Berwickshire High School

SCIENCES

CURRICULUM REVIEW 2020-21

BIOLOGY

S1
Biodiversity and Photosynthesis
Cells and Microbes

S2
Body Systems
Health and Disease

S3 Level 3
Cells, Microbes and DNA
Body Systems
Ecology

S3 Level 4
Cell Structure and Cell Membranes
DNA and the Production of Proteins
Genetic Engineering
Respiration and Fermentation

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CHEMISTRY

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Elements and Compounds
Solutions and Reactions

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Fuels and Metals
Acids and Bases

S3 Level 4
Atomic Structure
Rates of Reactions and Chemical Formulae
Bonding and Properties of Materials
Acids, Bases and Neutralisation

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Light
Energy

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Electricity
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Kinematics
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BIOLOGY OVERVIEW – BROAD GENERAL EDUCATION

S1 Biodiversity and Photosynthesis

- Biodiversity and Ecosystems
- Sampling Techniques
- Photosynthesis

S1 Cells and Microbes

- Microbes
- Personal Hygiene and Food Hygiene
- Animal, Plant and Specialised Cells
- Inheritance and DNA

S2 Body Systems

- The Skeletal System
- The Respiratory System
- The Circulatory System
- The Digestive System and Senses
- The Reproductive System

S2 Health and Disease

- Pathogens and Disease
- First and Second Lines of Defence
- Antibiotics and Vaccines
- Monitoring Health

S3 Level 3 Biology

- **Cells, Microbes and DNA**
  - Cells
  - Microbes
  - DNA Profiling

- **Body Systems**
  - The Cardiovascular System
  - The Immune System
  - The Digestive System
  - Excretery System
  - Health and Diseases

- **Ecology**
    - Sampling from the Environment
    - Photosynthesis and Limiting Factors
    - Food Production

S3 Level 4 Biology

- **Cell Structure and Cell Membranes**
    - Cell Structure and Organelle Function
    - Cell membrane Structure
    - Active and Passive Transport

- **DNA and the Production of Proteins**
    - DNA Structure
    - Proteins
    - The Production of Proteins
    - Enzyme Controlled Reactions

- **Genetic Engineering**
    - The Process of Genetic Engineering
    - Examples of Genetically Engineered Products

- **Respiration and Fermentation**
    - Respiration
    - Aerobic Respiration
    - Fermentation

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S1 Biology

Topic:	S1 Biodiversity and Photosynthesis
Overview:	To develop a knowledge of ecosystems and the factors that come together to comprise an ecosystem. To develop an understanding of how we use sampling techniques to investigate diversity within the environment. To investigate photosynthesis and factors affecting how plants grow.
Content:	**Biodiversity and Ecosystems** • A habitat is a place where an organism lives. • An ecosystem is a natural biological unit that is made up of both living and non-living parts. • Biodiversity is the degree of variation that exists among all living organisms on Earth. • The greater the number of different species that live in an ecosystem, the richer the biodiversity. **Sampling Techniques** **Quadrats** • Quadrats sample ground plants. • The frame is thrown randomly onto an area being sampled and the number of squares containing the plant being studied are counted. • Use a large number of quadrats to increase reliability. **Pitfall Traps** • Pitfall traps sample ground dwelling invertebrates. • The top of the carton/cup is buried so it is level with the soil surface. • The top of the trap is partially covered to keep out the rain and to stop birds eating the catch. • Set up several traps to increase reliability. • Check traps regularly. **Pond Dipping** • Pond dipping is used to sample freshwater invertebrates. • Sweep the net back and forth along the edge of the pond. • Take several samples. • Use a large net with a fine mesh. **Photosynthesis** • Photosynthesis is the process by which green plants use light energy to make glucose. • The raw materials for photosynthesis are carbon dioxide & water. • The products are glucose & oxygen

	• The conditions required are light & chlorophyll. • Chlorophyll is the green pigment found in plant leaves. • The greater the light intensity, the faster the rate of photosynthesis. • Plants make a range of carbohydrates. • Glucose is used for energy. • Starch is used for storage. • Cellulose is used for stability in cell walls. • Leaves can be tested for starch. • The leaf is boiled in water to kill the cells. • The leaf is boiled in alcohol to remove the chlorophyll. • The leaf is tested with a couple of drops of iodine solution. • If starch is present the iodine solution on the leaf goes from brown to black.

Topic:	S1 Cells and Microbes
Overview:	To explore the risk and impact of microorganisms in relation to health. To investigate cells at magnification, including specialised cells and the jobs they do. To discuss how organisms develop and pass on genetic information to the next generation. To examine genetic characteristics and the role of DNA.
Content:	**Microbes** • There are four types of micro-organism. These are bacteria, viruses, protozoa and fungi. • Microbes can be found anywhere they have a warm growing temperature, moisture and food supply. • Microbes are found all over the body, inside and out. • Microbes exist in the air, soil and most surfaces. • Microbes will not grow if the temperature is **too hot**. • If microbes are stored in an oven they are destroyed by the heat. • Microbes will not grow if the temperature is too cold. • If microbes are stored in a fridge they do not grow, when returned to warm conditions they will start to grow again. **Sampling Microbes Safely** • Hands must be washed before and after plating. • The desk must be cleaned down with antibacterial spray. • The agar plate is labelled with your **initials and the date**along the underside edge. • Two pieces of sellotape are used to seal the lid, this **allows oxygen to enter the plate.** • Plates are **incubated upside down** to prevent microbes spilling out due to condensation runoff. • **To prevent contamination**, the lid must be off the plate for as short a time as possible. **Personal Hygiene and Food Hygiene** • Symptoms of food poisoning include upset stomach, abdominal cramps, nausea and vomiting and diarrhoea. **To avoid food poisoning:** • Wash hands and work surfaces before and after preparing food. • Food should be cooked thoroughly. This kills any microbes living in the raw food. • Storing food in a fridge will slow the rate at which it spoils. • Cooked and uncooked meat should be stored separately in the fridge.

Personal Hygiene:

- Washing hands prevents the spread of microbes from one person to another or from one part of your body to another.
- Keeping your body clean is vital in combating and preventing illness.
- Flossing and brushing your teeth can reduce the likelihood of cavities and gum disease.

Animal, Plant and Specialised Cells

- Cells are the units of a living organism.
- To view cells, you must use a microscope.

Animal Cells:

- Animal cells have three organelles.
- Nucleus: Controls the cell activities.
- Cytoplasm: The site of cell chemical reactions.
- Cell Membrane: Controls the entry and exit of materials.

Plant Cells:

- Plant cells have six organelles.
- Nucleus: Controls the cell activities.
- Cytoplasm: The site of cell chemical reactions.
- Cell Membrane: Controls the entry and exit of materials.
- Vacuole: Stores cell sap and supports the cell.
- Cell Wall: Provides support to the cell.
- Chloroplast: The site of photosynthesis.

Specialised Cells:

- Specialised cells have a structure which relates to their function.

Sperm Cell

- Function: To reach the egg cell and fuse with it.
- Structure: Tail for swimming.

Red Blood Cell

- Function: To carry oxygen.
- Structure: Doughnut shape to give large surface area.

Egg Cell

- Function: To fuse with a sperm cell and feed the new cells produced.
- Structure: Large and packed with food.

Nerve Cell

- Function: To carry electrical messages around the body.
- Structure: Long and thin to carry electrical signals over long distances.

Inheritance and DNA

- The nucleus is an organelle containing chromosomes.
- Chromosomes are long strands of DNA.
- Genes are sections of the DNA.
- Genes determine what characteristics we have.
- All species have different numbers of chromosomes, this is called the chromosome complement.
- DNA molecules are made up of bases and sugars joined together.
- There are 4 different bases: Adenine, Thymine, Guanine and Cytosine.
- The order or sequence of the bases in the DNA is how information is stored.
- Different combinations of chromosomes from parents will give different characteristics in offspring. This is why we are different to our parents and siblings.
- An inherited trait- is a characteristic passed from the parents to the children through genes e.g. eye colour.
- Punnett squares are used to work out the characteristics of potential offspring.
- DNA profiling is a way of identifying individuals from their DNA profile.
- Everyone's DNA is unique (except for identical twins).

How DNA can be used:

- Paternity: who is the father or who is the mother?
- DNA found at crime scenes can be matched to a national database.
- The DNA profiles of convicted people are held on the database.
- Sometimes people are asked to volunteer a sample to eliminate them from suspicion.

Insurance

- Insurance companies use DNA profiling to set the cost of insurance.

Inherited diseases

- Over 4000 human diseases caused by single gene defects including:
- Sickle-cell anemia
- Huntington's disease
- Cystic fibrosis
- Hemophilia

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S2 Biology

Topic:	S2 Health and Disease
Overview:	Investigating how our bodies protect us from pathogens. Discussing the work of Alexander Fleming and how antibiotics were discovered. Discussing the work of Edward Jenner and the creation of vaccines. Examining the different types of technology in monitoring health and improving our quality of life.
Content:	**Pathogens and Disease** • A disease is anything that changes the normal functioning of the body. • A pathogen is an organism that causes a disease. • Most disease causing organisms are microbes. • Microbes can be classified as bacteria, fungi, viruses and protozoa. **Examples of a disease caused by each of the types of microbe:** • bacteria - food poisoning. • fungi - athletes foot. • protozoa - giardia. • virus - influenza, HIV. • Diseases caused by microbes are said to be infectious diseases. **The methods of disease transmission are:** • direct contact • airborne • waterborne • through contaminated food. **First and Second Lines of Defence** **The first lines of defence are:** • Acid in the stomach to kill microbes. • Sticky mucus in the lungs to trap microbes, and cilia to sweep the mucus out of the lungs. • The skin to stop microbes from getting into the body. • Scabs on the skin if you get a cut, to stop microbes from getting into your body. • Tears contain substances to kill bacteria. **The second lines of defence are:** • White blood cells. • Phagocytes are white blood cells that engulf pathogens to destroy them. • Lymphocytes are white blood cells that produce antibodies to inactivate pathogens.

