The Castle School Science Faculty: KS3 Curriculum Map- Biology

Theme	KS2: Previous knowledge	Year 7	Year 8	Year 9 Purple indicates content for set 1s only
Cells, tissues, organs and systems		Structure of plant and animal cells. Microscope parts and use- slide preparation. Specialised cells- egg, sperm, red blood cell, root hair cell. Total magnification.	Magnification (image size/actual size). Cell division and mitosis. Organisation of specialised cells into tissues and organs e.g. nervous system hierarchy. Structure of the skeleton. Muscles.	Neurons- structure and adaptation. Nervous system structure and function. Brain structure and regions. Endocrine system, examples of glands. **Brain and spinal cord problems.** **Negative feedback of thyroxine.**
		Structure of bacteria. Bacterial culture using agar- aseptic technique. Uses of microorganisms- fermentation, yoghurt, digestive health.	Importance of bacteria in the human digestive system. Digestion and the basic role of enzymes. Spread of communicable disease and preventative measures.	Enzymes. Examples and as a protein molecule. Conditions affecting enzyme action. Biotechnology. Conditions required and examples (Quorn/ cheese production). Immune system overview. Vaccination. Antibiotics.
Reproduction and health	• *describe the changes as humans develop to old age (including puberty and gestation periods* • *describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird* • *describe the life process of reproduction in some plants and animals* • *recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function*	Male and female reproductive organs. Puberty changes. Role of hormones (oestrogen, progesterone, testosterone). Menstrual cycle. Contraception.	Birth. Infant nutrition. Consequences of malnutrition- scurvy, kwashiorkor, rickets. Obesity. Effects of alcohol. Effects of smoking. Effects of drugs- stimulants/ depressants/ hallucinogens/ narcotics.	Hormonal control of the menstrual cycle (FSH, oestrogen, LH, progesterone). Role of the Corpus Luteum etc. Reproductive system overview. Artificial use of hormones in assisting conception (IVF) and contraception.

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		Sexual intercourse. Journey of a sperm. Fertilisation- haploid gametes fusing to form a diploid zygote.	Meiosis. Embryo development. Care of the foetus- role of placenta and umbilical cord.	Selective breeding- examples in agriculture. Artificial reproduction methods- tissue culture, cuttings.
		Plant reproduction. Flower structure. Pollination methods. Seed formation and dispersal. Importance in human food security.		Plant tissue and organ overview esp xylem and phloem. Transpiration and translocation. **Plant hormones – tropisms.**
Variation and Inheritance		DNA structure- double helix and GATC code. Chromosome definition and number. Work of Watson, Crick and Francis.	Monohybrid inheritance. Simple genetics. Punnett squares. Genetic diseases.	Genetic modification. **Example of insulin producing bacteria.**
	• *describe how living things are classified into broad groups according to common observable characteristics and based on similarities and differences, including micro-organisms, plants and animals* • *give reasons for classifying plants and animals based on specific characteristics*	Classification Definition of Species Hierarchy: Kingdom, Phylum, Class, Order, Family, Genus, Species Vertebrate classes and characteristics		Biodiversity and gene banks. Definition of species. Hybrids.
	• *recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago* • *recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents*	Environmental vs Genetic Variation. Continuous/ Discontinuous variables. Adaptation. Features of organisms living in extreme environments. How these lead to survival. Features of typical predator/ defences of prey.		Cloning. Survival/ Extinction. Darwin and Natural Selection. Theory of Evolution. Evidence for evolution.

	• *identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution*			
Life processes, Ecology and interdependence	• *identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood* • *recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function* • *describe the ways in which nutrients and water are transported within animals, including humans*	Characteristics of living things: MRS GREN Respiration (word equation). Definition of Autotroph/ Heterotroph.	Lungs and breathing. Structure of alveoli. The heart and circulation. Diffusion. Gaseous exchange. Nutrients. Food tests. Diabetes and Controlling blood glucose.	Respiratory system overview. Cardiovascular system overview. Components of blood. Long/ short term effects of exercise and conditions such as asthma/ bronchitis/ emphysema. Respiration- full process and importance. Structure of the digestive system. Role of each organ. Adaptation of the small intestine. Link between all the systems above in providing reactants for respiration to tissues. Active transport. Osmosis.
		Definitions of ecosystem, habitat, community, population. Biotic and Abiotic factors- examples. Human impacts on ecosystems. Photosynthesis (word equation).	Pyramids of number. Pyramids of biomass. Process of photosynthesis. Leaf adaptations. Limiting factors which affect rate of photosynthesis.	Eutrophication.
		Examples of interdependence. Competition. Predator/ prey relationships. Food Chains. Ecology: sampling methods including quadrats, transects and others such as pitfall traps. Human effects on interdependence- e.g. overfishing.	Food webs. Flow of energy through a food chain/ web.	Interdependence- effects of increase/ decrease of one population within a food web. Human effects on named ecosystems- deforestation, hunting, overfishing. Consequences for whole ecosystem. Bioaccumulation. Work of ecologists- case studies. Positive human effects – zoos and conservation. **Assessing pollution with indicator species**

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Year 7 Lesson/ Composite sequences.

Code	Lesson/ composite title	Substantive knowledge/ components	Disciplinary knowledge	Disciplinary literacy– Keywords *(etymology)* and linked articles	Cultural Capital/ Personal Development
7B1	**What are living things made of?**	Diagram of Animal Cell structure to include: • Nucleus • Membrane • Cytoplasm • Ribosome • Mitochondria Plant cell structure to include organelles above plus: • Cell wall • Chloroplast • Vacuole Roles of the organelles: • Nucleus – stores DNA/Controls cell activies • Cell membrane – controls what enters and exits the cell • Cytoplasm – where most chemical reactions take place • Ribosomes – site of protein synthesis • Mitochondria – releases energy through aerobic respiration. • Cell wall – structure and support • Chloroplast – site of photosynthesis • Vacuole -	Explaining the difference between those 2 cell structures Hooke and discovery (and naming) of cells	Organism *(Latin organum "that which performs some function")* Organelle *(Latin organum"organ of the body")* Nucleus *(Latin- "kernel of a nut")* Cytoplasm *(cyto-"cell" from Greek kytos "a hollow, receptacle" plasma "something molded or created")* Cell wall Cell membrane *(Latin membrana "a skin")* Chloroplast *(Greek khlōros "pale green", platos "formed, molded")* Vacuole *(Latin vacuus- "empty")* Cell *(Latin cella "small room, store room, hut")* Articles: History of the Cell: Discovering the Cell | National Geographic Society Cells and the Versatile Functions of Their Parts | National Geographic Society Intro to cells (article) | Khan Academy	
7B2	**Using a microscope**	Identify parts of microscope to include: • Stage • Eyepiece lens • Objective lens • Focusing knob Preparation of cheek cell with stain	Electron microscopes How better resolution has allowed us to see more Preparation of cheek cell with a stain.	Microscope *(Greek mikros "small," skopein "to look at, examine")* Magnification *(Latin magnificare- "make greater")* Focus *(Latin focus "point of convergence- fireplace")*	

		• Stain is used to see cell structures more clearly. Calculating total magnification – eyepiece x objective lens		Resolution *(Latin resolutionem "process of reducing things into simpler forms")* Lens *(Latin lens "a lentil")* Articles: History of the Cell: Discovering the Cell | National Geographic Society Intro to cells (article) | Khan Academy	
7B3	**What is DNA?**	DNA is stored in the nuclei of cells. Chromosomes are long strands of DNA (coiled around proteins) Most human cells contain 23 pairs of chromosomes (some other organisms for comparison) Structure of DNA • DNA has a double helix shape • DNA has a backbone and bases • The DNA bases are ATGC. • T always pairs with A • G always pairs with C	Work of Watson, Crick, Wilkins and Franklin Extracting DNA from a fruit.	DNA Chromosome *(German chroma- "colour as it was seen when took up stain")* Double Helix *(Latin helix "spiral, a volute in architecture")* Base *(Latin basis "foundation")* Articles: DNA (sciencedaily.com) Oldest sequenced DNA belonged to 1 million-year-old mystery mammoth | Live Science DNA: a timeline of discoveries - BBC Science Focus Magazine	
7B4	**Other types of cell**	Unicellular vs multicellular organisms. • Unicellular organisms consist of one cell e.g. bacteria. • Multicellular organisms consist of many cells e.g. plants, animals. Structure of bacterium: • Bacterium much smaller than plant/animal cells. • Highlight lack of nucleus • Cell wall • Chromosomal DNA • Plasmid • Some have flagella	Comparison of size of prokaryotic and eukaryotic cells (can link to use of electron microscopes)	Unicellular *(Latin uni- "having one only")* Multicellular *(Latin multus "much, many")* Bacterium/ bacteria as plural *(Greek-bakterion "small rod")* Plasmid *(Greek plasma "something molded or created")* Chromosomal DNA Flagellum *(Latin flagellum "whip, scourge")* Specialised cell Differentiated *(Latin differentia "diversity, difference")* Articles: Unicellular vs. Multicellular | National Geographic Society	

		Multicellular organisms need specialised cells. Specialised cells are cells which are adapted for a particular function. Function and adaptation of specialised cells to include: • Egg (function: to be fertilised by a sperm. Adaptations: Yolk/nutrients, only sperm able to enter through membrane) • Sperm (function: to fertilise an egg. Adaptations: tail, mitochondria, acrosome) • Red blood cell (function: to carry oxygen. Adaptations: no nucleus, haemoglobin, large surface area). • Root hair cell (function: to absorb water (large surface area, thin membrane).		Cells and the Versatile Functions of Their Parts | National Geographic Society	
7B5	**How can we see bacteria?**	Preparing a finger dab plate testing four conditions: • Dirty • Washed with water • Washed with soap • Use of hand gel Aseptic technique: • Clean area with disinfectant (Virkon) before and after. • Use of Bunsen burner. Kills microorganisms in surrounding area.	Aseptic technique Safety Comparison of results Sources of error Estimation of coverage	Aseptic technique *(Greek a “not” Latin septikos “rotten, putrid”)* Sterile *(French sterilite “not producing fruit”)* Agar plate *(Greek agarikon “name of a corky tree-fungus”)* Petri dish *(after German bacteriologist)* Microorganism *(Greek mikros "small" Latin organum "that which performs some function")* Articles: Role of microbes in human health and disease (genome.gov) Using Microorganisms in Food Production - ScienceAid	

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7B6	**How can we use microorganisms?**	7 life processes - MRS GREN (movement, respiration, sensitivity, growth, reproduction, excretion, nutrition). Word equation for respiration (glucose + oxygen → carbon dioxide + water) Only some bacteria are pathogenic. Stating the importance of bacteria in human digestive system Principles of Fermentation as a chemical reaction that yeast undergo to produce ethanol and carbon dioxide. Yeast used to make bread/beer. Making yoghurt – use of bacteria.	Yeast culture to show CO_2 produced, linking to being alive. How does biotechnology improve our lives? Making yogurt.	Microorganism *(Greek mikros "small" Latin organum "that which performs some function")* Fermentation *(Latin fermentare "to leaven, cause to rise or ferment")* Fungi *(Latin fungus "mushroom")* Yeast *(Germanic jest "froth")* Articles: Role of microbes in human health and disease (genome.gov) Using Microorganisms in Food Production - ScienceAid	
7B7	**Reproductive organs**	Male structure names and function to include: • Penis – sex organ that inserts sperm into the vagina. • Testis – Produce sperm and sex hormones. • Sperm duct – carry sperm from testes to penis. • Scrotum – Bag of skin containing the testes. Keep the temperature of testes slightly lower than the rest of the body. • Prostate/glands – adds fluid to the sperm to keep them alive. Female structure names and function • Uterus – where a fetus/baby develops until birth • Ovaries – glands which store and release eggs. • Vagina – muscular canal that receives sperm during intercourse. • Cervix – ring of muscle at the entrance to the uterus. • Oviduct – tube that carries the egg to the uterus.	Model of the male and female external and internal reproductive organs.	Penis *(French pénis "tail")* Vagina *(Latin vagina "sheath, scabbard, covering")* Genitals *(Latin genitalis "birth")* Sperm *(French esperme "seed")* Egg Testis *(Latin "witness as in testimony")* Sperm Duct *(Latin ductus "a leading, a conduit pipe")* Semen *(Latin "seed")* Glands *(Latin glans "acorn")* Scrotum *(Latin scortum "a skin, hide")* Ovary *(Latin ovum "egg")* Oviduct *(Latin ovum "egg", ductus "a leading, a conduit pipe")* Uterus *(Latin "womb, belly")* Cervix *(Latin "the neck, nape of the neck")* Prostate *(Greek prostates "a leader standing in front")* Erection *(Latin "to stand up")* Articles: fertility and infertility - Students | Britannica Kids | Homework Help	

				[Sexual Reproduction | National Geographic Society](#) [School of Anthias | National Geographic Society](#)	
7B8	**How do our bodies change?**	Puberty as the stage in development where sex organs become active, this can happen between the ages of 10-14 (for most but can be earlier or later). Changes in males during puberty to include: • Pubic hair • changes in body shape – more muscular • voice deepening • Sperm produced in testes. • Penis gets larger. Changes in females during puberty to include: • Eggs release. • Menstruation starts. • Hips widen. • Breasts grow. • Pubic hair. Hormones controlling these changes (Oestrogen, testosterone) Menstruation – 28 day cycle in females that starts at puberty and ends at menopause. • Days 1-5 - menstruation. Uterus lining breaks down. • Days 6-13 – uterus lining builds up • Day 14 – ovulation. Egg released. • Days 14-17 - Egg travels towards uterus. • Days 18-28 – uterus lining continued to build.		Hormone *(Greek hormone "which sets in motion")* Puberty *(Latin pubertatem "age of maturity")* Adolescence *(Latin/old French adolescentia "youth")* Menstrual Cycle *(Latin menstrualis "monthly")* Menopause *(Latin menopausis "monthly, cease")* Oestrogen *(Greek oistros "to bring about", estrus "madness, impulsiveness")* Progesterone *(pro- for, Latin gestare, "to carry about")* Testosterone *((Latin testis "witness as in testimony")* Articles: [Adolescent Development (clevelandclinic.org)](#)	

7B9	**What is fertilisation?**	Fertilisation defined as male and female sex cells (gametes) nuclei fuse. (Haploid gametes fusing to form a diploid zygote). Sexual reproduction of male and female. Basics of sexual intercourse. Males penis enters vagina and ejaculates sperm. Journey of a sperm from production in the testes to ejaculation. Journey of sperm from vagina, through cervix and uterus to meeting an egg in oviduct. Egg released from ovary. Role of cilia in pushing egg along oviduct. Point of fertilisation- • role of acrosome in breaking down jelly coat/ membrane. • Hardening of coat to prevent double fertilisation. • Combination of paternal and maternal DNA/ chromosomes. • Zygote starts to divide to form an embryo. STIs and contraception • STIs kept to diseases that can be spread during sexual intercourse. • Contraception can be used to prevent fertilisation e.g. condoms, the pill, implant.	Assisted Reproduction Therapy Contraception	Fertilisation *(Latin fertilis "bearing in abundance. Fruitful, productive")* Haploid *(Greek Haploos "Single")* Diploid *(Greek Diploos "Double")* Gamete *(PIE root gem "to marry")* Zygote *(Greek Zygotos "yoked")* Contraception *(Greek Contra "against", Latin concept "to take in and hold ie. Pregnant")* Sexual intercourse *(Latin sexus "copulation" French entrecors "exchange")* Ovulation *(Latin ovulum "small egg")* Ejaculation *(Latin ejaculari "to throw/shoot out")* In-vitro fertilisation *(Latin vitrium "glass," French "make productive")* Sex *(Latin sexus "copulation")* Gender *(French gendre "kind/species")* Erection *(Latin erectus – "upright/elevated")* Articles: fertility and infertility - Students | Britannica Kids | Homework Help School of Anthias | National Geographic Society Sexual Reproduction | National Geographic Society	
Mid biology review lesson					
7B10	**How do plants reproduce?**	Plants can either sexually or asexually reproduce. • Sexual reproduction involves sex cells fusing e.g. flowering plants. • Asexual reproduction involves the organism cloning itself e.g. algae, mosses, ferns.	Dissection of flower (Lily or similar) identifying reproductive organs. Stick and label in book and annotate with functions.	Stigma *(Greek "mark of a pointed instrument")* Stamen *(Latin "weaving, a warp in the upright loom")* Style *(Greek stylos "pillar")* Ovary *(Latin ovum "egg")* Pollen tube Sexual *(Latin sexus "copulation")*	

		Flower structure to include the: • Stigma – Where pollen lands. • Ovary – produces and stores ovules. • Anther – Produces pollen (containing male sex cells). • Petals – brightly coloured to attract insects. Pollination methods including: • Bees/ insects • Wind/ water • Artificial Fertilisation involving the pollen landing on the stigma and sex cell travelling towards the ovary. Seed formation and dispersal. To include: • Wind dispersal • Self-dispersal • Animal dispersal • Water dispersal. Importance of plant reproduction in human food security including loss of bees etc.		Asexual *(Greek a "not")* Anther *(Greek Anthos "flower")* Pollen *(Latin "mill dust, fine flour")* Pollination *(Latin "mill dust, fine flour") ation "action")* Articles: Saving Seeds | National Geographic Society Technology: Seed bank builds on frozen assets | New Scientist Bees of the sea: Tiny crustaceans pollinate underwater plants | New Scientist	

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7B11	**Why don't plants eat?**	Define autotroph as an organism that produces its own food. Define heterotroph as an organism that does not produce its own food Photosynthesis as a chemical reaction that plants use to make food. Process of photosynthesis: • Construction and recall of simple word equation. Carbon dioxide + Water → Oxygen + Glucose • Highlight need for light energy to make this reaction happen. Outcomes of photosynthesis- fate of glucose: • Use in respiration- highlight all plants respire- recall equation for respiration- note similarities and differences to photosynthesis. • Storage as starch • Transport to roots etc	Hydroponics/eden project Testing a leaf for starch	Autotroph *(Latin autos "self", troph- "pertaining to food")* Heterotroph *(Greek hetero "different")* Photosynthesis *(Greek phos "light" synthesis "making/ putting together")* Hydroponics *(Greek hydro "water" ponos- "labour/toil")* Glucose *(Greek gleuko "sweet wine")* Starch *(Old English stercan "make stiff")* Articles: Why do cabbages exist when their shape prevents photosynthesis? | New Scientist On the origin of oxygenic photosynthesis and Cyanobacteria – Sánchez-Baracaldo – 2020 – New Phytologist – Wiley Online Library	
7B12	**Why are living things different?**	Variation as the differences in characteristics. This can between different species or between individuals of the same species. Environmental vs genetic variation • Environmental variation is caused by our surroundings. • Examples of environmental to include scars, tattoos, piercings, accent etc. • Genetic variation is caused by our genes (DNA). We inherit genes from our parents. • Genetic to include eye colour, blood group, ear lobes etc. • Many characteristics can be influenced by both e.g. weight, height, intelligence etc. Continuous vs discontinuous variation	Nature vs nurture argument Measurement of 2 factors and construction of bar chart (discontinuous)/ histogram (continuous). Twin study	Environmental *(French environ "around")* Genetic *(Greek genetikos "origins of")* Continuous *(Latin "following after another")* Discontinuous *(dis "not" Latin "following after another")* Variation *(French- variacion "difference")* Genes *(Greek genea "generation/race")* Inherit *(old French "to make someone an heir")* Mutation *(Latin mutationem "a process of changing")* Characteristic *(Greek kharakter "character")* Articles: Biodiversity | National Geographic Society Nature vs. Nurture: Genes or Environment? (verywellmind.com)	

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		• Discontinuous- can be easily observed and only have certain values. • Continuous variations- need to be measured, all values possible between a range.			
7B13	**How are living things classified?**	Definition of a species as two individuals that can reproduce to produce fertile offspring. Hierarchy of taxonomy: • Kingdom (Plants, Animals, Fungi, Protists, Prokaryotes/bacteria) • Phylum • Class • Order • Family • Genus • Species Classes of vertebrate and main distinguishing features: • Mammals- live young (viviparous), lungs, fur, constant body temperature) • Birds- feathers, eggs (oviparous), lungs, constant body temperature. • Reptiles- scales, eggs (on land-hard shell), lungs, body temperature depends on surroundings. • Amphibians- eggs (in water-soft), lungs and gills, body temperature depends on surroundings. • Fish- scales, eggs (in water- soft), gills, body temperature depends on surroundings.	Specimen jars and observational skills Use of keys in classification	Classification *(French "put into a class")* Kingdom *(Old English cynn "family; race; kind, sort, rank, nature")* Species *(Latin "a particular sort or type")* Binomial *(Latin "having two names")* Specimen *(Latin "indication, mark, evidence")* Vertebrate *(Latin vertebratus "joint or articulation of the body")* Invertebrate *(in "not or without")* (Viviparous) *(Latin viviparus "bringing forth alive")* (Oviparous) *(Latin oviparus "that produces eggs")* Articles: An argument over dino-history is tearing palaeontology in two | WIRED UKnation Exploring Vertebrate Classification | National Geographic Society Top 10 New Species! – National Geographic Education Blog	
7B14	**How are living things suited to their environment?**	Define ecosystem as all the organisms and the environment in an area. Community – All the living organisms in an ecosystem	Research techniques Internet research skills Reliability of sources (e.g. mermaids, tree squids, drop bears)	Adaptation *(Latin adaptationem "to have adjusted")* Habitat *(Latin- habitare "to live in")* Environment *(French environ "around")* Camouflage *(French camoufler "to disguise")* Competition *(Latin competitionem "rivalry,")*	

		Population – all the individuals of the same species in a community. Habitat - the specific area in an ecosystem where organisms live. Adaptation as a feature of an organism which allows in to thrive/ survive in its habitat. Identification of common features in a certain habitat including: • Hot desert- large SA for cooling, water storage, plant defences. • Polar- small SA- large size, fat, fur or similar. Adaptations of a typical: • Predator- forward facing eyes, speed, claws or talons, sharp beak or teeth. • Prey- eyes on side of head, camouflage, behaviour e.g. burrowing.		Predator *(Latin praedari "to rob")* Prey *(Latin praeda "booty, plunder; game hunted.")* Articles: Prehistoric Animal Adaptations | National Geographic Society Response and Adaptation by Plants to Flooding Stress | Annals of Botany | Oxford Academic (oup.com)	
7B15	**Where do living things live?**	Identification of habitats, their conditions and how animals that live in those habitats are adapted to live in those conditions. The effects of Biotic and Abiotic factors on an ecosystem and its community. • Biotic factors as living factors. • Abiotic as non-living factors. Examples of Biotic factors: • New predator/ prey • Disease • Human activity Examples of Abiotic factors: • Light intensity/ day length • Temperature/ climate • Availability of water • Terrain	Human activity as a biotic factor. Link to pollution, conservation and our effect on the planet/ local ecosystem.	Biotic *(Greek biotikos "pertaining to life")* Abiotic *(Greek a "not")* Intensity *(Old French intense "great, extreme, stretched")* pH *(Mathematical- p- negative log to the base 10 ($1/10^x$)- of the hydrogen ion concentration)* Temperature *(Latin temperatura "state of being in proper proportion")* Terrain *(Latin terrenum "land, ground")* Articles: Exploring the Relationship between Human Activity and Habitat Loss in the Amazon | National Geographic Society floodplain | National Geographic Society Effects of Habitat Fragmentation on Biodiversity | Annual Review of Ecology, Evolution, and Systematics (annualreviews.org)	

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7B16	**How do living things interact?**	How organisms in an ecosystem are affected by competition for factors including: • Food/ prey • Water • Shelter • Territory • Mates That this competition is both inter- (between) and intra- (within) specific (a species). Construction of simple food chains. Identification of the: • Producer • Primary consumer (hervivore) • Secondary consumer (carnivore) • Tertiary consumer (top/ apex carnivore/predator) Dynamics of predator/ prey relationships. Prediction of the effect on the loss or increase of an organism at one level of the food chain on the number of those in other levels.	Construction of food chain diagram with arrows in correct direction to show flow of energy. Identification of the organisms at each trophic (feeding) level. How do ecologists monitor abundance of these organisms? Focus for next lesson. How does human activity influence these relationships?	Biomass *(Greek Bios "living")* Energy *(Greek energeia "activity")* Transfer *(Latin "carry across")* Relationship *(Old French relacion "report, connection")* Interdependence *(Inter "between" dependent Latin "consequence")* Food chain Omnivore *(Latin omni "all" vorare "devour")* Herbivore *(Latin Herbi "plant" vorare- "devour")* Carnivore *(Latin carni "flesh" vorare- "devour")* Producer *(Latin producere "lead or bring forth")* Primary/ Secondary/ Tertiary Consumer *(15C English "one who squanders or wastes")* Articles: Bees of the sea: Tiny crustaceans pollinate underwater plants | New Scientist Fish lure snails to their nest to help camouflage their babies | New Scientist Diverse effects of parasites in ecosystems: linking interdependent processes – Hatcher – 2012 – Frontiers in Ecology and the Environment – Wiley Online Library	
7B17	**How can we study an ecosystem?**	Identify and describe how to use simple equipment systematically to monitor the organisms in an ecosystem. To include: • Quadrat • Transect • Others e.g. pitfall traps Reinforcement of how a change in distribution/ abundance of one organism will affect the others in the ecosystem (interdependence) Human effects on interdependence- e.g. overfishing.	Practical use (on Longrun or school field) of Quadrats and transects. Use of random sampling. Observation methods (hides, drones, cameras)	Quadrat *(Latin quadratrus "a square")* Transect *(Latin trans "across" sectus "to cut")* Sample *(Latin exemplum "a sample/example")* Ecosystem *(Greek oikus "dwelling place" system Latin "an arrangement")* Systematic *(Latin "an arrangement")* Population *(Latin populationem "a people, a multitude)* Estimation *(Latin aestimationem "a valuation"* Articles:	

				Seagrass restoration project brings back a crucial ecosystem | Science News A Comparison of Two Herbaceous Cover Sampling Methods to Assess Ecosystem Services in High-Shrub Rangelands: Photography-Based Grid Point Intercept (GPI) Versus Quadrat Sampling – ScienceDirect	
End of biology review lesson					

The Castle School Science Faculty: KS3 Curriculum Map- Chemistry

Composite	KS2: Previous knowledge	Year 7	Year 8	Year 9 Purple indicates content for set 1s only
Atoms and Elements		Structure of the atom Subatomic particles- protons, neutrons and electrons. Model of a nucleus surrounded by clouds of electrons. Molecules- definition and examples (O_2, H_s, H_2O, $CO_{2)}$ Chemical formulae	Electron shells/ energy levels. Construction of diagrams showing the electron arrangement of first 20 elements. Electron configuration.	Models of the atom: Dalton, Thomson, Rutherford's experiment, Bohr. Isotopes Ion formation **Calculating relative atomic mass** Ionic bonding Covalent bonding Metallic bonding
	• *compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets* • *use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating* • *give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic*	Definition of element- made of 1 type of atom. Recognition of common elements Properties of elements including the properties of metals. Introduction to the Periodic Table: Groups and Periods Metals and Non-metals Symbols and Numbers Choices dependant on property: justification of uses of metals, composites, polymers.	Definition and examples of compound. "Strongly joined" Mixtures Definition and identification of pure substances. Separation techniques.	Metal extraction Mineral Ores- definition of ore. Electrolysis **Products of electrolysis**
Chemical Reactions	• *demonstrate that dissolving, mixing and changes of state are reversible changes* • *explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated*	Identifying chemical reactions vs physical changes Reactants -> Products. Construction of simple word equations.	Reactivity series of metals. Construction of symbol equations- use of symbols and chemical formulae. Factors affecting reaction rate: Temperature, Pressure, Concentration, Particle Size. Catalysts	Types of reaction: - Displacement - Oxidation/ Reduction - Combustion - Thermal decomposition Balanced symbol equations State symbols

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	with burning and the action of acid on bicarbonate of soda			
		Gas tests (Hydrogen, Carbon Dioxide) Observation of other features involved with chemical reactions- energy/ colour changes)	Combustion reactions. Fire Triangle	Energy changes in reactions Endothermic/ exothermic Problems with combustion: link to climate change, particulates (soot), carbon monoxide dangers.
		Identification of commonly used acids. Properties of acids. Definition of base/ alkali (as a soluble base) Examples of indicators Why we need different types of indicator Natural indicators- preparation of red cabbage indicator.	Reactions of acids with: metals, metal oxides, metal carbonates, alkalis. Neutralisation reactions. Use of indicators to demonstrate. Everyday examples.	Definition of pH Strong vs concentrated acids- Role of H+ ions Calculating pH when diluting Causes and effects of acid rain. **Strong and weak acids**
		Hazard symbols Risks associated with each hazard Everyday Applications		
Particles and States of Matter		Particle models of solids, liquids and gases. State changes as examples of physical changes. Properties of common substances.	Energy in change of state. Cooling curve of Octadecanoic Acid	Kinetic Theory
	• *know that some materials will dissolve in liquid to form a solution, and how to recover a substance from a solution*	Fluids- definition. Review of particle model. Definition and examples of diffusion. Brownian Motion. Factors affecting diffusion	Solubility. Definition of solute, solvent, solution. Identification of solutions- clear.	Definition and explanation of pressure Concentration- concept and (calculations) Solubility rules Saturation
The Earth: Rocks and Atmosphere		Structure of the Earth: Inner core, Outer core, Mantle, Crust. Tectonic plates		

		Plate movement- convection currents in mantle. Earthquakes, Tsunami and Volcanos		
		Rock types : Igneous, Sedimentary, Metamorphic. Properties of different rock types Fossil formation Fossils found in Sedimentary Rocks The Fossil Record	The Rock Cycle. Identification of different processes: Erosion, Weathering, Transportation, Deposition, Sedimentation, Compaction, Cementation etc. Igneous rocks Effect of cooling rate/ temperature on crystal size.	
		Fossil fuels- definition and examples Crude oil formation. Separation of crude oil. Properties and uses of fractions. Definition of finite resource and examples e.g. oil, metals, rocks. Definitions of sustainable/ renewable Recycling methods. Evaluation of recycling: challenges vs need to conserve resources/ energy. Composite materials	Fractional distillation of crude oil	Hydrocarbons- homologous series. Effects of chain length. Other organic molecules- alcohols, carboxylic acids. **Cracking – breaking down hydrocarbons.**
		Structure of the atmosphere- layers. Appreciation of depth. Air as a mixture. Composition (%) of atmospheric gases. The carbon cycle- contribution/ effects of different processes including: photosynthesis, combustion, respiration, death, decomposition, feeding, excretion, fossilisation. Biofuels. Concept of "carbon neutral".		Climate change- mechanism, contributing factors. Forecast effects of climate change. Solutions- carbon zero/ reduction technologies. Evolution of Earth's atmosphere

The Castle School Science Faculty: KS3 Curriculum Map- Chemistry

Code	Component Title	Substantive knowledge	Disciplinary knowledge	Disciplinary literacy– Keywords *(etymology)* and linked articles	Cultural capital/ Personal Development
7C1	**What are the states of matter?**	Everything exists as one of the three states of matter: Solids, liquids and gases Properties of solids liquids and gases. • Solids cannot flow, have a fixed volume (shape), cannot be compressed. • Liquids can flow, take the shape of the container, cannot be compressed. • Gases can flow, take the shape of the container, can be compressed. Basic particle diagrams Movement of particles • Solids particles vibrate • Liquid particles move over one another • Gas particles move quickly and randomly. State changes as examples of physical changes Named state changes • Melting, freezing, evaporation, condensation.	State of matter circus	State Matter *(Latin materia "substance from which something is made")* Particles *(Latin particula "little bit or part, grain, jot")* Physical Change *(Latin physicalis "of nature, natural")* Solids *(Old French solide "firm, dense, compact")* Liquids *(Latin liquidus "fluid, liquid, moist")* Gases *(Greek khaos "empty space")* Evaporation *(Latin evaporare "disperse in vapor or steam")* Condensation *(Latin condensare "to make dense")* Melting *(Old English-meltan "become liquid through heat")* Freezing *(from Old English freosan "turn to ice")* Articles: Frontiers | The Importance of Snow Sublimation on a Himalayan Glacier | Earth Science (frontiersin.org) Sublimation - an overview | ScienceDirect Topics	
7C2	**What is diffusion?**	Definition of diffusion as 'the movement of particles from an area of high concentration to an area of low concentration'. Diffusion occurs in fluids (liquids and gases) Examples to include the diffusing of smells and observing the diffusion of potassium permanganate in water. Factors affecting diffusion (the effect of temperature on the rate diffusion)	Modelling	Fluid *(Latin fluidus "fluid, flowing, moist")* Diffusion *(Latin diffundere "scatter, pour out")* Concentration Brownian motion Articles: Brownian motion | physics | Britannica Brownian motion | Nature	

		Brownian motion - random movement of particles originally observed in pollen grains.			
7C3	**What is the universe made of?**	Draw and label an atom including: • Nucleus • Protons • Electrons • Neutrons • Electron shells Table to show the mass, location and charge of each subatomic particle • Protons – mass 1, charge positive • Neutrons – mass 1, charge neutral • Electrons – mass 1/1835, charge negative Definitions of: • Atomic mass as sum of the number of protons and neutrons. • Atomic number as the number of protons. Calculating the number of protons, neutrons and electrons in an atom.	It's a model Size of atom Scale of the universe model	Atom *(Greek átomos "indivisible")* Nucleus *(Latin nucleus "kernel of a nut, core")* Proton *(Greek protos "first")* Electron *(link to electricity – flow of)* Neutron *(Latin neuter "of the neuter gender," literally "neither one nor the other")* Electron Shell *(Old English "husk" and gothic "covering that splits off)* Atomic Number *("Pertaining to atoms", "to count, reckon")* Atomic Mass *("Pertaining to atoms", "to gather in a mass, collect in masses")* Articles: A Brief History of Atomic Theory (thoughtco.com) A single atom is visible to the naked eye in this stunning photo | New Scientist	
7C4	**What is an element?**	Elements are found in the periodic table. This is separated into metals and non-metals. It is organised by groups and periods. Identification of elements based on their group and period number. Elements are made up of one type of atom only. Discussion of some simple molecules (O_2, H_2) and how they are still pure elements as they only have one type of atom present.		Element *(From latin elementum "rudiment, first principle, matter in its most basic form")* Groups Periods Metals *(Greek metallon "metal, ore")* Molecule *(Latin molecula "mass, barrier")* Articles: Elements and new discoveries (birmingham.ac.uk)	

The Castle School Science Faculty: KS3 Curriculum Map- Chemistry

		Properties of metals to include: • Electrical conductors • Thermal conductors • Solid at room temperature (most) • Malleable (bendy) • Shiny		[Oddball star could be home to long-sought superheavy elements | New Scientist]()	
7C5	**Hazards and everyday uses**	Identification of hazards in the lab. Identification of different hazard symbols and their meaning. To include: • Explosive • Flammable • Oxidising agent • Gas under pressure • Corrosive • Toxic • Health problems • Irritant • Toxic to the environment	International recognition language Investigation of hazardous acids based on their reactivity.	Irritant *(Latin irritantem "to excite, provoke")* Corrosive *(Old French corroder "to wear away")* Harmful *(Old English haermian "to hurt, injure")* Toxic *(Latin toxicus "poisoned")* Flammable *(Latin flammare "to set on fire," able "capable of")* Explosive *(Latin explodere "drive out, reject")* Pressure *(Latin pressura "action of pressing")* Acid *(Latin acidus "sour, sharp, tart")*	
7C6	**Chemical Reactions**	Identifying chemical reactions vs physical changes Chemical reactions produce a new substance and usually cannot be reversed. Reactants as the starting chemicals and products as the new chemicals produced. Chemical reactions can be observed by: • A colour change • A gas being released • An energy change (changing temperatures) Examples of word equations basic word equations. A physical change as a change in state that can be reversed.	Measurement of temperature change, colour change and effervescence (Describe what you would see) Examples of chemical reactions	Reaction *(Latin reagere "react," from re "back" + agere "to do, perform")* Reversible *(Reverse "opposite/turned backward" ible "capable of")* Irreversible *(ir "not/opposite of")* Reactant Product *(Latin productum "something produced")* Observation *(Latin observationem "a watching over, observance, investigation")* Articles: [The Conservation of Matter During Physical and Chemical Changes | National Geographic Society]()	

The Castle School Science Faculty: KS3 Curriculum Map- Chemistry

7C7	**What is an acid?**	Identification of everyday acids and bases/alkalis. Comparison of weak and strong acids. Weak acids safe to handle and sometimes eat e.g. orange, lemons, vinegar. Strong acids are corrosive e.g. battery acid, hydrochloric acid. Neutral substances are neither acidic nor alkali e.g. water. Alkali/bases are chemically opposite of acids. Comparison of weak and strong alkali/Bases. Weak bases used in soaps and cleaning products. Strong bases just as dangerous as strong acids, e.g. bleach, hydroxides. Universal indicator and the pH scale used to identify acids and bases. • Acids have a pH below 7 and turn red/orange in universal indicator. • Neutral substances have a pH of 7 and turn green in universal indicator. • Alkalis have a pH above 7 and turn blue/purple in universal indicator.	Universal indicator testing household substances Measuring pH	Acid *(Latin acidus "sour, sharp, tart")* Alkali *(Arabic al-qaliy "the ashes, burnt ashes")* Neutral *(Latin neutralis "neither the one nor the other, neither of two")* Indicator *(Latin indicare "to point out, show")* Articles: Explainer: What are acids and bases? | Science News for Students Shell shocked: Emerging impacts of our acidifying seas | Science News for Students	
7C8	**What is an indicator?**	pH indicators identify if a substance is acidic or alkali. Litmus paper as an example of a pH indicator. Colour changes of red, blue and yellow litmus paper in acids and bases. Making and using red cabbage indicator and evaluating its effectiveness.	Water to wine demo Making red cabbage indicator. Testing against known standards (known acid, known neutral, known base)	Indicator *(Latin indicare "to point out, show")* Litmus paper *(Old Norse lita "to dye, to stain")* Articles: Come clean: What's the difference between shampoo and shower gel? | New Scientist	
7C9	**Types of reaction**	Identification of different reactions and examples: Metal + acid → Salt + hydrogen Test for hydrogen: Place a lit splint over gas and a squeaky pop will be heard.	More opportunities to write word equations	Reaction *(Latin reagere "react," from re "back" + agere "to do, perform")* Reactants Products *(Latin productum "something produced")* Combustion *(Latin comburere "to burn up, consume")*	

		Naming salts: Hydrochloric acid forms chlorides Sulfuric acid forms sulfates Nitric acid forms nitrates Metal carbonate + acid → salt + carbon dioxide + water Test for carbon dioxide: Bubble gas through limewater and it will turn milky/cloudy. Combustion Fuel + oxygen → Water + carbon dioxide Metal + oxygen → metal oxide Neutralisation Acid + Base → Salt + water		Salt *(Old English sealt "salt, sodium chloride, abundant substance essential to life")* Articles: What is fire? | New Scientist Mechanical force induces chemical reaction | New Scientist	
7C10	**Review 1**				
7C11	**Structure of the earth**	Structure of the Earth to include: Inner core, outer core, mantle, crust. Earth is made up plates (like pieces of a jigsaw) that are constantly moving due to the movement of magma under the Earths crust. Plate movements can be: • Destructive - two plates pushing towards each other. • Constructive - two plates move apart. • Conservative - two move along side each other Effects of plate movement can cause Earthquakes, tsunamis and volcanos.	Plates are constantly moving – video to show this.	Crust *(Latin crusta "rind, crust, shell, bark")* Mantle *(Old French mantelen "become covered with a coating" (of liquids))* Tectonic *(Greek tektonikos "pertaining to building")* Destructive *(Latin destruere "to tear down, demolish")* Constructive *(Latin construere "to heap up")* Magma *(Greek magma "thick unguent, ointment")* Molten *(Old English meltian "melted, in a state of solution")* Articles: Geochemists measure new composition of Earth's mantle: Researchers suspect greater dynamics than previously assumed between the Earth's surface and its mantle -- ScienceDaily NASA's InSight Reveals the Deep Interior of Mars – NASA's Mars Exploration Program Continental Drift versus Plate Tectonics | National Geographic Society	

