MacIntyre Academies

Quest Academy

Whole School Long Term Science Plans 2022 – 2023

KS2						
	Autumn 1	**Autumn 2**	**Spring 1**	**Spring 2**	**Summer 1**	**Summer 2**
	7 weeks	**8 weeks**	**7 weeks**	**6 weeks**	**6 weeks**	**8 weeks**
FLORENCE NIGHTINGALE & ALBERT EINSTEIN	***Overview:***	***TOPIC COVERAGE:***			***Objectives:***	

A high-quality science education provides the foundations for understanding the world through the specific disciplines of biology, chemistry and physics. Science has changed our lives and is vital to the world's future prosperity, and all learners should be taught essential aspects of the knowledge, methods, processes and uses of science. Through building up a body of key foundational knowledge and concepts, pupils should be encouraged to recognise the power of rational explanation and develop a sense of excitement and curiosity about natural phenomena. Learners should be encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes.

The curriculum for Science aims to ensure that all learners:

- develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics
- develop understanding of the nature,

Autumn

Autumn 1

EARTH & SPACE:

1. Spherical Bodies
2. The Planets
3. Geocentric vs Heliocentric Model
4. Night and Day
5. Movement of the Moon

LIVING THINGS & THEIR HABITATS:

1. Grouping Living Things
2. Classifying Vertebrates
3. Classification Keys
4. Classifying Conundrums
5. Curious Creatures
6. Environmental Changes

Autumn 2

FORCES:

1. Forces & Magnets
2. Air Resistance
3. Gravity
4. Water Resistance
5. Friction
6. Simple Machines

FORCES & Magnets:

1. Pushes and Pulls
2. Faster and Slower
3. Scrapyard Challenge
4. Magnet Strength
5. Magnetic Poles
6. Marvellous Magnets

Spring

Spring 1

LIFE CYCLES:

1. Flowers
2. Life Cycle of Plants
3. Sexual and Asexual Reproduction I
4. Sexual and Asexual Reproduction II
5. Metamorphosis
6. Comparing Life Cycles I
7. Comparing Life Cycles II
8. Comparing Life Cycles III
9. Comparing Life Cycles IV

PLANTS:

1. Parts of Plants
2. What Do Plants Need I
3. What Do Plants Need II
4. Moving Water
5. Fantastic Flowers

Spring 2

HUMAN LIFE CYCLE:

1. The Human Timeline
2. Puberty
3. Changes in Old Age
4. Gestation

TYPES OF NUTRITION & THE SKELETAL SYSTEM:

1. Types of Nutrition
2. Amount of Nutrition
3. Types of Skeleton
4. Naming Bones
5. Functions of a Skeleton
6. Mighty Muscles

Autumn

EARTH & SPACE:

- I understand how we know the Sun, Earth and the Moon are spherical
- I can recall the order of the planets
- I can explain why models of the Solar System changed over time
- I can explain why we experience night and day on Earth
- I can describe the movement of the moon relative to the Earth, and the movement of the Earth relative to the Sun

LIVING THINGS & THEIR HABITATS:

- I can identify the key life processes carried out by all living things
- I can group living things using Venn and Carroll diagrams
- I can identify characteristics of living things
- I can use classification keys to help group, identify and name a variety of living things
- I can given reasons for classifying living things based on specific characteristics
- I know that environments can change and that this can sometimes cause dangers to living things
- I can identify the key roles in a food chain
- I understand food chains and food webs

FORCES:

- I can use my knowledge about magnetic poles, attraction and repulsion
- I can describe the effects of air resistance
- I can describe the effects of gravity
- I can describe the effects of water resistance
- I can use my knowledge to reduce the effects of resistive forces
- I can identify levers, pulleys and gears in simple machines
- I understand that levers, pulleys and gears can multiply the force on an object

<table>
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<td></td>
<td>processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them
• are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future</td>
<td colspan="2">6. Life Cycles</td>
<td rowspan="3">FORCES & MAGNETS:
• I understand that a force is a push or pull on an object
• I understand that surfaces cause different amounts of friction
• I can identify magnetic materials
• I can test the strength of magnets
• I know that magnets have two poles
• I know whether two magnets will attract or repel, depending on which poles are facing
• I can use and apply my knowledge of magnets

Spring

LIFE CYCLES:
• I can describe how flowers are pollinated
• I understand the differences between sexual and asexual reproduction
• I can describe the advantages and disadvantages of sexual and asexual reproduction
• I can describe the similarities and differences between the life cycles of mammals, amphibians, insects and birds

PLANTS:
• I can identify the parts of a plant
• I understand what plants need in order to survive
• I can investigate what plants need in order to survive
• I understand how plants transport water
• I can identify the parts of a flower
• I can describe the life cycle of a flowering plant

HUMAN LIFE CYCLE:
• I can order the stages of the human life cycle
• I can identify the changes which take place during puberty
• I can identify the changes which take place as a person gets older
• I can compare the gestation periods of different animals

TYPES OF NUTRITION & THE SKELETAL SYSTEM:
• I can name the nutrients which are needed as part of a balanced diet
• I understand the function of the different nutrients in a balanced diet</td>
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<td>PROPERTIES OF MATERIALS:
1. Properties of Materials
2. Keeping Cool
3. Brighter Bulbs
4. Dissolving
5. Separating Mixtures
6. Irreversible Changes

STATES OF MATTER:
1. States of Matter
2. Investigating Gases
3. Heating and Cooling
4. Wonderful Water
5. Evaporation Investigation
6. The Water Cycle</td>
<td>SEPARATING MIXTURES:
1. Solids, Liquids & Gases
2. Particle Model
3. Dissolving
4. Separating Mixtures I
5. Separating Mixtures II
6. Chromatography

SOUND:
1. Introduction to Sound
2. Hearing Sound
3. Higher and Lower
4. String Telephones
5. Sound Waves
6. The Ear</td>
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				• I understand the proportion of nutrients in a balanced diet • I understand that there are different types of skeletons • I can name some key bones in the skeleton • I can describe the functions of a skeleton • I understand the importance of muscles in movement ***Summer*** PROPERTIES OF MATERIALS: • I can use key terminology to describe the properties of different materials • I can test the properties of different materials • I can sort materials in to thermal conductors and thermal insulators • I can identify electrical conductors and electrical insulators • I can identify soluble and insoluble materials • I can identify the most appropriate technique to separate a variety of mixtures • I can identify reactions as reversible or irreversible STATES OF MATTER & SEPARATING MIXTURES: • I can identify solids, liquids and gases • I can investigate the properties of gases • I can describe changes of state • I can describe the different stages of the water cycle SOUND: • I understand that sounds are caused by vibrations • I can describe the volume of different sounds • I can describe how sound travels so that we can hear • I can describe the pitch of different sounds • I can use my knowledge of how sound travels to explain how string telephones work • I can describe characteristics of sound waves • I can describe the structure and function of the human ear

KS2						
	Autumn 1	**Autumn 2**	**Spring 1**	**Spring 2**	**Summer 1**	**Summer 2**
	7 weeks	**8 weeks**	**7 weeks**	**6 weeks**	**6 weeks**	**8 weeks**
ROSA PARKS & HELEN KELLER	***Overview:***	***TOPIC COVERAGE:***			***Objectives:***	

A high-quality science education provides the foundations for understanding the world through the specific disciplines of biology, chemistry and physics. Science has changed our lives and is vital to the world's future prosperity, and all learners should be taught essential aspects of the knowledge, methods, processes and uses of science. Through building up a body of key foundational knowledge and concepts, pupils should be encouraged to recognise the power of rational explanation and develop a sense of excitement and curiosity about natural phenomena. Learners should be encouraged to understand how science can be used to explain what is occurring, predict how things will behave, and analyse causes.

The curriculum for Science aims to ensure that all learners:

- develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics
- develop understanding of the nature, processes and

Autumn

Autumn 1

INHERITANCE & EVOLUTION:

6. Inheritance
7. Adaptation
8. Theories of Evolution
9. Evidence for Evolution I
10. Evidence for Evolution II
11. Adaptation, Evolution & Human Intervention

Autumn 2

ELECTRICITY:

7. Introduction to Circuits
8. Measuring Voltage
9. Series Circuits
10. Parallel Circuits
11. Resistance
12. Magnets
13. Static Electricity

Spring

Spring 1

CLASSIFICATION:

10. Grouping Living Things
11. Classification Keys
12. Classifying Vertebrates
13. Invertebrate Hunt
14. Food Chains
15. Predator vs Prey Relationships
16. Poison in Food Chains

Spring 2

THE CIRCULATORY SYSTEM:

5. The Circulatory System
6. Functions of the Circulatory System
7. The Lungs
8. The Heart & Circulation
9. The Effects of Exercise
10. The Effects of Smoking and Alcohol

Summer

Summer 1

LIGHT:

7. Making Shadows
8. Changing Shadows
9. Reflecting Light
10. Refraction
11. Spectacular Spectrum
12. How We See

Summer 2

PROPERTIES OF MATERIALS:

7. Properties of Materials
8. Keeping Cool
9. Brighter Bulbs
10. Dissolving
11. Separating Mixtures
12. Irreversible Changes

Autumn

INHERITANCE & EVOLUTION:

- I understand that some of our characteristics are inherited from our parents
- I can identify inherited characteristics and characteristics which are caused by the environment
- I can explain how living things are adapted for the habitat in which they live
- I understand the idea that organisms have evolved over time
- I can give examples of evidence which support the theory of evolution
- I understand the impact that human influence can have on evolution

ELECTRICITY:

- I can describe how to stay safe around electricity
- I can identify different types of electrical appliance
- I can identify complete and incomplete circuits
- I understand the difference between a cell and a battery
- I can use basic circuit symbols
- I can make circuits from diagrams
- I can investigate whether a material conducts electricity
- I can make a circuit with a working switch
- I can use a voltmeter to measure voltage
- I can explain resistance in electrical circuits

Spring

CLASSIFICATION:

- I can identify the key life processes carried out by all living things
- I can group living things using Venn and Carroll diagrams
- I can identify characteristics of living things
- I can use classification keys to help group, identify and name a variety of living things

	methods of science through different types of science enquiries that help them to answer scientific questions about the world around them • are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future			• I can given reasons for classifying living things based on specific characteristics • I know that environments can change and that this can sometimes cause dangers to living things • I can identify the key roles in a food chain • I understand food chains and food webs THE CIRCULATORY SYSTEM: • I can identify the parts of the circulatory system • I can describe the function of key parts of the circulatory system • I can identify the key parts of the lungs • I can describe how the blood travels around the circulatory systems • I can explain the effects of exercise on the body • I can explain the effects of drugs and alcohol on the body ***Summer*** LIGHT: • I can identify sources of light • I can explain how shadows are formed • I can explain how shadows change when the distance between the light source and the object changes • I can explain how light reflects off objects • I can explain the refraction of light • I understand that light is made up of a spectrum of colours; red, orange, yellow, green, blue, indigo and violet • I can use my knowledge of light to describe how we see objects • I understand that shadows are made when light is blocked by an object • I understand that light from the sun can be dangerous and how we can take steps to protect ourselves • I can investigate the reflection of light using mirrors • I can investigate the reflective properties of materials • I understand that darkness is the absence of light PROPERTIES OF MATERIALS: • I can use key terminology to describe the properties of different materials • I can test the properties of different materials