Antibiotics and Vaccines

- Antibiotics are produced by fungi.
- Antibiotics kill bacteria.
- We need a variety of antibiotics as some bacteria are becoming resistant to bacteria.
- If we have a limited supply of antibiotics we may not be able to deal with all bacterial infections.
- When a bacteria is no longer killed by an antibiotic the bacteria are resistant to that antibiotic.
- If bacteria are killed by the antibiotic, the bacteria are sensitive to that antibiotic.
- A multi disc experiment determines which antibiotic is best at treating a bacterial infection.
- A large zone of clearance around the disc shows the bacteria are sensitive to the antibiotic.
- The absence of a zone of clearance around the disc shows that the bacteria are resistant to the antibiotic.
- Vaccination involves putting a small amount of an inactive form of a pathogen into the body.

Vaccines contain:

- live pathogens treated to make them harmless
- harmless fragments of the pathogen
- dead pathogens
- Immunity is when the weakened pathogen stimulates the white blood cells to make memory cells.
- Memory cells are white blood cells.
- When the memory cells come in contact with the pathogen again, they reproduce, rapidly producing many lymphocytes.
- Lymphocytes produce antibodies to destroy the pathogen before the disease can occur.
- Edward Jenner created the first vaccine for smallpox.
- Alexander Fleming discovered the first antibiotic, penicillin.

Monitoring Health

- A digital sphygmomanometer is used to measure blood pressure.
- Blood pressure is a measure of the force that your heart uses to pump blood around your body.
- A normal blood pressure range is 120/80 to 140/90.
- A heart rate monitor is used to measure resting heart rate
- A normal resting heart rate is 60-80 beats per minute.
- Peak flow is a simple measurement of how quickly you can blow air out of your lungs.
- The vital capacity of your lungs is the maximum amount of air a person can expel from the lungs after a maximum inhalation.

	• Recovery time is the time taken for breathing rate and pulse rate to return to normal after vigorous exercise. • A fit person has a lower resting heart rate. • A fit person's heart is more efficient at delivering oxygen and glucose to the body tissue. • Obesity is an abnormal accumulation of body fat, usually 20% or more over an individual's ideal body weight. **The main causes of obesity are:** • A decrease in physical activity both at work and home • An energy dense (high fat) diet. **The treatment for obesity is:** • Reduced energy intake • Increase physical activity • Obesity is associated with increased risk of illness, disability, and death. • Diabetes is the failure of the body to control blood glucose levels. • Type 2 diabetes is linked to levels of obesity. **Technology is used to monitor health and improve the lives of patients:** • Examples include: o Nano-bots in Blood are tiny robots that behave like white blood cells. o A holographic keyboard to reduce the amount of infections people are exposed to. o Prosthetic limbs controlled by the brain. o Artificial retinas to improve vision in visually impaired individuals.

Topic:	S2 Body Systems
Overview:	To explore the structure and function of organs of the body, including the senses. Students will develop an understanding of their body systems and how each organ has specialised structures to enable the carrying out of specific tasks.
Content:	**The Skeletal System** **The function of the skeleton is for:** • support • shape • muscle attachment • protection • production of blood cells -bone marrow **The following bones can be identified:** • skull • jaw (mandible) • collar bone (clavicle) • shoulder blade (scapula) • humerus • vertebrae • sternum • rib • ulna • radius • phalanges (fingers +toes) • pelvis • femur • tibia • fibula • patella (knee cap) • Bones are joined together by ligaments • Tendons attach muscles to bones. • The ends of the bones are covered by **cartilage.** • A hinge joint can be found in the elbow and knee • Muscles work in pairs to **contract and relax** to move the joint **The Respiratory System** **The main structures of the lungs:** • trachea - windpipe that stays open due to rings of cartilage, to allow air to reach the lungs. • bronchus - pipe which allows air to enter each lung. • bronchioles - small pipes leading to the air sacs. • air sacs - tiny sacs where gas exchange occurs.

Air sacs have specific features that allow gas exchange:

- moist surface
- large surface area
- close contact with capillaries so they have a rich blood supply.
- Inhaled air contains approximately 21% oxygen.
- Inhaled air contains approximately 0.03% carbon dioxide.
- Exhaled air contains more carbon dioxide than inhaled air.

The Circulatory System

- The heart pumps blood around the body.
- The heart is mainly made from muscle.
- The heart has four chambers.
- The left side of the heart muscle is thickest.
- Blood from the body enters the right side of the heart.

The direction of flow is:

- Blood from the body flows into the heart via the vena cava.
- Chamber 1
- Chamber 2
- Out of the heart via the pulmonary artery.
- The lungs: Carbon dioxide is removed from the blood and oxygen moves into the blood.
- Oxygenated blood flows back to the heart and enters via the pulmonary vein.
- Chamber 3
- Chamber 4
- Pumped out of the heart via the aorta and to the rest of the body.

There are three types of blood vessel:

- Veins carry blood **to** the heart
- Arteries carry blood **away** from the heart
- Capillaries carry blood **through** the tissues.
- Veins contain valves that prevent the blood from flowing backwards.
- Some capillaries are so small that only one red blood cell can fit through at a time.
- Arteries have a thick layer of muscle as blood travelling through is at high pressure.

The Digestive System
The features of the digestive system:

- Mouth: Contains saliva and starts the mechanical breakdown of food.
- Oesophagus: Connects mouth to the stomach.
- Stomach: Contains acid, churning to break down food and kills microbes.
- Liver: Produces bile to break down fats.
- Pancreas: Produces enzymes that help with digestion.
- Small Intestine: Absorption of small, soluble molecules.
- Large intestine: Absorbs water.
- Rectum and Anus: storage and exit for waste.
- The main role of the digestive system is to break down large, insoluble molecules into small, soluble molecules which can pass through the lining of the gut and into the blood.
- One of the main types of food is carbohydrate. There are two types:
    - Simple carbohydrates such as glucose
    - Complex carbohydrates such as starch
- Iodine solution turns from brown to blue-black in the presence of starch.
- Benedict's solution changes from blue to orange when heated with glucose.
- Starch is a large, insoluble molecule which cannot not pass through the lining of our gut into the blood.
- Starch must first be broken down by enzymes in the digestive system into small, soluble glucose molecules.
- An enzyme is a biological molecule that speeds up a chemical reaction.

Senses
The five main senses are:

- Sight
- Touch
- Smell
- Hearing
- Taste
- Some parts of the skin are very sensitive to touch such as fingers and lips.
- Other areas of skin are not sensitive such as your calf and thigh.
- Taste is detected on the tongue by taste buds.

There are five different tastes:

- Sweet
- Salty
- Bitter
- Sour
- Savoury (umami)
- Flavour is the sense of smell and taste working together.

- The eye is the organ responsible for sight.
- Light is detected by the eye and changed into electrical signals.
- The signals are changed into images by the brain.
- Some people find it difficult to tell the difference between colours. This is known as colour blindness.

The Reproductive System

The parts of the male mammalian reproductive system:

- Testes - produce sperm
- Penis - used for depositing sperm in the female reproductive organs
- Scrotum - holds the testes outside the body
- Sperm duct - carries sperm from the testes to the penis
- Urethra - allows passage of the sperm and urine to the external environment

The parts of the female mammalian reproductive system:

- Ovary - produce eggs
- Oviduct - site of fertilisation
- Uterus or womb - site of foetus development
- Cervix - produces mucus
- Vagina - receives the penis so that sperm can be deposited
- Fertilisation is the fusion of the male and female gamete nuclei to form a zygote.
- The site of fertilisation is the oviduct.
- The fertilised egg passes down the oviduct and becomes attached to the wall of the uterus.
- The placenta provides nourishment and is a means of gas exchange for the foetus.
- The function of the amniotic fluid is protection.
- Pregnancy lasts for 9 months in a human.
- harmful substances can affect the development of the embryo. These Include:
    - Alcohol, drugs and smoking.
    - Harmful Effects: Slow development, low birth weight, genetic mutations, miscarriage.

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S3 Biology

Topic:	S3 Cells, Microbes and DNA - Level 3
Overview:	To investigate cells at magnification, including specialised cells and the jobs they do. To explore different cell structures including animal, plant, bacteria and fungi. Students will look at the importance of all cell organelles and their functions. To study the risk and impact of microorganisms in relation to health. To discover how the body can defend itself against disease and protection through vaccines.
Content:	**Microbes** • There are four types of micro-organism. These are bacteria, viruses, protozoa and fungi. • Microbes can be found anywhere they have a warm growing temperature, moisture and food supply. • Microbes will not grow if the temperature is **too hot**. • If microbes are stored in an oven they are destroyed by the heat. • Microbes will not grow if the temperature is too cold. • If microbes are stored in a fridge they do not grow, when returned to warm conditions they will start to grow again. **Sampling Microbes Safely:** • Hands must be washed before and after plating. • The desk must be cleaned down with antibacterial spray. • The agar plate is labelled with your **initials and the date,** along the underside edge. • Two pieces of sellotape are used to seal the lid, this **allows oxygen to enter the plate.** • Plates are **incubated upside down** to prevent microbes spilling out due to condensation runoff. • **To prevent contamination**, the lid must be off the plate for as short a time as possible. **Cell Types** • Cells are the units of a living organism. • To view cells, you must use a microscope. • Cells are measured in micro meters, µm. • Cell length and width can be calculated.