The Castle School Science Faculty: KS3 Curriculum Map- Chemistry

7C12	**Rocks**	Rocks can be identified by their: • Grains (size, shape) • Crystals • Texture • Minerals • Whether they are porous or not. Types of rocks to include - igneous, sedimentary, metamorphic.	Identifying properties of rocks	Sedimentary *(Latin sedimentum "a settling, sinking down, subsidence")* Metamorphic *(Greek meta "trans" morphē "form")* Igneous *(Latin igneus "of fire, fiery; on fire; burning hot")* Porous *(Latin porus "an opening")* Crystals *(Greek kreus- "to begin to freeze, form a crust")* Articles: Signs that Earth was once almost entirely molten found in ancient rock | New Scientist Rocks Information and Facts | National Geographic Mars rover grabs first rock sample, a major step in hunt for alien life (nationalgeographic.com)	
7C13	**What is a fossil?**	Fossils formed in sedimentary rocks. Sedimentary rock formation involves • Weathering/erosion • Transportation • Sedimentation • Compaction/cementaion Fossils as the 'remains of once living animals or plants.' Two main types of fossil: Body fossil - fossilised remains of a plant or animal e.g. a bones, shell, leaves. Trace fossil - record an activity of an animal e.g. footprints, trackways, coprolites. Fossils can give information about how long ago a plant/animal lived, what the environment was like and how the organism lived. Fossil record can show how an organism has evolved over time.	Fossil record is incomplete Palaeontology	Transportation *(Old French transporter "carry or convey across")* Deposition *(Latin depositionem "to lay aside")* Sedimentation *(Latin sedimentum "a settling, sinking down, subsidence")* Fossil *(Latin fossilis "dug up")* Articles: Perfectly preserved 310-million-year-old fossilized brain found | Live Science Peculiar parasitic fungi discovered growing out of the rectum of a 50 million-year-old fossilized ant | Live Science	
7C14					

	What are fossil fuels?	Crude oil formation: Formed from ancient dead animals and plants which have been buried in sediment and compressed over many years. Fuels store chemical energy and release energy when burnt. Definition of non-renewable as a substance that cannot be reused/will run out. Separation of crude oil using fractional distillation. Basic definition – crude oil is evaporated and condensed at different points along the column. Products of fractional distillation to include: • Gases – used for cooking/heating • Petrol – used as fuels in cars • Kerosene – used as fuels in aircraft • Diesel – used as fuel in trains/cars • Fuel oil – used as fuel in ships • Bitumen – roads and roofs Fuels release energy during combustion: Fuel + oxygen → carbon dioxide + water Problems with burning fossil fuels including the contribution to global warming.		Crude oil *(Latin crudus "rough; not cooked, raw, bloody")* Fuel *(Old French foaille "fuel for heating")* Energy *(Greek energeia "activity, action, operation")* Fractional distillation *(Latin fractionem "a breaking" distillare "to trickle down in minute drops").* Articles: The hydrogen solution? | Nature Climate Change	
7C15	**Finite resources and recycling**	Finite defined as something that can only be used once and is in limited supply. Naming examples of finite resources e.g. oil, metals, rocks Importance of recycling including: • Reduces litter/waste, saving space, protection of some habitats, preserves some wildlife. • Link to sustainability Recycling methods for plastic, metal, paper, glass. Challenges vs needs of recycling.	Challenges of recycling balanced with need	Finite *(Latin finire "to limit, set bounds; come to an end")* Non-renewable *(non not, Middle English newen "resume, revive, renew")* Recycling *(re back, Greek kyklos "circle, wheel")* Articles: Plastics recycling: challenges and opportunities (nih.gov) Sustainable use of phosphorus: A finite resource - ScienceDirect	

				Throwaway culture: The truth about recycling | New Scientist	
7C16	**Earth and the atmosphere**	Definition of the atmosphere as the layer of gas which surrounds a Planet. Layers of the atmosphere to include: • Troposphere • Mesosphere • Thermosphere • Ionosphere • Exosphere Model of the depth of the atmosphere Air is a mixture consisting of 78% Nitrogen, 21% oxygen, 1% Argon, 0.04% carbon dioxide.	Oxygen test chemical test Bell jar demo	Troposphere *(Greek Tropos "turning" sphere "ball/globe")* Mesosphere *(Greek mesos "middle")* Thermosphere *(Greek thermos "heat")* Exosphere *(Greek exo "outside/external/beyond")* Atmosphere *(Greek atmos "vapour")* Mixture *(Latin mixtura "to mix")* Articles: Parts of the Atmosphere | National Geographic Society	
7C17	**The Carbon Cycle**	The carbon cycle: • Photosynthesis as a chemical reaction uses carbon dioxide from the atmosphere. • Combustion as a chemical reaction which reacts carbon (in fuels) with oxygen and releases it as carbon dioxide into the atmosphere. • Respiration as a chemical reaction which releases carbon dioxide into the atmosphere • Decomposition • Feeding Concept of 'Carbon neutral' (no **net** release of carbon dioxide into the atmosphere) and biofuels (a fuel from living matter)	Our role in the carbon cycle Interactions How we influence the balance of carbon	Photosynthesis *(Greek photo "light" synthesis "putting together")* Respiration *(Latin re "again" spirare "to draw breath")* Decomposition *(de "the opposite of" Latin compositionem "a putting together, connecting, arranging")* Carbon *(Latin carbonem "a coal, glowing coal; charcoal")* Articles: Carbon Sources and Sinks | National Geographic Society	
7C18	**How do we choose a material**	Composite materials are made of two or more different types of substances. They are made because the different substances have useful properties.		Composite *(Latin compositus "placed together")*	

		Examples of composite materials including: • MDF • Plywood • Fibreglass • Concrete polymers including: • Polyethene • PVC Justification of choice of material including metals, composites and polymers for certain purposes based on: • Abundance of raw material • Extraction method and cost • Physical properties • Manufacturing cost and energy	Investigating strength of material for shopping bags (real life application).		
7C19	**Review 2**				

The Castle School Science Faculty: KS3 Curriculum Map- Physics

Composite	KS2: Previous knowledge	Year 7	Year 8	Year 9 Purple for set 1s only
Forces and Motion	• *explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object* • *recognise that some mechanisms including levers, pulleys and gears allow a smaller force to have a greater effect*	Basic force definitions Forces as a push or pull Free body diagrams- direction and magnitude Use of Newton meter Balanced/ unbalanced forces Equilibrium Resultant force- calculation Extension of a spring- calibration to N meter.	Weight vs mass. Calculation of weights with different values of g. Atmospheric pressure as the force of air molecules Pressure in liquids Calculating pressure using force/area	Definition, measurement and calculation of density. Newton's first law of motion- examples of equilibrium. Newton's second law- use of F=m x a Newton's third law- reaction forces
	• *identify the effects of air resistance, water resistance and friction, that act between moving surfaces*	Calculation of speed: Use of speed = distance/ time Unit as m/s- link to other units Relative and average speeds Distance-time graphs Air resistance and friction as forces which oppose motion	Acceleration as rate of change of speed. Use of the equation: a = v-u/t Velocity-time graphs: calculating acceleration from the gradient.	Vector and scalar quantities Momentum Car safety features Stopping distances **Momentum** Velocity-time graphs: calculating distance travelled from area under the graph.
Waves and Energy		Wave definitions: speed, wavelength, frequency, amplitude. Wave as an energy transfer with no net transfer of matter. Comparison of longitudinal and transverse	Superposition. Constructive and destructive interference.	
		Sound definitions to include pitch and volume- linked to frequency and amplitude. Explanation of why longitudinal (sound) waves travel at different speeds in solids, liquids and gases. Speed of sound in air- experimental measurement and value.	Human hearing range. Definition and uses of infrasound. Definition and uses of ultrasound. Structure of the ear. Function of each part. Description of sound conduction through inner ear. Hearing loss Sound insulation	Seismic waves

The Castle School Science Faculty: KS3 Curriculum Map- Physics

	• *recognise that light appears to travel in straight lines* • *use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye* • *explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes* • *use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them*	Luminous and non-luminous objects. Light travelling in rays Reflection and scattering from surfaces Definitions of translucent, transparent and opaque.	Law of reflection Refraction Lenses Pinhole cameras	Colours of visible light- use of prism to refract and split. Work of Herschel and Ritter Electromagnetic spectrum. Description. Uses and dangers of each section
		Energy defined as "something that is needed to make things happen or change". Principle of conservation of energy. Energy stores: - Chemical - Kinetic - Strain/ Elastic Potential - Gravitational Potential - Nuclear Energy transfers: - Mechanical - Heating - Light - Sound - Electrical	Renewable and non-renewable energy resources Advantages and disadvantages of each Sankey diagrams Energy efficiency	Evaluation of idea of "types of energy" Energy efficiency calculations and savings- payback time. Ionising radiation Properties of alpha, beta and gamma. Radioactive decay Uses and dangers of Ionising Radiation Background radiation and safety measures **Half-Life**
		Heat transfer. Definitions, explanations and examples of: - Conduction - Convection - Radiation	Insulation as an "energy saving" measure.	

The Castle School Science Faculty: KS3 Curriculum Map- Physics

		Explanation of why heat is transferred in different ways through solids, liquids, gases and a vacuum.		
Space		Scale and organisation of space Planets of the solar system. Order and simple descriptions	Exploring the solar system. ISS, probes, rovers. Dangers of space exploration.	Exploring the Universe Life cycle of a star Light year as astronomical distance **Theories of the universe and red shift**
	• *describe the movement of the Earth and other planets relative to the sun in the solar system* • *describe the movement of the moon relative to the Earth* • *describe the sun, Earth and moon as approximately spherical bodies* • *use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky*	Orbits of earth around the sun, moon around the Earth. Definition of year and day. Rotation and tilt of Earth on its axis- link to seasons. Explanation of phases of the moon.		
Electricity and Magnetism	• *associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit* • *compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches* • *use recognised symbols when representing a simple circuit in a diagram*	Simple circuit components and energy transfers involved. Concept of complete circuits- circuit repairs. Construction of circuit diagrams. Dangers of electricity Role of fuse and Earth wire Cost of 1 unit (kWh)	Static electricity. Voltage (potential difference) Current as a flow of charge Models of current flow in a circuit Construction and evaluation of series and parallel circuits.	Uses and dangers of static electricity Resistance Ohm's law Paying for electricity

The Castle School Science Faculty: KS3 Curriculum Map- Physics

		Magnetic/ non-magnetic materials Description of field around a bar magnet Permanent and temporary magnetism Earth's magnetic field	Electromagnets Induced Magnetism	Electromagnetic induction Motor effect. Magnetic field density **Flemings left hand rule,** **Magnetic flux density**

Code	Component	Substantive knowledge	Disciplinary knowledge	Disciplinary literacy including *(etymology)* and linked articles	Cultural Capital/ Personal Development
7P1	**What is a force?**	Basic force definition as a force is a push or pull that can change the speed, shape or direction of an object. Name and recognise forces: Air resistance, water resistance, friction, normal contact force, upthrust/buoyancy, thrust, weight, tension, magnetism, electrostatic, gravity, lift. Measuring forces with Newton meters (100g = 1N) Free body diagrams: • Size of arrow shows the size of the force. • The direction of the arrow shows the direction of the force.	Application to everyday situations Practically applying newton meter to everyday situations - forces circus.	Force *(Latin fortis "strong, mighty; firm, steadfast; brave, bold")* Resistance *(Latin resistere "make a stand against, oppose")* Contact (*Latin contactus "a touching")* Thrust *(Proto-Indo-European (PIE) treud "push, press")* Weight *(Old English gewiht "weighing, weight, downward force of a body, heaviness,")* Tension *(Latin tensionem (nominative tensio) "a stretching")* Gravity *(Latin gravitatem (nominative gravitas) "weight, heaviness, pressure")* Magnetism *(Greek ho Magnes lithos "the Magnesian stone" from Magnesia (see **magnesia**), region in Thessaly where magnetized ore was obtained)* Upthrust *(Proto-Indo-European (PIE) treud "push, press")* Electrostatic *(Greek ēlektron "amber" +* *Greek statikos "causing to stand, skilled in weighing")* Articles: Science: In a spin over fictitious forces | New Scientist Water effect: Why is it hard to put on gloves when your hands are wet? | New Scientist Physics of shoelaces shows why they come undone when you run | New Scientist	

The Castle School Science Faculty: KS3 Curriculum Map- Physics

7P2	**What is the resultant force?**	Resultant force defined as the overall force acting on an object. This has a size in Newtons and a direction. Forces can be balanced or unbalanced. • Balanced forces, no overall/resultant force – remain stationary, continue travelling at a constant speed • Unbalanced forces, there will be a change to speed/direction/shape of an object e.g. speed up or slow down. Shown on a free-body diagram. Calculating resultant forces. • Forces acting in the same direction are added together. • Forces acting in the opposite direction are subtracted.	Linking to motion How would these force interactions affect the motion of the object? Calculating resultant forces.	Resultant *(Latin 'resultare' meaning to spring forward from)* Balanced *(Latin bilanx "(scale) having two pans")* Unbalanced *(Latin bilanx "(scale) having two pans")* Articles: Science: In a spin over fictitious forces | New Scientist Water effect: Why is it hard to put on gloves when your hands are wet? | New Scientist Physics of shoelaces shows why they come undone when you run | New Scientist	
7P3	**How can we measure forces?**	Making a newton meter: • Spring and extension • Range of masses (100-500g) • Extension measured using a ruler (cm) Measuring the extension of a spring as weight (force) increases. • Extension measured as final length – original length of spring. Plotting graph and using this to identify the weight of an unknown object.	Calibration and accuracy of measurement Graph plotting. Spring extension against weight (force) Using a graph to predict weight of unknowns	Force *(Latin fortis "strong, mighty; firm, steadfast; brave, bold")* Meter *(Greek metreo "to measure, count or compare")* Weight *(Old English gewiht "weighing, weight, downward force of a body, heaviness")* Calibrate *(Latin qua libra "of what weight")* Measure *(Latin mensura "a measuring, a measurement; thing to measure by")* Newton *(after Isaac Newton)* Articles: Science: In a spin over fictitious forces | New Scientist Water effect: Why is it hard to put on gloves when your hands are wet? | New Scientist Physics of shoelaces shows why they come undone when you run | New Scientist	
7P4	**How can we measure speed?**	Speed is a measure of how fast an object is travelling.		Speed *(Old High German spuoten "to haste")* Distance *(Latin distantia "a standing apart,")* Time *(Old English tima "temporal duration, limited space of time,")*	

		Relative speed – the speed of one object compared to another object Example to include: trains and cars passing one another. Use of speed = distance/time Units of speed: m/s, mph, kmph Units of distance: metres, kilometres, miles Units of time: seconds, hours Recall and use: • Speed = Distance / Time Use the speed equation to calculate distance and time with given equation. • Distance = Speed x Time • Time = Distance / Speed	Application to speed cameras Measuring the speed of a toy car as the height of a ramp is increased. - Calculating average (mean) speed	Average *(French avarie "damage to a ship that would be paid for collectively by everyone on the ship")* Articles: Air Resistance, Drag Force, and Velocity: How Falling Works (thegreatcoursesdaily.com) What is inertia? | New Scientist	
7P5	**How can we show a journey?**	Distance-Time graphs A horizontal line shows a stationary object A straight sloping line shows a object travelling at a constant speed. Curved lines show acceleration and deceleration. Average speed – total distance travelled over total time taken. Calculating speed from a distance-time graph • Change in distance / change in time	Draw and interpret simple distance time graphs	Gradient *(Latin gradientem "to walk.")* Horizontal *(Latin horizontem "flat")* Acceleration *(Latin accelerationem "a hastening,")* Deceleration Axis *(Latin axis "axle, pivot, axis of the earth or sky")* Articles:	
7P6	**How can we go faster?**	Air resistance and friction are forces which oppose motion. • Air resistance – a resistive force acting on an object that is moving through air in the opposite direction • Friction – a resistive force acting between two surfaces sliding/rubbing together.		Friction *(Latin frictionem "a rubbing, rubbing down,")* Resistance *(Latin resistere "make a stand against, oppose")* Streamline *(Middle English strem "course of water, current of a stream, body of water flowing in a natural channel" + Old English line "cable, rope; series, row, row of letters; rule, direction")* Lubrication *(Latin lubricantem (nominative lubricans), present participle of lubricare "to make slippery or smooth")* Oppose *(Old French oposer "oppose, resist, rival; contradict, state opposing point of view")*	

		High performance cars/athletes have ways of overcoming this • Lubrication to reduce friction • Streamlining to reduce air resistance	Linking to bloodhound	Articles: Air Resistance, Drag Force, and Velocity: How Falling Works (thegreatcoursesdaily.com) Air resistance and its influence on the biomechanics and energetics of sprinting at sea level and at altitude - ScienceDirect The effect of air resistance on the jump performance of a small parasitoid wasp, Anagyrus pseudococci (Encyrtidae) | Journal of Experimental Biology | The Company of Biologists	
7P7	**What are waves?**	Definition of a wave as an energy transfer without overall transfer of matter Definitions of 2 types of waves • Transverse wave – movement of particles at a right angle to the direction of the wave • Longitudinal wave – movement of particles parallel (same) to the direction of the wave Examples of waves to include: • Transverse – light • Longitudinal – sound Drawn & labelled waves with keywords • Crest – top of a wave • Trough – bottom of a wave • Amplitude – height of the wave from the midpoint • Wavelength – distance from one point on a wave to another point on a wave (measured in metres)	Modelling with slinky Ripple tank Interpretations of different wave situations e.g. the sea, earthquake simulator	Wave *(Old English wafian "to wave, fluctuate" (move back and forth)* Wavelength *(Old English wafian "to fluctuate" + Old English lengðu "property of being long or extended in one direction; distance along a line")* Longitudinal *(Latin longitudo "length, long duration")* Transverse *(Latin transversus "turned or directed across")* Amplitude *(Latin amplitudinem (nominative amplitudo) "wide extent, width")* Crest *(Latin crista "tuft, plume")* Trough *(Old English trog "wooden vessel, tray, hollow vessel, canoe")* Articles: What causes waves in the ocean? | New Scientist	
7P8	**How does sound travel?**	Sound definitions to include: • Sound – a type of longitudinal wave that travels using vibrations of particles • Longitudinal wave - movement of particles parallel (same) to the direction of the wave	Sound circus so pupils compare the frequency and amplitude of sound produced by various objects Practicing the use of key words and definitions	Sound *(Latin sonus "sound, a noise")* Longitudinal *(Latin longitudo "length, long duration")* Amplitude *(Latin amplitudinem (nominative amplitudo) "wide extent, width")* Volume *(Latin volumen "roll (of a manuscript); coil, wreath")*	

		• Frequency – number of waves per second – measured in Hertz (Hz) • Pitch – type of sound produced, linked to frequency. • Volume – loudness of the sound, linked to the amplitude of a wave Application of pitch and volume to different examples of waves Linking sound to how longitudinal waves travel Sound in solids, liquids & gases • Sound travels fastest in solids • Sound travels slowest in gases • Linked to vibration of particles Recall the speed of sound in air 343 m/s	Application of sound travelling quicker in solids Measuring the speed of sound	Pitch *(Old English piccean "to thrust (something) in, drive (a stake), pierce with a sharp point, used to pitch a tent")* Frequency *(Latin frequentia "fact of occurring often")* Vibrations *(Latin vibrare "set in tremulous motion")* Articles: Sound waves may be able to trigger earlier tsunami warnings | New Scientist Amazing animal super senses - BBC Science Focus Magazine	
7P9 Mid Topic Review					
7P10	**How does light travel?**	Light definitions to include: • Light – a type of transverse wave produced by luminous sources, travels in rays in a straight line • Luminous source – objects that produce their own light. Examples to include: sun, lightbulb, TV • Non-luminous sources – object that do not produce their own light • Shadows - the absence of light, due to light not bending around opaque objects. • Transparent object - allow light to pass through • Translucent objects - allow some light to pass through but scatter the rays • Opaque objects - do not allow light to pass through Application of transparent, translucent and opaque objects	Construction of ray diagrams Understanding of light through time	Luminous *(Latin luminosus "shining, full of light, conspicuous,")* Non-luminous *(Latin non "not" + Latin luminosus "shining, full of light, conspicuous,")* Transparent *(Latin transparere "show light through")* Translucent *(Latin translucere "to shine through")* Opaque *(Latin opacus "shaded, in the shade, shady, dark, darkened, obscure")* Source *(Latin surgere "to rise, arise, get up, mount up, ascend; attack")* Reflection *(Latin reflectere "to bend back, bend backwards, turn away")* Scattering *(Middle English schateren "to squander, to waste")* Shadow *(Old English sceadwe "shade, the effect of interception of sunlight; dark image cast by someone or something when interposed between an object and a source of light")* Articles: Amazing animal super senses - BBC Science Focus Magazine Electromagnetic spectrum | New Scientist	
7P11					

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	How is heat transferred?	Link and reapplication of states of matter Definitions of heat transfer to include: • Transfer – movement of something from one place to another • Conduction - heat transfer through solid conductors, due to particles vibrating and passing on the vibrations. • Convection - heat transfer through fluids (liquids & gases). • Convection current - As particles gain kinetic energy, they become less dense and rise. As they cool they become more dense and sink • Radiation - a wave emitted by objects storing thermal energy. Radiation can travel through a vacuum. Examples to include central heating and solar energy	Conduction rods Convection Tube Absorption of radiation (coloured tubes) Cultural capital: Insulation of houses/money saving Devise a method to investigate which metal is the best conductor	Particles *(Latin particula "little bit or part, grain, jot")* Vibrate *(Latin vibrare "set in tremulous motion")* Collide *(Latin collidere "to strike together")* Heat *(Latin haetan "to make hot, to become hot")* Articles: Triple glazing – Is it worth it? - TheGreenAge Does a kettle boil quicker if you shake it? | New Scientist	
7P12	**What is energy?**	Energy defined as "something that is needed to make things happen or change" Principle of conservation of energy Energy can be described by stores or transfers Energy stores: • Chemical • Kinetic • Strain/Elastic potential • Gravitational potential • Nuclear • Thermal Energy transfers: • Mechanical • Heating (conduction, convection and radiation) • Light • Sound	Energy circus using it to identify the stores and transfers.	Energy *(Greek energos "active, working")* Chemical *(Madieval Latin alchimicus "relating to chemicals")* Kinetic *(Greek kineticos "to move")* Thermal *(Greek therme "heat")* Elastic *(Greek elastos "flexible")* Potential *(Greek potis "possible as opposed to actual")* Gravitational *(Latin gravitas "weight, heaviness")* Nuclear *(Latin nucleus "little nut, pertaining to centre of atom")* Articles: energy | Definition, Types, & Examples | Britannica	

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		• Electrical		[Could traffic noise be converted into useful energy? - BBC Science Focus Magazine] [Conservation of energy - AccessScience from McGraw-Hill Education]	
7P13	**How can I build a circuit?**	Recall that in a circuit there is an electrical transfer of energy. Simple circuit components and diagrams to include: • Bulb/lamp • Cell • Battery • Switch • Ammeter • Voltmeter • Wires • Motor Complete circuits must: • Be fully connected using wires • Include a power source • Include a component Drawing simple circuit diagrams • Cell/Battery, bulb and wires	Construction of simple circuit Observation of above Circuit repairs Representing concepts as diagrams	Electricity *(Electricity Latin Elekron “Amber, shining light”)* Component *(Latin componentem "to put together, to collect a whole from several parts")* Circuit Circuit *(Latin circuitus "a going around,")* Electron *(Greek ēlektron "amber" ion "to go”)* Articles: [What is superconductivity? | New Scientist] [Scientists create electric circuits inside plants (theconversation.com)] [New 'electronic skin' is a recyclable, self-healing wearable - BBC Science Focus Magazine] [How Circuits Work | HowStuffWorks]	
7P14	**How can I use electricity safely?**	Definition of electrocution: Death or severe injury caused by an electric current passing through the body. Symbol for a fuse Definition of a fuse: An electrical safety device used to protect from surge in current. How a fuse works A thin piece of wire, that melts and break the circuit when too much current flows through. Knowledge / Recall of cost per unit • All appliances have a power rating • Power is how much energy is transferred per second.	Human electrical conduction demonstration Rebuilding a plug	Mains Electricity *(Electricity Latin Elekron “Amber, shining light”)* Circuit breaker *(Middle Dutch breken "to break”)* Earth wire- (Old English *eorþe* "ground, soil, dirt, dry land; country, district,” Wir “metal drawn out into a fine thread”) Fuse *(Latin fusionem "to pour, melt")* Earth Wire Articles: [Fire Caused by a Phone Charger | National Home Repairs (repairmyhome.co.uk)]	CC: Danger of cheap imported chargers. Link to school fire incident PAT testing

		• Power is measured in Watts (W) • Some appliances transfer a large quantity of energy – so kilowatts are used (kW) • 1 kW = 1000W			
7P15	**What is magnetism?**	Definition of a magnet: A material or object that produces a magnetic field. Definition of magnetism: The force exert by magnets when they attract or repel each other. The magnetic field is invisible, but can be used to attract and repel objects • Attract – opposite poles • Repel – like poles A bar magnets magnetic field is strongest at the poles – where the magnetic field lines are closest together. Recall three magnetic materials: • Iron • Cobalt • Nickel Definition of a permanent magnet: A magnet that always has a magnetic field Definition of a temporary/induced magnet: A magnet that does not always have a magnetic field, only magnetic when placed near a permanent magnet. Examples of permanent and induced/temporary magnets: • Bar magnet - permanent magnet • Paper clips – induced/temporary magnet.	Creating a magnetic field with iron filing Magnetising a nail and observing strength and duration	Core *(Latin cor "heart")* Magnet *(Greek ho Magnes lithos "the Magnesian stone," from Magnesia - region in Thessaly where magnetized ore was obtained).* Permanent *(Latin permanentem "remaining")* Induced *(Latin inducere "lead into, bring in, introduce, conduct; persuade; suppose, imagine")* Temporary (*Latin temporarius "of seasonal character)* Magnetic *(Latin magnetismus "personal charm, attractive power or influence")* Magnetism *(Latin magnetismus "personal charm, attractive power or influence")* Magnetic Field *(Greek ho Magnes lithos "the Magnesian stone," from Magnesia - region in Thessaly where magnetized ore was obtained)* Magnetic Material *(Greek ho Magnes lithos "the Magnesian stone," from Magnesia - region in Thessaly where magnetized ore was obtained)* Articles: Core subject: how does Earth's magnetic field arise? | New Scientist Electromagnetism | New Scientist A three-dimensional self-consistent computer simulation of a geomagnetic field reversal | Nature	Earth's magnetic field and use of compasses over time

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7P16	**What is a day, month, year, season?**	An orbit is a regular, repeating path that one object in space takes around another • The Earth orbits the Sun • The Moon orbits the Earth The Earth has an axis of rotation, this is an imaginary line through the centre of athe Earth between North and South Poles which Earth rotates around. Day – Earth does one full rotation on its axis in • When Earth is facing the sun this is daylight • When Earth if facing away from the sun this is night. Month – measured by the time taken for the moon to orbit the Earth once (approx. 29.5 days) • Over 29.5 days the Moon enters 8 phases. • Recognise and match the 8 phases of the Moon with the image. Year – measured by the time taken for the Earth to orbit the Sun once (approx. 365.25 days – link to leap year). Seasons • The tilt of the Earth on its axis causes seasons. • Spring, Summer, Autumn, Winter • Summer – Earth's axis is tilted towards the sun. • Winter – Earth's axis is tilted away from the sun. • Summer solstice is middle of summer. • Winter solstice is middle of winter.	Tangible effects on earth e.g. tides	Orbit *(Latin orbita "wheel track, rut.")* Planet *(Greek planetes "wanderer")* Day *(Old English dæg "period during which the sun is above the horizon")* Month *(German menon "moon")* Year *(Greek hōra "year, season, any part of a year")* Season *(Old French seison "season, date; right moment, appropriate time")* Axis (Latin *axis* "axle, pivot, *axis* of the earth or sky") Articles: season | National Geographic Society Superfast spinning stars cause strangest weather in the universe | New Scientist Why is there a hurricane season? - BBC Science Focus Magazine Phases of the moon, facts and information (nationalgeographic.com)	
7P17	**Our solar system**	Our solar system is made up of the Sun (our Nearest star) and the objects that		Orbit *(Latin orbita "wheel track, rut.")* Planet *(Greek planetes "wanderer")*	

		orbit around it including planets, asteroid and comets. • Planets orbit the Sun • Moons orbit Planets • Sun's gravity holds all these objects together. Order of the Planet in our solar system • Sun • Mercury – Rocky planet, smallest fastest moving, orbit every 88 Earth days. • Venus – toxic atmosphere, covered with volcanoes, ridges and craters. Orbit every 243 Earth days • Earth – most of its surface covered with water, only known place with life. • Mars – dusty, cold planet with 2 moons. Rotates at same speed as Earth. Orbit every 687 Earth days. • Jupiter – biggest planet, could fit all other inside of it. Has 75 moons. Year is 12 Earth years. • Saturn – has 7 rings, made of mainly hydrogen and helium. Year is 29 Earth years. • Uranus – gas giant, hydrogen, and helium. One year is 84 Earth years. • Neptune – gas giant, atmosphere is hydrogen and helium. Year is 165 Earth years. Composition of Solar System- order of planets.	Pluto reclassified as dwarf planet How do we study other planets including satellites/ probes/rovers	Solar system *(Latin solaris "of the sun")* Articles: Pluto, the Kuiper Belt's most famous dwarf... | The Planetary Society Voyager 2 sent back its first detailed data from interstellar space | New Scientist Solar System Facts: A Guide to Things Orbiting Our Sun | Space NASA's Perseverance Rover Collects Puzzle Pieces of Mars' History | NASA	
7P18 End of Topic Review					

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Module	Substantive knowledge (from specification) to be taught	Required disciplinary knowledge to be taught with linked lesson (Maths skills in red)	KS3 links (to be checked by retrieval practice)	Disciplinary Literacy: • Keywords and Etymology • Linked articles (for homework and whole-class reading)
CB1 Key Concepts in Biology **Year 10** *(Papers 1 and 2)*	**Cells** B1.1 Explain how the sub-cellular structures of eukaryotic and prokaryotic cells are related to their functions, including: a animal cells – nucleus, cell membrane, mitochondria and ribosomes b plant cells – nucleus, cell membrane, cell wall, chloroplasts, mitochondria, vacuole and ribosomes c bacteria – chromosomal DNA, plasmid DNA, cell membrane, ribosomes and flagella B1.2 Describe how specialised cells are	B1.3 Explain how changes in microscope technology, including electron microscopy, have enabled us to see cell structures and organelles with more clarity and detail than in the past and increased our understanding of the role of sub-cellular structures B1.4 Demonstrate an understanding of number, size and scale, including the use of estimations and explain when they should be used- Relative size of cells.	**Year 7** **7B1** Structure of plant and animal cells Diagram of Animal Cell structure to include: • Nucleus • Membrane • Cytoplasm • Ribosome • Mitochondria Plant cell structure to include organelles above plus: • Cell wall • Chloroplast • Vacuole Roles of the organelles listed above	Eukaryotic *(From Greek 'eu-' meaning true and 'karyon' meaning nut)* Organelle *(Latin- organ- instrument)* Nucleus *(Latin- kernel of a nut)* DNA *(deoxy – without oxygen, ribo- to do with the pentose sugar ribose, nucleic – to do with the nucleus (kernel), acid – from Latin 'acidus' for sour)* Cytoplasm *(cyto-cell, plasm as in plasm- fluid, jelly, to spread out)* Cell wall Cell membrane *(Latin- membrana- a writing skin)* Mitochondrion *(from Greek 'mitos' for thread and 'khondrion' for little granule/grain)* Ribosome *(from ribo nucleic, so to do with DNA, and Greek 'soma' for body)* Chloroplast *(chloro- pale green, plast- granule)*

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	adapted to their function, including: a sperm cells – acrosome, haploid nucleus, mitochondria and tail b egg cells – nutrients in the cytoplasm, haploid nucleus and changes in the cell membrane after fertilisation c ciliated epithelial cells **Enzymes** B1.12 Explain the importance of enzymes as biological catalysts in the synthesis of carbohydrates, proteins and lipids and their breakdown into sugars, amino acids and fatty acids and glycerol B1.7 Explain the mechanism of enzyme action including the active site and enzyme specificity B1.8 Explain how enzymes can be denatured due to	B1.5 **(Higher Tier Only) Demonstrate an understanding of the relationship between quantitative units in relation to cells, including: a milli (10−3) b micro (10−6) c nano (10−9) d pico (10−12) e calculations with numbers written in standard form** – Microscope calculations B1.6 Core Practical: Investigate biological specimens using microscopes, including magnification calculations and labelled scientific drawings from observations B1.11 Demonstrate an understanding of rate	**7B2** Identify parts of microscope to include: • Stage • Eyepiece lens • Objective lens • Focusing knob Preparation of cheek cell with stain **7B4** Examples of Unicellular Organisms Roles of differentiated/ specialised cells in multicellular organisms including: • Egg • Sperm • Red blood cell • Root hair cell **7B4** Structure of bacteria • Size compared with eukaryotic • Highlight lack of nucleus • Cell wall • Chromosomal DNA • Plasmid • Some have flagella	Vacuole *(Latin- diminutive of vacuus- empty)* Cell *(as in room-monastry/prison)* Cell sap *(sap from PIE root 'sab', meaning fluid)* Chlorophyll *(from the Greek 'chloros', meaning green, and 'phyll', meaning leaf* Aerobic respiration *(aerobic – needs air to live, from Greek 'aero-' for air and 'bios' for life; respiration – breathes again, from Latin 're-' for again and 'spirare' for breathing)* Acrosome *(from Greek 'akro–' for the beginning or peak, and Greek 'soma' for body)* Adaptation *(from Latin 'adaptare' meaning to adjust or fit)* Adapted Ciliated epithelial cell *(ciliated from Latin 'cilia' for eyelash; epithelial from Greek 'epi-' meaning upon and 'thele' for nipple)* Cilium *(see ciliated above)* Digestion *(from Latin 'digirere' meaning to separate)* Diploid *(from Greek 'diplo' meaning double and 'eidos' meaning form)* Egg cell Embryo *(from Greek 'embryon' meaning young one)* Epithelial cell

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	changes in the shape of the active site B1.9 Explain the effects of temperature, substrate concentration and pH on enzyme activity **Transport** B1.15 Explain how substances are transported into and out of cells, including by diffusion, osmosis and active transport	calculations for enzyme activity Construct and interpret frequency tables and diagrams, bar charts and histograms- Enzyme activity B1.10 Core Practical: Investigate the effect of pH on enzyme activity B1.17 Calculate percentage gain and loss of mass in osmosis B1.16 Core Practical: Investigate osmosis in potatoes- calculation of means, plot draw and interpret appropriate graphs.	**7C17** Definition of diffusion as 'the movement of particles from an area of high concentration to an area of low concentration'. **Year 8** **8B1** Magnification as the number of times larger an image appears than the original size. Calculating magnification using the equation magnification = image size/actual size. Conversion between mm, µm, nm. Define resolution as the smallest distance between 2 points that can still be seen as 2 points. Compare resolution and magnification of electron and light microscopes.	Fertilisation *(from Latin 'fertilis' meaning to bear fruit)* Gamete *(from Greek 'gamete/gametes' meaning wife/husband)* Haploid *(from Greek 'haplos' meaning single)* Microvillus *(from Greek 'mikros' meaning small and Latin 'villus' meaning hair)* Oviduct *(from Latin 'ovi' meaning egg and PIE root 'deuk-' meaning to lead or channel)* Specialised cell Sperm cell *(sperm from Greek 'sperma' meaning seed or that which is sown)* Microscope *(micro-small, scope-instrument for seeing)* Magnification *(magnificare- make greater)* Focus *(point of convergence-fireplace)* Resolution *(breaking into parts)* Eyepiece lens *(PIE root for eye 'okw-' meaning to see; lens- from lentil shape)* Objective lens *(Latin – 'objectum' - to do with an object)* Stain *(Corruption of Middle English 'disteynen', meaning to discolour)* Field of view

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	Separate Sciences Only B1.14 Explain how the energy contained in food can be measured using calorimetry	B1.13 Core Practical: Investigate the use of chemical reagents to identify starch, reducing sugars, proteins and fats Measure energy content of food samples using simple calorimeter.	**8B11** Importance of enzymes in digestion as biological catalysts Naming enzymes in the digestive system; protease breaks down proteins into amino acids, lipase breaks down fats into fatty acids and glycerol, amylase breaks down starch (carbohydrate) into glucose **Year 9** **9B4** Enzymes can also synthesise molecules e.g. starch synthase in plants. Diagram of an enzyme to include; enzyme, substrate and active site Enzyme action and specificity Effect of substrate concentration on enzyme activity Effect of temperature and pH on enzymes Define denature as a change in shape of an enzyme's active site	Scale Bar *(scale from Latin 'scala' for a ladder or flight of stairs; bar comes from the homophonic word for a metal rod)* Scientific paper *(scientific from Latin 'scientia' for knowledge; paper from Greek 'papyros' or possibly Egyptian 'papyrus', meaning to do with the papyrus plant* Prokaryotic *(From Greek 'pro-' meaning before and 'karyon' meaning nut)* Unicellular *(uni- having one only- unicycle, unisex, unique)* Multicellular *(multi- many)* Bacterium/ bacteria as plural *(Greek- bakterion- small rod)* Plasmid *(from plasm)* Chromosomal DNA *(Chroma – colour, soma – body)* Flagellum *(Latin-whip)* Specialised cell *(cell – named after a monk's cell, often a small round room)* Differentiated *(different)* Index/indices *(from Latin 'index' meaning forefinger or to point out)* Plasmid *(from Greek 'plasma' meaning to mold)* Plasmid DNA Standard form Enzyme *(Greek 'enzymos' leavened)*

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			9B2 Osmosis as the movement of water from high water concentration to low water concentration through a partially permeable membrane Active transport as the movement of particles from a low concentration to a high concentration across a membrane, requiring energy.	Biological catalyst *(catalyst from 'cata-' meaning completely or down, and 'lyein' meaning to loosen or divide)* Catalyst Digest Monomer *(from Greek 'mono-' meaning one and 'meros' meaning part)* Polymer *(from Greek 'poly-' meaning many, from PIE root 'pele-' to fill)* Product *(from Latin 'producere' meaning to bring out)* Substrate *(from Latin 'sub' meaning below and 'sternere' to spread out)* Synthesis *(to put together - from Greek 'syn-' meaning together and 'tithenai' meaning to put)* Protease *(Latin 'proto' first, 'ine' like, 'ase' enzyme)* Amino *(containing an amine group)* Amylase *(Latin 'amylum' starch, 'ase' enzyme)* Synthesis *(Greek - putting together)* Active site Denatured *(from Latin 'de-'meaning away and 'natura' meaning character)* Lock-and-key model Specific Optimum pH *(from Latin 'optimus' meaning best)* Optimum temperature

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				Benedict's solution *(from Latin 'solutionem' meaning to loosen)* Biuret test Calorimeter *(from Latin 'calor' meaning heat and '-meter' meaning to measure)* Chemical reagent *(from Latin 're-' meaning again and 'agent' meaning the thing that acts)* Iodine solution Precipitate Reducing sugar Concentration *(Latin 'con' together, 'centrum' middle)* Gradient *(Latin 'gradi' to walk)* Diffusion *(Latin 'diffusus' to pour away)* Osmosis *(Latin 'endosmose' inwards passage of fluid through a membrane)* Active transport Passive *(from Latin 'passivus' meaning can be acted on)* Semi-permeable *(from Latin 'permeare' meaning to pass through)* Solute *(from Latin 'solvere' to loosen)* Solvent *(form Latin 'solvere' to loosen)* Articles:

