particles and Separating Mixtures** Describe what causes pressure Explain how pressure can be changed.	**Year 3: Forces and magnets** Know that magnetic forces act at a distance Know that magnets attract and repel each other Understand that magnets attract some materials, but not others Realise are always metal, but not all metals are magnetic Describe how magnets have two poles	**Year 7: Energy Costs and Transfers** **Year 7: Particles and Separating Mixtures** Describe different types of energy transfer.	**Year 7: Sound and light** Explain that sound is caused by the vibration of objects. Explain how sound is transferred through materials. Describe the differences between transverse and longitudinal waves. Understand that waves can reflect and refract.
	Key Knowledge	**Substantive** Explain the pressure in a fluid (gas or liquid) due to particles. Explain floating and sinking in terms of upthrust. Explain the difference between weight and mass. Explain the effects of gravity as a force between different bodies of mass. **Disciplinary** Calculate pressure using: pressure = force / area Calculate weight in terms of mass and gravity. Investigate the change in pressure of a fluid with depth. Investigate the effect of gravity on mass (on Earth).	**Substantive** Describe and explain magnetic properties and magnetic field lines. Describe and explain how electromagnets work. Describe the attractive/repulsive forces caused by magnets. Explain the effects of the Earth's magnetic field. **Disciplinary** Plot field lines using a plotting compass Investigate the factors that affect the strength of an electromagnet.	**Substantive** Describe the difference between temperature and heat. Describe and explain the way that heat energy can be transferred through conduction, convection, and infrared radiation. **Disciplinary** Use a thermometer to take accurate measurements of temperature. Critique the design of a thermal flask and suggest improvements.	**Substantive** Describe the properties of transverse and longitudinal waves. Explain how the human body interprets waves and how it can be damaged. Describe how varying wavelength will affect pitch or colour of a transmitted sound or light waves respectively. **Disciplinary** Interpret the reading from an oscilloscope screen. Take measurements of wavelength and amplitude from a waveform. Use a ripple tank to produce and observe the behaviour of simple waves.
	Next Steps	Year 10: Forces	Year 11: Magnetism and electromagnetism	Year 9: Energy	Year 11: Waves

Science Curriculum Map

Year 9 Physics	Unit	**Energy**	**Particle Model of Matter**	**Space**
	Key Concepts	Energy	Particles	Universe
	Prior Learning	**Year 8: Work and heating** Calculate work done when a force moves an object State that energy cannot be created or destroyed. Describe different types of energy transfer. Describe how heat energy can be transferred by conduction and radiation.	**Year 7: Particles and separating mixtures** Describe the arrangement and movement of particles in solids, liquids and gases and how they change with changes in energy. Explain the properties and how to classify substances which behave unusually as solids, liquids or gases.	**Year 7: Earth and the universe** Describe the structure of the Earth, Solar System and Universe. Describe how the Earth, Solar System and Universe are linked. Explain how the properties and features of planets are linked to their place in the Solar System.
	Key Knowledge	**Substantive** Identify and describe the 9 key energy stores. Explain how energy is always conserved. Describe how energy is useful or wasted/dissipated to the surroundings. Describe and explain heat energy transfer by conduction. Describe and explain heat energy transfer by infrared radiation. Describe and calculate specific heat capacity. Identify and explain measures to reduce heat energy loss from a home. Describe and compare different energy resources. Explain current energy issues in terms of sustainability and the environment. **Disciplinary** Follow a method to measure specific heat capacity of different materials. Calculate work done, power and efficiency	**Substantive** Explain changes of state with respect to energy changes. Describe internal energy of substances as KE+PE. Apply the latent heat and specific heat capacity equations. Explain Brownian motion. Explain the relationship between gas pressure and temperature for a fixed volume. Explain gas pressure in terms of particle movement. Explain pressure in a liquid and how it varies with depth. **Disciplinary** Use the appropriate apparatus to calculate the densities of various regular & irregular shaped solids and of liquids. Measuring and explaining rates of cooling and freezing wrt internal energy changes.	**Substantive** Describe how the solar system was formed Recall the life cycle of a star sequence and how energy is released in a star. Describe the forces that form a pro-star/ nebula Describe what happens after a supernova Describe the forces that keep a satellite in orbit Explain why the sun is stable and why stars become unstable Explain red shift and the Doppler effect Explain why people think the universe is expanding Explain why an orbiting object must move at a specific speed to stay in orbit **Disciplinary** Analyse data to estimate the age of the universe Plot the lifetime of a star on a diagram
	Next Steps	Year 12: Work, energy and power	Year 13: Thermal Physics	Year 13: astrophysics and cosmology