Animal Cells:

- Animal cells have three organelles.
- Nucleus: Controls the cell activities.
- Cytoplasm: The site of cell chemical reactions.
- Cell Membrane: Controls the entry and exit of materials.

Plant Cells:

- Plant cells have six organelles.
- Nucleus: Controls the cell activities.
- Cytoplasm: The site of cell chemical reactions.
- Cell Membrane: Controls the entry and exit of materials.
- Vacuole: Stores cell sap and supports the cell.
- Cell Wall: Provides support to the cell.
- Chloroplast: The site of photosynthesis.

Specialised Cells:

- Specialised cells have a structure which relates to their function.

Sperm Cell:

- Function: To reach the egg cell and fuse with it.
- Structure: Tail for swimming.

Red Blood Cell:

- Function: To carry oxygen.
- Structure: Doughnut shape to give large surface area.

Egg Cell

- Function: To fuse with a sperm cell and feed the new cells produced.
- Structure: Large and packed with food.

Nerve Cell

- Function: To carry electrical messages around the body.
- **Structure:** Long and thin to carry electrical signals over long distances.

DNA and DNA Profiling

DNA is located in the nucleus of cells and is found as a double helix shape. DNA is different in every person by coding for different proteins and can be represented by a DNA profile. DNA profiling in society can include paternity testing, forensics at crime scenes and identifying inherited diseases. Debate the advantages and disadvantages of DNA profiling and why it might be controversial.

	How DNA can be used: • Paternity: who is the father or who is the mother? • DNA found at crime scenes can be matched to a national database. • The DNA profiles of convicted people are held on the database. • Sometimes people are asked to volunteer a sample to eliminate them from suspicion. **Insurance** • Insurance companies use DNA profiling to set the cost of insurance. **Inherited diseases** • Over 4000 human diseases caused by single gene defects including: • Sickle-cell anemia • Huntington's disease • Cystic fibrosis • Hemophilia

Topic:	S3 Body Systems - Level 3
Overview:	To examine the basic structure and functions of some of the main organs and systems of the body. Explain how different systems can work together to sustain life of an organism. Describe how the immune system can protect the body against disease. Investigate different conditions relating to body systems and how to screen for these. Research the symptoms of these conditions and how to treat and prevent them.
Content:	**Cardiovascular System** The structure of the heart including the atria, ventricles, valves, aorta, vena cava, pulmonary vein and pulmonary artery. **Direction of Blood Flow:** • Blood from the body flows into the right atrium of the heart via the vena cava. • Blood enters into the right ventricle. • Blood leaves the heart via the pulmonary artery. • At the lungs carbon dioxide is removed from the blood and oxygen enters into the blood making it oxygenated. • The oxygenated blood flows back to the heart and enters into the left atrium via the pulmonary vein. • Blood enters into the left ventricle. • Blood is pumped out the heart to the rest of the body via the aorta. **Blood Vessels:** • Veins carry blood **to** the heart • Arteries carry blood **away** from the heart • Capillaries carry blood **through** the tissues. • Veins contain valves that prevent the blood from flowing backwards. • Some capillaries are so small that only one red blood cell can fit through at a time. • Arteries have a thick layer of muscle as blood travelling through is at high pressure. **Blood Cells:** • Red blood cells (RBC) carry oxygen around the body to cells and tissues. • White blood cells fight against illnesses and diseases. **Immune System** White blood cells protect the body through defence mechanisms, such as lymphocytes and phagocytes: • Lymphocytes – produces antibodies • Phagocytes – undergoes phagocytosis Vaccinations can be used to provide protection against the body to assist with the defence mechanisms.

	Vaccinations involve putting a small volume of an inactive form of a pathogen into the body. Vaccines contain: • Live pathogens treated to make them harmless or, • Harmless fragments of the pathogen or, • Dead pathogens. **Digestive System** The structure and function of the stomach, small and large intestine: • Stomach – churns and breaks down food. • Small intestine – absorbs important nutrients into the blood. • Large intestine – absorbs excess water from the waste. **Excretory System** The relationship between the excretory system with the digestive and cardiovascular system. The structure and function of the bladder and kidney: • Bladder – stores urine until ready to be expelled. • Kidney – filters the blood and removes toxic substances from the body. **Health Conditions** Investigate the effects of cardiovascular disease and diabetes in relation to the cardiovascular, digestive and excretory systems and how these can be prevented and/or treat.

Topic:	S3 Level 3 Ecology
Overview:	To develop a knowledge of ecosystems and the factors that come together to comprise an ecosystem. To develop an understanding of how we use sampling techniques to investigate diversity within the environment. To investigate photosynthesis and factors affecting how plants grow.
Content:	**Biodiversity and Ecosystems** • A habitat is a place where an organism lives. • An Organism is a living entity which is made up of many specialised cells. Some organisms are made of only one cell. • An ecosystem is a natural biological unit that is made up of both living and non-living parts. • Biodiversity is the degree of variation that exists among all living organisms on Earth. • A community is all the living organisms that live within a habitat. A community can contain a number of different species. • The greater the number of different species that live in an ecosystem, the richer the biodiversity. **Sampling Techniques** **Quadrats:** • Quadrats sample ground plants. • The frame is thrown randomly onto an area being sampled and the number of squares containing the plant being studied are counted. • Use a large number of quadrats to increase reliability. **Pitfall Traps:** • Pitfall traps sample ground dwelling invertebrates. • The top of the carton/cup is buried so it is level with the soil surface. • The top of the trap is partially covered to keep out the rain and to stop birds eating the catch. • Set up several traps to increase reliability. • Check traps regularly. **Transect Lines** In relation to sampling techniques: • Quadrats – sample ground plants • Pitfall Traps – sample ground dwelling invertebrates. **Abiotic Factors** An abiotic factor is a non-living factor which affects the biodiversity of organisms within an ecosystem. Examples are: • Moisture Levels • pH • Light Intensity

	Photosynthesis • Photosynthesis is the process by which green plants use light energy to make glucose. • The raw materials for photosynthesis are carbon dioxide & water. • The products are glucose & oxygen • The conditions required are light & chlorophyll. • Chlorophyll is the green pigment found in plant leaves. • The greater the light intensity, the faster the rate of photosynthesis. • Plants make a range of carbohydrates. • Glucose is used for energy. • Starch is used for storage. • Cellulose is used for stability in cell walls. • Leaves can be tested for starch. • The leaf is boiled in water to kill the cells. • The leaf is boiled in alcohol to remove the chlorophyll. • The leaf is tested with a couple of drops of iodine solution. • If starch is present the iodine solution on the leaf goes from brown to black. **Increasing Food Yield** • Fertiliser: A nutrient that is added to the soil to improve soil fertility. • Genetically Modified Organisms: A cell or organism that has had its genetic code altered by the addition of a gene from another organism. • Pesticides: A chemical that kills organisms/ pests. • Biological Control: The introduction of a natural predator to control pests.

Topic:	S3 Cell Structure - Level 4
Overview:	To explore different cell structures including animal, plant, bacteria and fungi. Discover the importance of all the cell organelles and their function and related these structures of processes and reactions in an organism. Investigate passive and active transport in relation to the cell membrane.
Content:	**Cell Structure** The structures found in animal, plant, bacteria and fungi cells. **Plant Cells Contain:** • Cell membrane – controls the entry and exit of substances • Cell wall – provides support to the cell • Nucleus – stores DNA and controls cell activity • Cytoplasm – site of many chemical reactions • Vacuole – stores excess water and cell sap • Chloroplast – site of photosynthesis • Mitochondria – site of aerobic respiration • Ribosome – site of protein synthesis **Animal Cells Contain:** • Cell membrane – controls the entry and exit of substances • Nucleus – stores DNA and controls cell activity • Cytoplasm – site of many chemical reactions • Mitochondria – site of aerobic respiration • Ribosome – site of protein synthesis **Fungal Cells Contain:** • Cell membrane – controls the entry and exit of substances • Cell wall – provides support to the cell • Nucleus – stores DNA and controls cell activity • Cytoplasm – site of many chemical reactions • Mitochondria – site of aerobic respiration • Ribosome – site of protein synthesis **Bacterial Cells Contain:** • Cell membrane – controls the entry and exit of substances • Cell wall – provides support to the cell • Ribosome – site of protein synthesis • Cytoplasm – site of many chemical reactions • Plasmid – used in genetic engineering • Flagella – tail-like structure to allow bacteria to move • Long-stranded DNA – genetic information in bacteria

	Cell Membrane The structure of the cell membrane as has a phospholipid bilayer with incorporated proteins. The proteins within the membrane provide a channel which allows small substances to pass through the membrane. Substances which are too big to pass through the channel cannot enter the cell. This is why the membrane is described as **Selectively Permeable**. Substances can move across and cell membrane by the processes of osmosis, diffusion and active transport. The difference between passive (diffusion and osmosis) and active transport: • **Diffusion (passive)** - the movement of molecules down a concentration gradient from an area of **high concentration** to an area of **low concentration.** • **Osmosis (passive)** - the movement of **water molecules** from an area of **high water concentration** to a **lower water concentration** through a **selectively permeable membrane.** • **Passive processes do not require energy.** • **Active Transport** – the movement of molecules from a low to a high concentration against a concentration gradient. Active processes require energy.