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				History of the Cell: Discovering the Cell | National Geographic Society Cells and the Versatile Functions of Their Parts | National Geographic Society Intro to cells (article) | Khan Academy Unicellular vs. Multicellular | National Geographic Society Cells and the Versatile Functions of Their Parts | National Geographic Society New super-enzyme eats plastic bottles six times faster | Plastics | The Guardian Osmotic Diarrhea: Symptoms, Causes, Treatments (healthline.com)
CB2 Cells and Control **Year 10** *(Paper 1)*	B2.1 Describe mitosis as part of the cell cycle, including the stages interphase, prophase, metaphase, anaphase and telophase and cytokinesis B2.2 Describe the importance of mitosis in growth, repair and asexual reproduction	B2.7 Demonstrate an understanding of the use of percentiles charts to monitor growth Calculate the percentage gain and loss of mass Translate information between numerical and graphical forms- Growth in animals	**Year 7** Pollen tube formation and fertilisation. Seed formation and dispersal. Importance of plant reproduction in human food security inc loss of bees etc. Changes during puberty- to include: -pubic hair -changes in body shape	Sexual *(Involving sex)* Asexual *('A-' not, as in atypical, asymmetric)* Zygote *(Greek Zygotos -yoked)* Mitosis *(Greek 'mitos' warp thread, 'osis' act)* Diploid *(Greek 'diploos' – double)* Interphase *('inter' between)* Prophase *(Greek 'prophasis' – that which appears)*

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	B2.3 Describe the division of a cell by mitosis as the production of two daughter cells, each with identical sets of chromosomes in the nucleus to the parent cell, and that this results in the formation of two genetically identical diploid body cells B2.4 Describe cancer as the result of changes in cells that lead to uncontrolled cell division B2.5 Describe growth in organisms, including: a cell division and differentiation in animals b cell division, elongation and differentiation in plants B2.6 Explain the importance of cell differentiation in the development of specialised cells	B2.9 Discuss the potential benefits and risks associated with the use of stem cells in medicine Use estimations and explain when they should be used- Stem Cells Use a scatter diagram to identify a correlation between two variables- Myelin and transition speed Opportunity for devising a method – effect of caffeine on reactions	-voice deepening -causes of acne, body odour linked to need for hygiene Hormones controlling these changes (Oestrogen, Progesterone, testosterone) **Year 8** Cell division and mitosis: Cell division is needed for growth and repair of organisms. Mitosis produces genetically identical, diploid daughter cells Cell cycle and mitosis: Interphase as the phase preparing for mitosis. DNA and organelles replicate. Prophase – Nuclear membrane breaks down Metaphase – chromosomes line up along the middle of the cell. Spindle fibres attached. Anaphase – chromosomes pulled apart by spindle fibres. Telophase & cytokinesis – nuclear membrane reforms and cells split	Metaphase *(Greek 'meta' – changed, 'phase' – stage)* Anaphase *(Greek 'an' – backwards, 'phase' – stage)* Telophase *(Greek 'telo' – the end, 'phase' – stage)* Cytokinesis *(Greek 'cyto' – cell, 'kinesis' – to move)* Cell cycle Clone *(from Greek 'klon' meaning a twig from a plant)* Cancer cell *(cancer from Latin 'cancer' meaning crab)* Tumour *(from Latin 'tumere' meaning to swell)* Stem cells *(German 'Stammzelle')* Multicellular Embryonic stem cell *(from Greek 'embryon' meaning young animal)* Spindle fibre *(from Old English 'spinel' meaning a device used to hand-spin thread)* Differentiation *(from Latin 'differentia' meaning diversity or difference)* Growth Percentile *(from Latin 'per centum' meaning by the hundred)* Differentiate

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	B2.8 Describe the function of embryonic stem cells, stem cells in animals and meristems in plants B2.13 Explain the structure and function of sensory receptors, sensory neurones, relay neurones in the CNS, motor neurones and synapses in the transmission of electrical impulses, including the axon, dendron, myelin sheath and the role of neurotransmitters B2.14 Explain the structure and function of a reflex arc including sensory, relay and motor neurones **Separate Sciences Only** B2.10 Describe the structures and functions of		Embryo development: Before 8 weeks it is known as the embryo After 8 weeks it is known as the foetus. Gestation period in humans is 40 weeks (9 months) role of placenta and umbilical cord: A foetus collects nutrients, oxygen and water from a mothers blood using a placenta. It travels to and from the placenta by the umbilical cord. Up to 1, babies predominately rely on a mother's milk (can also be formula). Weening from 6 months **Year 9** Define CNS as brain and spinal cord Define PNS as nerves which carry electrical impulses around the body Link the sense organs to the stimuli they detect	Elongation *(from Latin 'elongare' meaning to prolong)* Meristem *(from Greek 'meristos' meaning divided)* Meristem cell Rejection *(from Latin 'reiectionem' meaning the act of throwing something back)* Root hair cell Xylem cell *(xylem from Greek 'xylon' meaning woody plant)* Spine *(Latin spina "backbone")* Nerve *(from Latin 'nervus' meaning tendon)* Neurones *(Greek 'neura' bowstring)* Nerve cell Nervous system *(system from Greek 'systema' meaning an organised whole)* Axon *(from Greek 'axon' meaning a straight line around which a body rotates)* Axon terminal *(terminal from Latin 'terminus' meaning boundary)* Central nervous system/CNS Dendrite *(from Greek 'dendron' meaning tree)* Dendron Myelin sheath *(myelin from Greek 'myelos' meaning marrow; sheath from proto-Germanic 'skaith' meaning a covering for a blade)*

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	the brain including the cerebellum, cerebral hemispheres and medulla oblongata B2.11 Explain how the difficulties of accessing brain tissue inside the skull can be overcome by using CT scanning and PET scanning to investigate brain function B2.12 Explain some of the limitations in treating damage and disease in the brain and other parts of the nervous system, including spinal injuries and brain tumours B2.15 Explain the structure and function of the eye as a sensory receptor including the role of: a the cornea and lens b the iris c rod and cone cells in the retina		Identify the sensory, relay and motor neurones in a reflex arc Define stimulus as a change in the environment which can be detected by receptor cells Role of receptors to detect a stimulus Role of sensory neurone to carry electrical impulses from receptors to the relay neurone Role of relay neuron to carry electrical impulses from the sensory neurone to the motor neurone Role play motor neurone to carry electrical impulses from the relay neurone to the effectors. Role of effectors carry out a response. They are glands or muscles. Brain structure and regions: -Medulla oblongata – connects brain to spinal cord. Controls reflexes such as sneezing, vomiting, swallowing -Cerebellum – controls balance and posture,	Stimulus *(Latin stimulus "a goad, a pointed stick," figuratively "a sting, a pang; incitement, spur,")* Receptor *(from Latin 'recipere' meaning to hold)* Receptor cell Sense organ Sensory neurone Motor neurone *(motor from Latin 'motor' meaning mover)* Relay neurone *(relay from Old French 'relai', meaning hunting hounds that were placed along a line of chase to replace those that tired)* Synapse *(from Greek 'synapsis' meaning a joined junction/conjunction)* Spinal cord Impulse *(from Latin in- "into, in, on, upon" + pellere "to push, drive")* Reflex *(Latin 'reflexus' meaning a bending back)* Reflex arc *(arc from Latin 'arcus' meaning a bow or arch)* Response *(from Latin 'respondere' meaning to reply)* Neurotransmission *('neuro-' meaning to do with nerves, '-transmission' from Latin*

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	B2.16 Describe defects of the eye including cataracts, long-sightedness, short-sightedness and colour blindness B2.17 Explain how cataracts, long-sightedness and short-sightedness can be corrected		coordinates timing and fine control of muscle activity -Cerebral cortex – controls most of our senses, language, memory, behaviour consciousness etc. left and right hemispheres. Right side is generally used for facial recognition and musical appreciation. Left is generally used for mathematical ability, language and reasoning Tissue culture – growing cells on agar. Used for drug tests and studying viruses Cuttings - used to produce clones of plants, e.g. where species are endangered, for species which are hard to grow from seed, to grow lots of new individuals quickly and cheaply.	*'transmissionem' meaning take from one place to another)* Neurotransmitter Cataract *(from Greek 'katarhaktes' meaning a waterfall or a portcullis gate)* Ciliary muscle *(ciliary from Latin 'cilia', meaning hair-like; muscle from the Latin 'mus' meaning mouse)* Colour blindness Cone cell Rod cell Constrict *(from Latin 'constrictionem' meaning to bind together)* Cornea *(named after the Latin word for horn, 'cornu', because of the consistency of the cornea)* Dilate *(from Latin 'dilatare' meaning to make wider)* Iris *(from Greek 'iris' meaning rainbow)* Lens *(from Latin 'lens' meaning lentil)* Long-sightedness Short-sightedness Optic nerve *(optic from Greek 'optikos' meaning to do with sight)* Pupil *(from Latin 'pupilla' meaning little girl-doll, so-called because of the tiny reflection of yourself you can see in the pupils of others)*

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				Retina *(from Latin 'tunica retina' meaning a net-like tunic/top because of the net-like blood vessels covering the retina)* Medulla oblongata *(influenced by medius "middle" and Latin 'oblongus' meaning more long than broad)* Cerebellum *(Latin 'cerebellum' meaning a small brain)* Cerebral cortex *(cortex from Latin outer shell, husk;")* Hemisphere *(Greek hēmisphairion, from hēmi- "half")* Blood-brain barrier Chemotherapy *(means treatment using chemicals)* CT scan *(computerised tomography from Greek 'tomos' meaning slice, and '-graphy' meaning to record)* Gamma ray *(ray from Latin 'radius' meaning a staff or spoke of a wheel)* PET (positron emission tomography) scan *(positron is a combination of 'positive' and 'electron'; emission from Latin 'emittere' meaning send out; see above for tomography)*

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				Quadriplegia *(from Latin 'quadri-' meaning four and Greek 'plege' meaning stroke/strike)* Radioactive *(from Latin 'radius', meaning spoke/ray/staff, and 'activus' meaning doing)* Radiotherapy *(means to use radiation for treatment)* Tumour Genetic *(from genesis "origin")* Genome *(from gen "gene" + (chromos)om "chromosome")* Cloning *(klados "sprout, young branch, offshoot of a plant,")* Nucleus *(Latin- kernel of a nut)* Articles: Saving Seeds | National Geographic Society Technology: Seed bank builds on frozen assets | New Scientist Bees of the sea: Tiny crustaceans pollinate underwater plants | New Scientist

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				blastocyst_article.pdf (sciencejournalforkids.org) Myelin Sheath Disorders: Types, Causes, Symptoms, and Treatments (healthline.com) Emilia Clarke is missing 'quite a bit' of her brain. How can people survive and thrive after brain injury? (medicalxpress.com) Head Transplant: Donor Selection, Surgery, and Recovery (verywellhealth.com) How our brains cope with speaking more than one language - BBC Future How Many Senses Does a Human Have? - Bodytomy
CB3 Genetics **Year 10** *(Paper 1)*	B3.3 Explain the role of meiotic cell division, including the production of four daughter cells, each with half the number of chromosomes, and that this results in the formation of genetically different haploid gametes	Following method-controlling temperature-precipitation as separation technique- DNA Extraction	**Year 7** Haploids gametes fusing to form a diploid zygote Journey of a sperm from production in the testes to ejaculation. Egg released from ovary. Role of cilia in pushing egg along oviduct.	Meiosis (Greek 'mei' make smaller, 'osis' biological condition) Fertilisation *(French-make productive)* Haploid *(Greek Haploos - Single)* Diploid *(Greek Diploos - Double)* Gamete *(PIE root gem – to marry)* Zygote *(Greek Zygotos -yoked)* Vertebrate *(from Latin 'vertebra' meaning a joint of the body or the spine)* Invertebrate *(without vertebra)*

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	The stages of meiosis are not required B3.5 Describe the genome as the entire DNA of an organism and a gene as a section of a DNA molecule that codes for a specific protein B3.4 Describe DNA as a polymer made up of: a two strands coiled to form a double helix b strands linked by a series of complementary base pairs joined together by weak hydrogen bonds c nucleotides that consist of a sugar and phosphate group with one of the four different bases attached to the sugar B3.6 Explain how DNA can be extracted from fruit B3.12 Explain why there are differences in the	Discuss the outcomes of the Human Genome Project and its potential applications within medicine- collaboration, peer review- sharing of data. Discussion of potential benefits/ risks (genetic security- life insurance etc). Translate information between numerical and graphical forms. Extract and interpret information from graphs, charts and tables. Extract and interpret data from graphs, charts, and tables - Measurement of one continuous (e.g height/ hand-span) and one discontinuous (e.g. eye colour/tongue rolling) variable in the class or using	Sexual reproduction of male and female. Mechanics of sexual intercourse. Journey of sperm from vagina, through cervix and uterus to meeting an egg in oviduct. Point of fertilisation- • role of acrosome in breaking down jelly coat/ membrane. • Hardening of coat to prevent double fertilisation. • Combination of paternal and maternal DNA/ chromosomes. • Zygote starts to divide to form an embryo. Flower structure to include the: • Stigma and stamen • Stamen • Ovary • Anther and filament • Petals and sepals Pollination methods including: • Bees/ insects • Wind/ water • Artificial	Sexual *(Involving sex)* Asexual *(A-not as in atypical, asymmetric)* Clone *(from Greek 'klonos' meaning a shoot or twig)* DNA *(deoxy-one less oxygen, nucleic-nucleus, acid)* Chromosome *(chroma- colour as it was seen when took up stain)* Chromosome *(from Greek 'chroma' meaning colour, and 'soma' meaning body)* Double Helix *(a double spiral – from Greek 'helix' meaning spiral)* Base *(bottom/foundation)* Complementary base pair *(complementary from Latin 'complere' meaning to fill up/complete)* Hydrogen bond Polymer *(of many parts, from Greek 'poly' meaning many, and '-mer' meaning parts)* Adenine *(from Greek 'aden' meaning gland)* Cytosine *(from Greek 'cyto' meaning cell)* Thymine *(from the thymus gland, itself from the Greek 'thymos' meaning a warty excrescence/growth)* Guanine *(from 'guano', aka bird poo, from which it was first isolated)*

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	inherited characteristics as a result of alleles B3.13 Explain the terms: chromosome, gene, allele, dominant, recessive, homozygous, heterozygous, genotype, phenotype, gamete and zygote B3.14 Explain monohybrid inheritance using genetic diagrams, Punnett squares and family pedigrees B3.15 Describe how the sex of offspring is determined at fertilisation, using genetic diagrams B3.16 Calculate and analyse outcomes (using probabilities, ratios and percentages) from monohybrid crosses and pedigree analysis for dominant and recessive traits	a plant- e.g.Laurel. - Translation of this data into a relevant graph: bar chart with gaps for discontinuous, grouped data for continuous- Variation lesson Understand and use direct proportions and simple ratios- Inheritance (Punnett Squares) Understand and use the concept of probability in predicting the outcome of genetic crosses- Inheritance (Punnett Squarese)	Pollen tube formation and fertilisation. Seed formation and dispersal. Importance of plant reproduction in human food security inc loss of bees etc. Structure of DNA (limit to double helix with a code, just simple base pairs ATGC) Definition of chromosome and number in humans/ some other organisms for comparison Work of Watson, Crick and Francis Environmental vs genetic variation Examples of environmental to include height, weight etc. These are continuous variations- need to be measured, all values possible. Examples of genetic to include eye colour, tongue tolling, ear lobes etc. These are discontinuous- can be easily observed and only have certain values.	Uracil *(a possible combination of 'urea' from the Greek 'ouron' meaning urine, and 'acetic' meaning vinegarish)* Codon *(from Latin 'codex' meaning a book or system of laws)* Complementary Genetic code *(Greek- genetikos- origins of)* Ribonucleic acid (RNA) *(ribo- to do with the pentose sugar ribose, nucleic – to do with the nucleus (kernel), acid – from Latin 'acidus' for sour)* Messenger RNA (mRNA) Transfer RNA (tRNA) RNA polymerase *(polymerase from 'polymer' and 'ase' meaning a type of enzyme)* Template strand *(from 'templet' meaning a horizontal piece under a girder or a beam)* Nuclear pore *(from Greek 'poros' meaning a passage)* Transcription *(from Latin 'transcribere' meaning to write across)* Translation *(from Latin 'translatus' meaning to carry across)* Environmental *(French- environ- around)*

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	B3.19 State that most phenotypic features are the result of multiple genes rather than single gene inheritance B3.20 Describe the causes of variation that influence phenotype, including: a genetic variation – different characteristics as a result of mutation and sexual reproduction b environmental variation – different characteristics caused by an organism's environment (acquired characteristics) B3.21 Discuss the outcomes of the Human Genome Project and its potential applications within medicine B3.22 State that there is usually extensive genetic variation within a		**Year 8** Meiosis – as cell division that produces 4 genetically different haploid daughter cells. Meiosis produces gametes (sperm and egg cells in animals) Fertilisation as the fusing of a sperm and egg nuclei to produce a zygote. Zygote travels down the oviduct and implants into uterus wall. Variation as the differences in characteristics. Within species or between species. Characteristics can be inherited or environmental. Chromosomes are coiled up strands of DNA Genes are sections of DNA that code for proteins (that give us our characteristics) Alleles – different versions of the same gene. Dominant and recessive alleles. Inherited characteristics including sex determination.	Genetic *(Greek- genetikos- origins of)* Continuous *(Latin- following after another)* Discontinuous *(dis-not)* Variation *(French- variacion- difference)* Inherit *(old French- to make someone an heir)* Mutation *(French and Latin- a process of changing)* Characteristic *(Greek- character)* Variation *(Latin 'variatonem' a difference)* Characteristic *(Greek 'kharakter' symbol)* Gene *(PIE 'gen-' give birth)* Allele *(allelomorph) – (Greek 'al' other, 'morph' form)* Genetic disorder Disease *(Latin 'dis' not, 'ease' comfort)* Articles: fertility and infertility - Students | Britannica Kids | Homework Help School of Anthias | National Geographic Society Sexual Reproduction | National Geographic Society Saving Seeds | National Geographic Society

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	population of a species and that these arise through mutations B3.23 State that most genetic mutations have no effect on the phenotype, some mutations have a small effect on the phenotype and, rarely, a single mutation will significantly affect the phenotype **Separate Sciences Only** B3.1 Explain some of the advantages and disadvantages of asexual reproduction, including the lack of need to find a mate, a rapid reproductive cycle, but no variation in the population B3.2 Explain some of the advantages and		Use of Punnett squares to determine the chance of inheriting a characteristic. Type 1 Diabetes can be inherited Other inherited diseases to include cystic fibrosis (recessive) and Huntington's (dominant). Punnet squares to show probability of inheritance for these 2 inherited diseases.	Technology: Seed bank builds on frozen assets | New Scientist Bees of the sea: Tiny crustaceans pollinate underwater plants | New Scientist DNA (sciencedaily.com) Oldest sequenced DNA belonged to 1 million-year-old mystery mammoth | Live Science DNA: a timeline of discoveries - BBC Science Focus Magazine Biodiversity | National Geographic Society Nature vs. Nurture: Genes or Environment? (verywellmind.com) Do you love or loathe coffee? Your genes may be to blame. | National Geographic 18 Common Genetic Disorders: 4 Types, Symptoms, Causes & Human Genome (medicinenet.com)

	disadvantages of sexual reproduction, including variation in the population, but the requirement to find a mate B3.7 Explain how the order of bases in a section of DNA decides the order of amino acids in the protein and that these fold to produce specifically shaped proteins such as enzymes B3.8 Describe the stages of protein synthesis, including transcription and translation: 1. RNA polymerase binds to non-coding DNA located in front of a gene 2. RNA polymerase produces a complementary mRNA strand from the coding DNA of the gene	B3.11 Describe the work of **Mendel** in discovering the basis of genetics and recognise the difficulties of understanding inheritance before the mechanism was discovered		

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	3. the attachment of the mRNA to the ribosome 4. the coding by triplets of bases (codons) in the mRNA for specific amino acids 5. the transfer of amino acids to the ribosome by tRNA 6. the linking of amino acids to form polypeptides B3.9 Describe how genetic variants in the non-coding DNA of a gene can affect phenotype by influencing the binding of RNA polymerase and altering the quantity of protein produced B3.10 Describe how genetic variants in the coding DNA of a gene can affect phenotype by altering the sequence of amino acids			

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	and therefore the activity of the protein produced B3.17 Describe the inheritance of the ABO blood groups with reference to codominance and multiple alleles B3.18 Explain how sex-linked genetic disorders are inherited			
CB4 Natural Selection and Genetic Modification **Year 10** *(Paper 1)*	B4.4 Describe the evidence for human evolution, based on fossils, including: a Ardi from 4.4 million years ago b Lucy from 3.2 million years ago c Leakey's discovery of fossils from 1.6 million years ago B4.5 Describe the evidence for human evolution based on stone tools, including: a the development of stone tools over time b how	Translate information between numerical and graphical forms- Human Evolution timeline Changing ideas over time as new evidence is found- Three Domain system Construct and interpret frequency tables and	**Year 7** Definition of a species as two organisms that can breed to produce fertile offspring Hierarchy of taxonomy: • Kingdom • Phylum • Class • Order • Family • Genus • Species Classes of vertebrate and main distinguishing features:	Ardi *(Latin aridus "dry, arid, parched,")* Binomial system *(Late Latin binomius "having two personal names")* Evolution *(Latin evolutionem (nominative evolution) "unrolling (of a book))* Lucy Species *(Latin- a particular sort or type)* Ancestor *(Late Latin antecessor "predecessor," literally "fore-goer")* Antibiotic *(from anti- "against" + biotique "of (microbial) life")*

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	these can be dated from their environment B4.2 Explain Darwin's theory of evolution by natural selection B4.3 Explain how the emergence of resistant organisms supports Darwin's theory of evolution including antibiotic resistance in bacteria B4.7 Describe how genetic analysis has led to the suggestion of the three domains rather than the five kingdoms classification method B4.8 Explain selective breeding and its impact on food plants and domesticated animals B4.10 Describe genetic engineering as a process which involves modifying	diagrams, bar charts and histograms Plot and draw appropriate graphs, selecting appropriate scales for axes- Data analysis opportunity linked to Genetic Engineering/ Selective Breeding	• Mammals- live young (viviparous), lungs, fur, constant body temperature) • Birds- feathers, eggs (oviparous), lungs, constant body temperature. • Reptiles- scales, eggs (on land-hard shell), lungs, body temperature depends on surroundings. • Amphibians- eggs (in water-soft), lungs and gills, body temperature depends on surroundings. • Fish- scales, eggs (in water- soft), gills, body temperature depends on surroundings. Adaptation as a feature of an organism which allows in to thrive/ survive in its habitat.	Competition *(Latin- rivalry)* Genetic variation *(Latin 'variatonem' a difference)* Natural selection *(Latin selectionem "a choosing out, choice, selection")* Resistant *(Latin resistere "make a stand against, oppose")* Pentadactyl limb *(Greek "five, containing five")* Classification *(Latin "kind or class of things")* Domain *(French domaine-belonging to a Lord)* Genus *(Latin "kind or class of things")* Kingdom *(Old English. King "sort, rank" Dom "a law, statute, decree")* Artificial selection *(from artificium "a work of art; skill; theory, system")* Breed *("race, lineage, stock from the same parentage")* Disease resistance *(Latin resistere "make a stand against, oppose")* Gene *(Greek genea "generation, race")* Genetic engineering *(Greek. Genetic "origin")* Genetically modified organism (GMO) Genome *(from gen "gene" + (chromos)om "chromosome")*

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	the genome of an organism to introduce desirable characteristics B4.11 **(Higher Tier Only) Describe the main stages of genetic engineering including the use of: a restriction enzymes b ligase c sticky ends d vectors** B4.14 Evaluate the benefits and risks of genetic engineering and selective breeding in modern agriculture and medicine, including practical and ethical implications **Separate Sciences Only** B4.1 Describe the work of Darwin and Wallace in the development of the theory of evolution by natural selection and explain the	Development of a major scientific theory. Controversy and resistance to change- Darwin and Wallace Construct and interpret frequency tables and diagrams, bar charts and histograms Plot and draw appropriate graphs, selecting appropriate scales for axes- Data analysis opportunity linked to global	Identification of common features in a certain habitat including: • Hot desert- large SA for cooling, water storage, plant defences. • Polar- small SA- large size, fat, fur or similar. Adaptations of a typical: • Predator- forward facing eyes, speed, claws or talons, sharp beak or teeth. • Prey- eyes on side of head, camouflage, behaviour eg burrowing. How organisms in an ecosystem are affected by competition for factors including: • Food/ prey • Water • Shelter • Territory • Mates That this competition is both inter- (between) and intra- (within) specific (a species)	Selective breeding Variety *(French- variacion- difference)* Yield Callus *(latin callere "be hard")* Clone *(Greek klados "sprout, young branch, offshoot of a plant")* Differentiate *(Latin differentia "diversity, difference")* Extinction *(Latin extinctus/exstinctus "to put out, quench; go out, die out; kill, destroy")* Reject *(Latin reiectus "throw away, cast aside)* Stem cell Tissue culture *(Latin cultura "a cultivating, agriculture,")* Virus *(Pro-italian 'weis-o' poison)* Allele *(Greek 'al' other, 'morph' form)* Base *(Latin basis "foundation")* Diabetes *(Greek 'diabetes' to pass through)* Insulin *(Latin insula "island")* Ligase *(Latin ligare "to bind")* Plasmid Recombinant DNA *(Latin combinare "to unite, yoke together,")* Restriction enzyme Sticky end *(Old English "adhesive, inclined to stick")* Type 1 diabetes *(Greek 'diabetes' to pass through)*

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	impact of these ideas on modern biology B4.6 Describe how the anatomy of the pentadactyl limb provides scientists with evidence for evolution B4.9 Describe the process of tissue culture and its advantages in medical research and plant breeding programmes B4.12 Explain the advantages and disadvantages of genetic engineering to produce GM organisms including the modification of crop plants, including the introduction of genes for insect resistance from Bacillus thuringiensis into crop plants B4.13 Explain the advantages and disadvantages of agricultural solutions to the	population/ food supply and demand	Definition of Autotroph/ Heterotroph **Year 9** Define species as a group of organisms which can breed to produce fertile offspring Hybrid species cannot produce fertile offspring Selective breeding – organisms bred based on their desirable characteristics Genetic modification – changing an organism's genome, usually by inserting a gene. Cloning – placing a nucleus from a body cell into a zygote and implanting this into a surrogate. E.g. Dolly Tissue culture – growing cells on agar. Used for drug tests and studying viruses Cuttings - used to produce clones of plants, e.g. where species are endangered, for species which are hard to grow from seed,	Vector *(Latin "one who carries or conveys, carrier")* Bt toxin Insecticide *(-cide French – cida "cutter, killer, slayer")* Monoculture *(Mono. Greek "one, single, alone")* Pest *(Latin pestis "deadly contagious disease; a curse, bane,")* Resistance *(Latin resistere "make a stand against, oppose")* Strain *(Old English strion, streon "a begetting, procreation")* Biological control *(bio – Greek "life")* Fertiliser Pollution *(Latin polluere "to soil, defile, contaminate")* Weeds *(Old English weod, uueod "grass, herb)* Articles: An argument over dino-history is tearing palaeontology in two | WIRED UKnation Exploring Vertebrate Classification | National Geographic Society Top 10 New Species! – National Geographic Education Blog

	demands of a growing human population, including use of fertilisers and biological control		to grow lots of new individuals quickly and cheaply. Positive human effects on ecosystems – zoos and conservation, reforestation, gene banks linked to preserving biodiversity Charles Darwin's Theory of Natural selection Evolution define as gradual change in the characteristics of species over time Evidence for human evolution including; fossils, stone tools. Comparison of characteristics of; Ardi, Lucy, Homo habilis, Homo erectus and homo sapiens. To include; skull volume, height, spinal curvature, toe length etc… Fossil record is incomplete Predicting fossil age linked to rock layer (deeper rock, older fossil) Extinction can occur as a result of being outcompeted by other species	Prehistoric Animal Adaptations | National Geographic Society Response and Adaptation by Plants to Flooding Stress | Annals of Botany | Oxford Academic (oup.com) Biodiversity | National Geographic Society Genetically Modified Organisms | National Geographic Society Super cows https://youtu.be/IDN-QeVhQTc human evolution | History, Stages, Timeline, Tree, Chart, & Facts | Britannica Is there any evidence that humans are still evolving? (medicalnewstoday.com)

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			Antibiotic resistance used as evidence for evolution	
CB5 Health, Disease and the Development of Medicines **Year 10** *(Paper 1)*	5.1 Describe health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity, as defined by the World Health Organization (WHO) 5.2 Describe the difference between communicable and non-communicable diseases 5.3 Explain why the presence of one disease can lead to a higher susceptibility to other diseases 5.23 Describe that many non-communicable human diseases are caused by the interaction of a number of factors, including cardiovascular diseases,	Construct and interpret frequency tables and diagrams, bar charts and histograms. Understand the principles of sampling as applied to scientific data. Use a scatter diagram to identify a correlation between two variables- Life expectancy/ prevalence of disease in different countries- linked to income/GDP etc Non-linear relationships/ use of a more complex formula- BMI calculation	**Year 7** Structure of bacterium: • Size compared with eukaryotic • Highlight lack of nucleus • Cell wall • Chromosomal DNA • Plasmid • Some have flagella Preparing a finger dab plate testing four conditions: Aseptic technique, Safety, Comparison of results, Sources of error, Estimation of coverage **Year 8** Probiotic bacteria in the intestines. Useful bacteria which aids digestion and fights off harmful bacteria e.g. lactobacillus which is found in yogurt and helps digest lactose. Bifidobacterium found in dairy products, helps with IBS.	Cause *(Latin causa " a reason; interest")* Communicable disease *(Latin communicare "to share, divide out; communicate, impart, inform; join, unite, participate in")* Correlation *(French corrélation, from cor- "together")* Disease *(Latin 'dis' not, 'ease' comfort)* Health *(Old English hælþ "wholeness, a being whole, sound or well")* Immune system *(Latin immunis "exempt from public service, untaxed; unburdened, not tributary")* Lifestyle Non-communicable disease *(non – "not" Latin communicare "to share, divide out; communicate, impart, inform; join, unite, participate in")* Pathogen *(pathogene, "disease-producing micro-organism")* Cirrhosis *(Greek 'kirros' yellow, 'osis' condition)* Deficiency disease *(Latin 'deficentia' to fail)* Drug *(Old French droge "supply, stock, provision")*

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	many forms of cancer, some lung and liver diseases and diseases influenced by nutrition 5.24 Explain the effect of lifestyle factors on non-communicable diseases at local, national and global levels, including: a exercise and diet on obesity and malnutrition, including BMI and waist : hip calculations, using the BMI equation b alcohol on liver diseases c smoking on cardiovascular diseases 5.25 Evaluate some different treatments for cardiovascular disease, including: a life-long medication b surgical procedures c lifestyle changes	Construct and interpret frequency tables and diagrams, bar charts and histograms. Understand the principles of sampling as applied to scientific data. Use a scatter diagram to identify a correlation between two variables- Linking of named factors to probability and prevalence of non-communicable diseases e.g smoking	Definition of communicable diseases as diseases that can be passed from person to person. Caused by pathogens. Types of pathogens and examples of diseases caused by each - Bacteria – Salmonella, TB, cholera Virus – cold, flu, covid Fungi – athletes foot, ringworm and thrush Protists – malaria, dysentery Spread of communicable disease and preventative measures. Spread via touch, air, sex, food/water, animals. Preventative measures – hygiene, cleaning, isolation, ventilation, 'catch it, bin it, kill it.' Human defences against pathogens Physical (hairs, mucus, skin, cilia) and chemical barriers (enzymes in tears, saliva, stomach acid)	Genetic disorder *(From Latin dis- "not" + ordinare "to order, regulate")* Malnutrition *(Latin 'malus' bad, 'nutritionem' nourishing)* Body mass index Cardiovascular disease *(Greek 'Kardia' Heart, Latin 'vascularis' vessels)* Heart attack Obesity *(Latin 'ob' because of, 'ese' food)* Stent *(Greek stenos "narrow")* Stroke Waist:Hip ratio AIDs Chalara dieback Cholera *(Greek kholera "a type of disease characterized by diarrhoea)* Diarrhoea *(Greek diarrhoia "a flowing through,")* Haemorrhagic fever *(Latin febris "fever," related to fovere "to warm, heat")* Host *(Old French oste, hoste "guest, host, hostess, landlord")* HIV Malaria *(Italian mala aria, literally "bad air")* Protist *(Greek 'proto' first)* Secondary infection *(Old French infeccion "contamination, poisoning")*

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	5.4 Describe a pathogen as a disease-causing organism, including viruses, bacteria, fungi and protists 5.5 Describe some common infections, including: a cholera (bacteria) causes diarrhoea b tuberculosis (bacteria) causes lung damage c Chalara ash dieback (fungi) causes leaf loss and bark lesions d malaria (protists) causes damage to blood and liver e HIV (virus) destroys white blood cells, leading to the onset of AIDS 5.6 Explain how pathogens are spread and how this spread can be reduced or prevented, including: a cholera (bacteria) – water b tuberculosis (bacteria) – airborne c Chalara ash dieback (fungi) – airborne	and lung cancer, alcohol consumption and cirrhotic liver disease.	Up to 1, babies predominately rely on a mother's milk (can also be formula). Weening from 6 months Balanced diet proportions including water. Deficiency diseases as a result of malnutrition Scurvy, kwashiorkor, rickets. Symptoms and good sources of the relevant nutrients. Describe deficiency diseases as non-communicable diseases. Define non-communicable disease as a disease that cannot be spread from person to person. They can develop as a result of lifestyle choice, the environment or inheritance. Other examples of non-communicable diseases. Obesity – cardiovascular disease, type 2 diabetes The circulatory system includes the heart and blood vessels Heart as a pump that pushes blood around the circulatory	Tuberculosis *(Latin tuberculum "small swelling, pimple,")* Ulcer *(Greek elkos "a wound, sore)* Virus *(Pro-italian 'weis-o' poison)* White blood cell Epidemic *(Greek epi "among, upon" + dēmos "people, district")* Hygiene *(Greek 'hygies' healthy)* Oral route *(Latin oralis "mouth, opening, face, entrance")* Vector *(Latin "one who carries or conveys, carrier")* Bacterial lawn plate Capsid *(Latin capsa "box")* Cross-sectional area Lysis *(Greek lyein "to unfasten, loose, loosen, untie")* Lysogenic pathway Lytic pathway *(Greek lytikos "able to loose, loosing")* Nutrient agar *(Latin nutrient - nutrire "to nourish, suckle, feed")* Aseptic techniques *(a- not. septic- Latin septikos- rotten, putrid)* Autoclave *(French auto- "self" + clave, from Latin clavis "key")* Chemical defence

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	d malaria (protists) – animal vectors 5.8 Explain how sexually transmitted infections (STIs) are spread and how this spread can be reduced or prevented, including: a Chlamydia (bacteria) b HIV (virus) 5.12 Describe how the physical barriers and chemical defences of the human body provide protection from pathogens, including: a physical barriers, including mucus, cilia and skin b chemical defence, including lysozymes and hydrochloric acid B5.13 Explain the role of the specific immune	Construct and interpret frequency tables and diagrams, bar charts and histograms Plot, draw and interpret appropriate graphs Use a scatter diagram to identify a correlation between two variables- Graph showing antibody production in primary and secondary immune responses Practical use of aseptic techniques throughout unit. Calculate cross-sectional areas of bacterial cultures	system. Right hand side of the heart pumps the deoxygenated blood to the lungs. The left side pumps oxygenated blood to the working muscles (body). Arteries take blood from the heart Veins take blood into the heart Capillaries connect arteries and veins and are where exchange happens between the blood and cells Red blood cells carry oxygen (recap how they are specialised from year 7) Effects of alcohol – Short term effects: antisocial behaviour, vomiting, loss of coordination, dehydration. Long term effects - cirrhosis of liver, bowel cancer, high blood pressure, dependency and alcoholism. Effects of smoking – lung cancer, links to cardiovascular disease. Structure of the lungs	Cuticle *(Latin cuticula, diminutive of cutis "skin")* Pest *(Latin pestis "deadly contagious disease; a curse, bane")* Physical barrier Symptom *(Greek 'syn' together, 'piptein' to fall)* Diagnosis *(Greek diagnōsis "a discerning, distinguishing")* Distribution analysis *(Latin distributionem "a division, distribution," Greek analysis literally "a breaking up, a loosening, releasing")* Lesion *(Old French lesion "hurt, offense, wrong, injury, wound")* Yield Chlamydia *(Greek khlamys "short mantle, upper garment for men, military cloak")* Ciliated cells *(Latin "fringed with fine hairs")* Hydrochloric acid Lysozyme *(Lyso - "loosening, dissolving")* Mucus *(Latin 'mucus' slime)* Physical barrier Screening STIs Activate *(Latin actus "a doing")* Antibody *(anti – Greek "against")*

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	system of the human body in defence against disease, including: a exposure to pathogen b the antigens trigger an immune response which causes the production of antibodies c the antigens also trigger production of memory lymphocytes d the role of memory lymphocytes in the secondary response to the antigen B5.14 Explain the body's response to immunisation using an inactive form of a pathogen B5.16 Explain that antibiotics can only be used to treat bacterial infections because they inhibit cell processes in the bacterium but not the host organism. B5.20 Describe that the process of developing new	and clear agar jelly using πr2- Antibiotics lesson History of antibiotic discovery. Work of Fleming, Florey and Chain. Mention only- taught in separate Ethics of drug trialling. Use of animal/ human studies. Need for blind and double blind to avoid bias and importance of peer review. Practical use of aseptic techniques throughout unit. Calculate cross-sectional areas of bacterial cultures	• Trachea • Bronchus • Bronchioles • Alveoli Process of breathing Inhaling involves – diaphragm contracts, intercostal muscles contract, volume thorax increases, pressure decreases Exhaling involves – diaphragm relaxes, intercostal muscles relax, volume thorax decreases, pressure increases Structure of alveoli and adaptations to include – large surface area, thin walls and moist lining Diffusion – defined as movement from a high concentration to a low concentration Gaseous exchange and diffusion gradient **Year 9** Microorganisms as pathogens Immune system – • Exposure to pathogen • Antigens trigger an immune response which causes the	Antigen *(anti – Greek "against" gen "thing that produces or causes")* Herd immunity *(Old English heord "flock")* Immune *(Latin immunis "exempt from public service, untaxed; unburdened, not tributary")* Immunisation Lymphocyte *(Latin lympha "water, clear water + -cyte "a cell.")* Memory lymphocyte MMR Secondary response Vaccine *(from vaccine (adj.) "pertaining to cows, from cows")* Antibiotic *(from anti- "against" + biotique "of (microbial) life,")* Clinical trial *(Latin clinicus "physician that visits patients in their beds")* C Colony *(Latin colonia "settled land, farm, landed estate")* Dose *(Greek dosis "a portion prescribed")* Inhibit *(Latin inhibere "to hold in, hold back, keep back")* Penicillin *(Latin penicillus "paintbrush" in reference to the shape of the mould cells)* Pre-clinical testing Resistance Side effect

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	medicines, including antibiotics, has many stages, including discovery, development, preclinical and clinical testing. **Separate Sciences Only** B5.7 Describe the lifecycle of a virus, including lysogenic and lytic pathways B5.19 Calculate cross-sectional areas of bacterial cultures and clear agar jelly using πr2 B5.9 Describe how some plants defend themselves against attack from pests and pathogens by physical barriers, including the leaf cuticle and cell wall	and clear agar jelly using πr2- Use of viruses to kill bacteria on agar plates- similar to antibiotic practical- TEACH C/S AREA EXPLICITLY Calculate cross-sectional areas of bacterial cultures and clear agar jelly using πr2- Use of plant extracts to kill bacteria on agar plates- measure radius and CALCULATE C/S AREA EXPLICITLY	production of lymphocytes • Antigens also trigger production of memory lymphocytes • Role of memory lymphocytes in the secondary response to the antigen • Vaccinations – dead or weakened version of the pathogen. Triggers • immune response without symptoms. Memory lymphocytes produce lots of antibodies quickly. • Antibiotics used to destroy bacterial infections • Antibiotic resistance from not finishing antibiotic courses Respiratory system overview. • Recap respiratory system from year 8 • Conditions linking to the respiratory system such as	Cancer cell Chemotherapy Clone Diagnosis Hybridoma cell Monoclonal antibodies PET scanner Platelet *(English – little plate)* Radiotherapy Articles: Role of microbes in human health and disease (genome.gov) Using Microorganisms in Food Production - ScienceAid Poor diets damaging children's health, warns UNICEF - Unicef UK What does the appendix do? finally an answer! (news-medical.net) Cordyceps zombie fungus takes over ants' bodies (nationalgeographic.com) Poor diets damaging children's health, warns UNICEF - Unicef UK

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	B5.10 Describe how plants defend themselves against attack from pests and pathogens by producing chemicals, some of which can be used to treat human diseases or relieve symptoms B5.17 Explain the aseptic techniques used in culturing microorganisms in the laboratory, including the use of an autoclave to prepare sterile growth medium and petri dishes, the use of sterile inoculating loops to transfer microorganisms and the need to keep petri dishes and culture vials covered B5.11 Describe different ways plant diseases can be detected and identified, in	Understand the principles of sampling as applied to scientific data- Distribution analysis in monitoring crop disease Plot, draw and interpret appropriate graphs. Construct and interpret frequency tables and diagrams, bar charts and histograms- Plant disease/ crop yield data Discussion of factors in society affecting vaccine uptake. Confidence in science, misinformation esp on internet, importance of trials and peer review.	asthma, bronchitis and emphysema • Respiration defined as a chemical reaction which releases energy • Comparison of aerobic and anaerobic respiration including equations • Where the reactants come from • How waste carbon dioxide is removed Short term affects of exercise to include; increased heart, breathing and respiratory rates Long term affects to include; build-up of lactic acid and oxygen debt	Mammals Can Use Their Intestines to Breathe | The Scientist Magazine® (the-scientist.com) Physical and Chemical Barriers | The Immune System (nigerianscholars.com) Anatomical and Physico-chemical barriers of immune system - Online Biology Notes Altitude Training: Does It Work and How to Do (healthline.com) Asthma (who.int)

	the lab and in the field including the elimination of possible environmental causes, distribution analysis of affected plants, observation of visible symptoms and diagnostic testing to identify pathogens B5.15 Discuss the advantages and disadvantages of immunisation, including the concept of herd immunity B5.18 Core Practical: Investigate the effects of antiseptics, antibiotics or plant extracts on microbial cultures B5.21 Describe the production of monoclonal antibodies, including: a use of lymphocytes which produce desired antibodies but do not divide b production of hybridoma	Core Practical: Investigate the effects of antiseptics, antibiotics or plant extracts on microbial cultures. Use of aseptic technique, calculation of C/S area as above.		