				• I can sort materials in to thermal conductors and thermal insulators • I can identify electrical conductors and electrical insulators • I can identify soluble and insoluble materials • I can identify the most appropriate technique to separate a variety of mixtures • I can identify reactions as reversible or irreversible

KS3						
WILLIAM SHAKESPEARE, ARETHA FRANKLIN & WINSTON CHURCHILL	**Autumn 1**	**Autumn 2**	**Spring 1**	**Spring 2**	**Summer 1**	**Summer 2**
	7 weeks	**8 weeks**	**7 weeks**	**6 weeks**	**6 weeks**	**8 weeks**
	Overview:	***TOPIC COVERAGE:***			***Objectives:***	
	A high-quality science education provides the foundations for understanding the world through the specific disciplines of biology, chemistry and physics. Science has changed our lives and is vital to the world's future prosperity, and all learners should be taught essential aspects of the knowledge, methods, processes and uses of science. Through building up a body of key foundational knowledge and concepts, pupils should be encouraged to recognise the power of rational explanation and develop a sense of excitement and curiosity about natural phenomena. Learners should be encouraged to understand how science can be used	***Autumn***			***Autumn***	
		Autumn 1		***Autumn 2***	LAB SAFETY INTRODUCTION: • I can identify hazards in a Science lab • I can identify common hazard symbols • I can use a Bunsen Burner safely • I can use specialist lab equipment safely CELLS & ORGANISATION: • I can use a microscope appropriately • I can identify the main parts of a plant cell and describe their function • I can identify the main parts of an animal cell and describe their function • I can prepare a microscope slide for examination • I can give examples of specialised cells and describe how they are adapted to their function • I can identify the main parts of a bacterial cell and describe their function • I can put the hierarchical organisation of multicellular organisms in order • I can explain how muscles interact with different tissues in the body to cause movement	
		LAB SAFETY INTRODUCTION: 12. Lab Safety 13. Bunsen Burners 14. Flame Tests CELLS & ORGANISATION: 7. Microscopes 8. Animal Cells 9. Plant Cells 10. Investigating Cells 11. Specialised Cells 12. Bacterial Cells 13. Cell Organisation 14. Muscles 15. The Skeleton		STATES OF MATTER: 1. States of Matter 2. Particle Model 3. Changing State 4. Diffusion 5. Mixtures 6. Solubility 7. Filtration 8. Evaporation 9. Chromatography 10. Distillation ENERGY: 1. Energy Stores 2. Energy Efficiency & Calculations 3. Renewable & Non-Renewable Energy 4. Energy from Fuel 5. Temperatures and Heat Energy 6. Energy, Power & Domestic Bills		
		Spring				
		Spring 1		***Spring 2***		

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The curriculum for Science aims to ensure that all learners:
• develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics
• develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them
• are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future</td>
<td>REPRODUCTION:
17. Reproductive Systems
18. Puberty
19. The Menstrual Cycles
20. Sex Cells & Fertilisation
21. Development of a Baby
22. Contraception

ATOMS & THE PERIODIC TABLE:
7. Atoms & Elements
8. Compounds
9. The Periodic Table
10. Metals & Non-Metals
11. The Alkali Metals
12. The Halogens
13. The Nobel Gases</td>
<td>FORCES:
11. Contact & Non-Contact Forces
12. Measuring Forces
13. Gravity, Mass & Weight
14. Air Resistance
15. Friction
16. Reducing Drag
17. Hooke’s Law</td>
<td>• I understand the importance of the skeleton in the body and can name some key bones

STATES OF MATTER:
• I know that materials can be grouped together, according to whether they are solids, liquids and gases
• I can identify and explain the main features of the particles model
• I can describe changes of state in terms of particles
• I can use my knowledge of particles to describe diffusion
• I can identify mixtures and understand that techniques can be utilised to separate them
• I can use my knowledge of particles to describe mixtures and dissolving
• I understand how to use filtration as a separation technique
• I understand how to use evaporation as a separation technique
• I understand how to use chromatography as a separation technique
• I understand how to use distillation as a separation technique

ENERGY:
• I can identify different energy stores
• I can describe transfers of energy using given examples
• I can calculate the efficiency of an energy transfer
• I can identify renewable and non-renewable energy sources
• I can investigate the energy released from burning fuels
• I understand the difference between energy and temperature
• I understand the relationship between energy, power and running costs</td>
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REPRODUCTION:
• I can describe the structure and function of the male and female reproductive systems
• I understand the changes that the body goes through during puberty
• I understand the purpose of the menstrual cycle</td>
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<td>HEALTH & THE HUMAN BODY:
13. Gas Exchange
14. Movement of Substances
15. Breathing
16. The Digestive System
17. Healthy Diet
18. Healthy Lifestyle
19. Drugs
20. Alcohol

CHEMICAL REACTIONS:
7. Chemical Changes
8. Word Equations
9. Combustion
10. Thermal Decomposition
11. Conservation of Mass
12. Exothermic and Endothermic Reactions</td>
<td>ELECTRICITY:
13. Introduction to Circuits
14. Measuring Voltage
15. Series Circuits
16. Parallel Circuits
17. Resistance
18. Magnets
19. Electromagnets
20. Static Electricity</td>
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				• I understand the role of the sex cells in fertilisation • I understand the stages of development during a healthy pregnancy • I understand how different methods of contraception can be used to prevent pregnancy ATOMS & THE PERIODIC TABLE: • I understand the difference between atoms and elements • I can identify elements, mixtures and compounds • I can use the Periodic Table to find groups, periods, metals and non-metals • I can describe trends in Group 1 of the Periodic Table • I can describe trends in Group 7 of the Periodic Table • I can describe the properties of the Nobel Gases FORCES: • I can identify contact and non-contact forces • I can represent the magnitude and direction of forces using force diagrams • I understand the relationship between mass, gravitational field strength and weight • I can solve equations to work out weight = mass x gravitational field • I can investigate air resistance • I can explain the amount of friction caused by different surfaces • I can explain techniques to reduce resistive forces • I can explain Hooke's Law by describing how the force added to a spring affects its extension ***Summer*** HEALTH & THE HUMAN BODY: • I can identify the structure and functions of the gas exchange system in humans, including adaptations to function • I can describe the movement of substances in gas exchange • I can explain the mechanism of breathing to move air in and out of the lungs • I can identify the basic parts of the digestive system and describe their function • I can list the contents of a healthy human diet • I can describe the consequences of imbalances of imbalances in the diet

				• I understand the impact of drugs, exercise and lifestyle on my body CHEMICAL REACTIONS: • I can identify chemical and physical changes • I can write word equations for chemical reactions • I can describe complete and incomplete combustion • I can describe thermal decomposition reactions • I can use the law of conservation of mass to balance simple equations • I can identify endothermic and exothermic reactions ELECTRICITY: • I understand some of the reasons why circuits fail to work • I can identify key universal circuit symbols • I can use a voltmeter to measure voltage • I can identify differences between series and parallel circuits • I can explain resistance in electrical circuits • I can investigate patterns in magnetic fields • I can describe properties and uses of electromagnets • I can investigate and explain the effects of static electricity

KS4						
GEORGE ELIOT	**Autumn 1**	**Autumn 2**	**Spring 1**	**Spring 2**	**Summer 1**	**Summer 2**
	7 weeks	**8 weeks**	**7 weeks**	**6 weeks**	**6 weeks**	**8 weeks**
	Overview:	***TOPIC COVERAGE:***			***Objectives:***	
	GCSE study in the sciences provides the foundation for understanding the material world. Scientific understanding is changing our lives and is vital to the world's future prosperity. Learners will learn essential aspects of the knowledge, methods, processes and uses of	***Autumn***				
		Autumn 1		***Autumn 2***	***Autumn***	
		C1 – ATOMIC STRUCTURE: 1. Atoms 2. Investigating Masses in Reactions 3. Separating Mixtures 4. Fractional Distillation 5. History of the Atom 6. Structure of the Atom 7. Ions, Atoms & Isotopes 8. Electronic Structures		C2 – BONDING, STRUCTURE & THE PROPERTIES OF MATTER: 1. States of Matter 2. Atoms in to Ions 3. Giant Ionic Structure 4. Covalent Bonding 5. Structure of Simple Molecules 6. Giant Covalent Structures 7. Fullerenes and Graphenes 8. Bonding in Metals	C1 – ATOMIC STRUCTURE: • I know that all substances are made of atoms. • I know that an atom is the smallest part of an element that can exist. • I know that atoms of each element are represented by a chemical symbol • I know that elements are shown in the periodic table. • I understand that compounds are formed from elements by chemical reactions	