Topic:	S3 Production of Proteins - Level 4
Overview:	Examine the structure of a DNA molecule and its structure. Explore the complementary base pairing and how these can code for different proteins, such as hormones, antibodies, enzymes, receptor and structural. Investigate the use of enzymes as biological catalysts through different reactions and the factors that can effect an enzyme action.
Content:	**DNA** The structure of DNA as being a double helix composed of repeating bases and their base-pair: • Adenine and thymine • Cytosine and guanine **Producing Proteins** • A **gene** is a section of DNA which codes for a protein. • Repeating bases in DNA make up the genetic code. • The order of this sequence determines the amino acid formed. • Amino acids join together to form a protein. • The order of amino acids results in different protein shapes and functions. • DNA is copied by mRNA at the nucleus. • This mRNA transports this information to the ribosome where proteins are assembled from amino acids. • Examples of different proteins: o Hormones – carry chemical messages around the body o Enzymes – biological catalysts to speed up a reaction o Structural – supporting the structure of the cell o Antibodies – defends the body against disease o Receptors – sends signals into the cell from the outside **Enzymes** • Enzymes function as biological catalysts (speed-up a reaction) and are made by all living cells. • They speed up cellular reactions and are unchanged in the process. • The shape of the active site of an enzyme molecule is complementary to its specific substrate(s). • Enzyme action results in product(s). • Each enzyme is **most active** in its **optimum** is the conditions. • Enzymes and other proteins can be affected by **temperature** and **pH**. • Enzymes can be **denatured**, resulting in a change in their shape which will affect the rate of reaction. • Enzymes can be involved in degradation and synthesis reactions: o A **degradation** reaction is when the enzyme breaks up the substrate into two smaller products. o A **synthesis** reaction is when the enzyme joins together two smaller substrates to make one larger products.

Topic:	S3 Genetic Engineering - Level 4
Overview:	Explore new developments in science, such as genetic engineering and how it has been fundamental in science for medical purposes and the future this technology can bring.
Content:	Genetic information can be transferred from one cell to another by genetic engineering. Stages of genetic engineering: • identify section of DNA that contains required gene from source chromosome • extract required gene • extract plasmid from bacterial cell • insert required gene into bacterial plasmid • insert plasmid into host bacterial cell to produce a genetically modified (GM) organism. **Enzymes** are used to remove the desired gene, cut the plasmid and seal the gene into the plasmid. Insulin and the production of human growth hormone have been produced by genetic engineering. Food and crops have been genetically modified. Examples include Golden Rice, Flavr Savr Tomatoes and pest resistant cauliflowers.

Topic:	S3 Respiration - Level 4
Overview:	Explore respiration in cells through investigations and be able to write out the word equation for aerobic respiration. Explain what factors can affect respiration and describe the alternate pathway of fermentation in relation to animal, plant and yeast cells.
Content:	The chemical energy stored in glucose must be released by all cells through a series of enzyme-controlled reactions called respiration. The energy released from the breakdown of glucose is used to generate ATP. ATP stands for adenosine triphosphate. The energy transferred by **ATP** can be used for the cellular processes. Examples Include: • Mitosis (cell division) • Active Transport • Protein Synthesis • Muscle cell contraction • Transmission of nerve impulses. **Aerobic Respiration** Glucose is broken down in the cytoplasm. This produces two molecules of pyruvate, releasing enough energy to yield two molecules of ATP. Further breakdown depends upon the presence/absence of oxygen. If oxygen is present, aerobic respiration takes place in the mitochondria. Each pyruvate molecule is broken down to carbon dioxide and water. This results in releasing enough energy to yield a large number of ATP molecules. **Fermentation** In the absence of oxygen, the fermentation pathway takes place in the cytoplasm. In animal cells, the pyruvate molecules are converted to lactate. In plant and yeast cells they are converted to carbon dioxide and ethanol. The breakdown of each glucose molecule via the fermentation pathway yields only the initial two molecules of ATP. Without oxygen the pyruvate cannot enter into the mitochondria.

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CURRICULUM REVIEW 2021

CHEMISTRY OVERVIEW – BROAD GENERAL EDUCATION

S1 Elements and Compounds

- Atoms and Molecules
- Elements and the Periodic Table
- Properties of Elements
- Compounds, Mixtures and Separating Techniques

S1 Solutions and Reactions

- Solubility
- Signs of a Chemical Reaction
- Rates of Chemical Reactions

S2 Fuels and Metals

- Fossil Fuels and Combustion
- Crude oil and Hydrocarbons
- Climate Change and Alternative Fuels
- Metals and Corrosion

S2 Acids and Bases

- Indicators and the pH Scale
- Making acids and Alkalis
- Acid Rain
- Neutralisation
- Fertilisers

S3 Level 4 Chemistry

Structure of an Atom

- Atomic Structure and Sub Atomic Particles
- Atomic Number and Mass Number
- Isotopes and Relative Atomic Mass
- Electron Arrangement and Groups in the Periodic Table

Rates of Reaction

- Factors Effecting Reaction Rate
- Calculating an Average Reaction Rate
- Chemical Formulae
- Writing Word and Formula Equations

Bonding and Properties of Materials

- Ionic Compounds
- Properties of Ionic Compounds
- Covalent Compounds
- Properties of Covalent Molecular Compounds
- Properties of Covalent Network Compounds

Acids, Bases and Neutralisation

- Acids and Bases
- Neutralisation Reactions
- Writing Ionic Formulae

CURRICULUM REVIEW 2020-21

S1 Chemistry

Topic:	S1 Elements and Compounds
Overview:	To explore the properties of different substances, and how they can be changed, students develop an understanding of the chemical world around them. Students will learn how to use chemical symbols to represent elements and to develop and understand the differences between mixtures and compounds. Naming compounds, learning about their properties and how these differ from their constituent elements is key.
Content:	**Atoms and Molecules** • An element has only one type of atom. • Molecules are formed when two or more atoms are joined together. • Molecules can be made of atoms of the same type - O_2 • Molecules can also be made of different types of atoms joined together - CO_2. **Elements and the Periodic Table** • Elements are made from the same type of atom. • Elements are shown in a chart called the Periodic Table. • Elements all have their own symbol. • Symbols with one letter are written with a capital letter. • Symbols with two letters, the first letter is a capital, the second letter is lowercase. • Elements can be divided into two groups: metals and non metals. • Elements on the left of the zigzag line are metals. • Elements on the right of the zigzag line are non-metals. • Metal elements can be identified by their distinctive flame colours. • Groups are vertical columns in the periodic table. • Group 1: The alkali metals. • Group 7: The halogens. • Group 0: The noble gases • The large block of elements between group 2 and 3: The Transition Metals. • Elements in the same group have similar chemical properties.

Properties of Elements

Properties of metal elements:

- They are shiny, good conductors of electricity and heat, they can be shaped (malleable).
- The uses of metal elements relate to their properties.
- For example: Silver is used to make jewellery because it can be shaped.
- Copper is used in wires as it's a good conductor of electricity.

Properties on non-metal elements:

- They are dull
- poor conductors of electricity and heat
- they can't be shaped.

Compounds, Mixtures and Separating Techniques

- A mixture is formed when two or more different substances come together **without joining**.
- Examples of common mixtures are: **air** and **sea water**.
- Two common techniques for separating mixtures are filtration and chromatography.
- Compounds are substances which are made up of two or more different elements **joined together**.
- Examples of common compounds are **water**, **salt**, **sugar** and **carbon dioxide**.
- The properties of compounds are usually different to the properties of the elements which make the compounds up.
- Compound ending in **-ide** contain **two** elements
- For example: the compound iron sulph**ide** is made from **iron** and **sulphur.**

Topic:	S1 Solutions and Reactions
Overview:	To investigate solubility and to understand the differences between soluble and insoluble materials. This will include learning new terms such as solute, solvent, solution and what is meant by a saturated solution. To develop an understanding of energy changes in a chemical reaction and some of the factors affecting the rates of chemical reactions. This will include writing word equations to show the reactants and products in a reaction.
Content:	**Solubility** • A substance dissolved in a liquid is called a solute. • A liquid that a substance dissolves in is called a solvent. • A liquid with a substance dissolved in it is called a solution. • A soluble substance is one that dissolves. • A solid substance has dissolved when: • There is no solid left at the bottom of the test tube. • The solution is transparent. • The solution takes the colour of the solid. • The speed of dissolving can be increased by stirring and heating the solution. • A saturated solution is one where no more solute can dissolve in the solvent. • A concentrated solution is one that has lots of solute dissolved in it. • A dilute solution has a little substance dissolved in it. • A concentrated solution can be diluted by adding water to it. • An insoluble substance is one that does not dissolve. **Signs of a Chemical Reaction** In a chemical reaction a new substance is always formed. Signs are: • A colour change or a change in appearance. • An energy change: heat, light or sound. • A new substance is formed such as a solid or a gas. • Word equations are written to show what happens in a chemical reaction. • Reactants are the substances reacting together. • An arrow is used to show that new products are formed. • Products are the substances that are formed in the reaction. **Rates of Chemical Reactions** **Reaction rates are affected by changes in:** • Particle size: the smaller the particles, the faster the reaction. • Concentration: the more concentrated a solution, the faster the reaction. • Temperature: the hotter the temperature, the faster the reaction. • A catalyst is a substance that speeds up a chemical reaction, but is not used up in the reaction.