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	cells c hybridoma cells produce antibodies as they divide B5.22 Explain the use of monoclonal antibodies, including: a in pregnancy testing b in diagnosis including locating the position of blood clots and cancer cells and in treatment of diseases including cancer c the advantages of using monoclonal antibodies to target specific cells compared to drug and radiotherapy treatments			
CB6 Plant Structures and their Functions	B6.1 Describe photosynthetic organisms as the main producers of food and therefore biomass		**Year 7** Plant cell structure to include: • Nucleus • Membrane • Cytoplasm • Ribosome	Organism *(organic)* Organelle *(latin- organ- instrument)* Nucleus *(latin- kernel of a nut)* Cytoplasm *(cyto-cell, plasm as in plasm-fluid)* Cell wall

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Year 11 *(Paper 2)*	B6.2 Describe photosynthesis in plants and algae as an endothermic reaction that uses light energy to react carbon dioxide and water to produce glucose and oxygen B6.9 Explain how water and mineral ions are transported through the plant by transpiration, including the structure and function of the stomata B6.3 Explain the effect of temperature, light intensity and carbon dioxide concentration as limiting factors on the rate of photosynthesis **B6.4 (Higher Tier Only) Explain the interactions of temperature, light intensity and carbon dioxide concentration in**	Construct and interpret frequency tables and diagrams, bar charts and histograms. Understand the principles of sampling as applied to scientific data. Use a scatter diagram to identify a correlation between two variables. Plot, draw and interpret appropriate graphs- Limiting factor graphs- construction and analysis of. Where does each factor stop being limiting?	• Mitochondria • Cell wall • Chloroplast • Vacuole Seed formation and dispersal Importance in human food security including loss of bees etc Adaptation as a feature of an organism which allows in to thrive/ survive in its habitat. Identification of common features in a certain habitat including: • Hot desert- large SA for cooling, water storage, plant defences. • Polar- small SA- large size, fat, fur or similar. How these lead to survival Define autotroph and heterotroph Process of photosynthesis: • Construction and recall of simple word equation.	Cell membrane *(latin- membrana- a writing skin)* Chloroplast *(chloro- pale green, plast- granule)* Vacuole *(latin- diminutive of vacuus- empty)* Cell *(as in room-monastry/prison)* Adaptation *(Latin- to have adjusted)* Habitat *(Latin- habitare- to live in)* Environment *(French- environ- around)* Autotroph *(Auto- self, troph- pertaining to food)* Heterotroph *(Hetero- Greek- different)* Photosynthesis *(Greek- phos-light- synthesis- making/ putting together)* Hydroponics *(Hydro-water, Greek-ponos- labour/toil)* Glucose *(Greek- gleukos-sweet wine)* Starch *(Old English stercan- make stiff)* Photosynthesis *(from photo- "light" + synthese "to make")* Adaptation *(adaptare "to adjust,")* Epidermis *(Greek epidermis "the outer skin,")* Palisade Transpiration *("pass off in the form of a vapor or liquid,")*

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	limiting the rate of photosynthesis **B6.6 (Higher Tier Only) Explain how the rate of photosynthesis is directly proportional to light intensity and inversely proportional to the distance from a light source, including the use of the inverse square law calculation** B6.5 Core Practical: Investigate the effect of light intensity on the rate of photosynthesis B1.15 Explain how substances are transported into and out of cells, including by diffusion, osmosis and active transport B6.7 Explain how the structure of the root hair cells is adapted to absorb water and mineral ions	Understand and use simple compound measures such as the rate of a reaction Understand and use inverse proportion – the inverse square law and light intensity in the context of factors affecting photosynthesis- Rates of photosynthesis Core Practical: Investigate the effect of light intensity on the rate of photosynthesis	• Highlight need for light energy to make this reaction happen. Outcomes of photosynthesis- fate of glucose: • Use in respiration- highlight all plants respire- recall equation for respiration- note similarities and differences to photosynthesis. • Storage as starch • Transport to roots etc **Year 8** Process of photosynthesis (recap word equation from year 7) Leaf adaptations to include; Flat, large surface area, thin, stomata and palisade cells Limiting factors (light intensity, carbon dioxide concentration and temperature) which affect rate of photosynthesis. Interpreting the limiting factor from graphs	Stomata *(Greek stoma (genitive stomatos) "mouth; mouthpiece; talk, voice; mouth of a river; any outlet or inlet,")* Xylem *(from Greek xylon "wood")* Translocation *(trans "across, beyond, through, on the other side of, to go beyond," location "position, place; fact or condition* of being in a particular place,") phloem potometer Osmosis *(latin 'endosmose' inwards passage of fluid through a membrane)* Articles: History of the Cell: Discovering the Cell | National Geographic Society Cells and the Versatile Functions of Their Parts | National Geographic Society Intro to cells (article) | Khan Academy Response and Adaptation by Plants to Flooding Stress | Annals of Botany | Oxford Academic (oup.com)

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	B6.8 Explain how the structures of the xylem and phloem are adapted to their function in the plant, including: a lignified dead cells in xylem transporting water and minerals through the plant b living cells in phloem using energy to transport sucrose around the plant B6.9 Explain how water and mineral ions are transported through the plant by transpiration, including the structure and function of the stomata B6.10 Describe how sucrose is transported around the plant by translocation B6.12 Explain the effect of environmental factors on the rate of water uptake by	Carry out rate calculations for chemical reactions. Use simple compound measures such as rate. Calculate arithmetic means. Construct and interpret frequency tables and diagrams, bar charts and histograms. Plot, draw and interpret appropriate graphs- Transpiration rates- effect of different factors Understand the principles of sampling as applied to scientific data. Calculate cross-sectional areas using $\pi r2$- Leaf adaptation	**Year 9** Recap photosynthesis equation from year 7 Recap leaf adaptations from year 8 (flat, large surface area, thin and palisade cells) Recall the layers and their functions in a cross section of a leaf; • waxy cuticle as a waterproof layer • upper epidermis few organelles to allow light to travel through • palisade layer-packed full of chloroplasts • spongy layer – air gaps for diffusion • lower epidermis – containing guard cells and stomata (open in the day for photosynthesis, closed at night when not photosynthesising) Transpiration - movement of water through the roots up the xylem, out of the stomata.	Why do cabbages exist when their shape prevents photosynthesis? | New Scientist On the origin of oxygenic photosynthesis and Cyanobacteria - Sánchez-Baracaldo - 2020 - New Phytologist - Wiley Online Library Red light photosynthesis - - Diamond Light Source

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	a plant, to include light intensity, air movement and temperature B6.13 Demonstrate an understanding of rate calculations for transpiration **Separate Sciences Only** B6.11 Explain how the structure of a leaf is adapted for photosynthesis and gas exchange B6.14 Explain how plants are adapted to survive in extreme environments including the effect of leaf size and shape, the cuticle and stomata B6.15 Explain how plant hormones control and coordinate plant growth and development,	Plot, draw and interpret appropriate graphs- Graphs to show effects of hormones (concentration etc) in yield/ fruiting times etc.	Translocation – movement of sucrose around the plant via the phloem Osmosis as the movement of water from high water concentration to low water concentration through a partially permeable membrane	

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	including the role of auxins in phototropisms and gravitropisms B6.16 Describe the commercial uses of auxins, gibberellins and ethene in plants, including: a auxins in weedkillers and rooting powders b gibberellins in germination, fruit and flower formation and the production of seedless fruit c ethene in fruit ripening			
CB7 Animal Coordination, Control and Homeostasis **Year 11** *(Paper 2)*	B7.1 Describe where hormones are produced and how they are transported from endocrine glands to their target organs, including the pituitary gland, thyroid gland, pancreas, adrenal glands, ovaries and testes	Construct and interpret frequency tables and diagrams, bar charts and histograms. Translate information between numerical and graphical	**Year 7** Male structure names and function to include: • Penis • Testis • Sperm duct • Scrotum • Prostate Female structure names and function • Uterus (highlight lining)	Adrenal gland (Adrenal - "of the kidneys," from Latin renes "kidneys") (Gland - ," diminutive of glans "acorn, nut; acorn-shaped ball). Endocrine gland Endocrine "secreting internally. Latinized form of Greek krinein "to separate, distinguish" (Gland - ," diminutive of glans "acorn, nut; acorn-shaped ball). Hormone Greek hormon "that which sets in motion,"

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	B7.2 (Higher Tier Only) Explain that adrenalin is produced by the adrenal glands to prepare the body for fight or flight, including: a increased heart rate b increased blood pressure c increased blood flow to the muscles d raised blood sugar levels by stimulating the liver to change glycogen into glucose **B7.3 (Higher Tier Only) Explain how thyroxine controls metabolic rate as an example of negative feedback, including: a low levels of thyroxine stimulates production of TRH in hypothalamus b this causes release of TSH from the pituitary gland c TSH acts on the thyroid to produce thyroxine d when thyroxine levels are normal thyroxine inhibits**	forms. Plot, draw and interpret appropriate graphs- Concentrations of hormone levels affecting each other/ in response to stimuli etc. Construct and interpret frequency tables and diagrams, bar charts and histograms. Translate information between numerical and graphical forms. Plot, draw and interpret appropriate graphs- Concentrations of hormone levels affecting each other/ in response to stimuli etc. Plot, draw and interpret appropriate graphs-	• Ovaries • Vagina • Cervix • Oviduct Changes during puberty- to include: • pubic hair • changes in body shape • voice deepening • causes of acne, body odour linked to need for hygiene Role of hormones (oestrogen, progesterone, testosterone) The menstrual cycle: • Overview and purpose • Events during 28 day cycle- thickening of uterus lining, ovulation, menstruation) Menopause How the hormones control these changes. **Year 8** Other examples of non-communicable diseases.	Ovary from Latin ovum "egg," Pancreas Latinized form of Greek pankreas meaning "sweetbread" Pituitary gland (Gland - ," diminutive of glans "acorn, nut; acorn-shaped ball). Testis from Latin testis "testicle" Thyroid gland (Gland - ," diminutive of glans "acorn, nut; acorn-shaped ball). Hypothalamus - Greek hypo- "under" (see hypo-) + thalamus "part of the brain where a nerve emerges." Menstrual Cycle (Latin-monthly) Menopause (Latin- monthly, cease) Oestrogen *(Greek-gen- to bring about, estrus- madness, impulsiveness!!)* Obesity – (Latin 'ob' because of, 'ese' food) Having excess body fat Diabetes – (Greek 'diabetes' to pass through) Disease preventing the storage of glycogen in the body Insulin – (latin 'insula' island) Hormone which removes glucose from the bloodstream Pituitary *(Latin pituitarius "mucous," Taken as the name for the gland because it was believed that it channeled mucus to the nose* Thyroid *(from Greek thyreoeides "shield-shaped")* Contraception *(contra – against conception)*

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	the release of TRH and the production of TSH B7.4 Describe the stages of the menstrual cycle, including the roles of the hormones oestrogen and progesterone, in the control of the menstrual cycle B7.6 Explain how hormonal contraception influences the menstrual cycle and prevents pregnancy B7.7 Evaluate hormonal and barrier methods of contraception **B7.5 (Higher Tier Only) Explain the interactions of oestrogen, progesterone, FSH and LH in the control of the menstrual cycle, including the repair and maintenance of the uterus wall, ovulation and menstruation**	Diagram of menstrual cycle Construct and interpret frequency tables and diagrams, bar charts and histograms. Understand the principles of sampling as applied to scientific data- Analysis of the effectiveness of different contraception methods Plot, draw and interpret appropriate graphs- Graphs of FSH, LH, Oestrogen and Progesterone levels during different menstrual cycle stages	Obesity – cardiovascular disease, type 2 diabetes Type 1 Diabetes can be inherited Controlling blood glucose to include; Eating increases blood glucose, insulin production by pancreas, which removes glucose from blood and stored in muscle and liver cells. **Year 9** Hormones are chemical messengers which help to control what happens in the body Label a body diagram with the endocrine glands and the hormones they secrete. • Pituitary gland secretes growth hormone and FSH and LH. • Thyroid which releases thyroxine • Adrenal gland releases adrenalin • Pancreas releases insulin	Progesterone – Pregnancy – Clomifene therapy – Corpus luteum Glucagon Insulin Homeostasis Correlation Articles: fertility and infertility - Students | Britannica Kids | Homework Help Sexual Reproduction | National Geographic Society School of Anthias | National Geographic Society Adolescent Development (clevelandclinic.org) Poor diets damaging children's health, warns UNICEF - Unicef UK Adrenaline Anxiety: What Is It, And How Can You Manage It? (healthmatch.io)

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	B7.8 Explain the use of hormones in Assisted Reproductive Technology (ART) including IVF and clomifene therapy B7.9 Explain the importance of maintaining a constant internal environment in response to internal and external change B7.13 Explain how the hormone insulin controls blood glucose concentration **B7.14 (Higher Tier Only) Explain how blood glucose concentration is regulated by glucagon** B7.15 Explain the cause of type 1 diabetes and how it is controlled B7.16 Explain the cause of type 2 diabetes and how it is controlled	Evaluation of financial costs of assisted reproduction cycles against other medical treatments. Investigate the presence of sugar in simulated urine/body fluids Use simple compound measures such as rate. Understanding simple probability. Use of a	• Testes releases testosterone • Ovaries release progesterone and oestrogen Endocrine vs nervous system; endocrine system works more slowly and the effects are longer lasting, endocrine system transports chemical messages in the blood, nervous system transports electrical impulses via neurones. Recap days of the menstrual cycle from year 7 Hormonal control of menstrual cycle • FSH stimulate follicle to mature • Oestrogen build uterus wall lining • LH stimulates ovulation • Progesterone maintains the uterus lining If the egg is fertilised the progesterone levels remain	

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	B7.17 Evaluate the correlation between body mass and type 2 diabetes including waist:hip calculations and BMI, using the BMI equation: BMI = mass (kg) / height (m) ^{2} **Separate Sciences Only** B7.10 Explain the importance of homeostasis, including: a thermoregulation – the effect on enzyme activity b osmoregulation – the effect on animal cells B7.11 Explain how thermoregulation takes place, with reference to the	more complex equation- Calculation of BMI and evaluation of health risks associated	high to maintain the lining and menstruation stops ART – Artificial Reproductive Technologies. E.g. • Clomifene contains FSH and LH • IVF – when an egg is fertilised outside the body and is then implanted back into the uterus Hormonal contraception – the pill and implant Barrier contraception – condom and diaphragm	

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	function of the skin, including: a the role of the dermis b the role of the epidermis c the role of the hypothalamus B7.12 Explain how thermoregulation takes place, with reference to: a shivering b vasoconstriction c vasodilation B7.18 Describe the structure of the urinary system B7.21 Describe the treatments for kidney failure, including kidney dialysis and organ donation B7.22 State that urea is produced from the breakdown of excess amino acids in the liver	Ethics and challenges of organ transplantation- rejection, prioritisation etc.		

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	B7.19 Explain how the structure of the nephron is related to its function in filtering the blood and forming urine including: a filtration in the glomerulus and Bowman's capsule b selective reabsorption of glucose c reabsorption of water B7.20 Explain the effect of ADH on the permeability of the collecting duct in regulating the water content of the blood			
CB8 Exchange and Transport in Animals **Year 11** *(Paper 2)*	B8.1 Describe the need to transport substances into and out of a range of organisms, including oxygen, carbon dioxide, water, dissolved food molecules, mineral ions and urea B8.2 Explain the need for exchange surfaces and a	Calculate surface area : volume ratios. Calculate areas of triangles and rectangles, surface areas and volumes of cubes-	**Year 7** Respiration (word equation) **Year 8** Structure of the lungs • Trachea • Bronchus • Bronchioles • Alveoli Process of breathing	Aerobic respiration *(Greek aero- "air" + bios "life,")* Alveolus *(Latin "small hollow or cavity")* Capillary *(Latin "hair-like")* Circulatory system *(Greek - from circulare "form a circle")* Diffusion *(latin 'diffusus' to pour away)* Excretion past-participle stem of excernere "to sift out, separate" Gas exchange "act of reciprocal giving and receiving," from Anglo-French eschaunge,

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	transport system in multicellular organisms including the calculation of surface area : volume ratio B8.3 Explain how alveoli are adapted for gas exchange by diffusion between air in the lungs and blood in capillaries B8.6 Explain how the structure of the blood is related to its function: a red blood cells (erythrocytes) b white blood cells (phagocytes and lymphocytes) c plasma d platelets B8.7 Explain how the structure of the blood vessels is related to their function B8.8 Explain how the structure of the heart and circulatory system is	Demonstration using cubes of different sizes. Pupils to calculate SA and vol. Calculate with numbers written in standard form. Demonstrate an understanding of number, size and scale and the quantitative relationship between units- Numbers of blood cells per mm^3/ litre etc. Recognise and use expressions in decimal	Inhaling involves – diaphragm contracts, intercostal muscles contract, volume thorax increases, pressure decreases. Exhaling involves – diaphragm relaxes, intercostal muscles relax, volume thorax decreases, pressure increases. Structure of alveoli and adaptations to include – large surface area, thin walls and moist lining. Diffusion – defined as movement from a high concentration to a low concentration. Gaseous exchange and diffusion gradient. The circulatory system includes the heart and blood vessels. Heart as a pump that pushes blood around the circulatory system.	Old French eschange (Modern French échange) Metabolism *(Greek metabole "a change,")* Multicellular organism *(multi – many cells)* Urea *(Greek ouron "urine")* Antibody *(anti "against")* Artery *(Greek 'arteria' wind pipe)* Blood perhaps meaning "to swell, gush, spurt," Erythrocyte Haemoglobin *(Greek haimatos "blood"+ + globulin, a type of simple protein)* Heart Old English heorte "heart (hollow muscular organ that circulates blood Lymphocyte *(Latin lympha "water, clear water + -cyte "a cell.")* Phagocyte *(Greek phago- "eating, devouring" + -cyte "a cell.")* Plasma Greek plasma "something molded or created Platelet *(English – little plate)* Pulse *(latin pellere "to push, drive")* Valve *(Latin valva "section of a folding or revolving door")* Vein *(Latin 'vena' blood vessel)* Aorta *(latin a strap to hang from)*

	related to its function, including the role of the major blood vessels, the valves and the relative thickness of chamber walls B8.12 Calculate heart rate, stroke volume and cardiac output, using the equation cardiac output = stroke volume × heart rate B8.9 Describe cellular respiration as an exothermic reaction which occurs continuously in living cells to release energy for metabolic processes, including aerobic and anaerobic respiration B8.10 Compare the process of aerobic respiration with the process of anaerobic respiration B8.11 Core Practical: Investigate the rate of	form. Use an appropriate number of significant figures. Construct and interpret frequency tables and diagrams, bar charts and histograms. Change the subject of an equation. Translate information between graphical and numeric form. Plot two variables from experimental or other data- Calculation and use of data for cardiac output. Ethical considerations of using living organisms. Controls. Accuracy of measurement. Repeats and reliability. Recognise and use expressions in decimal form. Use an appropriate number of significant figures. Construct and interpret	Right hand side of the heart pumps the deoxygenated blood to the lungs. The left side pumps oxygenated blood to the working muscles (body). Arteries take blood from the heart. Veins take blood into the heart. Capillaries connect arteries and veins and are where exchange happens between the blood and cells Red blood cells carry oxygen (recap how they are specialised from year 7) Effects of smoking – lung cancer, links to cardiovascular disease. **Year 9** Recap diffusion as the movement of particles from high concentration to low concentration Concentration gradient	Atrium *(latin – first main room)* Cardiac output *(Greek kardiakos "pertaining to the heart")* Chamber *(French French chambre "room, chamber, apartment")* Contract Deoxygenated blood Heart attack Heart rate Impulse *(Latin impulsus "a push against, pressure, shock")* Oxygenated blood Pulmonary artery *(Latin 'pulmo' lungs)* Pulmonary vein *(latin 'pulmo' lungs)* Septum *(Latin saeptum "a fence, enclosure, partition")* Stroke volume Tendon *(Latin tendere "to stretch")* Vena cava *(latin 'vena' vein, 'cava' hollow)* Ventricle *(latin 'ventriculus' little belly)* Aerobic respiration *(Greek aero- "air" + bios "life,")* Anaerobic respiration *(an- "without" aēr "air" + bios "life")* Cellular respiration Exothermic *(Exo - Latin ex "out of, from within" Greek therme "heat")*

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	respiration in living organisms **Separate Sciences Only** B8.4 Describe the factors affecting the rate of diffusion, including surface area, concentration gradient and diffusion distance B8.5 Calculate the rate of diffusion using Fick's law: Rate of diffusion α surface area x concentration difference/ thickness of membrane	frequency tables and diagrams, bar charts and histograms. Plot, draw and interpret appropriate graphs- Core Practical: Investigate the rate of respiration in living organisms Opportunity for devising a methods – exercise and breathing/heart rates. Understand and use the symbol ∝, Solve simple algebraic equations- Fick's Law	Label the parts of the heart to include; atria, ventricles, aorta, vena cava, pulmonary artery, pulmonary vein and valves. Describe the route blood takes around the body Components of blood to include; red blood cells, white blood cells, plasma and platelets. Conditions linking to the respiratory system such as asthma, bronchitis and emphysema Respiration defined as a chemical reaction which releases energy Comparison of aerobic and anaerobic respiration including equations Where the reactants come from How waste carbon dioxide is removed Short term affects of exercise to include; increased heart, breathing and respiratory rates	Glucose *(Greek glykys "sweet")* Lactic acid *("procured from milk," in the chemical name lactic acid, which is so called because it was obtained from sour milk)* Mitochondrion *(Greek khondrion "little granule,")* Articles: US faces worst blood shortage in over a decade amid pandemic | US healthcare | The Guardian

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			Long term affects to include; build-up of lactic acid and oxygen debt	
CB9 Ecosystems and Material Cycles **Year 11** *(Paper 2)*	B9.1 Describe the different levels of organisation from individual organisms, populations, communities, to the whole ecosystem B9.3 Describe the importance of interdependence in a community B9.6 Explain how to determine the number of organisms in a given area using raw data from field-work techniques, including quadrats and belt transects B9.2 Explain how communities can be affected by abiotic and biotic factors, including: a temperature, light, water, pollutants	Calculate surface area : volume ratios. Understand the principles of sampling as applied to scientific data. Calculate arithmetic means. Plot, draw and interpret appropriate graphs. Extract and interpret information from charts, graphs and tables. Plot, draw and interpret appropriate graphs. Extract and interpret information from charts, graphs and tables. Practical	**Year 7** The effects of Biotic and Abiotic factors on an ecosystem and its community. Examples of Biotic factors: • New predator/ prey • Disease • Human activity Examples of Abiotic factors: • Light intensity/ day length • Temperature/ climate • Availability of water • Terrain How organisms in an ecosystem are affected by competition for factors including: • Food/ prey • Water • Shelter • Territory • Mates	Biotic *(Latin- pertaining to life)* Abiotic *(A- not- atypical, asymmetric, asexual)* Intensity *(Abstract noun of intense- great, stretched)* PH *(Mathematical- p- negative log to the base 10 (1/10^x)- of the hydrogen ion concentration)* Temperature *(Latin- state of being in proper proportion- as in temper, temperate)* Terrain *(Latin- ground)* Biomass *(Mass of, Bios-Greek- living)* Energy *(Greek- energeia- activity)* Transfer *(Latin- carry across- football/ bank transfer)* Relationship *(sense of being related)* Interdependence *(Inter- between, dependent- French/ Latin- consequence)* Food chain Omnivore *(Latin-Omni- all, vorare- devour)* Herbivore *(Latin- Herbi-plant, vorare- devour)*

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	b competition, predation. B9.5 Core Practical: Investigate the relationship between organisms and their environment using field-work techniques, including quadrats and belt transects. B9.4 Describe how the survival of some organisms is dependent on other species, including parasitism and mutualism. B9.9 Explain the positive and negative human interactions within ecosystems and their impacts on biodiversity, including: a fish farming b introduction of non-indigenous species c eutrophication	investigation into abiotic factors- choice chambers. Core Practical- Investigate the relationship between organisms and their environment using field-work techniques, including quadrats and belt transects. Understand the principles of sampling as applied to scientific data. Calculate arithmetic means. Plot, draw and interpret appropriate graphs. Extract and interpret information from charts, graphs and tables.	That this competition is both inter- (between) and intra- (within) specific (a species). Construction of simple food chains. Identification of the: • Producer • Primary consumer (hervivore) • Secondary consumer (carnivore) • Tertiary consumer (top/ apex carnivore/predator) Dynamics of predator/ prey relationships. Prediction of the effect on the loss or increase of an organism at one level of the food chain on the number of those in other levels. Identify and describe how to use simple equipment systematically to monitor the organisms in an ecosystem. To include: • Quadrat • Transect • Others e.g. pitfall traps	Carnivore *(Latin- Carni-flesh, vorare- devour)* Producer *(Latin- lead or bring forth)* Primary/ Secondary/ Tertiary *(1st, 2nd,3rd-as in education)* Consumer *(15C English- one who squanders or wastes)* Quadrat *(Latin- a square)* Transect *(Latin- trans- across, sectus- to cut)* Sample *(Latin- a sample/example)* Ecosystem *(Eco- Greek-oikus-dwelling place, system- Latin- an arrangement)* Systematic *(pertaining to system (above))* Population *(Latin- a people/ multitude)* Estimation *(Latin- to value (esteem)* Biomass (Greek- 'bio' life, 'massa' lump) The dry organic matter in an organism) Energy (Greek 'energos' active) Needed to make anything happen) Interdependence *(inter – between. Dependence "reliance, confidence, trust.")* Biodiversity *(bio – living. Diversity - "variety)* Ecosystem Eutrophication Bioaccumulation

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	B9.10 Explain the benefits of maintaining local and global biodiversity, including the conservation of animal species and the impact of reforestation B9.12 Describe how different materials cycle through the abiotic and biotic components of an ecosystem B9.14 Explain the importance of the water cycle, including the processes involved and the production of potable water in areas of drought including desalination B9.13 Explain the importance of the carbon cycle, including the processes involved and the role of microorganisms as decomposers	Use a scatter diagram to identify a correlation between two variables. Understand the terms mean, mode and median Construct and interpret frequency tables and diagrams, bar charts and histograms. Use a scatter diagram to identify a correlation between two variables.	Real life examples of how processed data from these investigations would be useful e.g. monitoring the effect of a motorway or pesticide on the distribution of living things. Reinforcement of how a change in distribution/ abundance of one organism will affect the others in the ecosystem (interdependence) **Year 8** Recap from year 7- food chains and key words to include; producer, consumer, herbivore, carnivore, omnivore, predator and prey Arrows show the flow of energy through a food chain/web Build food webs to show interdependence (recap interdependence from year 7) Construct pyramids of number E.g oak tree Construct pyramids of biomass.	Conservation *(Latin conservationem "a keeping, preserving, conserving,")* Gene *("give birth, beget,")* Articles: Exploring the Relationship between Human Activity and Habitat Loss in the Amazon | National Geographic Society floodplain | National Geographic Society Effects of Habitat Fragmentation on Biodiversity | Annual Review of Ecology, Evolution, and Systematics (annualreviews.org) Bees of the sea: Tiny crustaceans pollinate underwater plants | New Scientist Fish lure snails to their nest to help camouflage their babies | New Scientist

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	B9.15 Explain how nitrates are made available for plant uptake, including the use of fertilisers, crop rotation and the role of bacteria in the nitrogen cycle **Separate Sciences Only** B9.7 Explain how some energy is transferred to less useful forms at each trophic level and that this affects the number of organisms at each trophic level, limits the length of a food chain and determines the shape of a pyramid of biomass in an ecosystem B9.8 Calculate the efficiency of energy transfers between trophic levels and percentage calculations of biomass	Understand and use percentiles and calculate percentage gain and loss of mass. Calculate the percentage of mass. Use fractions and percentages. Extract and interpret information from charts, graphs and tables. Extract and interpret information from charts, graphs and tables. Plot, draw and interpret appropriate graphs.	**Year 9** Define Interdependence – organisms depend on each other for survival. Define biodiversity -the number of different species of organisms in an area. Negative human effects on ecosystems – deforestation, invasive species, fish farming, eutrophication and bioaccumulation – linked to reducing biodiversity and potentially extinction Positive human effects on ecosystems – zoos and conservation, reforestation, gene banks linked to preserving biodiversity	Diverse effects of parasites in ecosystems: linking interdependent processes - Hatcher - 2012 - Frontiers in Ecology and the Environment - Wiley Online Library Seagrass restoration project brings back a crucial ecosystem | Science News A Comparison of Two Herbaceous Cover Sampling Methods to Assess Ecosystem Services in High-Shrub Rangelands: Photography-Based Grid Point Intercept (GPI) Versus Quadrat Sampling - ScienceDirect Ecology of the Amazon rainforest (mongabay.com) Knepp Safaris

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	B9.11 Describe the biological factors affecting levels of food security, including: a increasing human population b increasing animal farming and the increased meat and fish consumption c the impact of new pests and pathogens d environmental change caused by human activity e sustainability issues, e.g. use of land for biofuel production and the cost of agricultural inputs B9.16 Evaluate the use of indicator species as evidence to assess the level of pollution, including: a polluted water – bloodworm, sludgeworm b clean water – freshwater shrimps, stonefly c air quality – different species of lichen, blackspot fungus on roses	Construct and interpret frequency tables and diagrams, bar charts and histograms. Use a scatter diagram to identify a correlation between two variables. Plot, draw and interpret appropriate graphs. Construct and interpret frequency tables and diagrams, bar charts and histograms. Plot, draw and interpret appropriate graphs. Calculate surface area : volume ratios. Construct and interpret frequency tables and diagrams, bar charts and histograms. Understand the terms		

	B9.17 Explain the effects of temperature, water content and oxygen availability on the rate of decomposition in **food preservation** B9.18 Explain the effects of temperature, water content and oxygen availability on the rate of decomposition in **composting.** B9.19 Calculate rate changes in the decay of biological material.	mean, mode and median. Plot, draw and interpret appropriate graphs.		

The Castle School Science Faculty: KS4 Curriculum Map- Chemistry

Module	Substantive knowledge (from specification) to be taught	Required disciplinary knowledge to be taught with linked lesson. (Maths skills in red)	KS3 links (to be checked by retrieval practice)	Disciplinary Literacy: • Keywords and Etymology • Linked articles (for homework and whole-class reading)
CC1 States of Matter CC2 Methods of Separating and Purifying Substances **Year 10** *(Paper 3)*	**States of matter** C2.1 Describe the arrangement, movement and the relative energy of particles in each of the three states of matter: solid, liquid and gas. C2.2 Recall the names used for the interconversions between the three states of matter, recognising that these are physical changes: contrasted with chemical reactions that result in chemical changes C2.3 Explain the changes in arrangement, movement and energy of particles during these interconversions C2.4 Predict the physical state of a substance under specified conditions, given suitable data **Methods of Separating and Purifying Substances** C2.5 Explain the difference between the use of 'pure' in chemistry compared with its everyday use and the differences in chemistry between a pure substance and a mixture C2.6 Interpret melting point data to distinguish between pure substances which have a sharp melting point and mixtures which melt over a range of temperatures C2.7 Explain the types of mixtures that can be separated by using the following experimental techniques: a simple distillation b fractional distillation p.t.o	Cooling curve of octadecanoic acid- construction of line graph to show change of state. Translate information between diagrammatic and numerical forms. Magnitude of negative numbers Interpretation of a line graph. Recognise and use expressions in decimal form. Evaluate the risks in a practical procedure and suggest suitable	**Year 7** Solids, liquids and gases State changes as examples of physical changes Basic particle diagrams **Year 8** Names and descriptions of separation techniques to include: **Filtration** - as a technique used to separate insoluble substances from mixtures. - Draw and label equipment for filtration including conical flask, filter paper, filter funnel, residue and filtrate. **Crystallisation** - As a technique to separate soluble substances from solutions. - Crystallisation involves evaporation - Draw and label a tripod, gauze, Bunsen burner, evaporating basin and filtrate. **Distillation** - Process of separating a liquid from a solution - Distillation involves evaporation and distillation - Sketch and label the flask, delivery tube, distillate. **Year 9** Recap of particle arrangements in solids, liquids and gases as well as changes of state from Y7 & 8. Link between temperature and kinetic energy therefore energy increase as substances move from solids → liquid → gas. Increase in energy causes attractive forces between particles to be overcome so particles move further apart Recap of keywords; soluble, solute, solution, saturated and solvent	Solid *(from the Old French 'firm, dense, compact')* Gases *(from Greek khaos"empty space")* Sublimation *(from Latin sublīmō 'I raise, I elevate'* Atom *(Ancient Greek átomos, " indivisible")* Attractive *(from Latin attractus, "to draw or pull")* Forces *(from Latin fortius, meaning "strong")* Boiling *(from Latin bullire "to bubble")* Chemical *(from Medieval Latin alchimicus)* Properties *(from Latin proprietatem "ownership")* Melting *(from Latin mollis "soft, mild")* Molecule *(from Modern Latin molecula, diminutive of Latin moles "mass, barrier")* Particle *(from Latin particula "little bit or part")* Physical *(from Latin physica "study of nature")* Matter *(from the latin'materia' substance from which something is made)* Compound *(from Latin componere "to put together," from com "with, together" + ponere "to place")* Element *(From latin elementum "rudiment, first principle, matter in its most basic form")* Impure (from Latin *impurus* "not pure, unclean") Melting *(from Latin mollis "soft, mild")* Mixture (from Latin *mixtura* "a mixing") Pure *(from Latin purus "clean, clear")* Chemical *(from Medieval Latin alchimicus)* Crystalisation *(from Greek krystallos, from kryos "frost,")* Filtration *(from Medieval Latin filtrum "felt" (used to strain impurities from liquid))* Filtrate *(noun. See above)* Hazard *(from Arabic yasara "he played at dice" later French has art "French game of chance")* Soluble *(from Late Latin solubilis "that may be loosened or dissolved")* Insoluble *(in- opposite; see above)* Residue *(from Latin residuum "a remainder, that which is left behind")* Risk *(from Italian risco, from riscare "run into danger")*

	c filtration d crystallisation e paper chromatography C2.9 Describe paper chromatography as the separation of mixtures of soluble substances by running a solvent (mobile phase) through the mixture on the paper (the paper contains the stationary phase), which causes the substances to move at different rates over the paper C2.10 Interpret a paper chromatogram: a to distinguish between pure and impure substances b to identify substances by comparison with known substances c to identify substances by calculation and use of Rf values *C2.11 Core Practical: Investigate the composition of inks using simple distillation and paper chromatography* C2.8 Describe an appropriate experimental technique to separate a mixture, knowing the properties of the components of the mixture C2.12 Describe how: a waste and ground water can be made potable, including the need for sedimentation, filtration and chlorination b sea water can be made potable by using distillation c water used in analysis must not contain any dissolved salts	precautions for a range of practicals including those mentioned in the specification Substitute numerical values into algebraic equations using appropriate units for physical quantities. Recognise and use expressions in decimal form. Interpret charts. Evaluate the risks in a practical procedure and suggest suitable precautions for a range of practicals including those mentioned in the specification Opportunity for devising a method – separating sand and salt from water	Recap of key terms from Y8 and 9C2: solute, solvent, solution, soluble, insoluble. Idea that in a solution the solute particles fill the gaps between solvent particles Some substances are more soluble than others – in water and other solvents. Concept of saturation as where maximum amount of solute is dissolved at that temperature – linked to idea of filling gaps in model above.	Saturated *(from Latin saturatus, past participle of saturare "to fill full, sate, drench" - from satur "sated, full")* Solute *(from Latin solutus, past participle of solvere "to loosen, dissolve")* Solution *(from Latin solutionem "a loosening or unfastening,")* Solvent *(from Latin solventem (nominative solvens) "to loosen, release)* Chromatography – *Chroma (form of Greek khrōma "color") - graph (to chart)* Stationary *(from Latin statio "a standing, post, job, position")* Mobile *(from Latin mobilis "movable, easy to move")* Chromatogram - *Chroma (form of Greek khrōma "color") -gram (from Greek gramma "that which is drawn")* Condense *(from Latin condensare "to make dense")* Distillation *(from Latin distillare "trickle down in minute drops" from dis- "apart" + stillare "to drip, drop")* Evaporate *(from Late Latin evaporatum, past participle of evaporare "disperse in vapor")* Fractional *(from Late Latin fractionem (nominative fractio) "a breaking")* Aquifier *(from Latin aqui-, aqua "water" + -fer "bearing," from ferre "to bear, carry")* Analysis *(from Greek analysis literally "a breaking up, a loosening, releasing")* Chlorination *to act with Chlorine (Chlorine coming from Greek khlōros "pale green")* Desalination *(de- removal + from Latin saline "salt cellar" + -ation "action of")* Precipitate *(from Latin praecipitatus, past participle of praecipitare "to throw or dive headlong")* Sedimentation *(from Latin sedimentum "a settling, sinking down, subsidence")* Frontiers | The Importance of Snow Sublimation on a Himalayan Glacier | Earth Science (frontiersin.org) Sublimation - an overview | ScienceDirect Topics https://edu.rsc.org/resources/the-art-of-crystallisation/1379.article https://www.sciencedirect.com/topics/chemistry/chromatography

				https://www.news-medical.net/life-sciences/Recent-Developments-in-Chromatography.aspx https://academic.oup.com/chromsci/article/40/10/538/534455?searchresult=1
CC3 Atomic Structure **Year 10** *(Papers 3 and 4)*	C1.1 Describe how the Dalton model of an atom has changed over time because of the discovery of subatomic particles C1.2 Describe the structure of an atom as a nucleus containing protons and neutrons, surrounded by electrons in shells C1.3 Recall the relative charge and relative mass of: a a proton b a neutron c an electron C1.4 Explain why atoms contain equal numbers of protons and electrons. C1.5 Describe the nucleus of an atom as very small compared to the overall size of the atom. C1.6 Recall that most of the mass of an atom is concentrated in the nucleus. C1.7 Recall the meaning of the term mass number of an atom. C1.8 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. C1.10 Calculate the numbers of protons, neutrons and electrons in atoms given the atomic number and mass number. C1.9 Describe isotopes as different atoms of the same element containing the same number of protons but different numbers of neutrons in their nuclei. C1.11 Explain how the existence of isotopes results in relative atomic masses of some elements not being whole numbers.	Relate size and scale of atoms to objects in the physical world. Estimate size and scale of atoms. Change the subject of an equation.	**Year 7** Atomic structure description to include: - Nucleus - Protons - Electrons - Neutrons - Electron shells Table to show the mass, location and charge of each subatomic particle Definitions of: - Atomic mass - Atomic number - Electron configuration **Year 8** Identify protons, neutrons, electrons their location, mass & charges Identify the location electron in an atom. Electron arrangement 2.8.8 Draw electron arrangement for first 20 elements (Recall from Y7) Define atomic number as the number of protons. Define atomic mass as the number of protons and neutrons. Number of protons = number of electrons. Calculate number of protons neutrons and electrons. **Year 9** Recap from Yr7 Atomic structure – protons, neutrons, electrons (location, relative charge and relative mass) Electron arrangement 2.8.8 and being able to draw and write electronic configuration Naming of key groups in the periodic table Recap from Yr8 Calculating number of protons, neutrons and electrons from relative atomic mass and atomic number Link between electrons in outer shell and group number Link between number of electron shells and period number Introduce: Origin of periodic table from Mendeleev linking to scientific collaboration	Atom *(Ancient Greek átomos, " indivisible)* Electron *(from Greek ēlektron "amber" + -on meaning ion)* Shell *(from Proto-Germanic skaljo "pod, rind")* Element *(from latin elementum "rudiment, first principle, matter in its most basic form")* Neutron *(from Neutral)* Nucleus *(from Latin nucleus "kernel, core")* Proton *(Greek prōton, neuter of prōtos"first" - link to hydrogen as first element)* Relative *(from Latin relatus, "bring back, bear back", from re- "back, again" + lātus "borne, carried")* Charge *(from Old French chargier "to load, burden, weigh down")* Mass *(from Latin massa "kneaded dough, lump")* Subatomic *(from sub- indicating "division into parts or sections"+ atomic)* Particles *(from Latin particula "little bit or part")* Periodic Table *(from Latin periodus "recurring portion, cycle" + from Latin tabula "a board, plank; writing table; list")* Isotopes *(literally "having the same place," from Greek isos "equal")* Mean *(from Latin medius "in the middle")* Nuclear Fission *("of or like the nucleus of a cell" + from Latin fissionem "a breaking up")* Atomic Mass *("Pertaining to atoms" from Latin massa "kneaded dough, lump")* Orbit (from Latin *orbita, "wheel track, beaten path, rut, course")* Articles: https://byjus.com/jee/atomic-structure/ https://www.sciencedirect.com/topics/earth-and-planetary-sciences/atomic-structure A Brief History of Atomic Theory (thoughtco.com) A single atom is visible to the naked eye in this stunning photo | New Scientist