Science Curriculum Map

Year 10 & 11 Physics

Unit	Atomic Structure	Electricity	Forces	Magnetism and Electromagnetism	Waves
Key Concepts	Particles	Energy	Forces	Forces	Energy
Prior Learning	**Year 9: Atomic Structure (Chemistry)** Identify models of the atom and compare the differences between them. Describe atoms using the atomic model including the subatomic particles.	**Year 7: Voltage, resistance and current** Identify and draw common circuit components. Draw circuit diagrams Recognise how the current and potential difference can vary in different circuits. State the difference between series and parallel circuits Compare the use of different components and different designs of circuits. Explain what happens to bulbs in series and parallel circuits when they are switched on/off Calculate resistance using R = V ÷ I	**Year 8: Pressure and gravity** Calculate pressure using pressure = force / area Calculate weight in terms of mass and gravity. Investigate the change in pressure of a fluid with depth. Investigate the effect of gravity on mass (on Earth).	**Year 8: Electromagnets and magnets** Describe and explain magnetic properties and magnetic field lines. Describe and explain how electromagnets work. Describe the attractive/repulsive forces caused by magnets. Explain the effects of the Earth's magnetic field.	**Year 8: Waves and their properties** Describe the properties of transverse and longitudinal waves. Explain how the human body interprets waves and how it can be damaged. Describe how varying wavelength will affect pitch or colour of a transmitted sound or light waves respectively. Take measurements of wavelength and amplitude from a waveform.
Key Knowledge	**Substantive** Describe the evolution of the atomic model, including the observations made during Rutherford's alpha scattering experiment. Describe alpha, beta and gamma decay using nuclear equations. Recall the penetration/uses of alpha, beta and gamma radiation. **Disciplinary** Describe the necessary precautions for the safe handling of radioactive samples. Compare nuclear fusion and nuclear fission. Calculate the half-life using a decay curve.	**Substantive** Describe electrostatic charge as an exchange of electrons. (Triple Only) Describe how like and unlike charges interact. (Physics Only) Explain electric current as a flow of negative charge (electrons). Explain potential difference in terms of energy transfers. Explain resistance. Identify/describe ohmic and non-ohmic conductors (including graphs). Describe and explain series and parallel circuits in terms of current, potential difference and resistance. Explain the difference between direct and alternating current. Describe a domestic mains circuit and the role of the National Grid. Recall and apply power, energy and charge related electrical equations. Explain the energy transfer by charge in an electrical circuit. Calculate and compare the efficiency of electrical devices. Understand how plugs are wired **Disciplinary** Investigate electrostatic charge and its effects. (Physics Only) Use ammeters and voltmeters to measure/investigate current and potential difference. Use equation to calculate resistance Plot graphs of voltage and current for different components	**Substantive** Describe forces and produce force diagrams for given situations. Recall and apply Newton's laws of motion. Calculate the resultant force from a force diagram. Explain and determine the position of the centre of mass of an object and its effect on stability. Apply the principle of moments. RP Hooke's law RP Investigating force and acceleration **Disciplinary** Determine the position of centre of mass for a 2-D irregular shape. Balancing moments using a ruler and hanging masses. Determine the resultant force using a parallelogram of forces.	**Substantive** Draw the magnetic field pattern around a pair of bar magnets. Draw the magnetic field pattern around a wire carrying a current Describe how to change the direction of the force on a wire in a magnetic field using Flemings left hand rule Describe the generator effect and explain how potential difference is induced in a wire. (Physics Only) Describe how a simple ac generator is constructed. (Physics Only) **Disciplinary** Determine the direction of the field lines around a current carrying wire. Calculate the force on a current-carrying wire F=BIl Describe how a split ring commutator can be used to make a dc generator/ dynamo . (Physics Only) Describe how transformers work with ac current . (Physics Only) Explain why a step-up and a step-down transformer may be used. (Physics Only) Use the transformer equation. (Physics Only)	**Substantive** Label the parts of a wave. Identify and describe longitudinal and transverse waves. Make calculations of wavelength, speed and frequency. Recall the EM spectrum and state their common uses. Differentiate between reflection, absorption, transmission and dispersion of EM waves. **Disciplinary** Use simple equipment to demonstrate features of longitudinal and transverse waves. Take measurements of waves in a ripple tank. Investigate how the properties of a surface affect its absorption and emission of IR radiation. Investigate the reflection and refraction of light waves.
Next Steps	Year 12: Particles	Year 12 Electricity	Year 12: Mechanics	Year 13 Fields (electric fields and magnetic fields)	Year 12: Waves