Topic:	S2 Fuels and Metals
Overview:	To develop knowledge and understanding of the chemistry of fuels and metals. The need for fuels and metals is investigated along with the various sources of these valuable resources. In addition to their impact on society and the environment, the sustainability of fuels and metals is considered. Some of the processes which contribute to climate change are investigated and the possible impact of atmospheric change on the survival of living things is discussed.
Content:	**Fossil Fuels and Combustion** • A fuel is a chemical which burns in oxygen giving out heat energy. • Combustion is another word for burning in oxygen. **The three main fossil fuels are:** ● coal ● crude oil ● natural gas • A finite resource is one that cannot be replaced and will run out. • Crude oil is a mixture of (mainly) hydrocarbons. • A hydrocarbon is a molecule made from hydrogen and carbon only. • The hydrocarbons in a crude oil mixture have different boiling points. • Fractional distillation is the process used to separate crude oil into fractions. • Crude oil fractions are mainly used as fuels. • Hydrocarbons that burn in a plentiful supply of oxygen produce carbon dioxide and water only. • The word equation for the reaction is: o Hydrocarbon + oxygen --> carbon dioxide + water • The chemical test for carbon dioxide is that it turns limewater cloudy. **Climate Change and Alternative Fuels** • The greenhouse effect occurs when energy from the sun is trapped as heat, by the atmosphere. • Carbon dioxide is a greenhouse gas linked to increasing global temperatures (global warming). **Possible reasons for global warming include the:** o burning of fossil fuels (man-made). o manufacture of concrete (man-made) o increased solar output (natural).

Many scientists think that global warming will lead to:

- more violent weather systems, e.g. hurricanes
- drought
- flooding of coastal areas
- more frequent forest fires.
- The effects of global warming destroy habitats and may lead to extinction of some species.
- Fermentation is a process which converts carbohydrates such as glucose into a type of alcohol called ethanol.
- Yeast is used to convert carbohydrates into alcohol in the absence of oxygen.
- The yeast becomes poisoned once the alcohol content reaches approx 15%.
- Drinks with an alcohol content over 15% are made by fermentation followed by distillation.
- Ethanol can be used to make fuel for cars and lorries.
- Fermenting food carbohydrates for fuel leads to increased food prices.

Ethanol can be fermented from inedible parts of plants (cellulose):

- grass
- waste wood
- inedible parts of plants eg straw
- Hydrogen can be used as an alternative fuel.
- Hydrogen is renewable (by passing electricity through water)
- Hydrogen only produces water when burned.

Metals

Properties and Uses of Metals

The use of a metal is related to its physical and chemical properties

Important properties are:

- Strength
- Malleability
- Electrical conductivity
- Heat conductivity
- Density
- Magnetism
- An alloy is a mixture of metals with metals or a mixture of metals with non-metals.
- The properties of an alloy are different from the properties of the metals in the mixture.

	Corrosion of Metals ○ Metals corrode by their reaction with oxygen and water. ○ Different metals corrode at different rates. ○ Rusting is the corrosion of iron. ○ Rust indicator is used to detect rusting. Rust indicator turns blue where rusting is occurring. ○ Two main methods can be used to prevent iron from rusting: ▪ Physical protection: This creates a barrier, preventing water and oxygen getting to the iron (including paint, oil, grease, plastic or an unreactive metal) ▪ Chemical protection: This prevents the iron from forming rust in the presence of water and oxygen (including sacrificial protection and connecting to a negative power terminal) ○ In sacrificial protection, a more reactive metal is attached to the iron. The more reactive metal corrodes instead of the iron when in contact with water and oxygen.

CURRICULUM REVIEW 2020-21

S2 Chemistry

Topic:	S2 Acids and Bases
Overview:	To develop knowledge and understanding of the chemistry of acids and bases. What determines whether a substance is an acid or base is investigated. Diluting solutions and making acids and alkalis is also a key component. This leads on to the chemistry behind the formation of acid rain and its impact on society and the environment. Acid and base reactions, the formation of salts and how these salts can be used as fertilisers is the final component. This links with sustainability and food production focusing on some of the problems associated with artificial fertilisers.
Content:	**Indicators and the pH Scale** • Solutions can be classified as "acidic", "alkaline" or "neutral". • Solutions can be classified as acidic, alkaline or neutral using universal indicator or pH paper • The colour universal indicator (or pH paper) changes to, when added to a solution can be compared against a pH chart and used to classify a solution as an acid, alkali or neutral. • Universal indicator is a mixture of different indicators. • Acids are solutions with a pH less than 7. • The lower the pH, the more acidic the solution is. • Alkalis are solutions with a pH of more than 7. • The higher the pH, the more alkaline the solution is. • Neutral solutions have a pH of exactly 7. • Pure water has a pH of exactly 7. **Common lab acids include:** ○ hydrochloric acid ○ nitric acid ○ sulfuric acid **Household acids include:** ○ Fizzy drinks ○ lemon juice ○ vinegar **Common lab alkalis include:** ○ sodium hydroxide ○ potassium hydroxide ○ calcium hydroxide

Household alkalis include:

- toothpaste
- baking soda
- bleach

- Diluting with water moves the pH of an acid up towards 7.
- Diluting with water moves the pH of an alkali down towards 7.

Making Acids and Alkalis

- Metal oxides that dissolve in water produce alkalis.
- Non-metal oxides that dissolve in water produce acids.
- Insoluble oxides will have no effect on the pH of water (neutral).

Acid Rain

- Normal rainfall is slightly acidic due to dissolved atmospheric carbon dioxide.
- Acid rain is rainwater that is more acidic than normal rainwater.
- Acid rain is caused when sulphur dioxide and nitrogen dioxide dissolve in rainwater.
- Sulphur dioxide is produced by burning sulphur containing fossil fuels, such as coal.
- Nitrogen oxides are produced when nitrogen and oxygen react together due to the energy produced by the spark plug in a petrol engine.

Neutralisation

- The reaction of an acid with base to form a salt and water is called neutralisation.
- Neutralisation reactions move the pH of a solution to 7.
- The general word equation is: acid + alkali → salt + water

Everyday examples of neutralisation reactions include:

- neutralising plaque acid with toothpaste.
- neutralising stomach acid with indigestion tablets.
- adding lime to reduce the acidity of soil/lochs.
- using baking powder (acid + carbonate) to produce bubbles in cakes.
- removing lime scale using vinegar.
- A base is a substance that reacts with an acid to produce salt and water.

The three types of base are:

- metal oxides
- metal hydroxides
- metal carbonates

	• An alkali is a solution made by dissolving a base in water. • The specific type of salt produced in a reaction will depend on both the metal and the type of acid used. • Hydrochloric acid produces metal chloride salts • Nitric acid produces metal nitrate salts • Sulphuric acid produces metal sulphate salts **Fertilisers** The three elements necessary for healthy plant growth are: ● nitrogen ● phosphorus ● potassium • Fertilisers are chemicals which are used to make crops grow larger and faster. • Fertilisers contain compounds with the elements nitrogen, phosphorus and potassium. • Fertilisers are necessary to replace the nutrients removed from the soil when crops are harvested. • Fertilisers are also necessary to ensure speedy crop growth to feed the ever increasing world population. • Fertilisers are soluble in water. • Many fertilisers make the soil acidic. • Very soluble fertilisers are washed out of the soil and into rivers and streams where they poison aquatic life. • Some fertilisers can make the soil too acidic for growing certain crops. • Natural fertilisers are made from the remains of crops or animal waste such as manure, compost and seaweed. • Man-made fertilisers are salts made by neutralisation reactions.

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S3 Chemistry

Topic:	S3 Level 4 Atomic Structure
Overview:	To develop knowledge and understanding of atoms and their sub atomic particles. To understand how the atomic number and mass number provide valuable information about at atom and its sub atomic particles. To know about electrons, how they are arranged in their energy levels and how this determines the chemical properties of different elements.

Content:	**Atomic Structure and Sub Atomic Particles**
	• Elements in the Periodic Table are arranged in order of increasing atomic number.
	• The Periodic Table can be used to determine whether an element is a metal or non-metal.
	• An element has only one type of atom.
	• An atom has a nucleus, containing protons and neutrons, and electrons that orbit the nucleus:
	  ○ Protons have a charge of one-positive and a mass of one atomic mass unit.
	  ○ Neutrons are neutral and have a mass of one atomic mass unit.
	  ○ Electrons have a charge of one-negative and have virtually no mass.
	  ○ In a neutral atom the number of electrons is equal to the number of protons.
	
	Atomic Number and Mass Number
	• The number of protons in an atom is given by the atomic number.
	• The mass number of an atom is equal to the number of protons added to the number of neutrons.
	• Nuclide notation is used to show the atomic number, mass number (and charge) of atoms (ions) from which the number of protons, electrons and neutrons can be determined.
	
	Isotopes and Relative Atomic Mass
	• Isotopes are defined as atoms with the same atomic number but different mass numbers, or as atoms with the same number of protons but different numbers of neutrons.
	• Most elements have two or more isotopes.
	• The average atomic mass has been calculated for each element using the mass and proportion of each isotope present.
	• These proportional values are known as relative atomic masses.

	Electron Arrangement and The Periodic Table • Groups are columns in the Periodic Table containing elements with the same number of outer electrons, indicated by the group number. • Elements within a group share the same valency and have similar chemical properties because they have the same number of electrons in their outer energy levels. • The electron arrangement of atoms can be written showing the number of electrons and their position within the energy levels.