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	C1.12 (Higher Tier only) Calculate the relative atomic mass of an element from the relative masses and abundances of its isotopes.	Recognise and use expressions in decimal form. Use ratios, fractions and percentages. Recognise and use expressions in decimal form. Use ratios, fractions and percentages. Understand and use the symbols: =, <>, >, ∝, ~. Substitute numerical values into algebraic equations using appropriate units for physical quantities.	Changes include more elements in the modern periodic table, no gaps in the modern table, now arranged by atomic number instead of atomic mass. Idea that we cannot see the structure of the atom and therefore need to use models Evolution of the atomic model over time to include: - Dalton model – Solid sphere - Thomson model – Plum pudding Modern understanding with nucleus and electrons in orbits (Bohr model) Timeline of evidence for these models especially Rutherford – gold leaf experiment: conclusions – - All positive charge, all mass, in dense volume in centre - Definition of isotopes – atoms the same element with different number of neutrons **Calculating relative atomic mass (RAM).** - Definition of ion – an atom that has a charge - Formation of ions - Draw diagrams to show the loss and gain of electrons to complete the outer shell. Examples to include sodium, chlorine, magnesium, oxygen.	https://www.livescience.com/topics/elements https://www.thetoptens.com/coolest-elements-periodic-table/
CC4 The Periodic Table **Year 10** *(Papers 3 and 4)*	C0.1 Recall the formulae of elements, simple compounds and ions. C1.13 Describe how Mendeleev arranged the elements, known at that time, in a periodic table by using properties of these elements and their compounds. C1.14 Describe how Mendeleev used his table to predict the existence and properties of some elements not then discovered. C1.15 Explain that Mendeleev thought he had arranged elements in order of increasing relative atomic mass but this was not always true because of the relative abundance of isotopes of some pairs of elements in the periodic table. C1.16 Explain the meaning of atomic number of an element in terms of position in the periodic table and number of protons in the nucleus. C1.17 Describe that in the periodic table:	Acceptance of new scientific ideas. Evidence needed to support. Evidence supporting hypothesis. Discovery of new elements- methods- over the decades. Changing of scientific ideas over time given new evidence.	**Year 7** Elements are found in the periodic table. This is separated into metals and non-metals. It is organised by groups and periods. Elements **(made of 1 type of atom)** Defining this term and using the periodic table to give examples. Discussion of some simple molecules (O_2, H_2) and how they are still pure elements as they only have one type of atom present. Properties of elements such as: • Conductivity (electrical) • Conductivity (thermal) • Boiling point • Melting point • State at room temperature • Appearance • Metal or non-metal • Magnetic Specifically state common metal properties Draw electron arrangement for first 20 elements **Year 8** Electron arrangement 2.8.8 Draw electron arrangement for first 20 elements (Recall from Y7) The periodic table is split into metals and non-metals. • Groups – vertical columns.	Chemical Property *(from Medieval Latin alchimicus + from Latin proprietatem "ownership")* Periodic Table *(from Latin periodus "recurring portion, cycle" + from Latin tabula "a board, plank; writing table; list")* Physical Property *(from Latin physica "study of nature" + from Latin proprietatem "ownership")* Prediction *(from Latin praedictio "a foretelling")* Group *(from Proto-Germanic kruppaz "round mass, lump")* Inert *(from Latin inertem (nominative iners) "unskilled, incompetent; inactive")* Period *(from Greek periodos "cycle, circuit, period of time," literally "a going around," from peri "around" + hodos "a going, traveling")* X-Ray *(from German X-strahlen, from X, algebraic symbol for an unknown quantity, + Strahl "beam, ray")* Electron *(from Greek ēlektron "amber" + -on meaning ion)* Shell *(from Proto-Germanic skaljo "pod, rind")* Electron Configuration Articles: Elements and new discoveries (birmingham.ac.uk) Oddball star could be home to long-sought superheavy elements | New Scientist https://byjus.com/jee/atomic-structure/

	a elements are arranged in order of increasing atomic number, in rows called periods b elements with similar properties are placed in the same vertical columns called groups C1.18 Identify elements as metals or non-metals according to their position in the periodic table, explaining this division in terms of the atomic structures of the elements. C1.19 Predict the electronic configurations of the first 20 elements in the periodic table as diagrams and in the form, for example 2.8.1 C1.20 Explain how the electronic configuration of an element is related to its position in the periodic table	Translate information between graphical and numeric form. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects. Translate information between graphical and numeric form.	• Periods – horizontal rows. • Identify elements from their group and period number. • Group number is the same as the number of electrons on the outer shell of an atom The period number is the same as the number of electron shells in an atom. **Year 9** Recap from Yr7 Atomic structure – protons, neutrons, electrons (location, relative charge and relative mass) Electron arrangement 2.8.8 and being able to draw and write electronic configuration Naming of key groups in the periodic table Recap from Yr8 Calculating number of protons, neutrons and electrons from relative atomic mass and atomic number Link between electrons in outer shell and group number Link between number of electron shells and period number Introduce: Origin of periodic table from Mendeleev linking to scientific collaboration Changes include more elements in the modern periodic table, no gaps in the modern table, now arranged by atomic number instead of atomic mass.	https://www.sciencedirect.com/topics/earth-and-planetary-sciences/atomic-structure
CC5 Ionic Bonding CC6 Covalent Bonding CC7 Types of Substance **Year 10** *(Papers 3 and 4)*	**Ionic bonding** C0.1 Recall the formulae of elements, simple compounds and ions. C1.21 Explain how ionic bonds are formed by the transfer of electrons between atoms to produce cations and anions, including the use of dot and cross diagrams. C1.22 Recall that an ion is an atom or group of atoms with a positive or negative charge. C1.23 Calculate the numbers of protons, neutrons and electrons in simple ions given the atomic number and mass number. C1.24 Explain the formation of ions in ionic compounds from their atoms, limited to compounds of elements in groups 1, 2, 6 and 7.	Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects. Change the subject of an equation. Use ratios, fractions and percentages. Visualise and represent 2D and 3D	**Year 7** Identifying chemical reactions vs physical changes Chemical reactions produce a new substance and usually cannot be reversed. Reactants as the starting chemicals and products as the new chemicals produced. Properties of elements such as: • Conductivity (electrical) • Conductivity (thermal) • Boiling point • Melting point • State at room temperature • Appearance • Metal or non-metal • Magnetic Specifically state common metal properties **Year 8**	Bond *(13th century – anything that binds or fastens)* Ions *(from Greek 'ienai' – to go)* Cation *(from Greek 'kata' – down, to go down)* Anion *(from Greek 'ana' – up, to go up)* Electrostatic *(from Latin 'electricus' – amber, and Greek 'statos' – to stand)* Compound *(from Latin 'componere' – to put together)* Lattice *(from Germanic 'latta' – plank – crossed planks)* Crystals *(from Greek 'krystallos – ice/frost)* Polyatomic *(from Greek 'polys' – much, more than one atom)* Aqueous *(from Latin 'aqua' – water, in water)* Solution *(from Latin 'solutionem' – to unfasten)* Anode *(from Greek 'ano' – up, and 'hodos' – way, to go up)* Cathode *(from Greek ' kata' – down, and hodos – way, to go down)* Molecule *(from Latin 'moles' – mass, and 'culus' – very small)* Covalent *(from Latin 'com' – together, and 'valens' – capacity, together full)* Valency *(from Latin 'valens' – capacity)* Intermolecular *(from Sanskrit 'antar' – among, and 'molecule' see above)*

	C1.25 Explain the use of the endings –ide and –ate in the names of compounds. C1.26 Deduce the formulae of ionic compounds (including oxides, hydroxides, halides, nitrates, carbonates and sulfates) given the formulae of the constituent ions. C1.27 Explain the structure of an ionic compound as a lattice structure a consisting of a regular arrangement of ions b held together by strong electrostatic forces (ionic bonds) between oppositely-charged ions. C1.33 Explain the properties of ionic compounds limited to: a high melting points and boiling points, in terms of forces between ions b whether or not they conduct electricity as solids, when molten and in aqueous solution. **Covalent bonding** C1.28 Explain how a covalent bond is formed when a pair of electrons is shared between two atoms. C1.29 Recall that covalent bonding results in the formation of molecules. C1.30 Recall the typical size (order of magnitude) of atoms and small molecules. C1.31 Explain the formation of simple molecular, covalent substances, using dot and cross diagrams, including: a hydrogen b hydrogen chloride c water d methane e oxygen f carbon dioxide **Types of substance** C1.34 Explain the properties of typical covalent, simple molecular compounds limited to: a low melting points and boiling points, in terms of forces between molecules (intermolecular forces) b poor conduction of electricity	forms, including two dimensional representations of 3D objects. Use ratios, fractions and percentages. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects. Translate information between graphical and numeric form. Make estimates of the results of simple calculations. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects. Translate information between graphical and numeric form.	Recap elements mixtures and compounds Elements are made up of one atom. Compounds consist of two or more different types of atoms chemically bonded together. Mixtures are two or more substances not chemically bonded. They can be easily separated. Chemical formulas show the number of atoms of each element. Representing a compound by a chemical formula. Recap of reactants $\rightarrow$ products Elements can be joined together in a chemical reaction – bonded Iron and sulphur can be reacted to form iron sulphide Properties of iron sulphide are different to the two elements. Word equation for reaction of iron sulphide Comparison with a mixture – 2 or more substance not chemically combined and so can be easily separated Use of numbers to represent numbers of atoms Construction of symbol equations from given word equations Identify whether a symbol equation is balanced or unbalanced. **Year 9** Ionic bonds form between metal and non-metal Involves the transfer of electrons from metal to non-metal. Electrostatic attraction between oppositely charge ions. Examples to include: NaCl, MgO using ion diagrams from previous lesson Ionic lattice structure linked simply to properties: high melting point, good conductors in solution or when molten. Definition of ion – an atom that has a charge Formation of ions Draw diagrams to show the loss and gain of electrons to complete the outer shell. Examples to include sodium, chlorine, magnesium, oxygen. Covalent bonds form between atoms of two or more non-metals Involves the sharing of **pairs of electrons** to achieve complete outer shells for all. Definition of a molecule – a cluster of non-metal atoms covalently bonded together. Examples to include Cl_2, O_2, H_2O, NH_3, CO_2 Construction of dot-cross diagrams. Properties of covalent molecules – low melting & boiling points, do not conduct electricity. Linked to, strong force within molecule but weak forces between molecules. Practical tests to compare ionic and covalent bonding e.g. salt and sugar; melting point, conduction of electricity as solid/in solution.	Monomer *(from Greek 'monos' – single, and 'meros' – part, a single part)* Polymer *(from Greek 'polys' – much, and 'meros' – part, many parts)* Allotrope *(from Greek 'alos' – different, and 'tropos' – way, a different way)* Fullerene *(named after Buckminster Fuller – inventor of geodesic domes)* Graphene *(from Greek 'graphein' – to write, derived from graphite)* Delocalised *('de' – opposite, Latin 'localis' – place, to displace from)* Lubricant *(from Latin 'lubricus' – slippery)* Metal *(unknown language 'metalleuein' – to mine/quarry)* Malleable *(from Latin 'malleus' – hammer, the ability to hammer into shape)* Ductile *(from Latin 'ductilis' – to draw, the ability to draw-out/stretch)* Electrical *(from Latin 'electricus' – amber, amber was first used to induce a charge)* Conductive *(from Latin 'com' – with, and 'ducere' – to lead, to lead through)* Articles: https://www.reference.com/science/compound-science-c93bb683d7673ac8 The Most Important Chemical Compounds (famousscientists.org) https://www.science.org/content/blog-post/these-are-real-compounds https://www.sciencenewsforstudents.org/article/new-coating-metals-could-cut-engine-wear https://interestingengineering.com/19-most-fascinating-chemical-reactions-that-prove-science-is-cool

	C1.39 Describe, using poly(ethene) as the example, that simple polymers consist of large molecules containing chains of carbon atoms. C1.35 Recall that graphite and diamond are different forms of carbon and that they are examples of giant covalent substances. C1.36 Describe the structures of graphite and diamond. C1.37 Explain, in terms of structure and bonding, why graphite is used to make electrodes and as a lubricant, whereas diamond is used in cutting tools. C1.38 Explain the properties of fullerenes including C60 and graphene in terms of their structures and bonding. C1.40 Explain the properties of metals, including malleability and the ability to conduct electricity. C1.42 Describe most metals as shiny solids which have high melting points, high density and are good conductors of electricity whereas most non-metals have low boiling points and are poor conductors of electricity. C1.32 Explain why elements and compounds can be classified as: a ionic b simple molecular (covalent) c giant covalent d metallic and how the structure and bonding of these types of substances results in different physical properties, including relative melting point and boiling point, relative solubility in water and ability to conduct electricity (as solids and in solution). C1.41 Describe the limitations of particular representations and models to, include dot and cross, ball and stick models and two- and three-dimensional representations	Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects. Use of scientific models- evaluation of their strengths and limitations. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects.	Recap of the properties of metals from Yr7. Introduce metal structure as regular arrangement of positively charged ions surrounded by a 'sea' of delocalised electrons. Introduce metallic bond as the electrostatic force of attraction between positively charged ions and negatively charged delocalised electrons. Link the structure of metals to metallic properties to include: high melting/boiling point, good conductor of electricity and heat, malleable and ductile.	

The Castle School Science Faculty: KS4 Curriculum Map- Chemistry

CC8 Acids and Alkalis **Year 10** *(Paper 3)*	C0.5 Describe the use of hazard symbols on containers: a to indicate the dangers associated with the contents b to inform people about safe-working precautions with these substances in the laboratory. C3.1 Recall that acids in solution are sources of hydrogen ions and alkalis in solution are sources of hydroxide ions. C3.2 Recall that a neutral solution has a pH of 7 and that acidic solutions have lower pH values and alkaline solutions higher pH values. C3.3 Recall the effect of acids and alkalis on indicators, including litmus, methyl orange and phenolphthalein. **C3.4 (Higher Tier only) Recall that the higher the concentration of hydrogen ions in an acidic solution, the lower the pH; and the higher the concentration of hydroxide ions in an alkaline solution, the higher the pH.** **C3.5 (Higher Tier only) Recall that as hydrogen ion concentration in a solution increases by a factor of 10, the pH of the solution decreases by 1.** **C3.7 (Higher Tier only) Explain the terms dilute and concentrated, with respect to amount of substances in solution.** **C3.8 (Higher Tier only) Explain the terms weak and strong acids, with respect to the degree of dissociation into ions.** C3.9 Recall that a base is any substance that reacts with an acid to form a salt and water only. C3.11 Explain the general reactions of aqueous solutions of acids with: a metals b metal oxides to produce salts C3.13 Describe a neutralisation reaction as a reaction between an acid and a base.	Use ratios, fractions and percentages. Use ratios, fractions and percentages.	**Year 7** Identification of hazards in the lab. Identification of different hazard symbols and their meaning. To include: • Explosive • Flammable • Oxidising agent • Gas under pressure • Corrosive • Toxic • Health problems • Irritant • Toxic to the environment Identification of everyday acids and bases/alkalis. Comparison of weak and strong acids. Weak acids safe to handle and sometimes eat e.g. orange, lemons, vinegar. Strong acids are corrosive e.g. battery acid, hydrochloric acid. Neutral substances are neither acidic nor alkali e.g. water. Alkali/bases are chemically opposite of acids. Comparison of weak and strong alkali/Bases. Weak bases used in soaps and cleaning products. Strong bases just as dangerous as strong acids, e.g. bleach, hydroxides. Alkalis are soluble bases. Universal indicator and the pH scale used to identify acids and bases. Universal indicator testing household substances Measuring pH pH indicators identify if a substance is acidic or basic. Litmus paper as an example of a pH indicator. Colour changes of red, blue and yellow litmus paper in acids and bases. Making and using red cabbage indicator and evaluating its effectiveness. Testing against known standards. **Year 8** Recall general word equations. And apply to reactions of specific acids and metals. Metal + acid → salt + hydrogen Metal carbonate + acid → salt + carbon dioxide + water Acid + alkali → Salt + water Definition of solvent – the liquid in which a substance dissolves to make a solution. Definition of solute – a substance that dissolves in a liquid to make a solution Definition of solution – formed when a substance has dissolved in a liquid	Aqueous *(from Latin 'aqua' – water, in water)* Acid *(from Latin 'acidus' - sour, sharp, tart)* Alkali *(Latin/Arabic - the ashes, burnt ashes (referring to the original source of alkaline substances. A water-extract of burned plant ashes, called potash and composed mostly of potassium carbonate, was mildly basic))* Neutral *(from latin 'neuter' – neither one nor the other)* pH *(German 'potenz' – potentcy power, of Hydrogen)* Indicator *(from Latin 'indicare' – to point out)* Polyatomic *(from Greek 'polys' – much, more than one atom)* Concentration *(from Latin 'com' – together, and 'centrum' centre, acollected mass)* Dilute *(from Latin 'dilutus' - to weaken/remove the strength)* Dissociate *(from Latin 'dissociatus' - to separate from companionship)* Base *(from Latin 'basis' – foundation)* Salt *(from PIE 'Sal' – salt)* Filtered *(from Latin 'filtrum' – felt, which was used to filter water)* Crystallisation *((from Greek 'krystallos – ice/frost, to make a crystal)* Equation *(from Latin 'aequationem' – an equal distribution)* Titration *(from French 'titre' – standard, to make standard)* Burette *(from French 'buie' – water jug)* Pipette *(from Latin 'pipa' – a tube)* Reactivity *(from Latin 'actus' – to set in motion, and 're' – again / in response to)* Effervescence *(from Latin 'ex' – out, and 'fervere' – to be hot/boil, boil over)* Ionic *(from Greek 'ienai' – to go, pertaining to ions)* Spectator *(from Latin 'spectare' – to view/watch)* Oxidation *(from Greek 'oxys' – sharp/acid, to add oxygen – acids were originally thought to contain oxygen)* Reduction *(from Latin 'reducer' – to bring back)* Precipitation *(from Latin 'praecipitantum' – to throw, a solid 'falls' out of solution)* Hydrogen *(from Latin 'hydr' – water, and 'gen' – producing)* Articles: Explainer: What are acids and bases? | Science News for Students Shell shocked: Emerging impacts of our acidifying seas | Science News for Students Come clean: What's the difference between shampoo and shower gel? | New Scientist

	C3.15 Explain why, if soluble salts are prepared from an acid and an insoluble reactant: a excess of the reactant is added b the excess reactant is removed c the solution remaining is only salt and water *C3.17 Core Practical: Investigate the preparation of pure, dry hydrated copper sulfate crystals starting from copper oxide including the use of a water bath.* C0.1 Recall the formulae of elements, simple compounds and ions. C0.2 Write word equations. C0.3 Write balanced chemical equations, including the use of the state symbols (s), (l), (g) and (aq) C3.10 Recall that alkalis are soluble bases. C3.11 Explain the general reactions of aqueous solutions of acids with metal hydroxides to produce salts. *C3.6 Core Practical: Investigate the change in pH on adding powdered calcium hydroxide or calcium oxide to a fixed volume of dilute hydrochloric acid.* C3.14 Explain an acid-alkali neutralisation as a reaction in which hydrogen ions (H+) from the acid react with hydroxide ions (OH–) from the alkali to form water. C3.16 Explain why, if soluble salts are prepared from an acid and a soluble reactant: a titration must be used b the acid and the soluble reactant are then mixed in the correct proportions c the solution remaining, after reaction, is only salt and water. C3.18 Describe how to carry out an acid-alkali titration, using burette, pipette and a suitable indicator, to prepare a pure, dry salt. **C0.4 (higher Tier only) Write balanced ionic equations.** C3.11 Explain the general reactions of aqueous solutions of acids with: a metals d metal carbonates to produce salts	Use of filtration and crystallisation- progression from CC2b (C2.7). Following a scientific method. Use ratios, fractions and percentages. Translate information between graphical and numeric form. Plot two variables from experimental or other data.	Idea that some substances are more soluble in water than others. Increasing temperature can increase solubility. **Year 9** Acids produce H^+ ions when they dissociate in water Definitions of concentrated and dilute acids in terms of H^+ **Definition of strong and weak acids.** Definition of pH as the concentration of hydrogen ions Idea that a change of 1 in pH is 10x change in H^+ ion concentration. Recap neutralisation reactions from Yr7 & 8 Application of writing word and balanced symbol equations from Yr 8 and 9C11 Serial dilution of HCl from 1 mol, x10, x100, x1000 using universal indicator and probe to measure pH. Making a neutral solution from NaOH and HCl Recap of key terms from Y8 and 9C2: solute, solvent, solution, soluble, insoluble. Idea that in a solution the solute particles fill the gaps between solvent particles Some substances are more soluble than others – in water and other solvents. Concept of saturation as where maximum amount of solute is dissolved at that temperature – linked to idea of filling gaps in model above. General solubility rules in water including: - All K, Na, Li and NH_4^+ salts are soluble in water All nitrates are soluble	https://www.epa.gov/acidrain/what-acid-rain https://www.thoughtco.com/definition-of-solution-604650 https://kids.britannica.com/kids/article/solution/399604 https://examples.yourdictionary.com/common-examples-of-solutions-science-in-everyday-life.html

	C3.12 Describe the chemical test for: a hydrogen b carbon dioxide (using limewater) **C0.4 (higher Tier only) Write balanced ionic equations.** C3.19 Recall the general rules which describe the solubility of common types of substances in water: a all common sodium, potassium and ammonium salts are soluble b all nitrates are soluble c common chlorides are soluble except those of silver and lead d common sulfates are soluble except those of lead, barium and calcium e common carbonates and hydroxides are insoluble except those of sodium, potassium and ammonium. C3.20 Predict, using solubility rules, whether or not a precipitate will be formed when named solutions are mixed together, naming the precipitate if any. C3.21 Describe the method used to prepare a pure, dry sample of an insoluble salt	Gas tests for hydrogen and carbon dioxide Filtration. Following a scientific method.		
CC9 Calculations Involving Masses **Year 10** *(Papers 3 and 4)*	C1.43 Calculate: a relative formula mass given relative atomic masses b percentage by mass of an element in a compound given relative atomic masses. C1.44 Calculate the formulae of simple compounds from reacting masses or percentage composition and understand that these are empirical formulae. C1.45 Deduce: a the empirical formula of a compound from the formula of its molecule b the molecular formula of a compound from its empirical formula and its relative molecular mass. C1.46Describe an experiment to determine the empirical formula of a simple compound such as magnesium oxide. C1.47 Explain the law of conservation of mass applied to: a a closed system including a precipitation reaction in a closed flask b a non-enclosed system including a reaction in an open flask that takes in or gives out a gas.	**Arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry** Recognise and use expressions in decimal form. Use ratios, fractions and percentages. Use an appropriate number of significant figures. Use ratios, fractions and percentages. Arithmetic computation and ratio when determining empirical formulae, balancing equations. Recognise and use expressions in decimal	**Year 7** Identifying chemical reactions vs physical changes Chemical reactions produce a new substance and usually cannot be reversed. Reactants as the starting chemicals and products as the new chemicals produced. Chemical reactions can be observed by: A colour change A gas being released An energy change (changing temperatures) Examples of word equations A physical change as a change in state that can be reversed. **Year 8** Recap of reactants → products Elements can be joined together in a chemical reaction – bonded Iron and sulphur can be reacted to form iron sulphide Properties of iron sulphide are different to the two elements Word equation for reaction of iron sulphide Comparison with a mixture – 2 or more substance not chemically combined and so can be easily separated Use of numbers to represent numbers of atoms Construction of symbol equations from given word equations	Empirical *(derived from evidence – the original method of deducing formulae through experimental means)* Formula *(from the Latin 'formula' – a form)* Molecule *(from Latin 'moles' – mass, and 'culus' – very small)* Relative *(from Latin 'relativus' – having reference to)* Mass *(from Latin 'massa' – bulk)* Solute *(from Latin 'solvere' – to loosen)* Solvent *(from Latin 'solvere' – to loosen)* Solution *(from Latin 'solutionem' – to unfasten)* Conservation *(from Latin 'conservare' – to preserve)* Concentration *(from Latin 'com' – together, and 'centrum' centre, acollected mass)* Avagadro *(Named after Amadeo Avagadro – who did not invent the constant)* Reactant *(from Latin 'actus' – to set in motion, and 're' – again / in response to. A substance which reacts)* Stoichiometry *(from Greek 'stoikheion' – elements, and 'metry' – measuring of)* Articles: The Conservation of Matter During Physical and Chemical Changes | National Geographic Society

	C1.48 Calculate masses of reactants and products from balanced equations, given the mass of one substance. C1.49 Calculate the concentration of solutions in g dm–3 **C1.50 (Higher Tier only) Recall that one mole of particles of a substance is defined as: a the Avogadro constant number of particles (6.02 × 1023 atoms, molecules, formulae or ions) of that substance b a mass of 'relative particle mass' g.** **C1.51 (Higher Tier only) Calculate the number of: a moles of particles of a substance in a given mass of that substance and vice versa b particles of a substance in a given number of moles of that substance and vice versa c particles of a substance in a given mass of that substance and vice versa.** **C1.52 (Higher Tier only) Explain why, in a reaction, the mass of product formed is controlled by the mass of the reactant which is not in excess.** **C1.53 (Higher Tier only) Deduce the stoichiometry of a reaction from the masses of the reactants and products.**	form. Use ratios, fractions and percentages. Use an appropriate number of significant figures. Recognise and use expressions in decimal form. Use ratios, fractions and percentages. Use an appropriate number of significant figures. Change the subject of an equation. Substitute numerical values into algebraic equations using appropriate units for physical quantities. Calculations with numbers written in standard form when using the Avogadro constant. Recognise and use expressions in decimal form. Recognise and use expressions in standard form. Use ratios, fractions and percentages. Understand and use the symbols: =, <>, >, ∝, ~. Change the subject of a mathematical equation. Substitute numerical values into algebraic equations using appropriate units for physical quantities. Provide answers to an appropriate number of significant figures. Use ratios, fractions and percentages.	Identify whether a symbol equation is balanced or unbalanced. **Year 9** Review of a chemical reaction as an irreversible change and evidence (colour change, temperature change, effervescence) from Yr7. Review of writing word and symbol equations and identifying reactants and products, from Yr7 & 8 Review or recognising if an equation is balanced, from Yr8 Introduce how to balance symbol equations Appreciation of different types of reaction to include: displacement, thermal decomposition, combustion, neutralisation. Observation skills to identify a chemical reaction has taken place Construction of word equations Construction of symbol equations using given formulae Balancing of provided equations Application of the state symbols to a balanced equation – explanation of (aq) Write word and balanced symbol equations for thermal decomposition reactions	https://www.sciencenewsforstudents.org/article/new-coating-metals-could-cut-engine-wear https://interestingengineering.com/19-most-fascinating-chemical-reactions-that-prove-science-is-cool

		Recognise and use expressions in decimal form. Use ratios, fractions and percentages. Convert units where appropriate particularly from mass to moles.		
CC10 Electrolytic Processes CC11 Obtaining and Using Metals CC12 Reversible Reactions and Equilibria **Year 10/11** *(Paper 3)*	**Electrolytic processes** C3.22 Recall that electrolytes are ionic compounds in the molten state or dissolved in water. C3.23 Describe electrolysis as a process in which electrical energy, from a direct current supply, decomposes electrolytes. C3.24 Explain the movement of ions during electrolysis, in which: a positively charged cations migrate to the negatively charged cathode b negatively charged anions migrate to the positively charged anode. **C3.27 (Higher Tier only) Write half equations for reactions occurring at the anode and cathode in electrolysis.** **C3.28 (Higher Tier only) Explain oxidation and reduction in terms of loss or gain of electrons.** **C3.29 (Higher Tier only) Recall that reduction occurs at the cathode and that oxidation occurs at the anode in electrolysis reactions.** *C3.31 Core Practical: Investigate the electrolysis of copper sulfate solution with inert electrodes and copper electrodes* C3.25 Explain the formation of the products in the electrolysis, using inert electrodes, of some electrolytes, including: a copper chloride solution b sodium chloride	Use ratios, fractions and percentages. Control variables- cleaning electrodes etc. Recognise and use expressions in decimal form. Translate information between graphical and numeric form. Understand that y = mx + c represents a linear relationship. Plot two variables from	**Year 7** Properties of elements such as: • Conductivity (electrical) • Conductivity (thermal) • Boiling point • Melting point • State at room temperature • Appearance • Metal or non-metal • Magnetic Specifically state common metal properties Finite defined as something that can only be used once and is in limited supply. Naming examples of finite resources e.g. oil, metals, rocks Importance of recycling including: • Reduces litter/waste, saving space, protection of some habitats, preserves some wildlife. Recycling methods for plastic, metal, paper, glass. **Year 8** Use of numbers to represent numbers of atoms Construction of symbol equations from given word equations Identify whether a symbol equation is balanced or unbalanced. Definition of reactivity - how likely an element is to undergo a chemical reaction Use of the reactivity series to understand displacement reactions. • potassium • sodium • calcium • magnesium • aluminium • **Carbon** • zinc • iron • **Hydrogen**	Cation *from Latinized form of Greek kation "going down,"* Anion *from Greek anion "(thing) going up,"* Dis- *from Old French des- or directly from Latin dis- "apart, asunder, in a different direction, between,"* -charge *from Old French charge "load, burden; imposition,"* Inert *from French inerte (16c.) or directly from Latin inertem (nominative iners) "unskilled, incompetent; inactive, helpless, weak, sluggish; worthless,"* Displacement *The action of moving something from its place or position* Equation *an equal distribution, a sharing in common* Reaction *from re- "back, again, anew" + action* Oxidation *from oxygen* Reactivity *Repercussive, echoing, a sense not obsolete, re "against" the action – re-action* Redox *from reduction + oxidation.* Reduction reduccioun, "a restoring to a former state Bio- *from Greek bios "one's life, course or way of living, lifetime* Leaching *from Old English leccan "to moisten, water, wet, irrigate," which, under Norse influence, became leak* Electrolysis *electro from electricity lysis to loosen or set free/split* Extraction *from Latin extractus, past participle of extrahere "draw out," from ex "out, out of" (see ex-) + trahere "to draw* Native *from Old French natif "native, born in; raw, unspoiled* Ore *from old English ora which relates to eorp meaning ground, soil, earth* Phyto- *from Greek phyton "plant," literally "that which has grown,* Corrosion *Old French corrosion and directly from Latin corrosionem stem of corrodere "to gnaw to bits, wear away,"* *Oxidation from French oxidation, noun of action from oxider "oxidize," from oxide.* Rusting *early 13c., rusten, of metals, "become rusty, gather rust," from rust (n.). The transitive sense of "cause to rust" is from 1590s.*

	solution c sodium sulfate solution d water acidified with sulfuric acid e molten lead bromide (demonstration). C3.26 Predict the products of electrolysis of other binary, ionic compounds in the molten state. C3.30 Explain the formation of the products in the electrolysis of copper sulfate solution, using copper electrodes, and how this electrolysis can be used to purify copper. **Obtaining and Using Metals** C4.1 Deduce the relative reactivity of some metals, by their reactions with water, acids and salt solutions. **C4.2 (Higher Tier only) Explain displacement reactions as redox reactions, in terms of gain or loss of electrons.** C4.3 Explain the reactivity series of metals (potassium, sodium, calcium, magnesium, aluminium, (carbon), zinc, iron, (hydrogen), copper, silver, gold) in terms of the reactivity of the metals with water and dilute acids and that these reactions show the relative tendency of metal atoms to form cations. C4.4 Recall that: a most metals are extracted from ores found in the Earth's crust b unreactive metals are found in the Earth's crust as the uncombined elements. C4.7 Explain why the method used to extract a metal from its ore is related to its position in the reactivity series and the cost of the extraction process, illustrated by a heating with carbon (including iron) b electrolysis (including aluminium) (knowledge of the blast furnace is not required). **C4.8 (Higher Tier only) Evaluate alternative biological methods of metal extraction (bacterial and phytoextraction).** **C4.2 (Higher Tier only) Explain displacement reactions as redox reactions, in terms of gain or loss of electrons.** C4.5 Explain oxidation as the gain of oxygen and reduction as the loss of oxygen.	experimental or other data. Determine the slope and intercept of a linear graph. Demand for/ cost of metals. Environmental impact of extraction methods.	• copper • silver • gold A displacement reaction defined as when a more reactive substance takes the place of a less reactive substance from its compound. **Year 9** Review of writing word and symbol equations and identifying reactants and products, from Yr7 & 8 Review or recognising if an equation is balanced, from Yr8 Introduce how to balance symbol equations. Definition of displacement – when a more reactive element replaces a less reactive element in a compound or solution Examples with metals and salt solutions. To include: copper sulfate and magnesium, zinc, iron. Examples to show less reactive metal cannot displace e.g. magnesium sulfate and copper. Location of metals from Y7 properties of metals and reactivity series from Yr8 properties and bonding from 9C9 Metallic bonding Definition of ore as a rock which contains enough compound to make it profitable to extract the metal. Examples of ores: haematite, bauxite etc. Link extraction techniques to position in reactivity series. Unreactive elements found in pure form (panning for gold nuggets). Heating with carbon for middle including iron, zinc, copper. Electrolysis for most reactive including sodium, magnesium, aluminium. Justification of extraction method, costs, reactivity and feasibility. Extraction of copper and lead from oxides using carbon (class prac) Implication of extraction costs and abundance of metal uses and demand need for recycling. Recap Ions and Ionic bonding from Yr8 and 9C6/9C7 What is an ore and Use of electrolysis to extract metals more reactive than carbon from their ores from 9C18 Electrolysis of brine, including chlorine test with damp blue litmus Definition of electrolysis as a method of splitting an ionic substance using an electric current. Diagram of an electrolysis cell including cathode, anode, electrolyte and DC supply. Need for ionic compounds to be molten or dissolved for electrolysis to work Idea that ions are attracted to the oppositely charged electrode where they are turned back into atoms	Tarnish *from Old French terniss-, present-participle stem of ternir "dull the luster or brightness of, make dim.* Life *from Proto-Germanic *leiban (source also of Old Norse lif "life, body," Old Frisian, Old Saxon lif "life, person, body," Dutch lijf "body," Old High German lib "life," German Leib "body"),* Cycle *from Late Latin cyclus, from Greek kyklos "circle, wheel, any circular body,"* Re- *from Old French re- and directly from Latin re- an inseparable prefix meaning "again; back; anew, against."* Closed *from Old French clos- (past participle stem of clore "to shut, to cut off from"* System *from Greek systema "organized whole, a whole compounded of parts," from stem of synistanai "to place together, organize, form in order,"* Dynamic *from Greek dynamikos "powerful," from dynamis "power,"* Equilibrium *from Latin aequilibrium "an even balance; a horizontal position," from aequilibris "equal, level, horizontal, evenly balanced,"* Endo- *from Greek endon "in, within"* Thermo *from Greek thermos "hot, warm," therme "heat"* Exo- *of Greek origin meaning "outer, outside, outer part,"* Reverse *early 14c., reversen, (transitive), "change, alter"* Decomposition *(de - the opposite of, composition - to put together)* Displacement – The action of moving something from its place or position Unreactive *un- meaning not* Cathode *from Latinized form of Greek kathodos "a going down, a way down," from kata "down"* Anode *coined from Greek anodos "way upward," from ano "upward," from ana "up"* Electrolyte *lytos means loosed* Current *that which runs or flows from the old French corant* Articles: https://www.sciencenewsforstudents.org/article/new-coating-metals-could-cut-engine-wear https://www.thoughtco.com/why-statue-of-liberty-is-green-4114936 https://bitwiseacademy.com/why-the-statue-of-liberty-changing-color/

	C4.6 Recall that the extraction of metals involves reduction of ores. C4.9 Explain how a metal's relative resistance to oxidation is related to its position in the reactivity series. C4.10 Evaluate the advantages of recycling metals, including economic implications and how recycling can preserve both the environment and the supply of valuable raw materials. C4.11 Describe that a life-cycle assessment for a product involves consideration of the effect on the environment of obtaining the raw materials, manufacturing the product, using the product and disposing of the product when it is no longer useful. C4.12 Evaluate data from a life cycle assessment of a product. **Reversible Reactions and Equilibria** C4.13 Recall that chemical reactions are reversible, the use of the symbol ⇌ in equations and that the direction of some reversible reactions can be altered by changing the reaction conditions. C4.14 Explain what is meant by dynamic equilibrium. C4.15 Describe the formation of ammonia as a reversible reaction between nitrogen (extracted from the air) and hydrogen (obtained from natural gas) and that it can reach a dynamic equilibrium. C4.16 Recall the conditions for the Haber process as: a temperature 450 °C b pressure 200 atmospheres c iron catalyst **C4.17 (Higher Tier only) Predict how the position of a dynamic equilibrium is affected by changes in:** **a temperature** **b pressure** **c concentration**	Impact of science on society. Consumer choices. Communication of scientific evidence.	Products of electrolysis from solutions – basic links to the reactivity series. At the cathode a metal or hydrogen will form. If the metal is less reactive than hydrogen the metal will form at the cathode. Otherwise hydrogen forms.	