	science. They will gain appreciation of how the complex and diverse phenomena of the natural world can be described in terms of a small number of key ideas that relate to the sciences and that are both inter-linked and of universal application. Key ideas in Chemistry are as follows: matter is composed of tiny particles called atoms and there are about 100 different naturally occurring types of atoms called elements • elements show periodic relationships in their chemical and physical properties • these periodic properties can be explained in terms of the atomic structure of the elements • atoms bond by either transferring electrons from one atom to another or by sharing electrons • the shapes of molecules (groups of atoms bonded together) and the way giant structures are arranged is of great importance in terms of the way they behave • there are barriers to reaction so reactions occur at different rates • chemical reactions take place in only three different ways: 1. proton transfer 2. electron transfer 3. electron sharing	9. Trends in the Periodic Table 10. Transition Metals 11. History of the Periodic Table	9. Giant Metallic Structures 10. Nanoparticles 11. Applications of Nanoparticles	• I understand that compounds contain two or more elements chemically combined in fixed proportions and can be represented by formulae using the symbols of the atoms from which they were formed • I understand that compounds can only be separated into elements by chemical reactions. • I know that chemical reactions can be represented by word equations or equations using symbols and formulae. • I can use the names and symbols of the first 20 elements in the periodic table • I can use the names and symbols of the elements in Groups 1 and 7 • I can name compounds of these elements from given formulae or symbol equations • I can write word equations for a range of chemical reactions • I can write formulae and balanced chemical equations for the reactions in this specification. • (HT Only) I can write balanced half equations and ionic equations where appropriate. • I understand that a mixture consists of two or more elements or compounds not chemically combined together. • I know the chemical properties of each substance in a mixture are unchanged. • I can explain that mixtures can be separated by physical processes such as filtration, crystallisation, simple distillation, fractional distillation and chromatography. • I can suggest suitable separation and purification techniques for mixtures when given appropriate information. • I understand that new experimental evidence may lead to a scientific model being changed or replaced • I know that before the discovery of the electron, atoms were thought to be tiny spheres that could not be divided • I can explain the plum pudding model, suggesting that the atom is a ball of positive charge with negative electrons embedded in it. • I can explain why the new evidence from the scattering experiment led to a change in the atomic model • I understand the difference between the plum pudding model of the atom and the nuclear model of the atom.
		Spring		
		Spring 1	***Spring 2***	
		C3 – QUANTITATIVE CHEMISTRY: 1. Balancing Equations 2. Relative Formula Mass 3. Changes in Mass 4. Chemical Measurements 5. Moles 6. Amounts of Substances in Equations 7. Using Moles to Balance Equations 8. Limiting Reactants 9. Concentrations of Solutions 10. Percentage Yield and Atom Economy	C4 - CHEMICAL CHANGES: 1. The Reactivity Series 2. Displacement Reactions 3. Extracting Metals 4. Salts from Metals 5. Salts from Insoluble Bases 6. Making Soluble Salts 7. Neutralisation and the pH Scale 8. Strong and Weak Acids 9. Titrations 10. Electrolysis 11. Ionic and Half Equations 12. Electrolysis of Brine	
		Summer		
		Summer 1	***Summer 2***	
		C5 - ENERGY CHANGES: 1. Energy Changes 2. Reaction Profiles 3. Energy Change Calculations 4. Cells & Batteries 5. Fuel Cells REVISION OF TOPICS	EXAM PREPARATION & MOCK EXAM	

	• energy is conserved in chemical reactions so can therefore be neither created nor destroyed.			• I can describe the relative electrical charges of the particles in atoms • I know that in an atom, the number of electrons is equal to the number of protons in the nucleus. • I can identify the atomic number as number of protons in an atom of an element • I know that atoms of a particular element have the same number of protons • I know that atoms of different elements have different numbers of protons • I can use the nuclear model to describe atoms. • I can describe relative masses of protons, neutrons and electrons • I know that the sum of the protons and neutrons in an atom is its mass number. • I understand that atoms of the same element can have different numbers of neutrons; these atoms are called isotopes of that element. • I can calculate the numbers of protons, neutrons and electrons in an atom or ion, given its atomic number and mass number. • I can relate size and scale of atoms to objects in the physical world. • I can calculate the relative atomic mass of an element given the percentage abundance of its isotopes. • I know that the electrons in an atom occupy the lowest available energy levels (innermost available shells). • I can represent the electronic structure of an atom by numbers or by a diagram • I can represent the electronic structures of the first twenty elements of the periodic table in both forms. • I know that the elements in the periodic table are arranged in order of atomic (proton) number and so that elements with similar properties are in columns, known as groups. • I understand that elements in the same group in the periodic table have the same number of electrons in their outer shell (outer electrons) and this gives them similar chemical properties. • I can explain how the position of an element in the periodic table is related to the arrangement of electrons in its atoms and hence to its atomic number • I can predict possible reactions and probable reactivity of elements from their positions in the periodic table.

				• I know that before the discovery of protons, neutrons and electrons, scientists attempted to classify the elements by arranging them in order of their atomic weights. • I understand that the early periodic tables were incomplete and some elements were placed in inappropriate groups if the strict order of atomic weights was followed. • I understand that Mendeleev overcame some of the problems by leaving gaps for elements that he thought had not been discovered and, in some places, changed the order based on atomic weights. • I understand that elements with properties predicted by Mendeleev were discovered and filled the gaps • I can use my knowledge of isotopes made it possible to explain why the order based on atomic weights was not always correct. • I can explain how testing a prediction can support or refute a new scientific idea. • I know that metals react to form positive ions • I know that non-metals do not form positive ions in reactions. • I know that the majority of elements are metals. • I know that metals are found to the left and towards the bottom of the periodic table, whereas non-metals are found towards the right and top of the periodic table. • I can explain the differences between metals and non-metals on the basis of their characteristic physical and chemical properties. • I can explain how the reactions of elements are related to the arrangement of electrons in their atoms and hence to their atomic number. • I know the elements in Group 0 of the periodic table are called the noble gases. • I can explain that the group 0 elements are unreactive and do not easily form molecules because their atoms have stable arrangements of electrons. • I know that the noble gases have eight electrons in their outer shell, except for helium, which has only two electrons. • I can explain how properties of the elements in Group 0 depend on the outer shell of electrons of the atoms • I can predict properties from given trends down the group.

				• I know that the elements in Group 1 of the periodic table are known as the alkali metals and have characteristic properties because of the single electron in their outer shell. • I can describe the reactions of the first three alkali metals with oxygen, chlorine and water. • I can explain that in Group 1, the reactivity of the elements increases going down the group. • I can explain how properties of the elements in Group 1 depend on the outer shell of electrons of the atoms • I can predict properties from given trends down the group. • I know that the elements in Group 7 of the periodic table are known as the halogens and have similar reactions because they all have seven electrons in their outer shell. • I know that the halogens are non-metals and consist of molecules made of pairs of atoms. • I can describe the nature of the compounds formed when chlorine, bromine and iodine react with metals and non-metals • I know that in Group 7, the reactivity of the elements decreases going down the group. • I can explain that a more reactive halogen can displace a less reactive halogen from an aqueous solution of its salt. • I can explain how properties of the elements in Group 7 depend on the outer shell of electrons of the atoms" • I can predict properties from given trends down the group. • I know that the transition elements are metals with similar properties which are different from those of the elements in Group 1. • I can describe the difference compared with Group 1 in melting points, densities, strength, hardness and reactivity with oxygen, water and halogens. • I know that many transition elements have ions with different charges, form coloured compounds and are useful as catalysts. • I can exemplify the general properties of transition metals by reference to compounds of Cr, Mn, Fe, Co, Ni, Cu. C2 – BONDING, STRUCTURE & THE PROPERTIES OF MATTER: • I know that there are three types of strong chemical bonds: ionic, covalent and metallic.

				• I understand that in ionic bonding the particles are oppositely charged ions. • I understand that in covalent bonding the particles are atoms which share pairs of electrons. • I understand that in metallic bonding the particles are atoms which share delocalised electrons. • I can explain that ionic bonding occurs in compounds formed from metals combined with non-metals. • I can explain that covalent bonding occurs in most non-metallic elements and in compounds of non-metals. • I can explain that metallic bonding occurs in metallic elements and alloys. • I can explain chemical bonding in terms of electrostatic forces and the transfer or sharing of electrons. • I know that when a metal atom reacts with a non-metal atom, electrons in the outer shell of the metal atom are transferred. • I can show that ions produced by metals in Groups 1 and 2 and by non-metals in Groups 6 and 7 produce atoms with full outer shells • I can represent the electron transfer during the formation of an ionic compound by a dot and cross diagram • I can draw dot and cross diagrams for ionic compounds formed by metals in Groups 1 and 2 with non-metals in Groups 6 and 7. • I can work out the charge on the ions of metals and non-metals from the group number of the element, limited to the metals in Groups 1 and 2, and non-metals in Groups 6 and 7 • I know that Ionic compounds are held together by strong electrostatic forces of attraction between oppositely charged ions • I can deduce that a compound is ionic from a diagram of its structure in one of the specified forms • I can describe the limitations of using dot and cross, ball and stick, two and three-dimensional diagrams to represent a giant ionic structure • I can work out the empirical formula of an ionic compound from a given model or diagram that shows the ions in the structure. • I can identify the structure of sodium chloride • I know that when atoms share pairs of electrons they form strong covalent bonds. • I can identify common substances that consist of small molecules from their chemical formula.

				• I know identify some covalently bonded substances have very large molecules, such as polymers. • I can identify some covalently bonded substances which have giant covalent structures, such as diamond and silicon dioxide. • I can represent covalent bonds in molecules and giant structures in different forms • I can draw dot and cross diagrams for the molecules of hydrogen, chlorine, oxygen, nitrogen, hydrogen chloride, water, ammonia and methane • I can represent the covalent bonds in small molecules, in the repeating units of polymers and in part of giant covalent structures, using a line to represent a single bond • I can deduce the molecular formula of a substance from a given model or diagram showing the atoms and bonds in the molecule. • I know that metals consist of giant structures of atoms arranged in a regular pattern. • I can explain that electrons in the outer shell of metal atoms are delocalised and so are free to move through the whole structure. The sharing of delocalised electrons gives rise to strong metallic bonds. • I can predict the states of substances at different temperatures given appropriate data • I can explain the different temperatures at which changes of state occur in terms of energy transfers and types of bonding • (HT only) I can explain the limitations of the particle theory in relation to changes of state when particles are represented by solid inelastic spheres which have no forces between them. • I know that in chemical equations, the three states of matter are shown as (s), (l) and (g), with (aq) for aqueous solutions. • I can include appropriate state symbols in chemical equations for a wide range of reactions. • I know that ionic compounds have regular structures (giant ionic lattices) in which there are strong electrostatic forces of attraction in all directions between oppositely charged ions. • I know that ionic compounds have high melting points and high boiling points because of the large amounts of energy needed to break the many strong bonds.

				• I know that when molten or dissolved in water, ionic compounds conduct electricity because the ions are free to move and so charge can flow. • I know that substances that consist of small molecules are usually gases or liquids that have relatively low melting points and boiling points. • I know that small molecules have only weak forces between the molecules (intermolecular forces), and that it is these intermolecular forces that are overcome, not the covalent bonds, when the substance melts or boils. • I understand that intermolecular forces increase with the size of the molecules, so larger molecules have higher melting and boiling points. • I know that small covalent molecules do not conduct electricity because the molecules do not have an overall electric charge. • I can use the idea that intermolecular forces are weak compared with covalent bonds to explain the bulk properties of molecular substances. • I know that the atoms in polymer molecules are linked to other atoms by strong covalent bonds. • I understand that the intermolecular forces between polymer molecules are relatively strong and so polymers are solids at room temperature. • I can recognise polymers from diagrams showing their bonding and structure. • I understand that atoms in giant covalent structures are linked to other atoms by strong covalent bonds, giving them very high melting points. • I know that diamond and graphite (forms of carbon) and silicon dioxide (silica) are examples of giant covalent structures. • I can recognise giant covalent structures from diagrams showing their bonding and structure. • I know that metals have giant structures of atoms with strong metallic bonding, giving them high melting and boiling points. • I understand that in pure metals, atoms are arranged in layers, which allows metals to be bent and shaped. • I understand that pure metals are too soft for many uses and so are mixed with other metals to make alloys which are harder. • I can explain why alloys are harder than pure metals in terms of distortion of the layers of atoms in the structure of a pure metal.