Science Curriculum Map

	Unit	Particles and radiation	Mechanics and materials	Electricity	Waves	Further mechanics & Thermal Physics
Year 12 Physics	Key Concepts	Particles	Forces	Electricity	Energy	Forces
	Prior Learning	**Year 10: Atomic structure** Describe the evolution of the atomic model, including timeline and key experimental discoveries. Describe alpha, beta and gamma decay using nuclear equations. Recall the penetration and uses of alpha, beta and gamma radiation. Describe properties and behaviour of light waves.	**Year 10: Forces** Define speed and velocity and calculate them using the correct equations. Define acceleration and calculate it using the correct equations. State and apply Newton's three laws of motion. Define gravitational field strength. Explain and calculate work done and energy transferred by a force moving an object. Define and calculate power as the rate of energy transfer. Understand that energy in a closed system is conserved. Define and calculate spring constant	**Year 10: Electricity** Describe an electric current as a flow of charge around a circuit due to the movement of electrons around the circuit. Measure electrical current in amperes and potential difference in volts using the correct apparatus. Describe the rules for current and potential difference in both series and parallel circuits. Describe the rules for current and resistance for resistors in series and parallel.	**Year 11: Waves** Identify and describe longitudinal and transverse waves and label the parts of a wave. Make calculations of wavelength, speed and frequency. Differentiate between reflection, absorption, transmission and dispersion of EM waves.	**Year 9: Energy** Define and calculate specific heat capacity Explain different ways heat can be transferred **Year 9: Particle model** Explain how gas pressure is caused and the factors such as temperature and volume affect it **Year 12: Mechanics** Use suvat equations to predict motions of objects Calculate resultant forces and use Newton's laws
	Key Knowledge	**Substantive** Describe the constituents of an atom. Describe what happens when an unstable nucleus undergoes alpha or beta (+/-) decay. Explain particle interactions wrt the 4 fundamental forces. Explain the photoelectric effect wrt the photon model. Describe/explain the classification and properties of particles wrt the Standard Model. Describe/explain absorption and emission line spectra. **Disciplinary** Represent particle interactions using Feynman diagrams. Calculate the energy of a photon.	**Substantive** Explain how vectors can be added and resolved. Explain the parallelogram of forces and why the direction of a force acting on an object must be considered. Describe the conditions necessary for a force to produce a turning effect and how this can be balanced. Explain the importance of the centre of mass of an object. Use moments to calculate the support force exerted on a body in equilibrium and explain what is meant by a couple. Explain stable and unstable equilibrium and assess when a tilted object will topple over. Explain why a vehicle with a lower centre of mass will be more stable. Explain the conditions which must be met for a body to be in equilibrium. Calculate the displacement of an object moving with uniform acceleration. Use distance and velocity-time graphs to calculate velocity and acceleration of moving objects. Use SUVAT equations to calculate displacement, velocity and acceleration. Describe the motion of projectiles. Explain what determines the terminal speed of falling objects. Describe braking and stopping distances of a moving vehicle and calculate impact forces in the event of a collision. Calculate the momentum of a moving object and the impulse or impact force causing an acceleration. Explain the conservation of momentum in a closed system. Describe the energy changes in collisions and explosions. Describe the energy changes of a moving object. Describe and calculate power and efficiency and discuss whether a device can be 100% efficient. Calculate the energy stored in a stretched spring. Explain Young's modulus, stress and strain, and what happens when a material is stretched beyond its elastic limit. **Disciplinary** Determine the acceleration due to gravity of an object in freefall. Investigate the factors that determine the motion of an object through a fluid. Investigate the efficiency of a motor used to raise a mass through a measured height. Measure the density of an object. Determine the Young's Modulus of a material.	**Substantive** Define charge carriers and calculate the charge flow in a circuit. Define potential difference, calculate electrical power and describe how energy transfers take place in electrical devices. Describe what causes electrical resistance and discuss when Ohm's law can be used. Explain what a superconductor is. Describe how the current through a filament lamp, a diode and a resistor varies with potential difference. State the principles behind the rules for series and parallel circuits and describe how these rules are used in circuits. Calculate resistances in series and parallel and so the current and pds for each component in a circuit. Explain the difference between the pd and emf of a battery and describe how much power is wasted in a battery. Describe a potential divider and explain how this can be used to design sensor circuits. **Disciplinary** Construct electric circuits using a range of components and measure currents and potential differences in these circuits. Investigate the current/resistance characteristics of a range of components. Determine the electrical resistivity of a wire. Design and construct potential divider circuits to achieve various outcomes and investigate the behaviour of these circuits. Measure the internal resistance of a battery.	**<u>Substantive</u>** State and use the principle of superposition of waves and describe the formation of stationary waves. Identify the position of nodes and antinodes. Describe the diffraction patterns of a single slit, double slit and diffraction grating using both experimental observation and mathematical formula. Calculate the refractive index of a material and the critical angle of total internal reflection. **<u>Disciplinary</u>** Explore how frequency of stationary waves is affected by altering length, mass and tension of a string. Take experimental measurements to calculate the refractive index of a material. Use laser light to produce interference patterns for single slit, double slit and diffraction gratings.	**<u>Substantive</u>** Use angular speed and radians to describe mathematically the motion of a body in a circular path. Use equations to calculate the centripetal force. Describe graphically and using mathematics the movement of a body in simple harmonic motion. Define the internal energy within a body. Calculate specific heat capacity and specific latent heat. Use the gas laws to describe the behaviour of an ideal gas. Describe the molecular kinetic theory model. **<u>Disciplinary</u>** Investigate the simple harmonic motion of both a mass spring system, and a simple pendulum. Investigate Boyle's and Charles Law for a gas. Investigate the specific heat capacity of different substances.
	Next Steps	Year 13: Nuclear physics	Year 13: Further Mechanics	Year 13: Fields and their consequences		