The Castle School Science Faculty: KS4 Curriculum Map- Chemistry

SC13 Transition Metals, Alloys and Corrosion SC14 Quantitative Analysis SC15 Dynamic Equilibria, Calculations Involving Volumes of Gases SC16 Chemical Cells and Fuel Cells *(Paper 1)*	**Separate Sciences Only:** **Transition Metals, Alloys and Corrosion** C5.1C Recall that most metals are transition metals and that their typical properties include: a high melting point b high density c the formation of coloured compounds d catalytic activity of the metals and their compounds as exemplified by iron. C5.2C Recall that the oxidation of metals results in corrosion. C5.3C Explain how rusting of iron can be prevented by: a exclusion of oxygen b exclusion of water c sacrificial protection C5.4C Explain how electroplating can be used to improve the appearance and/or the resistance to corrosion of metal objects. C5.5C Explain, using models, why converting pure metals into alloys often increases the strength of the product. C5.6C Explain why iron is alloyed with other metals to produce alloy steels. C5.7C Explain how the uses of metals are related to their properties (and vice versa), including aluminium, copper and gold and their alloys including magnalium and brass. **Quantitative Analysis**	Calculate areas of triangles and rectangles, surface areas and volumes of cubes.	**Year 7** Properties of elements such as: • Conductivity (electrical) • Conductivity (thermal) • Boiling point • Melting point • State at room temperature • Appearance • Metal or non-metal • Magnetic Specifically state common metal properties Air is a mixture consisting of 78% Nitrogen, 21% oxygen, 1% Argon, 0.04% carbon dioxide. **Year 8** The periodic table is split into metals and non-metals. Groups – vertical columns. Periods – horizontal rows. Identify elements from their group and period number. Use of numbers to represent numbers of atoms Construction of symbol equations from given word equations Identify whether a symbol equation is balanced or unbalanced. Definition of reactivity - how likely an element is to undergo a chemical reaction Use of the reactivity series to understand displacement reactions. • potassium • sodium • calcium • magnesium • aluminium • **Carbon** • zinc • iron • **Hydrogen**	Catalyst (Latin/Greek- katalysis- dissolution/ break apart) Solute *(leu - to loosen, divide, cut apart)* Solvent *(able to pay all one owes)* Solution *(***leu-** "to loosen, divide, cut apart)* Dissolve *(to break up, disunite, separate into parts)* Soluble (Latin- may be loosened or dissolved) Insoluble (In-not, soluble) Saturated *(full up)*Volume *(bulk, mass, quantity)* Volume *(bulk, mass, quantity)* Concentration *(act of collecting or combining into or about a central point)* Solution *(***leu-** "to loosen, divide, cut apart)* Mass *from old French masse meaning lump, heap or pile, or large amount* Delocalised *(de - undoing, local – nearby, lise – doing)* Metallic *(covered with metal)* Malleable *(malleare – to beat with a hammer)* Ductile *(capable of being led or drawn out)* Articles: The Conservation of Matter During Physical and Chemical Changes | National Geographic Society The hydrogen solution? | Nature Climate Change

	C5.11C Calculate the percentage yield of a reaction from the actual yield and the theoretical yield. C5.12C Describe that the actual yield of a reaction is usually less than the theoretical yield and that the causes of this include: a incomplete reactions b practical losses during the experiment c competing, unwanted reactions (side reactions). C5.13C Recall the atom economy of a reaction forming a desired product. C5.14C Calculate the atom economy of a reaction forming a desired product. C5.15C Explain why a particular reaction pathway is chosen to produce a specified product, given appropriate data such as atom economy, yield, rate, equilibrium position and usefulness of by-products. C5.8C Calculate the concentration of solutions in mol dm–3 and convert concentration in g dm–3 into mol dm–3 and vice versa. *C5.9C Core Practical: Carry out an accurate acid-alkali titration, using burette, pipette and a suitable indicator.* C5.10C Carry out simple calculations using the results of titrations to calculate an unknown concentration of a solution or an unknown volume of solution required. C5.16C Describe the molar volume, of any gas at room temperature and pressure, as the volume occupied by one mole of molecules of any gas at room temperature and pressure (The molar volume will be provided as 24 dm3 or 24000 cm3 in calculations where it is required). C5.17C Use the molar volume and balanced equations in calculations involving the masses of solids and volumes of gases. C5.18C Use Avogadro's law to calculate volumes of gases involved in a gaseous reaction, given the relevant equation.	Arithmetic computation when calculating yields and atom economy. Arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry. Provide answers to an appropriate number of significant figures. Change the subject of a mathematical equation. Arithmetic computation when calculating yields and atom economy. Arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry. Provide answers to an appropriate number of significant figures. Change the subject of a mathematical equation. Accuracy of measurement. Repeats with concurrent results. Arithmetic computation when calculating yields and atom economy. Arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry. Provide answers to an appropriate number of significant	• copper • silver • gold A displacement reaction defined as when a more reactive substance takes the place of a less reactive substance from its compound. Practice writing chemical equations and checking whether they are balanced or unbalanced. Definition of a catalyst as a substance which speeds up the rate of reaction without getting used up. Explanation of how catalysts work: They speed up chemical reactions because they lower the amount of energy particles need to react. Examples include: - Catalytic converters in cars **Year 9** Use of concentration (g/dm^3) = mass (g) / volume (dm^3) Use of mass (g) = concentration (g/dm^3) x volume (dm^3) Use of volume (dm^3) = mass (g) / concentration (g/ dm^3) Converting between cm^3 and dm^3 (÷1000) Converting between kg and g (x1000) Practice of concentration calculations Preparation of a solution to a named concentration. Introduce metal structure as regular arrangement of positively charged ions surrounded by a 'sea' of delocalised electrons Introduce metallic bond as the electrostatic force of attraction between positively charged ions and negatively charged delocalised electrons Link the structure of metals to metallic properties to include: high melting/boiling point, good conductor of electricity and heat, malleable and ductile. Construction of word equations Construction of symbol equations using given formulae Balancing of provided equations Application of the state symbols to a balanced equation – explanation of (aq)	

	Dynamic Equilibria, Calculations Involving Volumes of Gases C5.19C Describe the Haber process as a reversible reaction between nitrogen and hydrogen to form ammonia. C5.22C Recall that fertilisers may contain nitrogen, phosphorus and potassium compounds to promote plant growth. C5.23C Describe how ammonia reacts with nitric acid to produce a salt that is used as a fertiliser. C5.24C Describe and compare: a the laboratory preparation of ammonium sulfate from ammonia solution and dilute sulfuric acid on a small scale b the industrial production of ammonium sulfate, used as a fertiliser, in which several stages are required to produce ammonia and sulfuric acid from their raw materials and the production is carried out on a much larger scale (details of the industrial production of sulfuric acid are not required). C5.15C Explain why a particular reaction pathway is chosen to produce a specified product, given appropriate data such as atom economy, yield, rate, equilibrium position and usefulness of by-products. C5.20C Predict how the rate of attainment of equilibrium is affected by: a changes in temperature b changes in pressure c changes in concentration d use of a catalyst C5.21C Explain how, in industrial reactions, including the Haber process, conditions used are related to: a the availability and cost of raw materials and energy supplies b the control of temperature, pressure and catalyst used produce an acceptable yield in an acceptable time. **Chemical Cells and Fuel Cells**	figures. Change the subject of a mathematical equation. Arithmetic computation when calculating yields and atom economy. Arithmetic computation, ratio, percentage and multistep calculations permeates quantitative chemistry. Provide answers to an appropriate number of significant figures. Change the subject of a mathematical equation.		

	C5.25C Recall that a chemical cell produces a voltage until one of the reactants is used up. C5.26C Recall that in a hydrogen–oxygen fuel cell hydrogen and oxygen are used to produce a voltage and water is the only product. C5.27C Evaluate the strengths and weaknesses of fuel cells for given uses.			
CC13 Groups in the Periodic Table CC14 Rates of Reaction CC15 Heat Energy Changes in Chemical Reactions **Year 11** *(Paper 4)*	**Groups in the Periodic Table** C6.1 Explain why some elements can be classified as alkali metals (group 1), halogens (group 7) or noble gases (group 0), based on their position in the periodic table. C6.2 Recall that alkali metals a are soft b have relatively low melting points C6.3 Describe the reactions of lithium, sodium and potassium with water. C6.4 Describe the pattern in reactivity of the alkali metals, lithium, sodium and potassium, with water; and use this pattern to predict the reactivity of other alkali metals C6.5 Explain this pattern in reactivity in terms of electronic configurations C6.6 Recall the colours and physical states of chlorine, bromine and iodine at room temperature. C6.7 Describe the pattern in the physical properties of the halogens, chlorine, bromine and iodine, and use this pattern to predict the physical properties of other halogens C6.8 Describe the chemical test for chlorine. C6.9 Describe the reactions of the halogens, chlorine, bromine and iodine, with metals to form metal halides,	Make estimates of the results of simple calculations. Construct and interpret frequency tables and diagrams, bar charts and histograms. Gas test- chlorine	**Year 7** Elements are found in the periodic table. This is separated into metals and non-metals. It is organised by groups and periods. Identifying chemical reactions vs physical changes Chemical reactions produce a new substance and usually cannot be reversed. Reactants as the starting chemicals and products as the new chemicals produced. Linking irreversible reactions to chemical reactions Measurement of temperature change, colour change and effervescence (Describe what you would see) Examples of chemical reactions Chemical reactions can be observed by: A colour change A gas being released An energy change (changing temperatures) Fuels release energy (Fuel + oxygen --> carbon dioxide + water (+energy)) **Year 8** The periodic table is split into metals and non-metals. Groups – vertical columns. Periods – horizontal rows. Identify elements from their group and period number. Group number is the same as the number of electrons on the outer shell of an atom. The period number is the same as the number of electron shells in an atom. Combustion is a chemical reaction that releases heat energy Idea of successful collisions: Particles much collide with enough energy in order to react.	Groups *(An assemblage of figures or objects forming a harmonious whole in a painting or design, cluster, knot)* Periods *(A cycle of recurrence, a complete sentence, a going around)* Metals *(an undecomposable elementary substance having certain recognisable qualities, opacity, conductivity, plasticity, high specific gravity. From Latin metallum "metal, mineral; mine, quarry")* Non-metals *(An element which is not a metal, not, lack of, sham)* Energy *(active, action)* Particles *(from the latin - a bit or fragment)* Rate (French- price, value- to reason/ count). **Clear as the reciprocal of time.** Collisions *(act of striking or dashing together)* Concentration (Latin- bring to the centre) Kinetic *(keie- to set in motion)* Exothermic *exo means outer/outside/outer part from Greek. Thermic in relation to heat* Endothermic *endo meaning inside, within or internal from the Greek endon. Thermin in realation to heat* Enzyme *(Greek 'enzymos' leavened)* Articles: **https://www.science.org/doi/10.1126/science.1174885**

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	and use this pattern to predict the reactions of other halogens. C6.10 Recall that the halogens, chlorine, bromine and iodine, form hydrogen halides which dissolve in water to form acidic solutions, and use this pattern to predict the reactions of other halogens. **C0.4 (Higher Tier only) Write balanced ionic equations.** C6.11 Describe the relative reactivity of the halogens chlorine, bromine and iodine, as shown by their displacement reactions with halide ions in aqueous solution, and use this pattern to predict the reactions of astatine. **C6.12 (Higher Tier only) Explain why these displacement reactions are redox reactions in terms of gain and loss of electrons, identifying which of the substances are oxidised and which are reduced.** C6.13 Explain the relative reactivity of the halogens in terms of electronic configurations. C6.14 Explain why the noble gases are chemically inert, compared with the other elements, in terms of their electronic configurations. C6.15 Explain how the uses of noble gases depend on their inertness, low density and/or non-flammability. C6.16 Describe the pattern in the physical properties of some noble gases and use this pattern to predict the physical properties of other noble gases **Rates of Reaction** C7.2 Suggest practical methods for determining the rate of a given reaction. C7.5 Interpret graphs of mass, volume or concentration of reactant or product against time. C7.3 Explain how reactions occur when particles collide and that rates of reaction are increased when the frequency and/or energy of collisions is increased. C7.4 Explain the effects on rates of reaction of changes in temperature, concentration, surface area to volume ratio	Arithmetic computation, ratio when balancing equations Make estimates of the results of simple calculations. Construct and interpret frequency tables and diagrams, bar charts and histograms. Arithmetic computation, ratio when measuring rates of reaction. Drawing and interpreting appropriate graphs from data to determine rate of reaction. Determining gradients of graphs as a measure of rate of change to determine rate.	Rate (or speed) of a reaction is linked to the number of successful collisions. Factors affecting the rate of reaction to include: - Temperature - Particle size/surface area - Concentration of solution/pressure of gas - Pressure Catalysts Sequence of practicals investigating factors affecting reaction and methods of measuring - Temperature – sodium thiosulphate crosses Particle size/surface area – marble chips and HCl **Year 9** Recap from Yr7 Atomic structure – protons, neutrons, electrons (location, relative charge and relative mass) Electron arrangement 2.8.8 and being able to draw and write electronic configuration Naming of key groups in the periodic table Recap from Yr8 Calculating number of protons, neutrons and electrons from relative atomic mass and atomic number Link between electrons in outer shell and group number Link between number of electron shells and period number Introduce: Origin of periodic table from Mendeleev linking to scientific collaboration Changes include more elements in the modern periodic table, no gaps in the modern table, now arranged by atomic number instead of atomic mass Definitions of exothermic and endothermic Idea that energy is transferred to or from the surroundings Visual clues and use of temperature change to identify endo/exo Practical examples of both types of reaction: - Exothermic - Endothermic Application to everyday E.g. hand warmers, Ice packs, cooking, combustion, photosynthesis Enzymes- Recap -Importance of enzymes in digestion as biological catalysts Recap - Naming enzymes in the digestive system; protease breaks down proteins into amino acids, lipase breaks down fats into fatty acids and glycerol, amylase breaks down starch (carbohydrate) into glucose Enzymes can also synthesise molecules e.g. starch synthase in plants. Label a diagram of an enzyme to include; enzyme, substrate and active site	

	of a solid and pressure (on reactions involving gases) in terms of frequency and/or energy of collisions between particles. *C7.1 Core Practical: Investigate the effects of changing the conditions of a reaction on the rates of chemical reactions by:* *a measuring the production of a gas (in the reaction between hydrochloric acid and marble chips)* *b observing a colour change (in the reaction between sodium thiosulfate and hydrochloric acid).* C7.6 Describe a catalyst as a substance that speeds up the rate of a reaction without altering the products of the reaction, being itself unchanged chemically and in mass at the end of the reaction. C7.7 Explain how the addition of a catalyst increases the rate of a reaction in terms of activation energy. C7.8 Recall that enzymes are biological catalysts and that enzymes are used in the production of alcoholic drinks. **Heat Energy Changes in Chemical Reactions** C7.12 Recall that the breaking of bonds is endothermic and the making of bonds is exothermic. C7.13 Recall that the overall heat energy change for a reaction is: a exothermic if more heat energy is released in forming bonds in the products than is required in breaking bonds in the reactants b endothermic if less heat energy is released in forming bonds in the products than is required in breaking bonds in the reactants. **C7.14 (Higher Tier only) Calculate the energy change in a reaction given the energies of bonds (in kJ mol–1).** C7.15 Explain the term activation energy. C7.16 Draw and label reaction profiles for endothermic and exothermic reactions, identifying activation energy.	Proportionality when comparing factors affecting rate of reaction. Use ratios, fractions and percentages. Make estimates of the results of simple calculations. Calculate areas of triangles and rectangles, surface areas and volumes of cubes. Arithmetic computation, ratio when measuring rates of reaction. Translate information between graphical and numeric form. Drawing and interpreting appropriate graphs from data to determine rate of reaction. Determining gradients of graphs as a measure of rate of change to determine rate. Opportunity for devising a method – exothermic reactions. Arithmetic computation when calculating energy changes. Use ratios, fractions and percentages. Interpretation of charts and graphs when dealing with reaction profiles.	Enzyme action and specificity Effect of substrate concentration on enzyme activity Effect of temperature and pH on enzymes Define denature as a change in shape of an enzyme's active site	

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CC16 Fuels CC17 Earth and Atmospheric Science **Year 11** *(Paper 4)*	**Fuels** C8.1 Recall that hydrocarbons are compounds that contain carbon and hydrogen only. C8.2 Describe crude oil as: a a complex mixture of hydrocarbons b containing molecules in which carbon atoms are in chains or rings (names, formulae and structures of specific ring molecules not required) c an important source of useful substances (fuels and feedstock for the petrochemical industry) d a finite resource C8.15 Recall that petrol, kerosene and diesel oil are non-renewable fossil fuels obtained from crude oil and methane is a non-renewable fossil fuel found in natural gas. C8.3 Describe and explain the separation of crude oil into simpler, more useful mixtures by the process of fractional distillation. C8.4 Recall the names and uses of the following fractions: a gases, used in domestic heating and cooking b petrol, used as fuel for cars c kerosene, used as fuel for aircraft d diesel oil, used as fuel for some cars and trains e fuel oil, used as fuel for large ships and in some power stations f bitumen, used to surface roads and roofs C8.5 Explain how hydrocarbons in different fractions differ from each other in: a the number of carbon and hydrogen atoms their molecules contain b boiling points c ease of ignition d viscosity and are mostly members of the alkane homologous series C8.6 Explain an homologous series as a series of compounds which: a have the same general formula b differ by CH_2 in molecular formulae from neighbouring compounds c show a gradual variation in physical properties, as exemplified by their boiling points	Translate information between graphical and numeric form. Plot two variables from experimental or other data. Use ratios, fractions and percentages. Make estimates of the results of simple calculations. Translate information between graphical and numeric form.	**Year 7** Combustion: Fuel + oxygen --> Water + carbon dioxide Crude oil formation: Formed from ancient dead animals and plants which have been buried in sediment and compressed over many years. Separation of crude oil using fractional distillation. Products of fractional distillation to include: Gases, petrol, kerosene, diesel, bitumen. Fuels release energy (Fuel + oxygen --> carbon dioxide + water (+energy)) Problems with burning fossil fuels including the contribution to global warming. Definition of the atmosphere as the layer of gas which surrounds a Planet. Layers of the atmosphere to include: • Troposphere • Mesosphere • Thermosphere • Ionosphere • Exosphere Model of the depth of the atmosphere Air is a mixture consisting of 78% Nitrogen, 21% oxygen, 1% Argon, 0.04% carbon dioxide. The carbon cycle: Photosynthesis as a chemical reaction uses carbon dioxide from the atmosphere. Combustion as a chemical reaction which reacts carbon (in fuels) with oxygen and releases it as carbon dioxide into the atmosphere. Respiration as a chemical reaction which releases carbon dioxide into the atmosphere • Decomposition • Feeding • Fossilisation Concept of 'Carbon neutral' (no **net** release of carbon dioxide into the atmosphere) and biofuels (a fuel from living matter) Our role in the carbon cycle Interactions How we influence the balance of carbon **Year 8** Recall definition of fuel – fuels contain a store of chemical energy. They release energy during combustion. Crude oil is a mixture of fuels (called hydrocarbons). Simple idea that hydrocarbons come in different lengths so have differing properties. Describe the process of fractional distillation using diagram To be kept to: • Fractional distillation is used to separate crude oil • Fractional distillation separates mixtures of liquids.	Crude oil *(Crude - in a raw or unprepared state)* Fuel - *(material for burning)* Energy - *(Greek, energos - active/working)* Hydrocarbon *(hydro - hydrogen, carbon)* Global Warming *(global - worldwide/universal)* Fractional distillation *(Fraction - to break, distillation - to trickle down in minute drops)* Atmosphere *(Atmos - vapour (Greek), sphere - ball/globe)* Composition *(Latin - put together)* Mixture *(Latin - to mix)* Carbon neutral *– (neutral no positive or negative effect, not acid or alkali)* Carbon Cycle *(Greek-kyklos-wheel)* Biofuels – *(Bio (living). Fuel - material for burning)* Interactions - interaction between – *(acting upon or influencing each other)* Fuel - *(material for burning)* Fractional distillation *(Fraction - to break, distillation - to trickle down in minute drops)* Combustion *(Latin comburere - to burn up, consume)* Saturated *from latin saturatus meaning to fill full* Unsaturated *un-meaning not* Homologous *from Greek homologos meaning of one mind* Combustion *(Latin comburere - to burn up, consume)* Pollution *from latin polluere meaning to soil, defile or contaminate* Atmosphere *from Greek atmos- meaning vapour/steam and sphere meaning around* Vapour from *Old French vapor meaning "moisture, vapor"* Condensation *from Latin condensare "to make dense"* Composition *("action of combining," also "manner in which a thing is composed,")* Atmosphere *(atmos "vapor, steam," which is of uncertain origin, from Latin sphaera "globe, ball, celestial sphere")* Volcanic *(from French volcanique, from Italian vulcanico, "prone to explosive activity")* Activity *(from Latin activus "active", The meaning "state of being active, briskness, liveliness")* Hypothesis (from Latinized form of *Greek hypothetikos* "pertaining to a *hypothesis*,") Infrared *("below the red" (in the spectrum))* Emit *(from Latin emitter "to send forth, throw or give out,")* Absorb *(from Latin absorbere "to swallow up, devour," from ab "off, away from" + sorbere "suck in,")* Global *("spherical," Meaning "worldwide, universal, pertaining to the whole globe of the earth")* Climate *(from Old French climat "region, part of the earth," from Greek klima "region, zone,")*

	d have similar chemical properties. C8.7 Describe the complete combustion of hydrocarbon fuels as a reaction in which: a carbon dioxide and water are produced b energy is given out. C8.8 Explain why the incomplete combustion of hydrocarbons can produce carbon and carbon monoxide. C8.9 Explain how carbon monoxide behaves as a toxic gas. C8.10 Describe the problems caused by incomplete combustion producing carbon monoxide and soot in appliances that use carbon compounds as fuels. C8.11 Explain how impurities in some hydrocarbon fuels result in the production of sulfur dioxide. C8.12 Explain some problems associated with acid rain caused when sulfur dioxide dissolves in rain water. C8.13 Explain why, when fuels are burned in engines, oxygen and nitrogen can react together at high temperatures to produce oxides of nitrogen, which are pollutants. C8.14 Evaluate the advantages and disadvantages of using hydrogen, rather than petrol, as a fuel in cars. C8.16 Explain why cracking involves the breaking down of larger, saturated hydrocarbon molecules (alkanes) into smaller, more useful ones, some of which are unsaturated (alkenes). C8.17 Explain why cracking is necessary **Earth and Atmospheric Science** C8.18 Recall that the gases produced by volcanic activity formed the Earth's early atmosphere. C8.19 Describe that the Earth's early atmosphere was thought to contain: a little or no oxygen b a large amount of carbon dioxide	Issues in society around air pollution. Low emission zones. Childhood asthma etc. Use of scientific evidence to inform legislation. Use of scientific legislation to reduce emissions. Challenges associated with this. Use of scientific research/ new technology to provide solutions to global issues. Use ratios, fractions and percentages. Construct and interpret frequency tables and diagrams, bar charts and histograms.	• Crude oil is evaporated and condensed at different levels in the column due to having different boiling points. Names and main use of fractions • Gases (methane, heating/cooking/camping) • Petrol (fuel for cars) • Kerosene (fuel for aircrafts) • Diesel (fuel for lorries, trains) • Fuel oil (factories, ships) • Bitumen (surfacing roads, waterproofing roofs) Combustion requires fuel, oxygen and heat. Combustion is a chemical reaction that releases heat energy Recall the word equation for complete combustion: Fuel + Oxygen → Carbon dioxide + water Understand that complete combustion happens when there is excess oxygen and incomplete when oxygen is limiting. Complete combustion produces carbon dioxide and water Incomplete combustion produces carbon monoxide/carbon and water. **Year 9** Recap from Yr7&8: • Fire triangle • Fossil Fuels • Crude oil production • Fractional Distillation of crude oil Definition of fuel as a substance that can be burnt to release energy Good fuels are those which ignite easily and release lots of energy Introduce that most fuels come from crude oil Definition of crude oil as a mixture of hydrocarbon (compounds which contain hydrogen and carbon only) Alkanes and alkenes as two main groups of hydrocarbons – structure and properties including testing for alkenes. Idea of homologous series as a family of compounds that have the same general formula and similar properties but differ by CH_2 Application of homologous series definition to organic molecules including alkanes, carboxylic acids, alcohols and alkenes Class Practical – which fuel is the best? Prediction and drawing of alkane and alkene molecules using information from a name. E.g meth = 1, eth = 2, prop = 3, but = 4 • ANE = simple molecule with single bonds only and maximum amount of hydrogen (saturated) • ENE = contains at least one double bond (unsaturated). • Idea that each carbon atom forms 4 covalent bonds to construct diagrams above.	Correlation *(from cor- "together" + relation "action of bringing into orderly connection")* Resolution *(resolucioun, "a breaking or reducing into parts; process of breaking up, dissolution,")* Photosynthesis *(from photo- "light" from Greek synthesis "composition, a putting together,")* Articles: The hydrogen solution? | Nature Climate Change Parts of the Atmosphere | National Geographic Society Carbon Sources and Sinks | National Geographic Society https://www.nature.com/articles/069410a0 https://www.sciencedirect.com/topics/chemistry/fractional-distillation https://www.sciencedirect.com/science/article/pii/S1540748920305010 https://www.theguardian.com/environment/2020/dec/16/girls-death-contributed-to-by-air-pollution-coroner-rules-in-landmark-case

	c water vapour d small amounts of other gases and interpret evidence relating to this. C8.20 Explain how condensation of water vapour formed oceans C8.21 Explain how the amount of carbon dioxide in the atmosphere was decreased when carbon dioxide dissolved as the oceans formed. C8.22 Explain how the growth of primitive plants used carbon dioxide and released oxygen by photosynthesis and consequently the amount of oxygen in the atmosphere gradually increased. C8.23 Describe the chemical test for oxygen. C8.24 Describe how various gases in the atmosphere, including carbon dioxide, methane and water vapour, absorb heat radiated from the Earth, subsequently releasing energy which keeps the Earth warm: this is known as the greenhouse effect. C8.25 Evaluate the evidence for human activity causing climate change, considering: a the correlation between the change in atmospheric carbon dioxide concentration, the consumption of fossil fuels and temperature change b the uncertainties caused by the location where these measurements are taken and historical accuracy. C8.26 Describe: a the composition of today's atmosphere b the potential effects on the climate of increased levels of carbon dioxide and methane generated by human activity, including burning fossil fuels and livestock farming c that these effects may be mitigated: consider scale, risk and environmental implications	Using evidence from today to inform us about the past. Extract and interpret information from charts, graphs and tables. Understand and use the symbols: =, <>, >, ∝, ~. Translate information between graphical and numeric form. Evolution of scientific ideas given new evidence. Gas test- oxygen Political and economical implications of climate change action. Importance of the science being independent and robust. Extract and interpret information from charts, graphs and tables. Use orders of magnitude to evaluate the significance of data. Impact on society of climate change. Reasons for opposition to potential mitigations. Role of scientists of all nationalities in tackling this global issue.	Class Practical - Bromine test to test alkane and alkene e.g. cyclohexane, cyclohexene. **Shorter chain hydrocarbons in higher demand. Use of cracking to break long chain alkanes into shorter chain hydrocarbons.** Recap from Yr7&8 Definition of combustion fuels burning in oxygen General word equation for complete combustion of a fuel. Fuel + oxygen → carbon dioxide + water. Incomplete combustion occurs in lack of oxygen forming carbon monoxide or carbon (soot). Production of CO_2 from complete combustion (transport, electricity production and industry) and methane from livestock and rice fields as greenhouse gases. Mechanism of greenhouse effect and contributing factors including transport, electricity production, industry and agriculture. Global warming and Climate change Carbon monoxide and soot from incomplete combustion Toxic effects of CO Soot linked to breathing problems and blackening buildings Acid rain from combustion of impurities in fuel which produces sulfur dioxide and nitrogen oxide. These dissolve in clouds to produce sulfuric and nitric acid Forecasted effects of climate change Recap of concept of carbon neutral from Y7 Solutions including green energy, recycling, electric vehicles, carbon neutrality. Risk and need for CO detector. Public health effects of air pollution linked to asthma. Carbon footprint and carbon neutrality Early atmosphere was formed from volcanic gases including carbon dioxide, methane, ammonia and water vapour (little or no oxygen) Condensation due to temperature decrease formed oceans Evolution of plants, reduced CO_2 and produced O_2. Carbon dioxide also dissolved in the oceans. This has led to today's atmosphere, review % from Y7. 78% N_2, 21% O_2, 1% Argon and 0.04% CO_2. However, human activity continues to change. Evaluation of evidence for evolution of the atmosphere.	

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SC22 Hydrocarbons SC23 Alcohols and Carboxylic Acids SC24 Polymers *(Paper 2)*	**Hydrocarbons** C9.10C Recall the formulae of molecules of the alkanes, methane, ethane, propane and butane, and draw the structures of these molecules, showing all covalent bonds. C9.11C Explain why the alkanes are saturated hydrocarbons. C9.12C Recall the formulae of molecules of the alkenes, ethene, propene, butene, and draw the structures of these molecules, showing all covalent bonds (but-1-ene and but-2-ene only). C9.13C Explain why the alkenes are unsaturated hydrocarbons, describing that their molecules contain the functional group C=C C9.14C Recall the addition reaction of ethene with bromine, showing the structures of reactants and products, and extend this to other alkenes. C9.15C Explain how bromine water is used to distinguish between alkanes and alkenes. C9.16C Describe how the complete combustion of alkanes and alkenes involves the oxidation of the hydrocarbons to produce carbon dioxide and water. **Alcohols and Carboxylic Acids** C9.33C Describe the production of ethanol by fermentation of carbohydrates in aqueous solution, using yeast to provide enzymes. C9.34C Explain how to obtain a concentrated solution of ethanol by fractional distillation of the fermentation mixture. C9.26C Recall the formulae of molecules of the alcohols, methanol, ethanol, propanol (propan-1-ol only) and butanol (butan-1-ol only), and draw the structures of these molecules, showing all covalent bonds. C9.27C Recall that the functional group in alcohols is –OH and that alcohols can be dehydrated to form alkenes.	Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects.	**Year 7** Define what composite materials are and give examples of composite materials including MDF, plywood, fibreglass, concrete and polymers including polyethene and PVC . Justification of choice of material including metals, composites and polymers for certain purposes based on: - Abundance of raw material - Extraction method and cost - Physical properties - Manufacturing cost and energy Environmental impact including carbon footprint. Examining real life composite materials for their properties. Investigating strength of material for shopping bags (real life application). **Year 9** Definition of crude oil as a mixture of hydrocarbon (compounds which contain hydrogen and carbon only) Alkanes and alkenes as two main groups of hydrocarbons – structure and properties including testing for alkenes. Idea of homologous series as a family of compounds that have the same general formula and similar properties but differ by CH_2 Application of homologous series definition to organic molecules including alkanes, carboxylic acids, alcohols and alkenes Class Practical – which fuel is the best? Prediction and drawing of alkane and alkene molecules using information from a name. E.g meth = 1, eth = 2, prop = 3, but = 4 • ANE = simple molecule with single bonds only and maximum amount of hydrogen (saturated) • ENE = contains at least one double bond (unsaturated). • Idea that each carbon atom forms 4 covalent bonds to construct diagrams above. Class Practical - Bromine test to test alkane and alkene e.g. cyclohexane, cyclohexene.	Formula *(from Latin formula "form, draft, contract, regulation;" in law, "a rule, method;" literally "small form,")* Homologous *(from homos "same" + logos "relation, reasoning, computation,")* Saturated *(from satur "sated, full")* Unsaturated *("not" + "full")* Functional *(from Latin functionem (nominative functio) "a performance, an execution," noun of action from funct-, past-participle stem of fungi "perform, execute, discharge,")* Isomers *(from Greek isos "equal to, the same as; equally divided)* Oxidation *(noun of action from oxider "oxidize," from oxygen "ation" meaning process.)* Complete *(from Latin completus, past participle of complere "to fill up, complete the number of)* Combustion *(stem of Latin comburere "to burn up, consume," + *burere, based on a faulty separation of amburere "to burn around,")* Incomplete *from in- "not" from Latin completus, past participle of complere "to fill up, complete the number of* Addition *(from Old French adition "increase, augmentation")* Sugars (*late 13c., sugre, "sweet crystalline substance from plant juices,")* Carbohydrates *(from **carbo-**, combining form of carbon, + **hydrate** (n.), denoting compound produced when certain substances combine with water, from Greek hydor "water")* Starch *(The figurative sense of "stiffness and formality of manner")* Enzymes (from *en* "in + *zymē* "leaven") Fermentation *(directly from Latin fermentare "to leaven, cause to rise or ferment," "ation" pertaining a process)* Anaerobic *(from Greek an- "without" + aēr "air" + bios "life")* Fractional *(Old French fraccion, "a breaking," 12c., Modern French fraction stem of Latin frangere "to break (something) in pieces, shatter, fracture)* Distillation *(Latin distillare "to trickle down in minute drops" "ation pertaining a process")* Distillate *(late 14c., distillen, "to let fall in drops" Latin words ending in -atus, -atum)* Fraction *(Old French fraccion, "a breaking," 12c., Modern French fraction stem of Latin frangere "to break (something) in pieces, shatter, fracture)* Organic *("serving as a means or instrument,")* Compounds *(compounen, "to put together, to mix, to combine; to join, couple together,")* Alcohol *("fine powder produced by sublimation," from Medieval Latin alcohol "powdered ore of antimony," from Arabic al-*

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	C9.32C Recall members of a given homologous series have similar reactions because their molecules contain the same functional group and use this to predict the products of other members of these series. *C9.28C Core Practical: Investigate the temperature rise produced in a known mass of water by the combustion of the alcohols ethanol, propanol, butanol and pentanol.* C9.29C Recall the formulae of molecules of the carboxylic acids, methanoic, ethanoic, propanoic and butanoic acids, and draw the structures of these molecules, showing all covalent bonds. C9.30C Recall that the functional group in carboxylic acids is –COOH and that solutions of carboxylic acids have typical acidic properties. C9.31C Recall that ethanol can be oxidised to produce ethanoic acid and extend this to other alcohols (reagents not required). C9.32C Recall members of a given homologous series have similar reactions because their molecules contain the same functional group and use this to predict the products of other members of these series. **Polymers** C9.17C Recall that a polymer is a substance of high average relative molecular mass made up of small repeating units. C9.18C Describe: a how ethene molecules can combine together in a polymerisation reaction b that the addition polymer formed is called poly(ethene) (conditions and mechanisms not required). C9.25C Recall that: a DNA is a polymer made from four different monomers called nucleotides (names of nucleotides not required) b starch is a polymer based on sugars c proteins are polymers based on amino acids	Recognise and use expressions in decimal form. Use ratios, fractions and percentages. Construct and interpret frequency tables and diagrams, bar charts and histograms. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects.		*kuhul "kohl," the fine metallic powder used to darken the eyelids, from kahala "to stain, paint.")* Renewable *(reneuen, "make (something) like new "capable of; allowed; worthy of)* Carboxylic *(from carb-, combining form of **carbon** + **-ol** "oil" + **-ic**)* Polymers *from Greek polymeres "having many parts," from polys "many" + meros "part" "to get a share of something")*. Polymerisation *from Greek polymeres "having many parts," from polys "many" + meros "part" "to get a share of something"). "ation" pertaining to a process.* Monomers *from **mono-** + Greek meros "part" ***(s)mer-** (2) "to get a share of something"* Repeating *Latin repetere "do or say again; attack again,"* Synthetic *from Greek synthetikos "skilled in putting together, constructive,"* Polyester *from polys "many" from Essig "vinegar" + Äther "ether"* Finite finire "to limit, set bounds; come to an end" Cracked *"broken by a sharp blow,"* Biodegradable *from Greek bios "one's life, course or way of living, lifetime" degraden "lower in character, cause to deteriorate." -able "capable of; allowed; worthy of; requiring; to be ______ed,"* Incinerated incinerare "reduce to ashes" Flame *diminutive of flamma "flame, blazing fire,"* Photometer *from **photo-** "light" + **-meter** "device for measuring."* Calibration *"determine the relative value of"* Spectrum *"an appearance, image, apparition, specter," from specere "to look at, view"* Emission *from Latin emissionem (nominative emissio) "a sending out, a projecting, hurling, letting go, releasing,"*

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	C9.19C Describe how other addition polymers can be made by combining together other monomer molecules containing C=C, to include poly(propene), poly(chloroethene) (PVC) and poly(tetrafluoroethene) (PTFE) (conditions and mechanisms not required) C9.20C Deduce the structure of a monomer from the structure of an addition polymer and vice versa. C9.21C Explain how the uses of polymers are related to their properties and vice versa: including poly(ethene), poly(propene), poly(chloroethene) (PVC) and poly(tetrafluoroethene) (PTFE). C9.22C Explain: a why polyesters are condensation polymers b how a polyester is formed when a monomer molecule containing two carboxylic acid groups is reacted with a monomer molecule containing two alcohol groups c how a molecule of water is formed each time an ester link is formed. C9.23C Describe some problems associated with polymers including the: a availability of starting materials b persistence in landfill sites, due to non-biodegradability c gases produced during disposal by combustion d requirement to sort polymers so that they can be melted and reformed into a new product. C9.24C Evaluate the advantages and disadvantages of recycling polymers, including economic implications, availability of starting materials and environmental impact.	Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects.		
SC25 Qualitative Analysis: Tests for Ions SC26 Bulk and Surface Properties of	**Qualitative Analysis: Tests for Ions** C9.2C Describe flame tests to identify the following ions in solids: a lithium ion, Li+ (red) b sodium ion, Na+ (yellow) c potassium ion, K+ (lilac) d calcium ion, Ca2+ (orange-red)	Interpret charts, particularly in spectroscopy.		Precipitation *from praeceps (genitive praecipitis) "steep, headlong, headfirst," from prae "before, forth"* Confirmatory *confermen "to ratify, sanction, make valid by a legal act," + firmare "to strengthen," from firmus "strong, steadfast"* Halide *hal-, word-forming element meaning "salt, sea," in which the -ide is from acide "acid."*

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Matter Including Nanoparticles *(Paper 2)*	e copper ion, Cu^{2+} (blue-green) C9.7C Identify the ions in unknown salts, using results of the tests above. C9.8C Describe that instrumental methods of analysis are available and that these may improve sensitivity, accuracy and speed of tests. C9.9C Evaluate data from a flame photometer: a to determine the concentration of ions in dilute solution using a calibration curve b to identify metal ions by comparing the data with reference data (no knowledge of the instrument or how it works is required) C9.1C Explain why the test for any ion must be unique. C9.3C Describe tests to identify the following ions in solids or solutions as appropriate: a aluminium ion, Al^{3+} b calcium ion, Ca^{2+} c copper ion, Cu^{2+} d iron(II) ion, Fe^{2+} e iron(III) ion, Fe^{3+} f ammonium ion, NH_4^+ using sodium hydroxide solution C9.4C Describe the chemical test for ammonia. C9.7C Identify the ions in unknown salts, using results of the tests above. C9.5C Describe tests to identify the following ions in solids or solutions as appropriate: a carbonate ion, CO_3^{2-}, using dilute acid and identifying the carbon dioxide evolved b sulfate ion, SO_4^{2-}, using dilute hydrochloric acid and barium chloride solution c chloride ion, Cl^-, bromide ion, Br^-, iodide ion, I^-, using dilute nitric acid and silver nitrate solution C9.7C Identify the ions in unknown salts, using results of the tests above. *C9.6C Core Practical: Identify the ions in unknown salts, using the tests for the specified cations and anions in 9.2C, 9.3C, 9.4C, 9.5C*	Construct and interpret frequency tables and diagrams, bar charts and histograms.		Ceramics *from Greek keramikos, from keramos "potter's earth; tile; earthen vessel, jar, wine-jar, pottery,"* Transparent *transparere "show light through," from Latin trans "across, beyond; through" + parere "come in sight, appear; submit, obey"* Opaque *from Latin opacus "shaded, in the shade, shady, dark, darkened, obscure,"* Malleable *from Medieval Latin malleabilis, from malleare "to beat with a hammer," from Latin malleus "hammer"* Alloys *from Old French aloiier, aliier "assemble, join," from Latin alligare "bind to, tie to," from ad "to* Composite *from Latin compositus "placed together," com "with, together"* Matrix *matris, matrice, "uterus, womb," from Old French matrice "womb, uterus"* Tensile *Modern Latin tensilis "capable of being stretched," from Latin tensus, past participle of tendere "to stretch,"*

	Bulk and Surface Properties of Matter Including Nanoparticles C9.38C Compare, using data, the physical properties of glass and clay ceramics, polymers, composites and metals. C9.39C Explain why the properties of a material make it suitable for a given use and use data to select materials appropriate for specific uses. C9.35C Compare the size of nanoparticles with the sizes of atoms and molecules. C9.36C Describe how the properties of nanoparticulate materials are related to their uses including surface area to volume ratio of the particles they contain, including sunscreens. C9.37C Explain the possible risks associated with some nanoparticulate materials.	Construct and interpret frequency tables and diagrams, bar charts and histograms. Interpret, order and calculate with numbers written in standard form when dealing with nanoparticles. Estimate size and scale of atoms and nanoparticles. Make order of magnitude calculations. Use ratios when considering relative sizes and surface area to volume comparisons. Calculate surface areas and volumes of cubes.		