				• I understand that metals are good conductors of electricity because the delocalised electrons in the metal carry electrical charge through the metal. • I understand that metals are good conductors of thermal energy because energy is transferred by the delocalised electrons. • I can recognise the structure of diamond with each carbon atom forms four covalent bonds with other carbon atoms in a giant covalent structure. • I can explain the properties of diamond in terms of its structure and bonding. • I can recognise graphite with each carbon atom forms three covalent bonds with three other carbon atoms, forming layers of hexagonal rings which have no covalent bonds between the layers. • I can recognise that in graphite, one electron from each carbon atom is delocalised. • I can explain the properties of graphite in terms of its structure and bonding. • I know that graphite is similar to metals in that it has delocalised electrons. • I can recognise graphene as a single layer of graphite, with properties that make it useful in electronics and composites. • I can explain the properties of graphene in terms of its structure and bonding. • I can recognise that fullerenes are molecules of carbon atoms with hollow shapes. • I understand that carbon nanotubes are cylindrical fullerenes with very high length to diameter ratios. • I can describe how the properties of Graphenes and Fullerenes make them useful for nanotechnology, electronics and materials. • I can recognise graphene and fullerenes from diagrams and descriptions of their bonding and structure • I can give examples of the uses of fullerenes, including carbon nanotubes. • I understand that nanoscience refers to structures that are 1–100 nm in size, of the order of a few hundred atoms. • I can explain that nanoparticles may have properties different from those for the same materials in bulk because of their high surface area to volume ratio. • I can compare ‘nano’ dimensions to typical dimensions of atoms and molecules. • I can describe some of the many applications of nanoparticles in medicine, in electronics, in

				cosmetics and sun creams, as deodorants, and as catalysts. • I can, given appropriate information, evaluate the use of nanoparticles for a specified purpose • I can explain that there are possible risks associated with the use of nanoparticles. ***Spring*** C3 – QUANTITATIVE CHEMISTRY: • I understand that the law of conservation of mass states that no atoms are lost or made during a chemical reaction so the mass of the products equals the mass of the reactants. • I can balance symbol equations in terms of the numbers of atoms of each element involved on both sides of the equation. • I understand the use of the multipliers in equations in normal script before a formula and in subscript within a formula. • I can calculate the relative formula mass (Mr) of a compound • I can use the law of conservation of mass to show that in a balanced chemical equation, the sum of the relative formula masses of the reactants in the quantities shown equals the sum of the relative formula masses of the products in the quantities shown. • I can calculate the percentage by mass in a compound given the relative formula mass and the relative atomic masses. • I can explain that some reactions may appear to involve a change in mass but this can usually be explained because a reactant or product is a gas and its mass has not been taken into account. • I can explain any observed changes in mass in non-enclosed systems. • I can recognise that whenever a measurement is made there is always some uncertainty about the result obtained. • I can represent the distribution of results and make estimations of uncertainty • I can use the range of a set of measurements about the mean as a measure of uncertainty. • I know that chemical amounts are measured in moles. • I understand that the mass of one mole of a substance in grams is numerically equal to its relative formula mass.

				• I understand that the mole of a substance contains the same number of the stated particles, atoms, molecules or ions as one mole of any other substance. • I can recognise the number of atoms, molecules or ions in a mole of a given substance is the Avogadro constant. The value of the Avogadro constant is 6.02×10^{23} per mole. • I understand that the measurement of amounts in moles can apply to atoms, molecules, ions, electrons, formulae and equations. • I can use the relative formula mass of a substance to calculate the number of moles in a given mass of that substance and vice versa. • I can calculate the masses of reactants and products from balanced symbol equations. • I can interpret chemical equations in terms of moles. • I can calculate the balancing numbers in a symbol equation from the masses of reactants and products by converting the masses in grams to amounts in moles and converting the numbers of moles to simple whole number ratios. • I can balance an equation given the masses of reactants and products. • I can change the subject of a mathematical equation. • I understand that in a chemical reaction involving two reactants, the reactant that is completely used up is called the limiting reactant because it limits the amount of products. • I can explain the effect of a limiting quantity of a reactant on the amount of products it is possible to obtain in terms of amounts in moles or masses in grams. • I understand that the concentration of a solution can be measured in mass per given volume of solution, eg grams per dm3 (g/dm^3). • I can calculate the mass of solute in a given volume of solution of known concentration in terms of mass per given volume of solution • I can explain how the mass of a solute and the volume of a solution is related to the concentration of the solution. • I understand that even though no atoms are gained or lost in a chemical reaction, it is • not always possible to obtain the calculated amount of a product. • I can explain reasons why it is not always possible to obtain the calculated amount of a product.

				• I can calculate the percentage yield of a product from the actual yield of a reaction" • (HT Only) I can calculate the theoretical mass of a product from a given mass of reactant and the balanced equation for the reaction. • I know that the atom economy (atom utilisation) is a measure of the amount of starting materials that end up as useful products. • I recognise that it is important for sustainable development and for economic reasons to use reactions with high atom economy. • I know can calculate the atom economy of a reaction using the balanced equation for the reaction • (HT Only) I can explain why a particular reaction pathway is chosen to produce a specified product given appropriate data such as atom economy (if not calculated), yield, rate, equilibrium position and usefulness of by-products. • I understand that the concentration of a solution can be measured in mol/dm^3 . • I understand that the amount in moles of solute or the mass in grams of solute in a given volume of solution can be calculated from its concentration in mol/dm^3 • I can calculate the concentration of a solution, where the volumes of two solutions that react completely are known and the concentration of one solution is known. • I can explain how the concentration of a solution in mol/dm^3 is related to the mass of the solute and the volume of the solution. • I understand that equal amounts in moles of gases occupy the same volume under the same conditions of temperature and pressure. • I understand that the volume of one mole of any gas at room temperature and pressure (20oC and 1 atmosphere pressure) is 24 dm^3 . • I can calculate the volumes of gaseous reactants and products from the balanced equation for the reaction. • I can calculate the volume of a gas at room temperature and pressure from its mass and relative formula mass • I can calculate volumes of gaseous reactants and products from a balanced equation and a given volume of a gaseous reactant or product C4 - CHEMICAL CHANGES:

				• I know that metals react with oxygen to produce metal oxides. • I can explain reduction and oxidation reactions in terms of loss or gain of oxygen. • I understand that the reactivity of a metal is related to its tendency to form positive ions. • I can arrange metals in order of their reactivity in a reactivity series, based on their reactions with water and dilute acids. • I understand that the non-metals hydrogen and carbon are often included in the reactivity series. • I can explain that a more reactive metal can displace a less reactive metal from a compound. • I can deduce an order of reactivity of metals based on experimental results. • I understand that unreactive metals such as gold are found in the Earth as the metal itself, but most metals are found as compounds that require chemical reactions to extract the metal. • I understand that metals less reactive than carbon can be extracted from their oxides by reduction with carbon. • I can interpret or evaluate specific metal extraction processes when given appropriate information • I can identify the substances which are oxidised or reduced in terms of gain or loss of oxygen. • I can explain oxidation is the loss of electrons and reduction is the gain of electrons. • I can write ionic equations for displacement reactions • I can identify in a given reaction, symbol equation or half equation which species are oxidised and which are reduced. • I understand that acids react with some metals to produce salts and hydrogen. • (HT Only) I can explain in terms of gain or loss of electrons, that these are redox reactions. • (HT Only) I can identify which species are oxidised and which are reduced in given chemical equations. • I understand that acids are neutralised by alkalis (eg soluble metal hydroxides) and bases (eg insoluble metal hydroxides and metal oxides) to produce salts and water, and by metal carbonates to produce salts, water and carbon dioxide. • I understand that the particular salt produced in any reaction between an acid and a base or alkali depends on; the acid used (hydrochloric acid produces chlorides, nitric acid produces nitrates,

				sulfuric acid produces sulphates) and the positive ions in the base, alkali or carbonate. • I can predict products from given reactants • I can use the formulae of common ions to deduce the formulae of salts. • I can explain how soluble salts can be made from acids by reacting them with solid insoluble substances, such as metals, metal oxides, hydroxides or carbonates. • I understand that acids produce hydrogen ions (H+) in aqueous solutions. • I understand that aqueous solutions of alkalis contain hydroxide ions (OH–). • I can identify the pH scale, from 0 to 14, as a measure of the acidity or alkalinity of a solution, which can be measured using universal indicator or a pH probe. • I can explain that a solution with pH 7 is neutral. • I can explain that aqueous solutions of acids have pH values of less than 7 and aqueous solutions of alkalis have pH values greater than 7. • I understand that in neutralisation reactions between an acid and an alkali, hydrogen ions react with hydroxide ions to produce water. • I can describe the use of universal indicator or a wide range indicator to measure the approximate pH of a solution • I can use the pH scale to identify acidic or alkaline solutions. • I understand that the volumes of acid and alkali solutions that react with each other can be measured by titration using a suitable indicator. • I can describe how to carry out titrations using strong acids and strong alkalis only (sulfuric, hydrochloric and nitric acids only) to find the reacting volumes accurately • (HT Only) I can calculate the chemical quantities in titrations involving concentrations in mol/dm3 and in g/dm^3. • I can explain that a strong acid is completely ionised in aqueous solution, giving examples. • I can explain that a weak acid is only partially ionised in aqueous solution, giving examples. • I understand that for a given concentration of aqueous solutions, the stronger an acid, the lower the pH. • I can explain that as the pH decreases by one unit, the hydrogen ion concentration of the solution increases by a factor of 10.

				• I can use and explain the terms dilute and concentrated (in terms of amount of substance), and weak and strong (in terms of the degree of ionisation) in relation to acids • I can describe neutrality and relative acidity in terms of the effect on hydrogen ion concentration and the numerical value of pH • I understand that when an ionic compound is molten or dissolved in water, the ions are free to move about within the liquid or solution. • I understand that passing an electric current through electrolytes causes the ions to move to the electrodes. • I understand that positively charged ions move to the negative electrode (the cathode), and negatively charged ions move to the positive electrode (the anode). • I understand that ions are discharged at the electrodes in electrolysis producing elements. • (HT only) I can write half equations for the reactions occurring at the electrodes during electrolysis, and can balance supplied half equations. • I understand that when a simple ionic compound is electrolysed in the molten state using inert electrodes, the metal is produced at the cathode and the non-metal is produced at the anode. • I can predict the products of the electrolysis of binary ionic compounds in the molten state. • I understand that metals can be extracted from molten compounds using electrolysis. • I understand that electrolysis is used when the metal is too reactive to be extracted by reduction with carbon or if the metal reacts with carbon. • I understand that large amounts of energy are used in the process of extraction by electrolysis to melt the compounds and to produce the electrical current. • I can explain the process of manufacturing aluminium by the electrolysis of a molten mixture of aluminium oxide and cryolite using carbon as the positive electrode (anode). • I understand that the ions discharged when an aqueous solution is electrolysed using inert electrodes depend on the relative reactivity of the elements involved. • I understand that at the negative electrode (cathode), hydrogen is produced if the metal is more reactive than hydrogen.