Science Curriculum Map

Year 13 Physics	Unit	Nuclear Physics	Fields and their consequences	Astrophysics
	Key Concepts	Particles	Electricity Forces	Universe
	Prior Learning	**Year 12: Particles and radiation** Categorise the subatomic particles into hadrons and leptons Explain quark composition of hadrons Describe changes in the nucleus during alpha, beta and gamma decay	**Year 10: Forces** Describe what is meant by a gravitational and an electrostatic field. Describe the magnetic field patterns generated by bar magnets and electric currents (Fleming's LHR). Describe electromagnetic induction – including the generator effect and transformers.	**Year 9: Space** Life history of a star, red shift, big bang and structure of the solar system and universe
	Key Knowledge	**Disciplinary** Describe how the nucleus of the atom was discovered Distinguish in terms of ionisation and penetration the dangers of the different types of radiation Describe how dense a nucleus is and why density is not affected by nuclear radius **Substantive** Explain how to represent the change in a nucleus when it emits the different types of radiation. Define exponential decay and why $I = I_0e^{-\lambda t}$ Explain the position of different emitters on an NZ graph Explain $E=mc^2$ Explain why small nuclei can't be split and large nuclei can't be fused	**Substantive** Describe/explain a gravitational field between point masses with relation to forces, potential and field lines. Apply gravitational forces to planetary/satellite orbits. Define/explain electrostatic charge. Describe/explain an electrostatic field between point charges with relation to forces, potential and field lines. Describe/explain the charge and discharge of a capacitor. Define/explain magnetic flux, flux density and flux linkage. Describe motion of charged particles in a magnetic field. Describe/explain how electromagnetic induction generates an electric current. **Disciplinary** Investigate charge/discharge of a capacitor. Investigate how the force on a wire varies with magnetic flux density, current and length of wire. Investigate the effect on magnetic flux linkage of varying the angle between a search coil and the magnetic field. Calculate the time periods of satellites in orbit. Calculate energy needed to launch a satellite.	**Substantive** Describe the life cycle of a star Explain the links between colour and temperature of a star Define absolute and apparent magnitude Describe the structure of reflecting, refracting and non-optical telescopes Describe astronomical objects: neutron stars, quasars, black holes and supernovae Explain how evidence points to the big bang being the birth of the universe **Disciplinary** Use doppler equations to calculate the recessive speed of a galaxy Use Hubble's law to estimate the age of the universe Calculate the distance to stars using trigonometric parallax and spectral class parallax Calculate the apparent and absolute magnitude of stars using the Hipparcus scale and associated equation
	Next Steps			