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Module	Substantive knowledge (from specification) to be taught	Required disciplinary knowledge to be taught with linked lesson (Maths skills in red)	KS3 links (to be checked by retrieval practice)	Disciplinary Literacy: • Keywords and Etymology • Linked articles (for homework and whole-class reading)
Key Concepts of Physics *Year 10 and 11* *Papers 5 and 6*	***NOT** a discretely taught module. Units, prefixes and conversions below taught throughout relevant units.* P1.1 Recall and use the SI unit for physical quantities, as listed in Appendix 3 P1.2 Recall and use multiples and sub-multiples of units, including giga (G), mega (M), kilo (k), centi (c), milli (m), micro (μ) and nano (n) P1.3 Be able to convert between different units, including hours to seconds P1.4 Use significant figures and standard form where appropriate	Make calculations using ratios and proportional reasoning to convert units and to compute rates Recognise and use expressions in standard form.	**Year 7** Units for: • Time (hours, minutes, seconds) • Distance (metres) • Speed (m/s) • Force (Newtons) • Frequency (Hertz) • Energy (Joules) Conversions of time: s->m, m-h Conversion of distance m -> km **Year 8** Units for: • Force- inc weight (Newtons) • Mass (kg) • Pressure (Pascals- N/m^2) • Speed (m/s) • Acceleration (m/s^2) • Frequency (Hertz)	

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			• Sound level (decibels) • Energy (Joules) • Current (Amps) • Potential Difference (Volts) Conversions of time: s->m, m-h Conversion of distance m -> km **Year 9** Reinforcement of units above, plus: • Density (kg/m^3) • Radioactive decay (Bequerels) • Resistance (Ohms) • Magnetic flux density (top set only) (Teslas/ N/Am)	
CP1 Motion *Year 10* *Paper 5 (1)*	P2.1 Explain that a scalar quantity has magnitude (size) but no specific direction P2.2 Explain that a vector quantity has both magnitude (size) and a specific direction P2.3 Explain the difference between vector and scalar quantities	Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects	**Year 7** Speed calculations - Use of speed = distance/time Acknowledgement of different units referring back to m/s Relative speed Average speed Calculating your own speed Application of speed cameras Athletic performance Distance-Time graphs	Acceleration (accelerare to hasten to quicken) Displacement – (from *des- placer* "to place," from *place* ") Distance – (present participle of *distare* "stand apart," from *dis-* "apart, off") Distance-time graph Force – ("physical strength," from Old French force) Velocity-time graph Instantaneous speed

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	P2.4 Recall vector and scalar quantities, including: a displacement/distance b velocity/speed c acceleration d force e weight/mass f momentum g energy P2.5 Recall that velocity is speed in a stated direction P2.6 Recall and use the equations: a (average) speed (metre per second, m/s) = distance (metre, m) ÷ time (s) b distance travelled (metre, m) = average speed (metre per second, m/s) × time (s) P2.7 Analyse distance/time graphs including determination of speed from the gradient P2.11 Describe a range of laboratory methods for determining the speeds of objects such as the use of light gates	Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Make calculations using ratios and proportional reasoning to convert units and to compute rates Apply formulae relating distance, time and speed, for uniform motion, and for motion with uniform acceleration, and calculate average speed for non-uniform motion	What each type of line and gradient show Pupils are able to draw and interpret simple distance time graphs **Year 8** Re-cap of Y7 key components: Calculating speed - Speed = Distance/Time Distant-time graphs as a tool to show a journey of the distance an object travels over time. - A horizontal line shows a stationary object - A sloping line shows an object travelling at a constant speed - The steeper the line the faster the object is travelling - A curved line shows acceleration or deceleration. Calculating speed from a distance time graph - Speed calculated by calculating the gradient of the line. Acceleration as a rate of change of speed Calculating acceleration	Magnitude - (from Latin *magnitudo* "greatness, bulk, size,") Mass – (from Old French *masse* "lump, heap, pile) Momentum – (*meuə-*, Proto-Indo-European root meaning "to push away.") Scalar – (from Latin *scalaris* "of or pertaining to a ladder,") Vector – (1704, from Latin *vector* "one who carries or conveys, carrier") Velocity – (from Latin *velocitatem* (nominative *velocitas*) "swiftness, speed,") Weight – (Old English *gewiht* "weighing, weight, downward force of a body) Gradient – (from Latin *gradientem*, present participle of *gradi* "to walk.") Deceleration – (1894, originally in railroading, coined from de- "do the opposite of" + *(ac)celebration*)

	P2.12 Recall some typical speeds encountered in everyday experience for wind and sound, and for walking, running, cycling and other transportation systems P2.8 Recall and use the equation: acceleration (metre per second squared, m/s2) = change in velocity (metre per second, m/s) ÷ time taken (second, s) **a=(v-u)/t** P2.9 Use the equation: (final velocity)2 ((metre/second)2, (m/s)2) – (initial velocity)2 ((metre/second)2, (m/s)2) = 2 × acceleration (metre per second	Use of light gates/ data loggers to determine speed. Apply formulae relating distance, time and speed, for uniform motion, and for motion with uniform acceleration, and calculate average speed for non-uniform motion Make estimates of the results of simple calculations Relate changes and differences in motion to appropriate distance-time, and velocity-time graphs, and interpret lines and slopes Make calculations using ratios and proportional reasoning to convert units and to compute rates	Acceleration = change in velocity/time A = v-u/t Acceleration is measured in m/s^2 Velocity – time graphs: Interpret simple journeys on velocity-time graphs, demonstrating how velocity changes over time. - Horizontal line shows an object travelling at a constant velocity - Upwards sloping line demonstrates an object accelerating - Downwards sloping line demonstrates an object decelerating. Calculations from a velocity time graph - - Acceleration calculated from the gradient of the line Interpreting velocity time graphs and calculating acceleration and distance from a velocity-time graphs. **Year 9**	

	squared, m/s2) × distance (metre, m) **$v^2 – u^2 = 2× a× x$** P2.13 Recall that the acceleration, g, in free fall is 10 m/s2 and be able to estimate the magnitudes of everyday accelerations P2.10 Analyse velocity/time graphs to: a compare acceleration from gradients qualitatively b calculate the acceleration from the gradient (for uniform acceleration only) c determine the distance travelled using the area between the graph line and the time axis (for uniform acceleration only)	Apply formulae relating distance, time and speed, for uniform motion, and for motion with uniform acceleration, and calculate average speed for non-uniform motion Make estimates of the results of simple calculations Make order of magnitude calculations Relate changes and differences in motion to appropriate distance-time, and velocity-time graphs, and interpret lines and slopes **Interpret enclosed areas in velocity-time graphs**	A physical quantity is something that can be measured. Scalars as quantities that only require magnitude. Examples include: - Speed - Distance - Time - Mass - Energy Vectors as quantities that require a magnitude and direction. Examples to include: - Displacement - Velocity - Acceleration - Force - Weight - Momentum Displacement as the distance travelled in a straight line. Speed as how fast an object is travelling Velocity is the speed in a given direction. Investigating the difference between distance and displacement (marble run practical) Recap distance time graphs from Y7/Y8;	

			- Graphs to show stationary and constant speed objects - Gradient of graph shows speed Recap velocity time graphs from Y7/Y8; - Graphs to show constant speed and accelerating objects - Gradient of graph shows acceleration Area under graph = distance travelled Calculations of acceleration and distance travelled from velocity time graphs Interpreting and calculating distance travelled from velocity-time graphs.	
CP2 Forces and Motion *Year 10* *Paper 5 (1)*	P2.14 Recall Newton's first law and use it in the following situations: a where the resultant force on a body is zero, i.e. the body is moving at a constant velocity or is at rest b where the resultant force is not zero, i.e. the speed and/or direction of the body change(s) **P2.20 Explain that an object moving in a circular orbit at constant speed has a changing**	Apply formulae relating distance, time and speed, for uniform motion, and for motion with uniform acceleration, and calculate average speed for non-uniform motion	**Year 7** Basic force definition Defining types of force as push or pull Free body diagrams Measuring forces with Newton meters Size of arrow on free body diagrams Application to everyday situations	Acceleration *(Latin 'accelerare' meaning to hasten)* Balanced forces *('Balance' from Latin 'bilanx' meaning a scale with two pans)* Resultant *(Latin 'resultare' meaning to spring forward from)* Scalar quantity *(Latin 'scalaris' meaning to have steps like a ladder)* Speed Unbalanced forces Vector quantity *(Latin 'vector' meaning to carry)* Velocity *(Latin 'velocitatem' meaning swift)*

	velocity (qualitative only) (Higher Tier only) **P2.21 Explain that for motion in a circle there must be a resultant force known as a centripetal force that acts towards the centre of the circle (Higher Tier only)** P2.16 Define weight, recall and use the equation: weight (newton, N) = mass (kilogram, kg) × gravitational field strength (newton per kilogram, N/kg) W = m× g P2.17 Describe how weight is measured. P2.18 Describe the relationship between the weight of a body and the gravitational field strength P2.15 Recall and use Newton's second law as:	Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Understand and use the symbols: =, <>, >, ∝, ~ Change the subject of an equation. Substitute numerical values into algebraic equations using appropriate units for physical quantities. Solve simple algebraic equations. Construct and interpret frequency tables and diagrams, bar charts and histograms	Practically applying newton meter to everyday situations Interaction between different forces Balanced and unbalanced Equilibrium Resultant forces Calculating resultants Linking to motion How would these force interactions affect the motion of the object Making a newton meter Measuring the extension of a spring plus one other material (linking to plastics) Air resistance and friction as forces which oppose motion High performance cars/athletes have ways of overcoming this **Year 8** Re-cap of Y7 key components: Force as a push or pull which can change the speed, size or direction of an object Forces are measured in Newtons with a Newton meter Types of forces including - Air resistance - Water resistance	**Higher - Centripetal force** *(Latin 'centrum' meaning centre + Latin 'petere' meaning to go towards)* Mass *(Greek 'maza' meaning lump of dough)* Weight *('Weight' from Proto-Indo_European (P.I.E.) 'wegh' meaning to move/carry/transport)* Gravitational field strength *('Gravity' from Latin 'gravitas' meaning heavy)* Inertial mass *('‘Inertial' from Latin 'inertia' meaning idle/inactive)* Action–reaction forces Balanced forces Equilibrium *(Latin 'aequilibris' meaning balanced)* Conservation of momentum *('Conservation' from Latin 'conservare' meaning to keep or protect; 'Momentum' from Latin 'momentum' meaning movement of power)* Thinking distance Braking distance Stopping distance Reaction time *('Reaction' from Latin prefix 're-' meaning back + Latin 'agere' meaning to do)* Response *(Latin 'responsum' meaning answer)* Kinetic energy *('Kinetic' from Greek 'kinētikos' meaning to move; 'Energy' from Greek 'energeia' meaning activity)* Work done *('Work' from P.I.E. 'werg-' meaning to do)* Crumple zone *('Crumple' from Proto-Germanic 'krumbo' meaning to press/squeeze)*

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	force (newton, N) = mass (kilogram, kg) × acceleration (metre per second squared, m/s2) F = m × a **P2.22 Explain that inertial mass is a measure of how difficult it is to change the velocity of an object (including from rest) and know that it is defined as the ratio of force over acceleration (Higher Tier only)** P2.19 Core Practical: Investigate the relationship between force, mass and acceleration by varying the masses added to trolleys P2.23 Recall and apply Newton's third law both to equilibrium situations **and to collision interactions and relate it to the conservation of momentum in collisions.**	Understand and use the symbols: =, <>, >, ∝, ~ Change the subject of an equation. Substitute numerical values into algebraic equations using appropriate units for physical quantities. Solve simple algebraic equations. Relate changes and differences in motion to appropriate distance-time, and velocity-time graphs, and interpret lines and slopes Apply formulae relating distance, time and speed, for uniform motion, and for motion with uniform acceleration, and calculate average speed for non-uniform motion	- Upthrust - Friction - Static electricity - Magnetism Forces can change the motion of objects. Free body diagrams used to represent forces. - Arrows represent the size and direction of the force. Resultant forces - Opposing forces are subtracted Forces acting in the same direction are added together Gravitational field. Gravity as a force of attraction between masses. - Example of gravity keeping planets in orbit around the Sun. - Example of gravity keeping the moon in orbit around Earth Every object with mass has a gravitational pull The greater the mass of an object the greater the gravitational pull Strength of gravitational force on Earth = 10N/kg.	Deceleration *(Latin prefix 'de-' meaning the opposite of + Latin 'accelerare' meaning to hasten)*

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	P2.24 Define momentum, recall and use the equation: momentum (kilogram metre per second, kg m/s) = mass (kilogram, kg) × velocity (metre per second, m/s) p = m × v (Higher Tier only) **P2.25 Describe examples of momentum in collisions (Higher Tier only)** **P2.26 Use Newton's second law as: force (newton, N) = change in momentum (kilogram metre per second, kg m/s) ÷ time (second, s) F= (mv-mu)/t (Higher Tier only)** P2.27 Explain methods of measuring human reaction times and recall typical results. P2.28 Recall that the stopping distance of a vehicle is made up of the sum of the thinking distance and the braking distance.	Understand and use the symbols: =, <>, >, ∝, ~ Change the subject of an equation. Substitute numerical values into algebraic equations using appropriate units for physical quantities. Solve simple algebraic equations. Recognise and use expressions in decimal form Understand and use the symbols: =, <>, >, ∝, ~ Change the subject of an equation. Substitute numerical values into algebraic equations using appropriate units for physical quantities. Solve simple algebraic equations.	Weight as a force caused by gravity. Measured in newtons with a Newton meter. Mass as the amount of 'matter' in an object. It is measured in kg, using scales. Calculating weight Weight = Mass x gravity Mass remains the same in different gravitational fields but weight changes because the gravitational pull changes. Calculation of weight with different values of g - Calculating own weight on different planets. Comparison of gravitational field strength on different planets Effect of forces/weight on roller coasters. G-force Investigating the mass and weight of different masses. Drawing a graph to describe the relationship between mass and weight **Year 9** Recap forces from Y7/Y8;	

	2.29 Explain that the stopping distance of a vehicle is affected by a range of factors including: a the mass of the vehicle b the speed of the vehicle c the driver's reaction time d the state of the vehicle's brakes e the state of the road f the amount of friction between the tyre and the road surface P2.30 Describe the factors affecting a driver's reaction time including drugs and distractions P2.31 Explain the dangers caused by large decelerations **and estimate the forces involved in typical situations on a public road** **Separate Sciences Only** P2.32 Estimate how the distance required for a road vehicle to stop in an emergency varies over a range of typical speeds P2.33 Carry out calculations on work done to show the dependence of braking distance for	Use an appropriate number of significant figures. Find arithmetic means. Construct and interpret frequency tables and diagrams, bar charts and histograms. Use a scatter diagram to identify a correlation between two variables. Make order of magnitude calculations Make estimates of the results of simple calculations. Make order of magnitude calculations. Make estimates of the results of simple calculations. Find	- Forces are measured in Newtons - Forces are measured using a Newton meter - Forces equal in size and opposite in direction are balanced. - Forces not equal in size are unbalanced. - Forces are represented with arrows using free-body diagrams. - Resultant force is the difference between the two forces acting in opposite directions on an object. Newton's first law: - an object will continue to move at the same speed and direction unless an external force acts on it. - A stationary object will remain stationary unless an external force acts on it. Balanced forces produce a resultant force of zero, therefore no acceleration/change in motion.	

	a vehicle on initial velocity squared (work done to bring a vehicle to rest equals its initial kinetic energy)	arithmetic means. Find arithmetic means. Substitute numerical values into algebraic equations using appropriate units for physical quantities. Estimate how the distances required for road vehicles to stop in an emergency, varies over a range of typical speeds	Unbalanced forces change the speed or direction of an object. Newton's second law: - an unbalanced force on an object causes it to accelerate. - The acceleration will depend on the size of the force and the mass of the object Calculating force using Force (N) = mass (Kg) x acceleration (m/s^2) **Momentum as the tendency of an object to keep moving.** **Momentum = mass x velocity** Crater size practical; investigate how changing the mass and/or acceleration (height) will affect the force (size of crater). Newton's Third Law: Whenever two objects interact they exert equal and opposite forces on each other (every action has an equal and opposite reaction). - This can happen when objects touch e.g. when a person sits on a chair - Or at a distance e.g. the gravitational pull between the Earth and the Moon.	

			The pairs of forces acting on two interacting forces are called action-reaction forces - - They are always equal in size and opposite in direction. An equilibrium situation is when nothing is moving. Action-reaction forces in everyday situations Stopping distance = thinking distance + braking distance. - Thinking distance as the distance travelled whilst reacting to hazard/stimuli. - Factors affecting thinking distance to include; alcohol, distractions, tiredness. - Braking distance as the distance travelled once brakes have been applied. - Factors affecting braking distance to include; tyres, brakes, road conditions, mass of vehicle. Car safety features designed to increase deceleration time examples:	

			- Crumple zones. These increase the time taken for the car to come to a stop reducing the force. - Air bags. Increase the time taken for the persons head to collide with the dashboard. Reducing the force on the person. Seat belts. Applies a force to hold the person in the car. Dropping an egg. Video showing crash testing. Use a bicycle helmet to explain how a small increase in deceleration time affects the overall force. Crash test dummies video.	
CP3 Conservation of Energy *Year 10* *Paper 5 (1)*	P3.3 (P8.2) Draw and interpret diagrams to represent energy transfers P3.4 Explain what is meant by conservation of energy	Construct and interpret frequency tables and diagrams, bar charts and histograms Use ratios, fractions and percentages	**Year 7** Energy defined as "something that is needed to make things happen or change" Principle of conservation of energy Energy can be described by stores or transfers Energy stores: • Chemical • Kinetic • Strain/Elastic potential	Energy (Greek 'energos' – active, to do) Chemical (Madieval latin 'alchimicus' – relating to chemicals) Kinetic (Greek 'kineticos' – to move) Thermal (Greek 'therme' – heat) Elastic (Greek 'elastos' – flexible) Potential (Greek 'potis' – possible as opposed to actual) Gravitational (Latin 'gravitas' – weight, heaviness) Nuclear (Latin 'nucleus' – little nut, pertaining to centre of atom)

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	P3.5 Analyse the changes involved in the way energy is stored when a system changes, including: a an object projected upwards or up a slope b a moving object hitting an obstacle c an object being accelerated by a constant force d a vehicle slowing down e bringing water to a boil in an electric kettle P3.6 (P8.3) Explain that where there are energy transfers in a closed system there is no net change to the total energy in that system P3.8 (P8.10) Explain, using examples, how in all system changes energy is dissipated so that it is stored in less useful ways P3.7 (P8.11) Explain that mechanical processes become wasteful when they cause a rise in temperature so dissipating energy in heating the surroundings P3.9 Explain ways of reducing unwanted energy transfer including	Calculate relevant values of stored energy and energy transfers; convert between newton-metres and joules Make calculations of the energy changes associated with changes in a system, recalling or selecting the relevant equations for mechanical, electrical, and thermal processes; thereby express in quantitative form and on a common scale the overall redistribution of energy in the system	• Gravitational potential • Nuclear Energy transfers: • Mechanical • Heating (conduction, convection and radiation) • Light • Sound • Electrical Heat transfer by: Conduction, Convection and Radiation Link and revision of states of matter Examples to include central heating and solar energy **Year 8** Recap of Y7 knowledge on energy stores and transfers. - Energy is measured in joules (J) - Energy can cannot be created or destroyed. Only stored and transferred - Energy stores include: Chemical, kinetic, Thermal/heat, Gravitational potential, Elastic potential, Nuclear. - Energy transfers include: Mechanical,	Conservation (Latin 'conservationem' – keeping the same) Dissipated (Latin 'disipatus' – to scatter) Lubrication (Latin 'lubricus' – slippery) Efficiency (Latin 'efficere' – to accomplish) Insulation (Latin 'insula' – island, to make like an island) Conduction (Latin 'com' - together with, and 'ducere' – to lead) Convection (Latin 'com' – together with, and 'vehere' – to carry) Radiation (Latin 'radiato' – a shining) Infrared (Latin 'infra' – beneath, and PIE 'reudh' – red) Fossil (Latin 'fossilis' – dug up) Renewable (Latin 'renovare' – to renew, and 'abilis' – capable of) Climate (Greek 'klima' – slope of Earth from equator to pole) Solar (Latin 'solarium' – proceeding from the sun) Hydroelectricity (Greek 'hydro' – water, and latin 'electrum' – amber) Turbine (Latin 'turbinem' – spinning top) Tidal (Proto-Germanic 'tidi' – period of time, and latin 'alis' – pertaining to)

	through lubrication, thermal insulation P3.11 (P8.15) Recall and use the equation: Efficiency = useful energy transferred to the device/ total energy supplied to the device **P3.12 (Higher Tier only) Explain how efficiency can be increased** P3.9 (P9.10) Explain ways of reducing unwanted energy transfer including through lubrication, thermal insulation P3.10 Describe the effects of the thickness and thermal conductivity of the walls of a building on its rate of cooling qualitatively P3.1 (P8.8) Recall and use the equation to calculate the change in gravitational PE when an object is raised above the ground: change in gravitational potential energy (joule, J) = mass (kilogram, kg) × gravitational field strength (newton per kilogram, N/kg) × change in vertical height (metre, m) $\Delta GPE = m \times g \times \Delta h$	Make calculations using ratios and proportional reasoning to convert units and to compute rates Make calculations using ratios and proportional reasoning to convert units and to compute rates Calculate relevant values of stored energy and energy transfers; convert between newton-metres and joules	sound, heating, light, electrical. Energy transfer diagrams to show how energy can be transferred. E.g. in a simple circuit, Newtons cradle. Use of Sankey diagrams to show energy transfers. Including the identification of useful and wasted energy. Refer back to conservation of energy. Non-renewable sources - Non-renewable defined as resources that are being used quicker than being replaced. - Non-renewable resources will run out. - coal, oil, gas – are fossil fuels. - Fossil fuels store chemical energy and are burnt to release energy. - - Nuclear energy - Radioactive elements as a store of nuclear energy. Release of energy as unstable nuclei break down.	

	P3.2 (P8.9) Recall and use the equation to calculate the amounts of energy associated with a moving object: kinetic energy (joule, J) = 0.5 × mass (kilogram, kg) × $(speed)^2$ $((metre/second)^2, (m/s)^2)$ KE = × m× v^2 P3.13 Describe the main energy sources available for use on Earth (including fossil fuels, nuclear fuel, bio-fuel, wind, hydroelectricity, the tides and the Sun), and compare the ways in which both renewable and non-renewable sources are used	Make calculations of the energy changes associated with changes in a system, recalling or selecting the relevant equations for mechanical, electrical, and thermal processes; thereby express in quantitative form and on a common scale the overall redistribution of energy in the system Use a scatter diagram to identify a correlation between two variables Construct and interpret frequency tables and diagrams, bar charts and histograms	Renewable energy sources - Alternative to non-renewable resources. - Renewable resources will not run out. - Examples to include: solar, wind, hydroelectric, tidal, wave, geothermal. General advantages and disadvantages of non-renewable energy Disadvantages - All will run out - Burning fossil fuels releases carbon dioxide (a greenhouse gas) which contributes to climate change - Nuclear power stations produce radioactive waste and are expensive to decommission. Advantages - Stores a lot of energy - At the moment they are widely available. General advantages and disadvantages of renewable energy Disadvantages - Some are not always available e.g. solar, wind, wave power	

	P3.14 Explain patterns and trends in the use of energy resources		- Damaging to habitats e.g. tidal - Ruins landscapes e.g. wind turbines. Advantages - No release of greenhouse gases once set up. - Will not run out Recap methods of heat transfer from Y7 (conduction, convection, radiation). - Conduction as heat transfer through solid conductors, due to particles vibrating and passing on the vibrations. - Convection as heat transfer through fluids. As particles gain kinetic energy, they become less dense and rise. As they cool they become more dense and sink – convection current. - Radiation as a wave emitted by objects storing thermal energy. Radiation can travel through a vacuum. Insulation as an energy saving measure.	

			- Thermal insulator as a material which does not easily allow heat to transfer through e.g. air, plastic, wood, foam. Discussion around how vacuum flasks reduce heat energy transfer The effect of home insulation on saving energy and money. How a vacuum flask reduces conduction, convection and radiation Testing insulation practical – investigation into how good different insulating materials are. **Year 9** Recap energy stores and transfers from Y7+8 Recap of Y7 knowledge on energy stores and transfers. - Energy is measured in joules (J) - Energy can cannot be created or destroyed. Only stored and transferred - Energy stores include: Chemical, kinetic, Thermal/heat, Gravitational potential, Elastic potential, Nuclear.	

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			- Energy transfers include: Mechanical, sound, heating, light, electrical. Calculating energy efficiency - useful output / total output x 100 - Payback time of energy saving appliances as the time required to recoup the funds from the original investment	
CP4 Waves *Year 10* *Paper 5 (1)*	P4.1 Recall that waves transfer energy and information without transferring matter. P4.2 Describe evidence that with water and sound waves it is the wave and not the water or air itself that travels. P4.3 Define and use the terms frequency and wavelength as applied to waves. P4.4 Use the terms amplitude, period, wave velocity and wavefront as applied to waves.	Make calculations using ratios and proportional	**Year 7** Wave definitions to include speed Definition of a wave as an energy transfer with no net transfer of matter Comparison of longitudinal and transverse Drawn & labelled waves with key words Modelling with slinky Ripple tank Interpretations of different wave situations e.g. the sea, earthquake simulator Sound definitions including frequency, pitch and volume –	Amplitude - from latin, state or quality of being ample Electromagnetic Waves - meaning "electrical, electricity," and move back and forth," Old English wafian "to wave, fluctuate" Frequency - "fact of occurring often;" from Latin frequentia Hertz (Hz) - named in reference to German physicist Heinrich Hertz Longitudinal wave- Medium- Period - medieval Latin periodus "recurring portion, cycle” Seismic Waves - from Greek seismos "a shaking, shock; an earthquake” Transverse Wave - from Latin transversus turned or directed across

	P4.5 Describe the difference between longitudinal and transverse waves by referring to sound, electromagnetic, seismic and water waves. P4.6 Recall and use both the equations below for all waves: wave speed (metre/second, m/s) = frequency (hertz, Hz) × wavelength (metre, m) v = f ×λ wave speed (metre/second, m/s) = distance (metre, m) ÷ time (second, s) v=x/t P4.7 Describe how to measure the velocity of sound in air and ripples on water surfaces. P4.17 Core Practical: Investigate the suitability of equipment to measure the speed, frequency and wavelength of a wave in a solid and a fluid **P4.10 (Higher Tier Only) Explain how waves will be refracted at a boundary in terms of the change of direction and speed.**	reasoning to convert units and to compute rates. Apply formulae relating velocity, frequency and wavelength. Use a scatter diagram to identify a correlation between two variables Use a scatter diagram to identify a correlation between two variables	linked to wave definitions to previous lessons Linking back to how longitudinal waves travel Sound in solids, liquids and gases Speed of sound in air 343 m/s Sound circus so pupils compare the frequency and amplitude of sound produced by various objects Practicing the use of key words and definitions Air cannon Application of sound travelling quicker in solids Measuring the speed of sound **Year 8** Re-cap of Y7 key components: Wave diagrams showing - Amplitude - Wavelength - Crest - Trough Wave defined as the transfer of matter without the transfer of matter. Comparison of Transverse and longitudinal waves. - Transverse wave as particles moving at a right angle to the direction of the wave	Velocity – from Latin velocitatem meaning "swiftness, speed," Wave - old English wafian "to wave, fluctuate" (move back and forth) Wavelength Interface Refraction - late Latin refractionem "a breaking up," Absorb - latin absorbere "to swallow up, devour" Transmit – from Latin transmittere "send across, cause to go across" Amplify - early 15c., "to enlarge, expand, increase," from Old French amplifier (15c.) Cochlea - from Latin cochlea "snail shell," Ear canal- Ear drum- Impulse - from Latin impulsus "a push against, pressure, shock Neurone- Ultrasound - From ultra- meaning "beyond" Sonar- Ultrasound scan- Infrasound – from Latin infra "below, under, beneath" P wave- S wave- Seismic wave- Seismometer- Shadow zone-

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	4.11 (Higher Tier only) Recall that different substances may absorb, transmit, refract or reflect waves in ways that vary with wavelength. **Separate Sciences Only** P4.8 Calculate depth or distance from time and wave velocity P4.9 Describe the effects of a reflection b refraction c transmission d absorption of waves at material interfaces P4.16 Describe how changes, if any, in velocity, frequency and wavelength, in the transmission of sound waves from one medium to another are inter-related P4.12 Describe the processes which convert wave disturbances	Apply formulae relating velocity, frequency and wavelength. Show how changes, if any, in velocity, frequency and wavelength, in transmission of sound waves from one medium to another, are inter-related. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Apply formulae relating velocity,	e.g. light and other EM waves. - Longitudinal wave as particles moving parallel to the direction of the wave e.g. sound and shock (seismic) waves. Superposition as when two waves meet they can affect one another (interference) Constructive interference as when two waves coincide with peaks and troughs matching they are said to be in phase. - If two waves are in phase they add together and reinforce each other. They produce a much higher wave, a wave with a greater amplitude. Destructive interference as when two waves coincide with peaks of one meeting troughs of the other they are said to be out of phase. - If two waves are exactly out of phase they will interfere destructively to produce zero amplitude. Recap of frequency - Frequency as the number of waves per second	

	between sound waves and vibrations in solids, and a explain why such processes only work over a limited frequency range b use this to explain the way the human ear works P4.13 Recall that sound with frequencies greater than 20 000 hertz, Hz, is known as ultrasound. P4.14 Recall that sound with frequencies less than 20 hertz, Hz, is known as infrasound P4.15 Explain uses of ultrasound and infrasound, including a sonar b foetal scanning c exploration of the Earth's core	frequency and wavelength. Show how changes, if any, in velocity, frequency and wavelength, in transmission of sound waves from one medium to another, are inter-related Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects	- Frequency is measured in Hertz (Hz) Wave speed can be calculated by Wave speed = frequency x wavelength Use of v = f x λ Waves travel at different speeds through different media. Use of ripple tank to measure wavelength and frequency. Ruben's tube – measuring speed of sound in methane (optional). - Sound waves are produced by vibrating particles e.g. vocal cords, guitar strings, tuning forks - An increasing amplitude of sound waves increases the sound intensity (volume) - An increasing wavelength decreases the pitch of the sound - Link between frequency and wavelength. Shorter the wavelength the higher the frequency. Human hearing range is between 20-20,000 Hz Structure of ear: - Ear canal – sound waves travel towards the ear and through the ear canal	

			- Ear drum – As a thin membrane. Sound waves cause the ear drum to vibrate. - Small bones – 3 small bones. The vibrating ear drum causes these bones to vibrate. - Cochlea – converts vibrations into electrical signals (impulses). The bones vibrating cause the liquid in the cochlea to vibrate. - - Auditory nerve – sends the electrical signals to the brain. Sound level is measured in decibels (dB) Ear damage can cause hearing loss, possible causes including: - The ear canal can get blocked by wax. - Accidents or a loud bang could damage the eardrum. - The middle ear can get infected (by bacteria). - As people get older the tiny bones in their ears can fuse together and so don't vibrate.	

			- Sometimes the nerve cells in the cochlea do not work as well when you get older so the signals are not sent to the brain. - The cochlea can be damaged by loud noise, for example from nightclubs or wearing personal stereos that are too loud. Sound insulation; materials used, absorption of sound waves. Noise pollution discuss examples (construction, machinery, loud music etc)and effects. Use of online hearing test. Use of sound insulation in recording studios etc. Decibel meter to monitor noise in class/around school. Investigating the best sound insulator. Noise cancelling headphones; relate to destructive interference. Ultrasound - Frequencies of sound above 20,000Hz - We cannot hear ultrasound - Uses of ultrasound including: Antenatal	

			scanning, sonar, detecting cracks in structures. Infrasound - Frequencies of sound below 20Hz. - We cannot hear infrasound. - Uses of infrasound including animal communication (elephants, giraffes, hippos), investigating the structure of the Earth. **Year 9** Recap knowledge from Y7+8: - Waves transfer energy without the overall transfer of matter. - Transverse waves as particles moving at a right angle to the direction of the wave - Longitudinal waves as particles moving parallel to the direction of the wave. - Labelling a wave diagram: amplitude, wavelength, frequency, period.	

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			Wave speed can be calculated in two ways. - Wave speed (m/s) = distance (m) / time (s) Wave speed (m/s) = frequency (Hz) x wavelength (m) Earthquakes produce shockwaves called seismic waves. - These waves can be detected using seismographs. - Seismographs as a piece of equipment that pick up the vibrations from the ground. There are two types of seismic waves. Primary (P) and Secondary (S) waves. - P waves travel faster so arrive first. - P waves can travel through the Earth - S waves are slower so arrive second. S waves travel along the surface of the Earth.	
CP5 Light and the Electromagnetic Spectrum	P5.7 Recall that all electromagnetic waves are transverse, that they travel at the same speed in a vacuum.		**Year 7** Luminous and non-luminous objects	Refraction (from Late Latin *refractionem* (nominative *refractio*) "a breaking up,")

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Year 10 Paper 5 (1)	P5.8 Explain, with examples, that all electromagnetic waves transfer energy from source to observer P5.12 Recall that our eyes can only detect a limited range of frequencies of electromagnetic radiation P5.14 (Higher Tier only) Explain the effects of differences in the velocities of electromagnetic waves in different substances P5.9 Core Practical: Investigate refraction in rectangular glass blocks in terms of the interaction of electromagnetic waves with matter. P5.10 Recall the main groupings of the continuous electromagnetic spectrum including (in order) radio waves, microwaves, infrared, visible (including the colours of the visible spectrum), ultraviolet, x-rays and gamma rays. P5.11 Describe the electromagnetic spectrum as continuous from radio waves to gamma rays and that the	Make calculations using ratios and proportional reasoning to convert units and to compute rates. Apply the relationships between frequency and wavelength across the electromagnetic spectrum. Construct two-dimensional ray diagrams to illustrate reflection and refraction (qualitative – equations not needed) Make calculations using ratios and proportional reasoning to convert	Light travelling in rays Reflection and scattering from surfaces Shadow formation Opaque, translucent and transparent definitions Construction of ray diagrams Understanding of light through time **Year 8** Re-cap of Y7 key components: - luminous objects produce their own light - non-luminous objects do not produce their own light - light travelling in rays in straight lines - shadows are the absence of light, due to light not bending around opaque objects. - Transparent objects allow light to pass through - Translucent objects allow some light to pass through but scatter the rays	Reflection (Latin *reflectere* "to bend back, bend backwards, turn away," from *re-* "back") Incidence (Late Latin *incidentia*, from *incidere* "to happen, befall") Absorb (from Latin *absorbere* "to swallow up, devour) Filter (early 15c., "piece of felt through which liquid is strained,") Luminous (from Latin *luminosus* "shining, full of light, conspicuous,") Transmit (from Latin *transmittere* "send across, cause to go across, transfer, pass on,") Converging (from Late Latin *convergere* "to incline together" from assimilated form of *com* "with, together") Diverging (from Modern Latin *divergere* "go in different directions," from assimilated form of *dis-* "apart") Focal ("of or pertaining to a focus," 1690s, from Modern Latin *focalis)* Electromagnetic (*electr-*, word-forming element meaning "electrical, electricity," from Old French *magnete* "magnetite, magnet, lodestone,") Frequency (from Latin *frequentia* "an assembling in great numbers, a crowding; crowd, multitude, throng,") Transverse (from Latin *transversus* "turned or directed across,"

	radiations within it can be grouped in order of decreasing wavelength and increasing frequency. **P5.13 (Higher Tier only) Recall that different substances may absorb, transmit, refract or reflect electromagnetic waves in ways that vary with wavelength.** **P5.14 (Higher Tier only) Explain the effects of differences in the velocities of electromagnetic waves in different substances.** P5.22 Describe some uses of electromagnetic radiation a radio waves: including broadcasting, communications and satellite transmissions b microwaves: including cooking, communications and satellite transmissions c infrared: including cooking, thermal imaging, short range communications, optical fibres, television remote controls and security systems d visible light: including vision, photography and illumination	units and to compute rates Apply the relationships between frequency and wavelength across the electromagnetic spectrum Make calculations using ratios and proportional reasoning to convert units and to compute rates Apply the relationships between frequency and wavelength across the electromagnetic spectrum	- Opaque objects do not allow light to pass through Reflection. - Light reflects evenly off smooth surfaces e.g. mirrors. - Construction of ray diagrams to represent reflection including the incident ray, reflected ray, angle of incidence, angle of reflection, normal line. - Law of reflection: angle of incidence = angle of reflection. Refraction - The changing of a light ray's direction as it passes through different substances. Refraction is due to light changing speed in different materials. - Construction of ray diagrams to show refraction of light through a glass block including: Incident ray, refracted ray, angle of incidence, angle of	Ultraviolet ("beyond the violet end of the visible spectrum,") Vacuum (from Latin *vacuum* "an empty space, vacant place, a void,") Microwaves (micro word-forming element meaning "small in size or extent, microscopic; magnifying;" Old English *wagian* "to move to and fro,") Radiowaves (Latin *radius* "beam" Old English *wagian* "to move to and fro,") Oscillations (*oscillare* "to swing,") Fluorescence (property of glowing in ultraviolet light,) Mutation (*mutacioun*, "action or process of changing,") Critical angle Incident ray Interface Total internal reflection Diffuse reflection Specular reflection Visible spectrum White light Real image Virtual image

	e ultraviolet: including security marking, fluorescent lamps, detecting forged bank notes and disinfecting water f x-rays: including observing the internal structure of objects, airport security scanners and medical x-rays g gamma rays: including sterilising food and medical equipment, and the detection of cancer and its treatment P5.23 Recall that radio waves can be produced by, or can themselves induce, oscillations in electrical circuits P5.20 Recall that the potential danger associated with an electromagnetic wave increases with increasing frequency. P5.21 Describe the harmful effects on people of excessive exposure to electromagnetic radiation, including: a microwaves: internal heating of body cells	Use angular measures in degrees	refraction, interface, normal. - When light enters a more dense material (e.g. air to glass) it bends towards the normal - When light enters a less dense material it bends away from the normal. Lenses - Identification of converging lenses (thicker in the centre than at the ends) - Identification of diverging lenses (thicker at edges than in the centre) - Focal point as where the rays of light converge (come together) or where they appear to come from - Focal length as the distance between the focal point and the centre of the lens - Converging lenses bend the light rays towards each other	

	b infrared: skin burns c ultraviolet: damage to surface cells and eyes, leading to skin cancer and eye conditions d x-rays and gamma rays: mutation or damage to cells in the body P5.24 Recall that changes in atoms and nuclei can a generate radiations over a wide frequency range b be caused by absorption of a range of radiations **Separate Sciences only** P5.1 Explain, with the aid of ray diagrams, reflection, refraction and total internal reflection (TIR), including the law of reflection and critical angle. P5.2 Explain the difference between specular and diffuse reflection P5.3 Explain how colour of light is related to a differential absorption at surfaces b transmission of light through filters	Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Calculate areas of triangles and rectangles, surface areas and volumes of cubes.	- Diverging lenses spread the light rays away from one another. Pinhole cameras - Pinhole cameras bend light onto a screen. - Comparison of the lens in the eye bending light onto the retina Use of ray boxes and mirrors to demonstrate the law of reflection. Ray boxes and glass blocks to demonstrate refraction. Measuring the angle of incidence and angle of refraction. Ray boxes to demonstrate concave (diverging) and convex (converging) lenses. Measuring of focal point. Build and use pinhole cameras to create an image on a screen. **Year 9** Recap refraction from Y8 - Refraction as the bending or changing of light when it enters a new medium. - This is because the light wave changes speed. White light can be split into its constituent colours by refracting through a prism.	