				• I understand that at the positive electrode (anode), oxygen is produced unless the solution contains halide ions when the halogen is produced. • I can predict the products of the electrolysis of aqueous solutions containing a single ionic compound. • I understand that during electrolysis, at the cathode (negative electrode), positively charged ions gain electrons and so the reactions are reductions. • I understand that during electrolysis, at the anode (positive electrode), negatively charged ions lose electrons and so the reactions are oxidations. • I can represent reactions at electrodes by half equations ***Summer*** C5 - ENERGY CHANGES: • I understand that energy is always conserved in chemical reactions. • I can explain that an exothermic reaction is one that transfers energy to the surroundings so the temperature of the surroundings increases. • I understand that exothermic reactions include combustion, many oxidation reactions and neutralisation. • I can explain that an endothermic reaction is one that takes in energy from the surroundings so the temperature of the surroundings decreases. • I understand that endothermic reactions include thermal decompositions and the reaction of citric acid and sodium hydrogencarbonate • I can explain everyday uses of exothermic and endothermic reactions. • I can distinguish between exothermic and endothermic reactions on the basis of the temperature change of the surroundings. • I understand that chemical reactions can occur only when reacting particles collide with each other and with sufficient energy. • I can explain that the activation energy is the minimum amount of energy that particles must have to react. • I can use reaction profiles to show the relative energies of reactants and products, the activation energy and the overall energy change of a reaction.

				• I can draw simple reaction profiles (energy level diagrams) for exothermic and endothermic reactions showing the relative energies of reactants and products, the activation energy and the overall energy change, with a curved line to show the energy as the reaction proceeds • I can identify reactions as exothermic or endothermic using reaction profiles • I know that during a reaction energy must be supplied to break bonds in the reactants • I know that energy is released when bonds in the products are formed. • I know that the energy needed to break bonds and the energy released when bonds are formed can be calculated from bond energies. • I can identify the overall energy change of the reaction as the difference between the sum of the energy needed to break bonds in the reactants and the sum of the energy released when bonds in the products are formed. • I understand that in an exothermic reaction, the energy released from forming new bonds is greater than the energy needed to break existing bonds. • I understand that in an endothermic reaction, the energy needed to break existing bonds is greater than the energy released from forming new bonds. • I can calculate the energy transferred in chemical reactions using bond energies supplied. • I know that cells contain chemicals which react to produce electricity • I understand that the voltage produced by a cell is dependent upon a number of factors including the type of electrode and electrolyte. • I understand that a simple cell can be made by connecting two different metals in contact with an electrolyte. • I understand that batteries consist of two or more cells connected together in series to provide a greater voltage. • I understand that in non-rechargeable cells and batteries the chemical reactions stop when one of the reactants has been used up. • I know that alkaline batteries are non-rechargeable. • I understand that rechargeable cells and batteries can be recharged because the chemical reactions are reversed when an external electrical current is supplied.

				• I can interpret data for relative reactivity of different metals and evaluate the use of cells. • I know that fuel cells are supplied by an external source of fuel (eg hydrogen) and oxygen or air, which is oxidised electrochemically within the fuel cell to produce a potential difference. • I understand that the overall reaction in a hydrogen fuel cell involves the oxidation of hydrogen to produce water. • I understand that hydrogen fuel cells offer a potential alternative to rechargeable cells and batteries. • I can evaluate the use of hydrogen fuel cells in comparison with rechargeable cells and batteries • (HT only) I can write the half equations for the electrode reactions in the hydrogen fuel cell. EXAM PREPARATION • Learners will revise all of the 'I can' statements from the GCSE specification in preparation for their final examination.

KS4						
MAHATMA GHANDI & LEWIS HAMILTON	**Autumn 1**	**Autumn 2**	**Spring 1**	**Spring 2**	**Summer 1**	**Summer 2**
	7 weeks	**8 weeks**	**7 weeks**	**6 weeks**	**6 weeks**	**8 weeks**
	Overview:	***TOPIC COVERAGE:***			***Objectives:***	
	GCSE study in the sciences provides the foundation for understanding the material world. Scientific understanding is changing our lives and is vital to the world's future prosperity. Learners will learn essential aspects of the knowledge, methods, processes and uses of science. They will gain appreciation of how the complex and diverse phenomena of the	***Autumn***			***Autumn***	
		Autumn 1		***Autumn 2***	C8 – ORGANIC CHEMISTRY: • I understand that crude oil is a finite resource found in rocks, made up of the remains of an ancient biomass that was buried in mud. • I understand that crude oil is a mixture of a very large number of compounds. Most of the compounds in crude oil are hydrocarbons, which are molecules made up of hydrogen and carbon atoms only. • I know that most of the hydrocarbons in crude oil are hydrocarbons called alkanes. The general formula for the homologous series of alkanes is CnH2n+2	
		C8 – ORGANIC CHEMISTRY: 12. Hydrocarbons 13. Fractional Distillation 14. Burning Hydrocarbons 15. Reactions of Alkenes 16. Cracking Hydrocarbons 17. Alcohols, Carboxylic Acids & Esters 18. Polymerisation 19. Natural Polymers & DNA		MOCK EXAM PREPARATION C7 – CHEMICAL ANALYSIS: 12. Pure Substances and Mixtures 13. Analysing Chromatograms 14. Testing for Gases 15. Testing for Positive & Negative Ions 16. Instrumental Analysis		
		Spring				
		Spring 1		***Spring 2***		

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<td>natural world can be described in terms of a small number of key ideas that relate to the sciences and that are both inter-linked and of universal application. Key ideas in Chemistry are as follows:
matter is composed of tiny particles called atoms and there are about 100 different
naturally occurring types of atoms called elements
• elements show periodic relationships in their chemical and physical properties
• these periodic properties can be explained in terms of the atomic structure of the elements
• atoms bond by either transferring electrons from one atom to another or by sharing electrons
• the shapes of molecules (groups of atoms bonded together) and the way giant structures are arranged is of great importance in terms of the way they behave
• there are barriers to reaction so reactions occur at different rates
• chemical reactions take place in only three different ways:
4. proton transfer
5. electron transfer
6. electron sharing
• energy is conserved in chemical reactions so can therefore be</td>
<td>C9 & C10 – THE EARTH'S ATMOSPHERE & RESOURCES:
11. The History and Evolution of Atmosphere
12. The Greenhouse Effect
13. Global Climate Change
14. Atmospheric Pollutants
15. Finite and Renewable Resources
16. Water Treatment
17. Extracting Metals from Ores
18. Life Cycle Assessments
19. Reduce, Reuse and Recycle</td>
<td>C6: THE RATE AND EXTENT OF CHEMICAL CHANGE
13. Calculating Rates of Reactions
14. Factors Affecting the Rates of Chemical Reactions
15. Collision Theory and Activation Energy
16. Catalysts
17. Reversible Reactions
18. Energy Changes and Reversible Reactions
19. Equilibrium
20. The Effect of Changing Conditions on Equilibrium</td>
<td>• I can identify and name the first four members of the alkanes; methane, ethane, propane and butane.
• I can represent alkane molecules in formulae and in diagrams
• I can recognise substances as alkanes given their formulae
• I understand that many hydrocarbons in crude oil may be separated into fractions, each of which contains molecules with a similar number of carbon atoms, by fractional distillation.
• I understand that the fractions in crude oil can be processed to produce fuels and feedstock for the petrochemical industry.
• I understand that many of the fuels on which we depend for our modern lifestyle, such as petrol, diesel oil, kerosene, heavy fuel oil and liquefied petroleum gases, are produced from crude oil.
• I understand that many useful materials on which modern life depends are produced by the petrochemical industry, such as solvents, lubricants, polymers, detergents.
• I can explain how fractional distillation works in terms of evaporation and condensation.
• I can describe some properties of hydrocarbons depend on the size of their molecules; including boiling point, viscosity and flammability, and that these properties influence how hydrocarbons are used as fuels.
• I can describe how boiling point, viscosity and flammability change with increasing molecular size.
• I understand that the combustion of hydrocarbon fuels releases energy.
• I understand that during combustion, the carbon and hydrogen in the fuels are oxidised, producing carbon dioxide and water.
• I can write balanced equations for the complete combustion of hydrocarbons with a given formula.
• I know that hydrocarbons can be broken down (cracked) to produce smaller, more useful molecules.
• I understand that cracking can be done by various methods including catalytic cracking and steam cracking.
• I can describe in general terms the conditions used for catalytic cracking and steam cracking.
• I know that the products of cracking include alkanes and another type of hydrocarbon called alkenes.</td>
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<td>EXAM PREPARATION, REVISION & FINAL EXAMINATIONS</td>
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	neither created nor destroyed.			• I understand that alkenes are more reactive than alkanes and react with bromine water, which is used as a test for alkenes. • I can recall the colour change when bromine water reacts with an alkene. • I know there is a high demand for fuels with small molecules and so some of the products of cracking are useful as fuels. • I understand that alkenes are used to produce polymers and as starting materials for the production of many other chemicals. • I can balance chemical equations as examples of cracking, given the formulae of the reactants and products. • I can give examples to illustrate the usefulness of cracking. • I understand that alkenes are hydrocarbons with a double carbon-carbon bond. • I can identify and use the general formula for the homologous series of alkenes is CnH2n • I understand that alkene molecules are unsaturated because they contain two fewer hydrogen atoms than the alkane with the same number of carbon atoms. • I can identify and name the first four members of the homologous series of alkenes; ethene, propene, butene and pentene. • I can represent alkene molecules using diagrams and formulae. • I understand that alkenes react with oxygen in combustion reactions in the same way as other hydrocarbons, but they tend to burn in air with smoky flames because of incomplete combustion. • I understand that alkenes react with hydrogen, water and the halogens, by the addition of atoms across the carbon-carbon double bond so that the double bond becomes a single carbon-carbon bond. • I can describe the reactions and conditions for the addition of hydrogen, water and halogens to alkenes • I can draw fully displayed structural formulae of the first four members of the alkenes and the products of their addition reactions with hydrogen, water, chlorine, bromine and iodine. • I can identify that alcohols contain the functional group –OH. • I can identify and name the first four members of a homologous series of alcohols; ethanol, ethanol, propanol and butanol.