Topic:	S3 Level 4 Reaction Rates
Overview:	To develop an understanding of the factors that alter the rate of a chemical reaction. Through experimentation, you will monitor the rate of a chemical reaction and calculate the average rate of a chemical reaction at different points as the reaction proceeds. Writing chemical formulae and equations is a fundamental skill in Chemistry. You will learn how to write chemical formulae and convert word equations into formula equations.
Content:	**Factors Effecting Reaction Rate** To follow the progress of chemical reactions, changes in mass, volume and other quantities can be measured. Graphs can then be drawn and be interpreted in terms of: • end-point of a reaction • quantity of product • quantity of reactant used • effect of changing conditions Rates of reaction can be increased: • by increasing the temperature • by increasing the concentration of a reactant • by increasing surface area/decreasing particle size • through the use of a catalyst Catalysts are substances that speed up chemical reactions but can be recovered chemically unchanged at the end of the reaction. **Calculating an Average Reaction Rate** • The average rate of a chemical reaction can be calculated, with appropriate units, using the equation: $$\textbf{Average rate} = \frac{\Delta\, \boldsymbol{quantity}}{\Delta\, \boldsymbol{time}}$$ • The unit, mol l^{-1} s^{-1} represents moles per litre per second. • The unit cm^3 s^{-1} represents centimetres cubed per second. • The rate of a reaction can be shown to decrease over time by calculating the average rate at different stages of the reaction. **Chemical Formulae** • Compound names are derived from the names of the elements from which they are formed. • Most compounds with a name ending in '-ide' contain the two elements indicated. • The ending '-ite' or '-ate' indicates that oxygen is also present. • Chemical formulae can be written for two element compounds using valency rules and a Periodic Table.

	• Roman numerals can be used, in the name of a compound, to indicate the valency of an element. • The chemical formula can also be determined from names with prefixes. • The chemical formula of a covalent molecular substance gives the number of each type of atom present in a molecule. • The formula of a covalent network gives the simplest ratio of each type of atom in the substance. • Ions containing more than one type of atom are often referred to as group ions. • Chemical formulae can be written for compounds containing group ions using valency rules and the data booklet. • In formulae, charges must be superscript and numbers of atoms/ions must be subscript. • Word equations showing the reactants and products in a chemical reaction can be written. • Equations using formulae can be written showing the reactants and products.

Topic:	S3 Level 4 Bonding and the Properties of Materials
Overview:	To know about the bonding of elements and compounds. To investigate a range of properties including: solubility, conductivity, melting and boiling point of elements and compounds.
Content:	**Ionic Compounds** • Ionic compounds Ions are formed when atoms lose or gain electrons to obtain the stable electron arrangement of a noble gas. • In general, metal atoms lose electrons forming positive ions and non-metal atoms gain electrons forming negative ions. • Ion-electron equations can be written to show the formation of ions through loss or gain of electrons. • Ionic bonds are the electrostatic attraction between positive and negative ions. • Ionic compounds form lattice structures of oppositely charged ions with each positive ion surrounded by negative ions and each negative ion surrounded by positive ions. **Properties of Ionic Compounds** • Ionic compounds have high melting and boiling points because strong ionic bonds must be broken in order to break up the lattice. • Many ionic compounds are soluble in water. • As they dissolve the lattice structure breaks up allowing water molecules to surround the separated ions. • Ionic compounds conduct electricity only when molten or in solution as the lattice structure breaks up allowing the ions to be free to move. • Conduction in ionic compounds can be explained by the movement of ions towards oppositely charged electrodes. **Covalent bonding** • Covalent bonds form between non-metal atoms. • A covalent bond forms when two positive nuclei are held together by their common attraction for a shared pair of electrons. • Diagrams can be drawn to show how outer electrons are shared to form the covalent bond(s) in a molecule. • 7 elements exist as diatomic molecules through the formation of covalent bonds: H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2. • The shape of simple covalent molecules depends on the number of bonds and the orientation of these bonds around the central atom. • These molecules can be described as linear, angular, trigonal pyramidal or tetrahedral. • More than one bond can be formed between atoms leading to double and triple covalent bonds. • Covalent substances can form either discrete molecular or giant network structures.

	Covalent molecular substances: • have strong covalent bonds within the molecules and only weak attractions between the molecules • have low melting and boiling points as only weak forces of attraction between the molecules are broken when a substance changes state • do not conduct electricity because they do not have charged particles which are free to move. • Covalent molecular substances which are insoluble in water may dissolve in other solvents. **Covalent network structures:** • have a network of strong covalent bonds within one giant structure • have very high melting and boiling points because the network of strong covalent bonds is not easily broken • do not dissolve In general, covalent network substances do not conduct electricity. This is because they do not have charged particles which are free to move.

Topic:	S3 Level 4 Acids, Bases and Neutralisation
Overview:	To investigate a range of acid/base neutralisation reactions. To understand dilution and how to prepare acid and alkaline solutions. To be able to represent these neutralisation reactions using balanced equations and hence calculate concentrations/volumes of reactants.
Content:	**Acids and Bases** **pH** • The pH scale is an indication of the hydrogen ion concentration and runs from below 0 to above 14. • A neutral solution has equal concentrations of H+ (aq) and OH^-(aq) ions. • Water is neutral as it dissociates according to the equation $H_2O(\ell) \rightleftharpoons H^+(aq) + OH^-(aq)$ • producing equal concentrations of hydrogen and hydroxide ions. • At any time, only a few water molecules are dissociated into free ions. • The symbol ⇌ indicates that a reaction is reversible and occurs in both directions. • Acidic solutions have a higher concentration of H+ (aq) ions than OH^-(aq) and have a pH below 7. • Alkaline solutions have a higher concentration of OH^-(aq) ions than H+ (aq) ions and have a pH above 7. • Dilution of an acidic solution with water will decrease the concentration of H+ (aq) and the pH will increase towards 7. • Dilution of an alkaline solution with water will decrease the concentration of OH^-(aq) and the pH will decrease towards 7. • Soluble non-metal oxides dissolve in water forming acidic solutions. • Soluble metal oxides dissolve in water to form alkaline solutions: • metal oxide + water → metal hydroxide • Metal oxides, metal hydroxides, metal carbonates and ammonia neutralise acids and are called bases. • Those bases that dissolve in water form alkaline solutions. **Neutralisation reactions** • A neutralisation reaction is one in which a base reacts with an acid to form water. A salt is also formed in this reaction. • Equations can be written for the following neutralisation reactions: a metal oxide + an acid → a salt + water a metal hydroxide + an acid → a salt + water a metal carbonate + an acid → a salt + water + carbon dioxide • The name of the salt produced depends on the acid and base used. • Hydrochloric acid produces chlorides, sulfuric acid produces sulfates and nitric acid produces nitrates. • Spectator ions are ions that remain unchanged by the reaction. • Reaction equations can be used to identify spectator ions.

- For neutralisation reactions, equations can be written omitting spectator ions:

$2H^+(aq) + O_2^{-}(s) \rightarrow H_2O(\ell)$	for metal oxides
$H^+(aq) + OH^-(aq) \rightarrow H_2O(\ell)$	for metal hydroxides
$2H^+(aq) + CO_3^{2-}(aq) \rightarrow H_2O(\ell) + CO_2(g)$	for aqueous metal carbonates
$2H^+(aq) + CO_3^{2-}(s) \rightarrow H_2O(\ell) + CO_2(g)$	for insoluble metal carbonates

- In an acid-base titration, the concentration of the acid or base is determined by accurately measuring the volumes used in the neutralisation reaction.
- An indicator can be added to show the end-point of the reaction.
- Given a balanced equation for the reaction occurring in any titration:
    - the concentration of one reactant can be calculated given the concentration of the other reactant and the volumes of both solutions
    - the volume of one reactant can be calculated given the volume of the other reactant and the concentrations of both solutions
- Neutralisation reactions can be used to prepare soluble salts.
- Titration can be used to produce a soluble salt.
- Once the volumes of acid and alkali have been noted, the reaction can be repeated without the indicator to produce an uncontaminated salt solution.
- The solution can then be evaporated to dryness.
- Insoluble metal carbonates and insoluble metal oxides can be used to produce soluble salts.
- Excess base is added to the appropriate acid, the mixture is filtered and the filtrate evaporated to dryness

Ionic Formulae & Equations

- Ionic formulae give the simplest ratio of each type of ion in the substance and can show the charges on each ion, if required.
- In formulae, charges must be superscript and numbers of atoms/ions must be subscript.
- Chemical equations, using formulae and state symbols, can be written and balanced.

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CURRICULUM REVIEW 2021

PHYSICS OVERVIEW – BROAD GENERAL EDUCATION

S1 Light

- Reflection
- The Eye
- Lenses
- Colours of Light
- Electromagnetic Radiation

S1 Energy

- States of Matter
- Types of Energy
- Heat Energy
- Insulating Your Home
- Fossil Fuels and Renewable Energy

S2 Electricity

- Types of electricity
- Circuits
- Voltage
- Making Electricity
- Chemical Cells and the Electrochemical Series

S2 Forces and Transport

- Transport and Speed
- Balanced and Unbalanced Forces
- Transport and Forces
- Examples of Forces
- Mass
- Magnetism and Electromagnets

S3 Level 4 Physics Kinematics, Mechanics and Dynamics

- Vectors and Scalars
- Velocity- Time Graphs
- Acceleration
- Newtons Laws
- Energy
- Projectile Motion

CURRICULUM REVIEW 2020-21

S1 Physics

Topic:	S1 Light
Overview:	To develop a knowledge and understanding of light and how we see colours, as well as light beyond the visible spectrum. Identifying the structure and function of the different parts of the eye is key. Students will learn about sight conditions and how different shaped lenses bend light. Through further practical work our students will learn about how we see colour and how colours are mixed.
Content:	**Reflection** • The speed of light is 300 million meters per second. • Light travels in straight lines. • An object that blocks light creates a shadow. • A beam of light shines onto a flat reflector, the angle of incidence (i) is equal to the angle of the reflected light (r). • Three beams of light shine onto a curved reflector, the beams converge to a focal point. • The signal is strongest at the focal point. • Curved reflectors can be used to transmit and receive television signals. **The Eye** Parts of the eye: • Cornea: The clear outer layer at the front of the eye. • Iris: Changes the size of the pupil • Pupil: The part of the eye that allows light to enter. • Lens: A jelly material that Focuses light onto the retina. • Retina: Detects light at the back of the eye. • Optic nerve: Transfers information from the retina to the brain. • When light enters the eye it passes through the lens. • The image is upside down and a mirror image. • The brain processes this image and turns it the right way around. **Lenses** • When light travels through lenses it refracts (bends). • There are two types of lenses, convex and concave. • Convex lens: light passes through the lens and bends inwards at a point, known as the focal point. • Concave lens: Concave lenses are thinner in the middle. Light passes through the lens and spreads out (the light rays diverge).