				• I can represent alcohol molecules using diagrams and formulae. • I can describe what happens when any of the first four alcohols react with sodium, burn in air, are added to water, react with an oxidising agent. • I can recall the main uses of the first for members of a homologous series of alcohols. • I understand that aqueous solutions of ethanol are produced when sugar solutions are fermented using yeast. • I can explain the conditions used for fermentation of sugar using yeast. • I can identify that alcohols contain the functional group –COOH. • I can identify and name the first four members of a homologous series of carboxylic acids are methanoic acid, ethanoic acid, propanoic acid and butanoic acid. • I can represent alcohol molecules using diagrams and formulae. • I can describe what happens when any of the first four carboxylic acids react with carbonates, dissolve in water, react with alcohols (HT Only) • I can explain why carboxylic acids are weak acids in terms of ionisation and pH • I can recall the main uses of the first for members of a homologous series of alcohols. • I understand that alkenes can be used to make polymers such as poly(ethene) and poly(propene) by addition polymerisation. • I know that in addition polymerisation reactions, many small molecules (monomers) join together to form very large molecules (polymers). • I understand that in addition polymers the repeating unit has the same atoms as the monomer because no other molecule is formed in the reaction • I can recognise addition polymers and monomers from diagrams in the forms shown and from the presence of the functional group C=C in the monomers • I can draw diagrams to represent the formation of a polymer from a given alkene monomer • I can relate the repeating unit in a polymer to the monomer. • I understand that condensation polymerisation involves monomers with two functional groups, and that when these types of monomers react they join together, usually losing small molecules such as water.

				• I understand that the simplest polymers are produced from two different monomers with two of the same functional groups on each monomer. • I can explain the basic principles of condensation polymerisation by reference to the functional groups in the monomers and the repeating units in the polymers. • I know that amino acids have two different functional groups in a molecule. • I understand that amino acids react by condensation polymerisation to produce polypeptides. • I understand that different amino acids can be combined in the same chain to produce proteins. • I can understand that DNA (deoxyribonucleic acid) is a large molecule essential for life, which encodes genetic instructions for the development and functioning of living organisms and viruses. • I understand that most DNA molecules are two polymer chains, made from four different monomers called nucleotides, in the form of a double helix. • I can recognise other naturally occurring polymers important for life include proteins, starch and cellulose. • I can name the types of monomers from which these naturally occurring polymers are made. C7 – CHEMICAL ANALYSIS • I can identify a pure substance as a single element or compound, not mixed with any other substance • I understand that in everyday language, a pure substance can mean a substance that has had nothing added to it, so it is unadulterated and in its natural state, eg pure milk. • I can use melting point and boiling point data can be used to distinguish pure substances from mixtures. • I understand that a formulation is a mixture that has been designed as a useful product e.g. fuels, cleaning agents, paints, alloys, fertilisers and foods. • I understand that formulations are made by mixing the components in carefully measured quantities to ensure that the product has the required properties. • I can identify formulations given appropriate information

				• I understand that chromatography can be used to separate mixtures and can give information to help identify substances. • I understand that chromatography involves a stationary phase and a mobile phase and that separation depends on the distribution of substances between the phases. • I understand that the ratio of the distance moved by a compound (centre of spot from origin) to the distance moved by the solvent can be expressed as its Rf value • I understand that different compounds have different Rf values in different solvents, which can be used to help identify the compounds. • I recognise that the compounds in a mixture may separate into different spots depending on the solvent but a pure compound will produce a single spot in all solvents. • I can explain how paper chromatography separates mixtures • I can suggest how chromatographic methods can be used form distinguishing pure substances from impure substances • I can interpret chromatograms and determine Rf values from chromatograms • I can describe the test for hydrogen; using a burning splint held at the open end of a test tube of the gas. • I can identify the positive test for hydrogen, burning rapidly with a pop sound. • I can describe the test for oxygen; using a glowing splint inserted into a test tube of the gas. • I can identify the positive test for the presence of oxygen; The splint relights in oxygen. • I can describe the test for carbon dioxide; using an aqueous solution of calcium hydroxide (lime water). • I can identify a positive test for the presence of carbon dioxide; when carbon dioxide is shaken with or bubbled through limewater the limewater turns milky (cloudy). • I can describe the test for chlorine; using damp litmus paper. • I can identify a positive test for the presence of chlorine; when damp litmus paper is put into chlorine gas the litmus paper is bleached and turns white. • I understand that lame tests can be used to identify some metal ions (cations). • I can identify species from the results of the tests

				• I know that sodium hydroxide solution can be used to identify some metal ions (cations). • I know that solutions of aluminium, calcium and magnesium ions form white precipitates when sodium hydroxide solution is added but only the aluminium hydroxide precipitate dissolves in excess sodium hydroxide solution. • I understand that solutions of copper(II), iron(II) and iron(III) ions form coloured precipitates when sodium hydroxide solution is added. • I can identify that copper(II) forms a blue precipitate, iron(II) a green precipitate and iron(III) a brown precipitate. • I can write balanced equations for the reactions to produce the insoluble hydroxides. • I recognise that carbonates react with dilute acids to form carbon dioxide gas, which can be identified with limewater. • I recognise that halide ions in solution produce precipitates with silver nitrate solution in the presence of dilute nitric acid. • I can identify the precipitates formed by the reaction of halides and sliver nitrate; Silver chloride is white, silver bromide is cream and silver iodide is yellow. • I recognise that sulphate ions in solution produce a white precipitate with barium chloride solution in the presence of dilute hydrochloric acid. • I understand that elements and compounds can be detected and identified using instrumental methods, which are accurate, sensitive and rapid. • I can state advantages of instrumental methods compared with the chemical tests in this specification. • I know that flame emission spectroscopy is an example of an instrumental method used to analyse metal ions in solutions. • I can explain how to carry out and analyse flame emission spectroscopy. • I can interpret an flame emission spectroscopy result given appropriate data in chart or tabular form, when accompanied by a reference set in the same form ***Spring*** C9 & C10 – THE EARTH'S ATMOSPHERE & RESOURCES • I can describe theories about what was in the Earth's early atmosphere and how the

				atmosphere was formed have changed and developed over time. • I can explain evidence for the early atmosphere is limited because of the time scale of 4.6 billion years • I understand that one theory suggests Earth's early atmosphere was formed by intense volcanic activity that released gases and water vapour that condensed to form the oceans. • I understand that some theories suggest that the Earth's early atmosphere was mainly comprised of carbon dioxide with little to no atmosphere. • I understand that some theories state that volcanoes also produced nitrogen which gradually built up in the atmosphere. • I can explain that some theories suggest that when the oceans formed carbon dioxide dissolved in the water, producing sediments and reducing the amount of carbon dioxide in the atmosphere. • I can, given appropriate information, interpret evidence and evaluate different theories about the Earth's early atmosphere. • I can explain that algae and plants produced the oxygen that is now in the atmosphere by photosynthesis, and can represented this process with an equation. • I understand that algae first produced oxygen about 2.7 billion years ago and the evolution of plants gradually increased this to a level that enabled animals to evolve. • I can explain that algae and plants decreased the percentage of carbon dioxide in the atmosphere by photosynthesis. • I can explain that carbon dioxide levels also decreased due to the formation of sedimentary rocks and fossil fuels that contain carbon. • I can describe the main changes in the atmosphere over time and some of the likely causes of these changes • I can describe and explain the formation of deposits of limestone, coal, crude oil and natural gas. • I understand that greenhouse gases in the atmosphere maintain temperatures on Earth high enough to support life. • I can identify water vapour, carbon dioxide and methane as greenhouse gases. • I can describe the greenhouse effect in terms of the interaction of short and long wavelength radiation with matter.

				• I understand that some human activities increase the amounts of greenhouse gases in the atmosphere. • I can recall two human activities that increase the amounts of each of the greenhouse gases carbon dioxide and methane. • I understand that based on peer-reviewed evidence, many scientists believe that human activities will cause the temperature of the Earth's atmosphere to increase at the surface and that this will result in global climate change. • I can evaluate the quality of evidence in a report about global climate change given appropriate information. • I can describe uncertainties in the evidence base of climate change. • I can recognise the importance of peer review of results and of communicating results to a wide range of audiences. • I understand that an increase in average global temperature is a major cause of • climate change. • I can describe briefly four potential effects of global climate change. • I can discuss the scale, risk and environmental implications of global climate change. • I can describe the carbon footprint as the total amount of carbon dioxide and other greenhouse gases emitted over the full life cycle of a product, service or event. • I can describe actions to reduce emissions of carbon dioxide and methane • I can give reasons why actions may be limited. • I understand that the combustion of fuels is a major source of atmospheric pollutants. • I know that most fuels, including coal, contain carbon and/or hydrogen and may also contain some sulphur. • I can describe how carbon monoxide, soot (carbon particles), sulphur dioxide and oxides of nitrogen are produced by burning fuels • I can predict the products of combustion of a fuel given appropriate information about the composition of the fuel and the conditions in which it is used. • I can identify that carbon monoxide is a toxic gas, which is colourless and odourless and so is not easily detected.

				• I understand that sulphur dioxide and oxides of nitrogen cause respiratory problems in humans and cause acid rain. • I understand that particulates in the atmosphere cause global dimming and health problems for humans • I can describe and explain the problems caused by increased amounts of pollutants in the air. • I know that humans use the Earth's resources to provide warmth, shelter, food and transport. • I can state examples of natural products that are supplemented or replaced by agricultural and synthetic products • I can distinguish between finite and renewable resources given appropriate information. • I understand that water that is safe to drink is called potable water, and that this water is not pure water in the chemical sense because it contains dissolved substances. • I understand the methods used to produce potable water depend on available supplies of water and local conditions. • I can describe the process of producing potable water. • I can identify sterilising agents used for potable water including chlorine, ozone or ultraviolet light. • I understand that if supplies of fresh water are limited, desalination of salty water or sea water may be desalination by distillation to produce potable water. • I understand that desalination processes require large amounts of energy. • I understand that urban lifestyles and industrial processes produce large amounts of waste water that require treatment before being released into the environment. • I know that sewage and agricultural waste water require removal of organic matter and harmful microbes, and industrial waste water may require removal of organic matter and harmful chemicals. • I can describe the process of sewage treatment • I can comment on the relative ease of • obtaining potable water from waste, ground and salt water. • I recognise that the Earth's resources of metal ores are limited. • I understand that copper ores are becoming scarce and new ways of extracting copper from low-grade ores include phytomining, and bioleaching.

				• I can evaluate alternative biological methods of metal extraction, given appropriate information. • I understand that life cycle assessments (LCAs) are carried out to assess the environmental impact of products in: extraction, processing, manufacturing, packing, use and disposal • I understand that LCA is not a purely objective process as allocating numerical values to pollutant effects is difficult. • I understand that selective or abbreviated LCAs can be devised to evaluate a product but these can be misused to reach pre-determined conclusions, eg in support of claims for advertising purposes. • I can carry out simple comparative LCAs for shopping bags made from plastic and paper. • I understand that the reduction in use, reuse and recycling of materials by end users reduces the use of limited resources, use of energy sources, waste and environmental impacts. • I understand that metals, glass, building materials, clay ceramics and most plastics are produced from limited raw materials. • I understand that much of the energy for the processes comes from limited resources. • I understand that obtaining raw materials from the Earth by quarrying and mining causes environmental impacts. • I know that some products, such as glass bottles, can be reused, whilst other products cannot be reused and so are recycled for a different use. • I know that metals can be recycled by melting and recasting or reforming into different products. • I can evaluate ways of reducing the use of limited resources, given appropriate information. • I understand that corrosion is the destruction of materials by chemical reactions with substances in the environment. • I understand that corrosion can be prevented by applying a coating that acts as a barrier, such as greasing, painting or electroplating. • I understand that some coatings are reactive and contain a more reactive metal to provide sacrificial protection, eg zinc is used to galvanise iron. • I can describe experiments and interpret results to show that both air and water are necessary for rusting • I know that most metals in everyday use are alloys.

				• I can describe some uses of alloys of copper e.g. bronze and brass. • I understand that gold used as jewellery is usually an alloy with silver, copper and zinc. • I understand that the proportion of gold in the alloy is measured in carats, with 24 carat being 100% (pure gold), and 18 carat being 75% gold. • Steels are alloys of iron that contain specific amounts of carbon and other metals. High carbon steel is strong but brittle. Low carbon steel is softer and more easily shaped. Steels containing chromium and nickel (stainless steels) are hard and resistant to corrosion. • I understand that aluminium alloys are low density. • I understand that most of the glass we use is soda-lime glass, made by heating a mixture of sand, sodium carbonate and limestone. • I understand that Borosilicate glass, made from sand and boron trioxide, melts at higher temperatures than soda-lime glass. • I understand that clay ceramics, including pottery and bricks, are made by shaping wet clay and then heating in a furnace. • I understand that the properties of polymers depend on what monomers they are made from and the conditions under which they are made. • I can explain how low density and high density poly(ethene) are both produced from ethene • I can explain the difference between thermosoftening and thermosetting polymers in terms of their structures. • I know that most composites are made of two materials, and can give examples • I can compare quantitatively the physical properties of glass and clay ceramics, polymers, composites and metals • I can explain how the properties of materials are related to their uses and select appropriate materials. • I can recall the Haber process is used to manufacture ammonia, which can be used to produce nitrogen-based fertilisers. • I can recall the raw materials for the Haber process are nitrogen and hydrogen. • I can recall a source for the nitrogen and a source for the hydrogen used in the Haber process. • I can recall the conditions used in the Haber Process

				• (HT Only) I can interpret graphs of reaction conditions versus rate for the Haber Process. • I know that compounds of nitrogen, phosphorus and potassium are used as fertilisers to improve agricultural productivity. • I can explain that NPK fertilisers contain compounds of all three elements; Nitrogen, Phosphorous and Potassium. • I can describe that industrial production of NPK fertilisers can be achieved using a variety of raw materials in several integrated processes. • I know that Ammonia can be used to manufacture ammonium salts and nitric acid. • I can recall the names of the salts produced when phosphate rock is treated with nitric acid, sulfuric acid and phosphoric acid. • I can compare the industrial production of fertilisers with laboratory preparations of the same compounds, given appropriate information. C6 – THE RATE & EXTENT OF CHEMICAL CHANGE • I understand the rate of a chemical reaction can be found by measuring the quantity of a reactant used or the quantity of product formed over time • I understand that the quantity of reactant or product can be measured by the mass in grams or by a volume in cm3 . • I understand that the units of rate of reaction may be given as g/s or cm3 /s. • I can calculate the mean rate of a reaction from given information about the quantity of a reactant used or the quantity of a product formed and the time taken • I can draw, and interpret, graphs showing the quantity of product formed or quantity of reactant used up against time • I can draw tangents to the curves on these graphs and use the slope of the tangent as a measure of the rate of reaction • (HT only) I can calculate the gradient of a tangent to the curve on these graphs as a measure of rate of reaction at a specific time. • I can explain the factors which affect the rates of chemical reactions include: the concentrations of reactants in solution, the pressure of reacting gases, the surface area of solid reactants, the temperature and the presence of catalysts. • I can recall how changing factors affects the rate of chemical reactions.

				• I can explain how various factors affect rates of reactions using collision theory. • I can predict and explain using collision theory the effects of changing conditions of concentration, pressure and temperature on the rate of a reaction • I can predict and explain the effects of changes in the size of pieces of a reacting solid in terms of surface area to volume ratio • I can use simple ideas about proportionality when using collision theory to explain the effect of a factor on the rate of a reaction. • I can explain that catalysts change the rate of chemical reactions but are not used up during the reaction. • I can explain that catalysts increase the rate of reaction by providing a different pathway for the reaction that has a lower activation energy. • I can draw a reaction profile for a catalysed reaction • I can identify catalysts in reactions from their effect on the rate of reaction and because they are not included in the chemical equation for the reaction. • I can explain catalytic action in terms of activation energy. • I understand that in some chemical reactions, the products of the reaction can react to produce the original reactants, and that these are called reversible reactions • I understand that the direction of reversible reactions can be changed by changing the conditions. • I understand that if a reversible reaction is exothermic in one direction, it is endothermic in the opposite direction and that the same amount of energy is transferred in each case. • I understand that when a reversible reaction occurs in apparatus which prevents the escape of reactants and products, equilibrium is reached when the forward and reverse reactions occur at exactly the same rate. • I understand that the relative amounts of all the reactants and products at equilibrium depend on the conditions of the reaction. • I understand that if a system is at equilibrium and a change is made to any of the conditions, then the system responds to counteract the change.

				• I understand the effects of changing conditions on a system at equilibrium can be predicted using Le Chatelier's Principle. • I can make qualitative predictions about the effect of changes on systems at equilibrium when given appropriate information. • I understand that iff the concentration of one of the reactants or products is changed, the system is no longer at equilibrium and the concentrations of all the substances will change until equilibrium is reached again. • I understand that if the concentration of a reactant is increased, more products will be formed until equilibrium is reached again. • I understand that if the concentration of a product is decreased, more reactants will react until equilibrium is reached again. • I can interpret appropriate given data to predict the effect of a change in concentration of a reactant or product on given reactions at equilibrium. • I understand that if the temperature of a system at equilibrium is increased the relative amount of products at equilibrium increases for an endothermic reaction. • I understand that if the temperature of a system at equilibrium is increased the relative amount of products at equilibrium decreases for an exothermic reaction. • I understand that if the temperature of a system at equilibrium is decreased the relative amount of products at equilibrium decreases for an endothermic reaction. • I understand that if the temperature of a system at equilibrium is decreased the relative amount of products at equilibrium increases for an exothermic reaction. • I can interpret appropriate given data to predict the effect of a change in temperature on given reactions at equilibrium. • For gaseous reactions at equilibrium an increase in pressure causes the equilibrium position to shift towards the side with the smaller number of molecules as shown by the symbol equation for that reaction • For gaseous reactions at equilibrium a decrease in pressure causes the equilibrium position to shift towards the side with the larger number of molecules as shown by the symbol equation for that reaction.

				• I can interpret appropriate given data to predict the effect of pressure changes on given reactions at equilibrium. ***Summer*** EXAM PREPARATION, REVISION & FINAL EXAMINATIONS: • Learners will revise all of the 'I can' statements from the GCSE specification in preparation for their final examination.

KS4						
	Autumn 1	**Autumn 2**	**Spring 1**	**Spring 2**	**Summer 1**	**Summer 2**
	7 weeks	**8 weeks**	**7 weeks**	**6 weeks**	**6 weeks**	**8 weeks**
ALAN TURING & DALAI AMA	***Overview:***	***TOPIC COVERAGE:***			***Objectives:***	
	The aims and objectives of this qualification are to enable students to: ● acquire a body of basic scientific knowledge and an understanding of some important scientific ideas consistent with the programme of study ● develop basic experimental and investigative abilities ● develop a basic understanding of some of the important technological and environmental applications of science and the economic, ethical and social implications consistent with the programme of study ● develop an interest in science leading to further study at a higher level, e.g. the Edexcel GCSE in Combined Science.	***Autumn***			***Autumn*** B1: CELLS, GENETICS, INHERITANCE & MODIFICATION: • I can describe the process of selective breeding. • I can explain Darwin's theory of evolution by Natural Selection. • I can describe genetic variation as the variation that occurs as the variation that arises because an organism's environment makes it develop different characteristics. • I can recall that differences in characteristics within organisms in a species is called variation. • I can recall that a person's sex is determined at fertilisation by the inheritance of an X chromosome from the mother, and either an X chromosome (in girls) or a Y chromosome (in boys) from the father. • I can use genetic diagrams and Punnett squares to show monohybrid inheritance. • I can define the terms allele, dominant and recessive. • I can recall that a gene is a section of a DNA molecule. • I can recall that each chromosome contains several genes, which contain the information needed to make a protein.	
		Autumn 1		***Autumn 2***		
		B1: CELLS, GENETICS, INHERITANCE & MODIFICATION: 20. Using Microscopes 21. Animal Cells 22. Plant Cells 23. Cell Organisation 24. Variation 25. Genes & Chromosomes 26. DNA Modelling 27. Genetic Crosses 28. Antibiotics & Painkillers 29. Antibiotic Resistance 30. The Nervous System		B2: HEALTH, DISEASE & THE DEVELOPMENT OF MEDICINE 1. Infectious Disease 2. Bacterial Cells 3. Culturing Microbes 4. Contraception & STIs 5. Drug Development 6. The Circulatory System 7. Healthy Diet 8. Healthy Lifestyle 9. The Digestive System		
		Spring				
		Spring 1		***Spring 2***		
		C1: ATOMS, COMPOUNDS & STATES OF MATTER 20. Atoms & Elements 21. The Periodic Table 22. Structure of the Atom 23. Ions & Ionic Bonding 24. Covalent Bonding 25. Bonding in Metals 26. Particle Model		C2: SEPARATING MIXTURES, BREAKING DOWN SUBSTANCES, ACIDS & METALS 21. Separating Mixtures 22. Electrolysis 23. Indicators 24. Neutralisation 25. Naming Compounds 26. Testing for Gases 27. The Reactivity Series		