Normal sight:

- The lens in our eye is convex.
- Images are focused on our retina by changing the shape of the lens.
- Light from distant objects makes the lens thinner.
- Light from close objects makes the lens thicker.

Eye Conditions:

- Short-sightedness can be corrected with a concave lens.
- Long -sightedness can be corrected with a concave lens.
- The focal length of a lens is the distance between the middle of the lens and the focal point.
- The power of a lens is calculated using: power = 1/f (where f is the focal length in meters)
- Examples of lenses in everyday items.

Colours of Light

- White light is made up of a mixture of coloured light.
- White light can be split with a prism. This shows all of the colours in the visible spectrum.
- The colours in the visible spectrum are red, orange, yellow, green, blue, indigo and violet.
- The three primary colours of light are red, green and blue.
- The primary colours of light can be mixed to produce other colours.
- Blue and red = magenta.
- Green and blue = cyan
- Red and green = yellow.

Seeing Colour:

- The colour of an object depends on the colours of light which are reflected and those that are absorbed. For example, grass appears green because when white light shines on grass, the colour green is reflected into our eyes. All of the other colours are absorbed.
- If all of the colours of visible light are reflected, the object appears white.
- If all of the colours of light are absorbed, the object appears black.
- A coloured filter lets light through of a specific colour and absorbs all of the other colours.
- For example: A red filter will let through red light, all of the other colours will be absorbed.

Electromagnetic Radiation

- Visible light is a small part of a spectrum of radiation called the Electromagnetic (EM) Spectrum.
- The individual types of radiation differ in wavelength but all travel at the speed of light.
- Only visible light can be detected by the human eye.
- Some high energy wavelengths of radiation are harmful and damage living cells.

Gamma Rays:

- Used in the medical industry to treat cancer and tumours.
- Used in industry to measure the thickness of materials.

X Rays:

- Used in medicine to check for broken bones. Doctors and dentists leave the room when x rays are taken to protect themselves from over exposure.
- They are used in airports for security.

Ultraviolet Radiation:

- Used to disinfect drinking water by killing bacteria.
- Can also be used to detect forged banknotes.
- UV light is also used to set white dental fillings.
- When skin becomes damaged by UV radiation it becomes sunburned.
- Too much UV radiation can eventually cause skin cancer.

Infrared Radiation:

- Used in remote controls and night vision cameras.
- Can be used to detect tumours as they produce more heat.

Microwaves:

- Used for mobile phone signals and to heat up food.

Radio waves:

- Used in broadcasting and satellite communications.

Topic:	S1 Energy
Overview:	To develop a knowledge of the different states of matter and how a change in temperature can affect matter. Students will explore state changes which leads into investigating the water cycle. The types of energy and how energy changes into different forms is also examined. The transfer of heat and the processes of conduction, convection and radiation are explored through practical experimentation. Sustainability and how we insulate our homes is a key concept. Sources of renewable energy, their positives and some of the problems associated with their use are explored.
Content:	**States of Matter** • Everything in the world is made up of tiny particles called atoms. • There are three states of meter, solid, liquid and gas. **Solids:** o Do not flow. o Have their own shape. o Keep their own volume. o The particles are arranged neatly. o The particles vibrate slowly. o Everyday examples of solids are a table, a bowling ball and a door. **Liquids:** o The particles flow. o It doesn't have its own shape. It takes the shape of the container you put it in. o It has a fixed volume. o The particles are disordered. o The particles vibrate quickly. o Everyday examples of liquids are water, hot sauce, orange juice and mouthwash. **Gases:** o The particles flow and spread out. o It doesn't have a fixed shape. o It can change volume. o The particles are disordered and move around the container. o The particles vibrate very quickly. o Everyday examples of gases are air, methane – the gas we burn in school and when cooking and carbon dioxide. **Changing States of Matter** A change of state occurs when heat is added or taken away from a substance. **Adding Heat:** • Ice melts to form liquid water. • Liquid water boils to form steam.

Removing heat:

- Steam condensed to form water droplets.
- Liquid water freezes to form ice.

Melting and Boiling:

- Different substances melt and boil at different temperatures.
- The melting point is the temperature at which a solid turns into a liquid.
- The melting point of water is 0 C
- The boiling point is the temperature at which a liquid turns into a gas.
- The boiling point of water is 100 C
- The boiling point of alcohol is 78 C

Evaporation:

- Evaporation is a special type of boiling that takes place below the boiling point.
- The energy needed to turn a liquid into a gas is taken from the surroundings.
- An example is water evaporating from the skin to cool the body.

The Water Cycle:

- The water cycle is the continuous movement of water. It provides all of the fresh water needed for life on land.
- Water evaporates from the surface of the earth – lake or sea.
- It rises into the atmosphere then condenses into rain or snow.
- This falls to the surface as precipitation.

Types of Energy

- There are eight different forms of energy.
    - Potential
    - Sound
    - Heat
    - Nuclear (atomic)
    - Chemical
    - Kinetic (movement)
    - Light
    - Electrical

- Potential energy is stored energy.
- Atomic energy is the energy we gain from nuclear fuel.
- Chemical energy is the energy stored inside chemicals.
- Kinetic energy is movement energy.
- Energy is measured in joules (J).
- Energy can’t be made or destroyed, it only changes from one form to another.

- For example: A kettle changes electrical energy into heat energy. A match changes chemical energy into heat and light energy.
- Energy can be wasted when it is transferred.
- For example: A car, chemical energy is transferred into kinetic energy. Heat and sound energy are wasted in the process.

Heat Energy Transfer

- Heat energy travels from hot objects to cold objects.
- There are three ways in which heat energy can travel, these are conduction, convection and radiation.

Conduction:

- Vibrating particles in a solid pass on their vibrations to neighbouring particles. The vibration travels throughout the solid.
- Metals are the best conductors of heat.
- Non-Metals are poor conductors of heat and are known as insulators.
- Gases and liquids are poor conductors as their particles are too far apart to collide and pass on the energy.

Convection:

- Hot liquid rises upwards through a cold liquid.
- Hot gases rise up through gold gases. These currents transfer heat energy through liquids and gases.

Radiation:

- All hot objects give out heat in the form of invisible light called radiation.
- Particles are not needed so radiation can pass through a vacuum – space.
- Radiation is how heat energy travels from the sun to earth.
- Heat loss by radiation can be prevented using a shiny surface.

Insulating Your Home

- There are many ways to save heat in the home.
- Loft and cavity wall insulation.
- Double or triple glazing.
- Draught excluders.
- Carpets.

	Renewable Energy • The three fossil fuels are coal, oil and natural gas. • Fossil fuels are finite resources, meaning they will eventually run out. • Fossil fuels are non- renewable sources of energy. • Burning fossil fuels produces gases which damage the environment. • In Scotland, one of the main uses of coal is to produce electricity. • Steam produced by burning coal is used to turn a turbine which generates electricity. • Electricity can also be produced using a magnet and a coil of wire. • A renewable source of energy is one that will not run out. • Examples are: • Wind • Hydroelectric • Wave • Tidal • Solar • Biomass • Geothermal • Most renewable sources of energy are used to turn a turbine attached to a generator to make electricity. • There can be some disadvantages to renewable sources of energy. • For example, Building hydroelectric dams will destroy natural habitats. • Wind turbines can be unreliable on clam days.

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S2 Physics

Topic:	S2 Electricity
Overview:	To develop their knowledge and understanding of different types of electricity. A focal point is identifying structures of different circuits and how they can have advantages and disadvantages through the use of building their own circuit designs. Students will also calculate current and voltage within these different circuits. Through further practical work our students will be able to make their own electricity as well as investigating how to make the most appropriate chemical cells.

Content:	**Types of electricity**
	• **Static** electricity is electricity that stays in one place.
	• Static electricity is produced when some materials are rubbed together.
	• **Current** electricity is the most common type where there is a flow of negatively charged electrons around a circuit.
	• A circuit is when electrical parts called components are joined together in a continuous loop. The components of a circuit:
	  ○ Cell (battery)
	  ○ Wire
	  ○ Bulb
	  ○ Switch
	  ○ Motor
	  ○ Bell
	  ○ Buzzer
	
	Circuits
	Series circuit
	• In a series circuit all the components are connected one after the other in a loop and there is only one route the current can take.
	• If there is more than one bulb connected this way and one breaks or is unscrewed then all the bulbs will go out.
	
	Parallel circuit
	• In a parallel circuit the components are connected in branches and there is a choice of routes for the current to take.
	• If one bulb is broken or unscrewed the others stay lit. This is how the lights are arranged in a house.
	