		27. Changing State	28. Displacement Reactions 29. Extracting Metals	• I can recall that DNA is found in a cell's nucleus, packaged in to chromosomes. • I can describe the structure of DNA. • I can recall the functions of sensory neurones, relay neurones in the spinal cord and motor neurones. • I can describe how sperm cells, egg cells, nerve cells and muscle cells are adapted to their function. • I can describe the importance of cell differentiation in the development of specialised cells. • I can describe how growth takes place in plants by cell elongation. • I can describe how growth takes place in organisms by cell division in animals and plants. • I can describe the functions of the nucleus, cell membrane, cytoplasm and chloroplasts in plant cells. • I can describe the functions of the nucleus, cell membrane and the cytoplasm in animal cells. B2: HEALTH, DISEASE & THE DEVELOPMENT OF MEDICINE • I can recall that cardiovascular disease can be treated by life-long medication, surgical procedures and lifestyle changes. • I can describe the harmful effects of smoking on the lungs and the heart and circulatory system. • I can describe the use of BMI (body mass index) as a measure of obesity and perform simple BMI calculations. • I can describe the effect of exercise and diet on obesity. • I can describe cancer as the result of changes in cells that lead to uncontrolled cell division. • I can recall that many non-communicable diseases, such as cancer, are cause by the interaction of a number of factors, such as diet, lifestyle and genetics. • I can describe how the process of developing new medicines has many stages. • I can recall that antibiotics can only be used to treat bacterial infections. • I can describe the role of the immune system of the human body in defence against disease. • I can describe how chemical defences of the of the human body provide protection from
		Summer		
		Summer 1	***Summer 2***	
		P1: FORCES, MOVEMENT & ENERGY 1. Force Diagrams 2. Distance-Time Graphs 3. Speed-Time Graphs 4. Resultant Forces 5. Weight, Mass & Gravity 6. Stopping Distances 7. Energy Transfers 8. Energy Transfer Diagrams 9. Calculating Energy Efficiency 10. Sources of Energy	P2: WAVES & RADIATION 1. How Do We See? 2. Properties of Waves 3. Electromagnetic Spectrum I 4. Electromagnetic Spectrum II 5. Revisiting Atoms 6. Radiation 7. Radioactive Decay	

				pathogens, including hydrochloric acid (in the stomach) and lysozomes (in tears). • I can describe how physical barriers of the human body provide protection from pathogens, including the skin and mucus. • I can describe how STIs can be recued or prevented by avoiding unprotected sexual activity and regular testing for infections. • I can describe how sexually transmitted infections are spread through sexual contact. • I can describe methods for reducing or preventing the spread of pathogens e.g. hand washing, water treatment and control of vectors. • I can describe how pathogens are spread. • I can describe some common infections and the pathogens which cause them. • I can describe viruses as non-living particles that contain genetic material and can only reproduce inside living cells. • I can describe fungi as organisms that may be single celled or multicellular, and which digest food outside of the organism before absorbing it. • I can describe bacteria as single-celled organisms, with circular DNA and flagella for movement. • I can identify bacteria, fungi, protists and viruses as pathogens. • I can describe a pathogen as a disease-causing organism. • I can describe the difference between communicable and non-communicable diseases. ***Spring*** C1: ATOMS, COMPOUNDS & STATES OF MATTER • I can recognise that these interconversions are physical changes, unlike chemical reactions that result in chemical changes. • I can describe the changes in arrangement and movement of particles during these interconversions. • I can recall the names used for the interconversions between the three states of matter. • I can describe the arrangement and movement of particles in each of the three states of matter: solid, liquid and gas.

				• I can describe the properties of metals in terms of metallic bonding. • I can describe, using (poly)ethene as the example, that simple polymers consist of large molecules containing chains of carbon atoms. • I can describe the uses of graphite in electrodes or as a lubricant, and diamond in cutting tools, and related them to their properties. • I can recall that graphite and diamond are different forms of carbon and that they are examples of giant covalent substances. • I can describe the properties of giant covalent compounds, limited to melting and boiling point, conductivity of electricity and solubility in water. • I can recall that covalent bonding sometimes results in the formation of giant molecules. • I can describe the properties of typical covalent, simple molecular compounds, limited to melting point, boiling point, and conductivity of electricity. • I can describe the formation of simple molecular, covalent substances using dot-and-cross diagrams. • I can recall that covalent bonding usually results in the formation of simple molecules. • I can describe how a covalent bond is formed when a pair of electrons is shared between two non-metal atoms. • I can describe the properties of ionic compounds, limited to melting and boiling point, solubility in water and the ability to conduct electricity as solids, when molten and in aqueous solution. • I can describe the structure of an ionic compound as a giant structure of positive and negative ions. • I can describe the formation of ions in ionic compounds from their atoms, limited to compounds of elements in groups 1 and 7. • I can describe how ionic bonds are formed between metals and non-metals. • I can recall that when elements react, their atoms join with other atoms to form compounds. • I can explain how the arrangement of electrons in an element is related to its position in the Periodic Table. • I can describe most metals as shiny solids that have high melting points, high density and are good conductors of electricity, whereas most non-metals have low boiling points and are poor conductors.

				• I can identify elements as metals or non-metals according to their position in the Periodic Table. • I can describe that elements in the Periodic Table with similar properties are arranged the same vertical comments called groups. • I can describe that elements in the Periodic Table are arranged in order of increasing atomic number in rows called periods. • I can describe how Mendeleev used his table to predict the existence and properties of some elements not then discovered. • I can describe how Mendeleev arranged the elements, known at that time, in a Periodic Table by using properties of these elements and their compounds. • I can recall that atoms of the same element with different number of neutrons are called isotopes. • I can recall the meaning of the term mass number of an atom. • I can describe atoms of a given element as having the same number of protons in the nucleus and that this number is unique to that element and known as the atomic number. • I can recall that most of the mass is concentrated in the nucleus. • I can recall the relative charges and masses of a proton, neutron and electron. • I can describe the nucleus of an atoms as very small compared to the overall size of the atom. • I can describe the structure of an atom. C2: SEPARATING MIXTURES, BREAKING DOWN SUBSTANCES, ACIDS & METALS • I can describe the advantages of recycling metals, including economic implications and how recycling can preserve both the environment and the supply of valuable raw materials. • I can describe the uses of metals in relation to their properties. • I can explain why the method used to extract a metals from it's ore is related to it's position in the reactivity series and the cost of the extraction process. • I can recall that unreactive metals are found in the Earth's crust as the uncombined elements. • I can recall that most metals are extracted from ores found in the Earth's crust.

				• I can deduce the relative reactivity of some metals by their reactions with water, acids and salt solutions. • I can describe the process of preparing a soluble salt from an acid and an insoluble reactant. • I can describe the chemical test for hydrogen and carbon dioxide (limewater). • I can recall that hydrochloric acid produces chloride salts, nitric acid produces nitrate salts and sulfuric acid produces sulfates. • I can recall that acids are neutralised by metals, metal oxides and metal carbonates to produce salts. • I can recall the effect of acids and alkalis on indicators, including litmus, pH indicator paper/ universal indicator solution. • I can recall that a neutral solution has a pH of 7, acidic solutions have lower pH values and alkaline solutions have higher pH values. • I can predict the products of electrolysis or ionic compounds in the molten state. • I can describe electrolysis as a process in which electricity decomposes ionic compounds in the molten state or dissolved in water. • I can describe how waste and ground water can be made drinkable, including the need for sedimentation, filtration and chlorination. • I can interpret a paper chromatogram to distinguish between pure and impure substances and identify substances by comparison with known substances. • I can describe an appropriate experimental technique to separate a mixture, knowing the properties of the components of the mixture. • I can describe the experimental techniques for separation of mixtures. • I can recall that a mixture contains two or more substances that are not chemically combined. ***Summer*** P1: FORCES, MOVEMENT & ENERGY • I can explain why both renewable and non-renewable sources are used. • I can classify sources of energy as either renewable or non-renewable.

				• I can describe the main energy sources that we can use on Earth e.g. fossil fuels, nuclear fuel, wind, solar etc. • I can calculate the efficiency of an energy transfer. • I can describe how to reduce unwanted energy transfers, including using lubrication or thermal insulation. • I understand that every time energy is transferred, some energy is always lost to the surroundings. • I can recall that energy lost to the surroundings is not useful energy. • I understand that energy can be wasted or lost to the surroundings. • I understand that energy can be transferred from one form to another and can give examples. • I can recall that energy cannot be created or destroyed. • I can use energy transfer diagrams. • I can use simple Sankey diagrams. • I can recall that a driver's reaction time is increased when using drugs (medicine and alcohol) or when being distracted. • I can recall that the stopping distance of a vehicle can be impacted by a number of factors. • I understand that the stopping distance of a vehicle is equal to the thinking distance plus the braking distance. • I can use the weight of an object in Newton (N) is equal to it's mass in kg x10. • I can recall that forces cause objects to speed up or slow down. • I can recall that forces acting on an object are balanced or zero when the object is not moving or moving at a constant speed. • I can recall that (unbalanced) forces cause a change of position, speed and shape. • I can understand relative speeds for everyday contexts such as walking, running, cycling, for a car, for a train, for an airplane and the speed of sound. • I can relate the distance travelled to the area under a speed-time graph. • I can relate acceleration to the steepness of the gradient on a speed-time graph. • I can calculate the acceleration of an object.

				• I can recall that large acceleration means large speed changes or small times or both. • I can relate the speed to the steepness of the gradient on a distance-time graph. • I can calculate the average speed of an object. • I can recall that all forces have size and direction, including friction which acts in the opposite direction P2: WAVES & RADIATION • I can recall that irradiation is when alpha, beta or gamma radiation passes through an object, and contamination is when an object becomes in contact with a radioactive source. • I can describe methods to minimise the exposure to radioactive isotopes. • I can recall that radioactive isotopes can cause cells in the body to be damaged, die or mutate. • I understand that the half-life of a radioactive isotope is the time it takes for the activity to half. • I can describe how the activity of a radioactive source can be shown on a graph that never gets to zero. • I can describe how the activity of a radioactive source decreases with time. • I know that the number of radioactive decays in a second is called the activity of a radioactive source. • I can recall that when a gamma ray is emitted from a nucleus, the atom stays the same element. • I can recall that when a beta particle is emitted from a nucleus, the atoms has become a different element. • I can recall that when an alpha particle is emitted from a nucleus, the atoms has become a different element. • I understand that when an unstable atom decays it emits an alpha particle, a beta particle or gamma rays and this is called radioactive decay. • I can describe some uses of electromagnetic radiation. • I can describe the harmful effects on people of excessive exposure to electromagnetic radiation. • I can recall that electromagnetic waves travel more slowly in some materials than in others. • I can describe the pattern in the frequency, wavelength and energy of waves in the electromagnetic spectrum.

				• I can recall the order of the electromagnetic spectrum. • I can recall that electromagnetic waves travel at the same speed in a vacuum. • I can recall that waves change direction and speed at a boundary (refraction). • I can use the equation: wave speed = frequency x wavelength. • I can describe a wave using the terms; frequency, wavelength, amplitude and wave speed. • I can recall that waves transfer energy and information.