	Voltage and Current
	• Current is a measure of the amount of electricity flowing around a circuit.
	• It is measured in amperes (A) using an ammeter set up in series with the component that it measures the current flowing through.

In a Series Circuit:

- Current is the same in all parts of a series circuit.
- Adding extra batteries in a series circuit increases the current and so the bulbs are brighter.
- Increasing the number of bulbs in a series circuit lowers the current and the bulbs get dimmer.

In a Parallel Circuit

- The current coming out of the batteries equals the current in the branches added together.
- When the number of bulbs in a parallel circuit is increased, the total current increases.
- Adding bulbs in parallel makes no difference to the brightness of the bulbs.

Voltage

- Voltage is a measure of the energy that drives an electric current around a circuit.
- It is measured in volts (V) using a voltmeter. A voltmeter is always connected in parallel across the component to be measured.
- In a series circuit, the voltage across the battery, V1 is equal to the voltages across all the components added together.
- In a parallel circuit the voltage across each component is the same as the voltage across the battery.

Making Electricity

- In a chemical cell, electricity is produced by a chemical reaction. These cells need to be replaced when the chemicals run out.
- When two or more cells are connected together it is then called a battery.
- The energy change in a chemical cell is chemical energy to electrical energy.

When charging the battery the energy change is:

- electrical energy --> chemical energy

Examples of rechargeable batteries are:

- lead/acid battery in a car.
- lithium ion battery in laptops, mobile phones.

	Chemical Cells and the Electrochemical Series • Electricity can be produced by connecting two different metals together with a conducting solution, usually salt solution. • This is called a chemical cell. • In this type of cell, electrons flow through the wires. • Charged atoms, called ions flow through the solution. • The electrochemical series lists metals in order of their willingness to give up electrons. • This list is on page 10 of the data booklets. • The most willing is lithium at the top and the least willing is gold at the bottom. • In a chemical cell the electrons flow from the higher metal to the lower metal in the electrochemical series. • The further apart the metals are in the electrochemical series, the bigger the voltage between them.

Topic:	S2 Forces and Transport
Overview:	To be able to calculate the speed of an object. To develop a knowledge of forces, and the effects of forces. To be able to calculate the resultant force when multiple forces are acting on an object. To develop an understanding of the difference between mass and weight. To develop a knowledge of forces that oppose the motion of objects on the ground and in the air. To Investigate the factors effecting the strength of an electromagnet
Content:	**Transport – Speed** Speed is the distance travelled per second. In physics: • Speed has the symbol v • Speed is measured in meters per second (m/s) • Distance has the symbol d • Distance is measured in meters (m) • Time has the symbol t • Time is measured in seconds (s) The equation for speed is: • $v = \frac{d}{t}$ or $Speed = \frac{Distance}{Time}$ Average Speed can be measured in multiple ways including: • Using a stopwatch to time a car traveling along a set distance • Using light gates to time a car over a set distance • Measuring average speed is reliable because values for time and distance are large • Measurements of speed can be made more accurate by repeating the measurements. • Average speed means that the car may have a higher or lower speed for part of this distance **Transport/Forces - Definitions** A force is a push or a pull. **When a force is applied to an object it will change:** ○ speed ○ shape ○ direction of travel ○ Force is measured in units called newtons (N). ○ Force is measured with a spring balance.

Transport/Forces - Balanced and Unbalanced Resultant

- The resultant force is the overall effect of multiple forces acting on an object
- A free body diagram is used to calculate the resultant force.
- Unbalanced forces occur when the resultant force is **not** 0N.
- when forces acting on car are unbalanced, the car will **change** speed.
- If the resultant force acts in the same direction as the car travels, it will increase speed.
- If the resultant force acts in the opposite direction as the car travels, it will decrease speed.
- Balanced forces occur when forces acting on an object are equal and opposite.
- Balanced forces occur when the resultant force is 0N.
- Newton's 1st Law: when forces on a car are balanced it will remain stationary or continue to move at a **constant** speed in a straight line.
- A free body diagram is used to calculate the resultant force.

Transport/Forces - Friction

- Friction is the force that opposes the motion of an object.
- Friction converts Kinetic energy into Heat Energy.
- When the force of friction is equal in magnitude to the engine force of a car it will move at a constant speed
- When the force of friction is less than the engine force of a car, the speed will increase (Acceleration)
- When the force of friction is greater than the engine force of a car, the speed will decrease (Deacceleration)

  Situations where friction is useful include:
  - bike brakes (between the brake blocks and wheel rim)
  - car tyres (between the tyres and the road surface)
  - striking a match (between the match head and the side of the box)

  Situations where friction is a nuisance include:
  - worn out clothes (due to your body rubbing on your clothes)
  - air resistance (between the air and a car when it is moving)
  - friction burns (between hands and a fast-moving rope)

  Friction can be reduced by:
  - Lubrication
  - Reducing the force applied
  - Smoothing the surface of the object

	Forces - Examples Mass and Weight: • Mass is measured in kilograms (kg) • Mass is the measure of the amount of matter in an object • Weight is measured in Newtons (N) • Weight is the measure of the force due to gravity acting on an object • Gravitational Field Strength is measured in newtons per kilogram (N/kg) • Mass remains constant on all planets • Weight varies from planet to planet due to the gravitational field strength of different planets • Earth has a gravitational field strength of 10 N/kg. • Equation: $w = mg$ or $weight = mass \times gravitationalfeildstrength$ Magnetism: • All magnets have 2 poles (ends) • North and south poles are attracted to each other • Like poles repel each other • Magnets generate a magnetic field • Magnetic field lines show the direction a magnetic metal will move in this field • The shape of magnetic field lines can be seen using iron filings • Magnetic field lines are always drawn from north to south Electromagnetism: • Normal Magnets are always Magnetic • Electromagnetic can be switched on an off • Electromagnets can be used in scrapyards to move old cars. • Electromagnets are made by wrapping coils of wire around an iron core and connecting it to a power supply • Increasing the number of coils increases the strength of an electromagnet • Increasing the supply Voltage increases the strength of an electromagnet

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S3 Physics

Topic:	S3 Physics – Level 4: Kinematics, Mechanics and Dynamics
Overview:	Kinematics is the study of motion without considering the forces involved. We will study speed velocity, displacement, acceleration, distance and time. You will learn the symbols and units for each of these. Dynamic is the study of motion considering the forces involved. We will learn to state and apply Newton's three laws of motion. The mechanics studied in S3 will look at the individual energy stores and the energy transfer (work done, gravitational potential energy and kinetic energy) when an object is in motion.
Content:	**Vectors and scalars** • Definition of vector and scalar quantities. • Force, velocity, displacement, acceleration are vector quantities. • Speed, distance, mass, time and energy are scalar quantities. • Calculation of the resultant of two vector quantities in one dimension or at right angles. • Determination of displacement and/or distance using scale diagram or calculation. • Determination of velocity and/or speed using scale diagram or calculation. • Use of appropriate relationships to solve problems involving velocity, speed, displacement, distance and time. $s = vt$ $s = \bar{v}t$ $d = \bar{v}t$ • Description of experiments to measure average and instantaneous speed. **Velocity-time graphs** • Drawing or sketching of velocity-time or speed-time graphs from data. • Interpretation of a velocity-time graph to describe the motion of an object. • Determination of displacement from a velocity-time graph. s = area under v-t graph.

Acceleration

- Definition of acceleration in terms of initial velocity, final velocity and time.
- Use of an appropriate relationship to solve problems involving acceleration, initial velocity (or speed), final velocity (or speed) and time.

$$a = \frac{v-u}{t}$$

- Determination of acceleration from a velocity–time graph:
  a=gradient of the line on a *v*-*t* graph
- Description of an experiment to measure acceleration.

Newton's laws

- Newton's first law: Application of Newton's laws and balanced forces to explain constant velocity (or speed), making reference to frictional forces.
- Newton's second law: Application of Newton's laws and unbalanced forces to explain and/or determine acceleration for situations where more than one force is acting.

$$F=ma$$

- Use of an appropriate relationship to solve problems involving unbalanced force, mass and acceleration for situations where one or more forces are acting in one dimension or at right angles.

$$W = mg$$

- Newton's third law: explanation of motion resulting from a 'reaction' force.
- Explanation of free-fall and terminal velocity in terms of Newton's laws.

Energy

- The conservation of energy: energy cannot be created or destroyed; energy can only be transferred between stores.
- Use of an appropriate relationship to solve problems involving work done, unbalanced force and distance/displacement.

$$E_w = Fd, \text{ or } W = Fd$$

- Definition of gravitational potential energy.
- Use of an appropriate relationship to solve problems involving gravitational potential energy, mass, gravitational field strength and height.

$$E_p = mgh$$

- Definition of kinetic energy.
- Use of an appropriate relationship to solve problems involving kinetic energy, mass and speed.

$$E_k = \frac{1}{2}mv^2$$

- Use of appropriate relationships to solve problems involving conservation of energy.

	Projectile motion • Explanation of projectile motion in terms of constant vertical acceleration and constant horizontal velocity. • For vertical motion use uvats (initial velocity, final velocity, acceleration, time, displacement). • For horizontal motion use svt (displacement, horizontal velocity, time). • Use of appropriate relationships to solve problems involving projectile motion from a horizontal launch, including the use of motion graphs. area under v_h-t graphs (horizontal range) area under v_v-t graphs (vertical height) $v_h = \frac{s}{t}$ (constant horizontal velocity) $v_v = u_v + at$ (constant vertical acceleration) • Explanation of satellite orbits in terms of projectile motion, horizontal velocity and weight.