	P5.4 Relate the power of a lens to its focal length and shape. P5.5 Use ray diagrams to show the similarities and differences in the refraction of light by converging and diverging lenses. P5.6 Explain the effects of different types of lens in producing real and virtual images. P5.15 Explain that all bodies emit radiation, that the intensity and wavelength distribution of any emission depends on their temperature. P5.16 Explain that for a body to be at a constant temperature it needs to radiate the same average power that it absorbs. P5.17 Explain what happens to a body if the average power it radiates is less or more than the average power that it absorbs.	Understand the terms mean, mode and median. Use an appropriate number of significant figures. Construct and interpret frequency tables and diagrams, bar charts and histograms. Translate information between graphical and numeric form. Plot two variables from experimental or other data.	- Different frequencies of colours cause them to be refracted by different amounts (violet most, red least). - Order of colours in light: Red, orange, yellow, green, blue, indigo, violet (ROYGBIV) - - The colours have different wavelengths. Red has the longest wavelength, violet has the shortest. - Infrared cannot be seen but exists before red light Ultraviolet exists after violet. We can see colour because objects absorb and reflect the different frequencies of light e.g. a blue object appears blue because the object absorbs all the colours in white light and reflects blue. Herschell used a prism and thermometer to investigate infrared radiation. Ray boxes and prisms to split white light.	

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	P5.18 Explain how the temperature of the Earth is affected by factors controlling the balance between incoming radiation and radiation emitted. P5.19 Core Practical: Investigate how the nature of a surface affects the amount of thermal energy radiated or absorbed.		All electromagnetic waves transfer energy, are transverse and travel at 300,000,000m/s through a vacuum Waves of the electromagnetic spectrum; radio, microwaves, infrared, visible, ultraviolet, x-rays, gamma rays. The waves in the electromagnetic spectrum vary in frequency and wavelength. - Radio waves have the longest wavelength and lowest frequency. Gamma rays have the shortest wavelength and highest frequency. Uses of each of the different types of wave. - Radio: can be used in communication - Microwaves: Used to heat up food and used for communication between mobile phones - Infrared: Short distance communication e.g. remote controls. - Visible light: In photography - UV: Used to treat water. - X-ray: Medical imaging (to see bones) - Gamma: Cancer treatments and to	

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			sterilise medical equipment Dangers of the EM spectrum - UV, X-ray and gamma are ionising. - Prolonged exposure can cause DNA mutations which can lead to cancers.	
CP6 Radioactivity Year 10 Paper 5 (1)	P6.1 Describe an atom as a positively charged nucleus, consisting of protons and neutrons, surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with almost all of the mass in the nucleus. P6.2 Recall the typical size (order of magnitude) of atoms and small molecules. P6.17 Describe how and why the atomic model has changed over time including reference to the plum pudding model and Rutherford alpha particle scattering leading to the Bohr model P6.3 Describe the structure of nuclei of isotopes using the terms atomic (proton) number and mass	Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Recognise and use expressions in decimal form. Understand and use	**Year 7** (from Chem) Atomic structure description to include: • Nucleus • Protons • Electrons • Neutrons • Electron shells Table to show the mass, location and charge of each subatomic particle Definitions of: • Atomic mass • Atomic number • Electron configuration Elements are found in the periodic table. This is separated into metals and non-metals. It is organised by groups and periods. Elements **(made of 1 type of atom)** Defining this term and using the periodic table to give examples.	Alpha from Latin alpha, from Greek alpha, from Hebrew or Phoenician alephname for the Hebrew and Phoenician first letter Atom from Latin *atomus* (especially in Lucretius) "indivisible particle," from Greek *atomos* "uncut, unhewn; indivisible," Electron coined 1891 by Irish physicist George J. Stoney (1826-1911) from **electric** + *-on*, as in **ion** Element from Latin *elementum* "rudiment, first principle, matter in its most basic form" Kinetic 1841, from Greek *kinētikos* "moving, putting in motion," Nucleus from Latin nucleus "kernel," from nucula "little nut," Sub- of Latin origin meaning "under, beneath; behind; from under; resulting from further division," Isotope literally "having the same place," from Greek isos "equal" (see iso-) + topos "place" Mass late 14c., "irregular shaped lump; body of unshaped, coherent matter," from Old French masse "lump, heap, pile; crowd, large amount; ingot, bar"

	(nucleon) number and using symbols in the format using symbols in the format $^{13}_{6}C$ P6.4 Recall that the nucleus of each element has a characteristic positive charge, but that isotopes of an element differ in mass by having different numbers of neutrons. P6.5 Recall the relative masses and relative electric charges of protons, neutrons, electrons and positrons. P6.6 Recall that in an atom the number of protons equals the number of electrons and is therefore neutral P6.7 Recall that in each atom its electrons orbit the nucleus at different set distances from the nucleus. P6.8 Explain that electrons change orbit when there is absorption or emission of electromagnetic radiation.	the symbols: =, <>, >, ∝, ~ Use a scatter diagram to identify a correlation between two variables	**Year 8** (from Chem) Identify protons, neutrons, electrons their location, mass & charges Identify the location electron in an atom Electron arrangement 2.8.8 Draw electron arrangement for first 20 elements (Recall from Y7) Define atomic number as the number of protons Define atomic mass as the number of protons and neutrons. Number of protons = number of electrons Calculate number of protons neutrons and electrons. **Year 9** (from Chem) Recap from Yr7 Atomic structure – protons, neutrons, electrons (location, relative charge and relative mass) Electron arrangement 2.8.8 and being able to draw and write electronic configuration Naming of key groups in the periodic table	Neutron electrically neuter particle of the atom," 1921, coined by U.S. chemist William D. Harkins (1873-1951) from neutral (adj.) + -on Proton from noun use of Greek prōton, neuter of prōtos "first" Absorb "to drink in, suck up, take in by absorption," early 15c., from Old French absorbir, assorbir Electromagnetic "Pertaining to electromagnetics, or to the relation between electricity and magnetism; of the nature of electromagnetism," Configuration from Late Latin configurationem (nominative configuratio), noun of action from past-participle stem of Latin configurare "to fashion after a pattern," Emission early 15c., "something sent forth," from Old French émission (14c.) and directly from Latin emissionem (nominative emissio) "a sending out, a projecting, hurling, letting go, releasing," Spectrum from Latin spectrum (plural spectra) "an appearance, image, apparition, specter," from specere "to look at, view" Ion 1834, introduced by English physicist and chemist Michael Faraday, coined from Greek ion, neuter present participle of ienai "go,"

	P6.9 Explain how atoms may form positive ions by losing outer electrons. P6.12 Explain what is meant by background radiation. P6.13 Describe the origins of background radiation from Earth and space. P6.14 Describe methods for measuring and detecting radioactivity limited to photographic film and a Geiger–Müller tube. P6.10 Recall that alpha, β– (beta minus), β+ (positron), gamma rays and neutron radiation are emitted from unstable nuclei in a random process. P6.11 Recall that alpha, β– (beta minus), β+ (positron) and gamma rays are ionising radiations. P6.15 Recall that an alpha particle is equivalent to a helium nucleus, a	Make calculations using ratios and proportional reasoning to convert units and to compute rates Balance equations representing alpha-, beta- or gamma-radiations in terms of the masses and charges of the atoms involved	Recap from Yr8 • Calculating number of protons, neutrons and electrons from relative atomic mass and atomic number • Link between electrons in outer shell and group number • Link between number of electron shells and period number Introduce: • Origin of periodic table from Mendeleev linking to scientific collaboration Changes include more elements in the modern periodic table, no gaps in the modern table, now arranged by atomic number instead of atomic mass Idea that we cannot see the structure of the atom and therefore need to use models Evolution of the atomic model over time to include: • Dalton model – Solid sphere • Thomson model – Plum pudding • Modern understanding with nucleus and	Orbit from Old French orbite or directly from Medieval Latin orbita, a transferred use of Latin orbita "wheel track, beaten path, rut, course" Visible from Old French visable, visible "perceptible" (12c.) and directly from Latin visibilis "that may be seen," Radiation mid-15c., radiacion, "act or process of emitting light," from Latin radiationem Cosmic from Latinized form of Greek kosmikos "worldly, earthly, of the world," from kosmos "world-order, world" Dose from Medieval Latin dosis, from Greek dosis "a portion prescribed," literally "a giving," Beta second letter of the Greek alphabet Decay late 15c., "to decrease," also "to decline, deteriorate, lose strength or excellence," from Anglo-French decair Gamma third letter of the Greek alphabet, c. 1400, from Greek gamma, from Phoenician gimel, said to mean literally "camel" and to be so called for a fancied resemblance of its shape to some part of a camel. Penetrate from Latin penetratus, past participle of penetrare "to put or get into, enter into; cause to go into." Positron "anti-particle of the electron," 1933, coined from positive electron Random from an alteration of the Middle English noun randon, randoun "impetuosity; speed" Unstable early 13c., "apt to move," from un- (1) "not" + stable (adj.). Similar formation in Middle High German unstabel. Meaning "liable to fall"

	beta particle is an electron emitted from the nucleus and a gamma ray is electromagnetic radiation P6.16 Compare alpha, beta and gamma radiations in terms of their abilities to penetrate and ionise. P6.18 Describe the process of β– decay (a neutron becomes a proton plus an electron) P6.19 Describe the process of β+ decay (a proton becomes a neutron plus a positron) P6.20 Explain the effects on the atomic (proton) number and mass (nucleon) number of radioactive decays (α, β, γ and neutron emission) P6.21 Recall that nuclei that have undergone radioactive decay often undergo nuclear rearrangement with a loss of energy as gamma radiation. P6.22 Use given data to balance nuclear equations in terms of mass and charge	Balance equations representing alpha-, beta- or gamma-radiations in terms of the masses and charges of the atoms involved Use a scatter diagram to identify a correlation between two variables. Plot two variables from experimental or other data Make estimates of the results of simple calculations	electrons in orbits (Bohr model) • Definition of isotopes – atoms the same element with different number of neutrons **Calculating relative atomic mass (RAM).** Definition of ion – an atom that has a charge Formation of ions Draw diagrams to show the loss and gain of electrons to complete the outer shell. Examples to include sodium, chlorine, magnesium, oxygen. Timeline of evidence for these models especially Rutherford – gold leaf experiment: conclusions – - All positive charge, all mass, in dense volume in centre Prediction of charge depending on group number Ionising radiation: Ionising radiation as the emission of high energy subatomic particles or waves which have the ability to ionise atoms (by removing electrons) Background radiation	Activity from Latin activus "active" (see active). The meaning "state of being active, briskness, liveliness" Becquerel Irradiate from Latin irradiatus, past participle of irradiare "shine forth, beam upon, illumine," Sterilise from Old French stérile "not producing fruit" and directly from Latin sterilis "barren, unproductive, unfruitful; unrequited; unprofitable." Tracer from Old French trace "mark, imprint, tracks" Contaminate from Latin contaminatus, past participle of contaminare "to defile, to corrupt, to deteriorate by mingling," originally "to bring into contact," Mutation from Old French mutacion (13c.), and directly from Latin mutationem "a changing, alteration, a turn for the worse," External from Latin externus "outside, outward" Radio word-forming element meaning 1. "ray, ray-like" (see radius) from Latin radius "staff, stake, rod; spoke of a wheel; ray of light, beam of light; radius of a circle," Therapy from Modern Latin therapia, from Greek therapeia "curing, healing, service done to the sick; a waiting on, service," Internal from Medieval Latin internalis, from Latin internus "within, inward, internal,"

	P6.23 Describe how the activity of a radioactive source decreases over a period of time P6.24 Recall that the unit of activity of a radioactive isotope is the Becquerel, Bq. P6.25 Explain that the half-life of a radioactive isotope is the time taken for half the undecayed nuclei to decay or the activity of a source to decay by half. P6.26 Explain that it cannot be predicted when a particular nucleus will decay but half-life enables the activity of a very large number of nuclei to be predicted during the decay process P6.27 Use the concept of half-life to carry out simple calculations on the decay of a radioactive isotope, including graphical representations	Calculate the net decline, expressed as a ratio, in a radioactive emission after a given number of half-lives Substitute numerical values into algebraic equations using appropriate units for physical quantities. Solve simple algebraic equations. Visualise and represent 2D and 3D forms, including two dimensional	- Background radiation as the radiation we are exposed to all the time at a safe level. - The majority of background radiation comes from radon gas. - Other sources include medical facilities, ground/rocks, buildings, cosmic rays, food and drink. Radioactivity is measured with a Geiger-muller tube. Radioactive decay is measured in Becquerels (Bq). 1 Bq = 1 decay per second. Properties of alpha, beta and gamma. - Alpha: Made up of 2 protons and 2 neutrons. Mass of 4. Charge of 2+. - Beta negative: High energy electron. Mass of 1/1835 (negligible). Charge of -. - Beta positive: High energy positron. Mass of 1/1835 (negligible). Charge of +. - Gamma: High energy electromagnetic wave. Mass of 0. Charge of 0. Uses of radioactivity - Alpha – smoke detector	Tumour early 15c., from Latin tumor "swelling, condition of being swollen, a tumor," from tumere "to swell" (from PIE root *teue- "to swell"). Climate from Old French climat "region, part of the earth," from Latin clima (genitive climatis) "region; slope of the earth," Fossil from Latin fossilis "dug up," from fossus, past participle of fodere "to dig," Renewable late 14c., reneuen, "make (something) like new, refurbish; begin (an activity) again; replenish, replace with a fresh supply; Fission from Latin *fissionem* (nominative *fissio*) "a breaking up, cleaving," from past participle stem of *findere* "to split" Fusion from French fusion or directly from Latin fusionem (nominative fusio) "an outpouring, effusion," noun of action from fusus, past participle of fundere "to pour, melt" Reaction from re- "back, again, anew" + action (q.v.). Modeled on French réaction, older Italian reattione, from Medieval Latin reactionem (nominative reactio), a noun of action formed in Late Latin from the past-participle stem of Latin reagere "react," from re- "back" + agere "to do, perform." Chain from Old French *chaeine* "chain" (12c., Modern French *chane*), from Latin *catena* "chain" Control from Anglo-French *contreroller* "exert authority," from Medieval Latin *contrarotulus* "a counter, register,"

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	Separate Sciences only P6.28 Describe uses of radioactivity, including: a household fire (smoke) alarms b irradiating food c sterilisation of equipment d tracing and gauging thicknesses e diagnosis and treatment of cancer P6.30 Explain how the dangers of ionising radiation depend on half-life and relate this to the precautions need P6.33 Compare and contrast the treatment of tumours using radiation applied internally or externally P6.34 Explain some of the uses of radioactive substances in diagnosis of medical conditions, including PET scanners and tracers P6.35 Explain why isotopes used in PET scanners have to be produced nearby P6.36 Evaluate the advantages and disadvantages of nuclear power for	representations of 3D objects Balance equations representing nuclear fission events in terms of the atomic and mass numbers of the nuclei involved Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects	- Beta – checking paper thickness - Gamma – Radiotherapy. Dangers of Ionising Radiation - All ionising radiation can cause mutation in DNA which can lead to cancers. Safety - Limit/monitor exposure - Use tongs - Do not directly point sources at peoples - Protective clothing.	Core probably from Old French cor, coeur "core of fruit, heart of lettuce," literally "heart," from Latin cor "heart," Daughter from Old English dohtor "female child considered with reference to her parents," from Proto-Germanic *dokhter Fuel from Old French foaille "fuel for heating," Moderator from Latin moderatus "within bounds, observing moderation;" figuratively "modest, restrained," past participle of moderari "to regulate, mitigate, restrain, temper, set a measure, keep (something) within measure," Electro- Latinized form of Greek ēlektro-, combining form of ēlektron "amber" Static from Modern Latin statica, from Greek statikos "causing to stand, skilled in weighing," Repulsion directly from Late Latin repulsionem (nominative repulsio) "a repelling," noun of action from past-participle stem of repellere "to drive back"

	generating electricity, including the lack of carbon dioxide emissions, risks, public perception, waste disposal and safety issues P6.37 Recall that nuclear reactions, including fission, fusion and radioactive decay, can be a source of energy P6.42 Recall that the products of nuclear fission are radioactive P6.38 Explain how the fission of U-235 produces two daughter nuclei and the emission of two or more neutrons, accompanied by a release of energy P6.39 Explain the principle of a controlled nuclear chain reaction P6.40 Explain how the chain reaction is controlled in a nuclear reactor, including the action of moderators and control rods P6.41 Describe how thermal (heat) energy from the chain reaction is used in the generation of electricity in a nuclear power station	Balance equations representing nuclear fission events in terms of the atomic and mass numbers of the nuclei involved		

	P6.43 Describe nuclear fusion as the creation of larger nuclei resulting in a loss of mass from smaller nuclei, accompanied by a release of energy, and recognise fusion as the energy source for stars P6.44 Explain the difference between nuclear fusion and nuclear fission P6.45 Explain why nuclear fusion does not happen at low temperatures and pressures, due to electrostatic repulsion of protons P6.46 Relate the conditions for fusion to the difficulty of making a practical and economic form of power station			
SP7 Astronomy Year 10 Paper 5 (1)	**Separate Sciences only** P7.2 Recall that our Solar System consists of the Sun (our star), eight planets and their natural satellites (such as our Moon); dwarf planets; asteroids and comets	Visualise and represent 2D and 3D forms, including two dimensional	**Year 7** Orbits of earth around the sun, the moon around earth Rotation and tilt of earth on its axis (23.4 degrees) Explanation of phases of the moon	Asteroid - From the Greek word "asteroeidēs," where "aster" means "star" and the suffix "-oeidēs" denotes "like" or "in the form of." Therefore, "asteroid" literally means "star-like" or "resembling a star."

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	P7.3 Recall the names and order, in terms of distance from the Sun, of the eight planets P7.4 Describe how ideas about the structure of the Solar System have changed over time P7.19 Describe how methods of observing the Universe have changed over time including why some telescopes are located outside the Earth's atmosphere P7.1 Explain how and why both the weight of any body and the value of g differ between the surface of the Earth and the surface of other bodies in space, including the Moon P7.5 Describe the orbits of moons, planets, comets and artificial satellites P7.6 Explain for circular orbits how the force of gravity can lead to changing velocity of a planet but unchanged speed	representations of 3D objects Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects	Tangible effects on earth e.g. tides Scale and organisation of space. Composition of Solar System- order of planets. Facts and conditions of each planet Pluto reclassified as dwarf planet How do we study other planets including satellites/ probes/rovers **Year 8** Gravitational field. Gravity as a force of attraction between masses. - Example of gravity keeping planets in orbit around the Sun. - Example of gravity keeping the moon in orbit around Earth Every object with mass has a gravitational pull The greater the mass of an object the greater the gravitational pull	Comet - From Latin "comēta," which means "long-haired," derived from the Greek "kometēs," meaning "long-haired." Dwarf Planet: - "Dwarf" comes from Old English "dweorh," meaning "dwarf." From Greek "planetes," meaning "wanderer." Elliptical - From Greek "elleiptikos," meaning "deficient in speech, ungrammatical," derived from "elleipein," meaning "to fall short." Geocentric: - From Greek "ge," meaning "earth," and "kentron," meaning "center." Heliocentric - From Greek "helios," meaning "sun," and "kentron," meaning "center." Moon - Old English "mōna," from Proto-Germanic "mēnô," and cognate with other Germanic languages. Natural Satellite - "Natural" comes from Latin "naturālis," and "satellite" from Latin "satelles," meaning "attendant." Orbit - From Latin "orbita," meaning "wheel track" or "rut." Planet: - From Greek "planetes," meaning "wanderer." Star - Old English "steorra," from Proto-Germanic "sternô," and related to Old High German "sterno." Telescope - From Greek "tele," meaning "far," and "skopein," meaning "to look" or "to see."

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	P7.7 Explain how, for a stable orbit, the radius must change if orbital speed changes (qualitative only) P7.16 Describe the evolution of stars of similar mass to the Sun through the following stages: a nebula b star (main sequence) c red giant d white dwarf P7.17 Explain how the balance between thermal expansion and gravity affects the life cycle of stars P7.18 Describe the evolution of stars with a mass larger than the Sun P7.11 Describe that if a wave source is moving relative to an observer there will be a change in the observed frequency and wavelength P7.12 Describe the red-shift in light received from galaxies at different distances away from the Earth	Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Use a scatter diagram to identify a correlation between two variables Use a scatter diagram to identify a correlation between two variables Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects	Strength of gravitational force on Earth = 10N/kg. Weight as a force caused by gravity. Measured in newtons with a Newton meter. Mass as the amount of 'matter' in an object. It is measured in kg, using scales. Calculating weight Weight = Mass x gravity Mass remains the same in different gravitational fields but weight changes because the gravitational pull changes. Calculation of weight with different values of g - Calculating own weight on different planets. Comparison of gravitational field strength on different planets Effect of forces/weight on roller coasters. G-force Investigating the mass and weight of different masses. Drawing a graph to describe the relationship between mass and weight. Our solar system consists of the Sun (our star), 8 planets, 5 dwarf plants, plus many other celestial bodies Dangers of exploring the solar system.	Artificial Satellite - "Artificial" comes from Latin "artificium," and "satellite" from Latin "satelles," meaning "attendant." Gravitational Field Strength - "Gravitation" from Latin "gravitas," meaning "weight," and "field" from Old English "feld," meaning "open land." Vector Quantity - "Vector" from Latin "vehere," meaning "to carry" or "to transport." Velocity - From Latin "velocitatem," derived from "velox," meaning "swift" or "quick. Weight - From Old English "gewiht," from Proto-Germanic "gewihtiz." Black Hole - The term was coined in 1967 by physicist John Archibald Wheeler. Electromagnetic Radiation - "Electromagnetic" combines "electric" and "magnetic." "Radiation" from Latin "radiare," meaning "to shine." Fusion Reaction - "Fusion" from Latin "fundere," meaning "to pour" or "to melt." Main Sequence Star - "Main" from Old English "mǣnan," meaning "to mean" or "to intend." Nebula - From Latin "nebula," meaning "mist" or "cloud." Neutron Star - "Neutron" from Latin "neutron," meaning "neutral." Protostar - "Proto-" from Greek "prōtos," meaning "first," and "star" as mentioned earlier. Red Giant - "Red" from Old English "rēad," and "giant" from Latin "gigas," meaning "giant." Red Supergiant -"Red" as before, and "supergiant" combining "super-" and "giant."

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	P7.13 Explain why the red-shift of galaxies provides evidence for the Universe expanding P7.8 Compare the Steady State and Big Bang theories P7.9 Describe evidence supporting the Big Bang theory, limited to red-shift and the cosmic microwave background (CMB) radiation P7.10 Recall that as there is more evidence supporting the Big Bang theory than the Steady State theory, it is the currently accepted model for the origin of the Universe P7.14 Explain how both the Big Bang and Steady State theories of the origin of the Universe both account for red-shift of galaxies P7.15 Explain how the discovery of the CMB radiation led to the Big Bang theory becoming the currently accepted model	Use a scatter diagram to identify a correlation between two variables Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects	- Vladimir Komarov 1967 Parachute failed upon re-entry - Soyuz 11 crew 1971 Cabin decompressed in space - Challenger crew 1986 – shuttle exploded How we explore space - International space station (ISS) - Probes/telescopes - Rovers e.g. Mars rover Arguments for exploring space could include: • Human beings are curious and like to explore. • To search for life on other worlds. • To inspire people. • • To develop new technologies that can benefit life here on Earth. • To ensure the long-term survival of the human race. • To find new resources. • By studying other planets, we can compare them to the	Supernova - "Super" as before, and "nova" from Latin "novus," meaning "new." White Dwarf - "White" from Old English "hwīt," and "dwarf" from Old English "dweorh." Meaning "very short human being, person much below ordinary stature, whether of proportionate parts or not". Doppler Effect - Named after Austrian physicist Christian Doppler, who first proposed it in 1842. Pitch - From Old English "pic," meaning "pitch" or "tar." Red-Shift - Describes the shift of light towards longer wavelengths. "Red" as before, and "shift" from Old English "sciftan." Universe - From Latin "universum," meaning "all things," derived from "universus," meaning "whole" or "all together." Big Bang Theory - Coined by British astronomer Fred Hoyle during a BBC radio broadcast in 1949. Cosmic Microwave Background (CMB) Radiation - "Cosmic" from Greek "kosmikos," and "microwave" from "micro-" and "wave." Steady State Theory - Named after its assertion of a steady and unchanging universe.

			Earth and learn more about our home planet. Arguments against exploring space could include: • Government money used for space travel should be spent to help people here on Earth instead. • Space exploration is too dangerous and too expensive. • There are lots of things we still don't know about our own planet. **Year 9** Use of space probes and telescopes to explore the universe. Life cycle of a star. Stars similar size to our sun - Starts as a nebula (huge cloud of dust and gas – mostly hydrogen) - The gravitational pull causes the nebula to form a protostar. - When the pressure from the hot gases balances gravity it forms a main sequence star which is stable (our Sun is in this stage)	

			- Eventually the star collapses the outer layer expands and forms a red giant. - Eventually the red giant throws off a shell of gas - This collapses to form a white dwarf. - It cools over a billion years to form a black dwarf. Stars much larger than our sun - Starts as a nebula (huge cloud of dust and gas – mostly hydrogen) - The gravitational pull causes the nebula to form a protostar. - When the pressure from the hot gases balances gravity it forms a massive main sequence star. - - Eventually the star collapses the outer layer expands and forms a red supergiant. - The Supergiant explodes in a supernova. - Gravity pulls the remnants from the supernova into a	

			neutron star or black hole. Light year as the distance light travels in one year. Big bang theory - Big bang – universe started from a single point - Red-shift as evidence for the big bang theory	
CP7 (SP8) Energy- Forces Doing Work. CP8 (SP9) Forces and their Effects Year 11 Paper 6 (2)	P8.1 Describe the changes involved in the way energy is stored when systems change P8.4 Identify the different ways that the energy of a system can be changed a through work done by forces b in electrical equipment c in heating P8.5 Describe how to measure the work done by a force and understand that energy transferred (joule, J) is equal to work done (joule, J) P8.6 Recall and use the equation: work done (joule, J) = force (newton, N) × distance moved in the direction of the force (metre, m)	Make calculations using ratios and proportional reasoning to convert units and to compute rates Make calculations of the energy changes associated with	**Year 7** Basic force definition Defining types of force as push or pull Free body diagrams Interaction between different forces Balanced and unbalanced Equilibrium Resultant forces Calculating resultants Linking to motion How would these force interactions affect the motion of the object? Bar magnet Describe magnetic field including NS poles Permanent and temporary magnets	Energy – (from Greek *energeia* "activity, action, operation,") Power - (*pouer*, "ability; ability to act or do; strength, vigor, might,") Watts- named after James Watt, developer of steam engine Work done- proto-Germanic "werka"- to do action–reaction forces contact forces – force: c. 1300, "physical strength," electric field/ electrostatic field force field friction - 1560s, "a chafing, rubbing," gravitational field magnet - Old French *magnete* "magnetite, *magnet*, lodestone," Figurative sense of "something which attracts" is from 1650s. magnetic field magnetic material

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	E = F × d P8.7 Describe and calculate the changes in energy involved when a system is changed by work done by forces P8.12 Define power as the rate at which energy is transferred and use examples to explain this definition P8.13 Recall and use the equation: power (watt, W) = work done (joule, J) ÷ time taken (second, s) P=E/t P8.14 Recall that one watt is equal to one joule per second, J/s P9.1 Describe, with examples, how objects can interact: a at a distance without contact, linking these to the gravitational, electrostatic and magnetic fields involved b by contact, including normal contact force and friction c producing pairs of forces which can be represented as vectors	changes in a system, recalling or selecting the relevant equations for mechanical, electrical, and thermal processes; thereby express in quantitative form and on a common scale the overall redistribution of energy in the system Calculate relevant values of stored energy and energy transfers; convert between newton-metres and joules	**Year 8** Re-cap of Y7 key components: Force as a push or pull which can change the speed, size or direction of an object Forces are measured in Newtons with a Newton meter Forces can be either contact or non-contact Types of forces including - Air resistance - Water resistance - Upthrust - Friction - Static electricity - Magnetism Forces can change the motion of objects. Free body diagrams used to represent forces. - Arrows represent the size and direction of the force. Resultant forces - Opposing forces are subtracted Forces acting in the same direction are added together Gravitational field. Gravity as a force of attraction between masses.	magnetism magnitude non-contact force normal contact force scalar quantity - 1650s, "resembling a ladder," from Latin scalaris "of or pertaining to a ladder," static electricity - Modern Latin statica, from Greek statikos "causing to stand, skilled in weighing," upthrust vector - from Latin vector "one who carries or conveys, carrier" Component (*componere* "to put together, to collect a whole from several parts,") Resolving (Latin *resolvere* "to loosen, loose, unyoke, undo; explain; relax; set free; make void, dispel.") Resultant (in mathematics, "the total or sum, the sum of an addition or product of a multiplication,") Gears (*gøra*, *gørva* "to make, construct, build; set in order, prepare,") Equilibrium (from Latin *aequilibrium* "an even balance; a horizontal position,") Lever (Old French *levier* (12c.) "a lifter, a *lever*, crowbar," agent noun from *lever* "to raise")

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	P9.2 Explain the difference between vector and scalar quantities using examples **P9.3 (Higher Tier only) Use vector diagrams to illustrate resolution of forces, a net force, and equilibrium situations (scale drawings only)** **P9.4 (Higher Tier only) Draw and use free body force diagrams** **P9.5 (Higher Tier only) Explain examples of the forces acting on an isolated solid object or a system where several forces lead to a resultant force on an object and the special case of balanced forces when the resultant force is zero** **Separate Sciences only** P9.6 Describe situations where forces can cause rotation P9.7 Recall and use the equation: moment of a force (newton metre, N m) = force (newton, N) × distance	Make calculations using ratios and proportional reasoning to convert units and to compute rates Substitute numerical values into algebraic equations using appropriate units for physical quantities. Solve simple algebraic equations. Visualise and represent 2D and 3D	- Example of gravity keeping planets in orbit around the Sun. - Example of gravity keeping the moon in orbit around Earth Every object with mass has a gravitational pull The greater the mass of an object the greater the gravitational pull Insulators like plastic can gain a charge. Electrical charges can be positive or negative Static electricity is caused by the movement of electrical charge (electrons), when two insulators are rubbed together. Attraction and repulsion of charges; - opposite charges attract like charges repel. Recap from year 7 - Magnetism is force produced by magnets. - Magnetic materials are iron, nickel and cobalt. - A magnetic field is the area around a magnet where it can affect magnetic materials. Permanent magnets always have a magnetic field around them.	Moment (directly from Latin *momentum* "movement, motion; moving power; alteration, change;") Normal (in geometry, "standing at a right angle, perpendicular,") Free body diagram Net force Newton metre

	normal to the direction of the force (metre, m) P9.8 Recall and use the principle of moments in situations where rotational forces are in equilibrium: the sum of clockwise moments = the sum of anti-clockwise moments for rotational forces in equilibrium P9.9 Explain how levers and gears transmit the rotational effects of forces	forms, including two dimensional representations of 3D objects	**Year 9** Vectors as quantities that require a magnitude and direction. Examples to include: - Displacement - Velocity - Acceleration - Force - Weight - Momentum Displacement as the distance travelled in a straight line. Speed as how fast an object is travelling Velocity is the speed in a given direction. Recap ideas on static from Y8. - Static electricity is caused by the movement of electrical charge (electrons), when two insulators are rubbed together. - Attraction and repulsion of charges; opposite charges attract, like charges repel. Uses of static electricity e.g. - car spraying: paint particles given a charge	

			to make the paint spread out evenly and attract to the car. - crop spraying: insecticide particles given a charge to make the spray spread out evenly and attract to the crop. - photocopier: oppositely charged copying plate and toner used to make the ink 'stick' to the paper. Dangers of static electricity e.g. - refuelling - lightening - All dangerous due to the build up of charge on objects causing electric shock/ignition of combustible materials.	
CP9 (SP10) Electricity and Circuits **SP11 Static Electricity** Year 11	P10.1 Describe the structure of the atom, limited to the position, mass and charge of protons, neutrons and electrons P10.2 Draw and use electric circuit diagrams representing them with the conventions of positive and negative terminals, and the symbols that represent cells,	Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Visualise and represent 2D and 3D forms, including two	**Year 7** Simple circuit components and energy transfers involved e.g. buzzer, bulb Concept of complete circuits Circuit diagrams Construction of simple circuit Observation of above Circuit repairs	Atom - from Greek *atomos* "uncut, unhewn; indivisible Battery – from Middle English, *bateri* meaning "forged metal ware Component - from Latin *componentem* "to put together, to collect a whole from several parts" Circuit - from Latin *circuitus* "a going around" Electron – Electro: from Greek *ēlektron* "amber"; from Greek *ion*, "to go"

Paper 6 (2)	including batteries, switches, voltmeters, ammeters, resistors, variable resistors, lamps, motors, diodes, thermistors, LDRs and LEDs P10.3 Describe the differences between series and parallel circuits P10.4 Recall that a voltmeter is connected in parallel with a component to measure the potential difference (voltage), in volt, across it P10.7 Recall that an ammeter is connected in series with a component to measure the current, in amp, in the component P10.10 Describe that when a closed circuit includes a source of potential difference there will be a current in the circuit P10.11 Recall that current is conserved at a junction in a circuit P10.5 Explain that potential difference (voltage) is the energy	dimensional representations of 3D objects Make calculations of the energy changes associated with changes in a system, recalling or selecting the relevant equations for mechanical, electrical, and thermal processes; thereby	Representing concepts as diagrams Electrocution Role of fuse and earth wire Cost of unit (kWh) Human electrical conduction demonstration Rebuilding a plug PAT testing CC: Danger of cheap imported chargers. Link to school fire incident **Year 8** Insulators like plastic can gain a charge. Electrical charges can be positive or negative Static electricity is caused by the movement of electrical charge (electrons), when two insulators are rubbed together. Attraction and repulsion of charges; - opposite charges attract - like charges repel. Recap simple circuits from Y7 - circuit symbols	Neutron - from Latin *neutralis* "neither the one nor the other, neither of two" Nucleus - from Latin *nucleus* "kernel" Parallel – from Latin *para-* "beside + *allēlois* "each other," Proton - from Greek *prōtos* "first" Series - from Latin *serere* "to join" Shell (electron shell) - Voltage – Volt: root word + age: from Late Latin -*aticum* "belonging to, related to," Ampere - named for French physicist André-Marie *Ampère* Amp - an abbreviation of **ampere** Ammeter - Am: named for French physicist André-Marie *Ampère* + meter: from Greek *metron* "a measure," Cell - from Proto-Indo-European "to cover, conceal, save." Conserved - from Latin *conservare* "to keep, preserve, keep intact, guard" Potential difference - from Latin *potentia* "power, might, force" + from Latin *dis-* "apart, away from" + *ferre* "to bear, carry," Voltmeter – root word + meter: from Greek *metron* "a measure," Volt – root word Charge - from Late Latin *carricare* "to load" Coulomb - named for French chemist Charles-Augustin de *Coulomb*

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	transferred per unit charge passed and hence that the volt is a joule per coulomb P10.6 Recall and use the equation: energy transferred (joule, J) = charge moved (coulomb, C) × potential difference (volt, V) E = Q x V P10.8 Explain that an electric current as the rate of flow of charge and the current in metals is a flow of electrons P10.9 Recall and use the equation: charge (coulomb, C) = current (ampere, A) × time (second, s) Q = I x t P10.12 Explain how changing the resistance in a circuit changes the current and how this can be achieved using a variable resistor P10.13 Recall and use the equation: potential difference (volt, V) = current (ampere, A) × resistance (ohm, Ω) V = I x R	express in quantitative form and on a common scale the overall redistribution of energy in the system Make calculations using ratios and proportional reasoning to convert units and to compute rates Make calculations using ratios and proportional reasoning to convert units and to compute rates	- A circuit is a loop of wire that electricity flows around Difference between series and parallel circuits. - Series circuits only have one path for electricity to flow - Parallel circuits have more than one path for electricity to flow. Current - Current as a flow of charge (electrons) around a circuit. - Current is measured in amps with an ammeter. - Current is conserved/stays the same around a series circuit - Current splits at a junction in parallel circuits. Voltage/potential difference - Voltage as potential difference in energy across a component. - Potential difference is measured in volts - Potential difference is measured with a voltmeter. - Potential difference is shared across	Rate - from Latin *rata* "fixed, settled" Ohm - named for German physicist Georg S. *Ohm* Resistance - from Old French *resister* "hold out against" Direct Proportion – direct: from Latin *dirigere* "set straight" proportion: from Latin phrase *pro portione* "according to the relation" Diode - from Greek *di-* "twice" + *hodos* "a way, path, track, road," Light Dependent Resistor (LDR) - Thermistor – from Greek *thermos* "hot, warm," + suffix "istor" from resistor Dissipated - from Latin *dissipatus* "to spread, scatter" Work - Old English *wircan* (Mercian) "to operate" Power - from Latin *potis* "powerful, to be able" Power Rating – "a fixing of rates" Watt – named for English Physicist James *Watt* Alternating Current - from Latin *alternus* "one after the other, in turns" Direct Current - from Latin *dirigere* "set straight" Current - from Latin *currere* "to run, move quickly" Hertz – named for German physicist Heinrich *Hertz* Mains Electricity – main: from Proto-Germanic **maginam* "power" National Grid - from French *national +* altered from Old French *graille* "grill, grating,"

	P10.14 Explain why, if two resistors are in series, the net resistance is increased, whereas with two in parallel the net resistance is decreased P10.15 Calculate the currents, potential differences and resistances in series circuits P10.16 Explain the design and construction of series circuits for testing and measuring P10.18 Explain how current varies with potential difference for the following devices and how this relates to resistance a filament lamps b diodes c fixed resistors P10.19 Describe how the resistance of a light-dependent resistor (LDR) varies with light intensity P10.20 Describe how the resistance of a thermistor varies with change of temperature (negative	Apply the equations relating p.d., current, quantity of charge, resistance, power, energy, and time, and solve problems for circuits which include resistors in series, using the concept of equivalent resistance Use graphs to explore whether circuit elements are linear or non-linear and relate the curves produced to their function and properties Use graphs to explore whether circuit elements are linear or non-linear and relate the curves produced to their function and properties Visualise and represent 2D and 3D forms, including two	components in a series circuits. Potential difference stays the same across the strands in a parallel circuit. Measuring current in series and parallel circuits. Measuring voltage in series and parallel circuits. Models to demonstrate current and potential difference. **Year 9** Recap ideas on static from Y8. - Static electricity is caused by the movement of electrical charge (electrons), when two insulators are rubbed together. - Attraction and repulsion of charges; opposite charges attract, like charges repel. Uses of static electricity e.g. - car spraying: paint particles given a charge to make the paint spread out evenly and attract to the car.	Thermal Energy Store – thermal: from Greek *therme* "heat" + Energy: , from Greek *energeia* "activity, action" + Store: from Latin *instaurare* "to set up, establish" Circuit breaker- Old English "Brecan"- to destroy Earth wire- Earth: from Old English *eorþe* "ground, soil, dirt, dry land; country, district," + Wire: from old English "Wir"- metal drawn out into a fine thread. Fuse - from Latin *fusionem* "to pour, melt" Live Wire - from Old English *libban* (West Saxon) "to be, be alive" Neutral Wire Charge *(Old French 'chargier' meaning to carry)* Induction *(Latin 'inductionem' meaning to lead into)* Insulator *(Latin 'insulatus' meaning to make like an island)* Static electricity *('Static' from Greek 'statikos' causing to stand; 'Electricity' from Greek 'ēlektron' meaning amber)* Discharge *(Old French 'deschargier' meaning to unload)* Earthing *(Proto-Germanic 'ertho' meaning soil)* Electrostatic spraying *('Electrostatic' is a portmanteau of 'electricity' and 'static'; 'Spraying' from Proto-Germanic ' sprewjan' meaning to sprinkle liquid in drops)*

	temperature coefficient thermistors only) P10.21 Explain how the design and use of circuits can be used to explore the variation of resistance in the following devices: a filament lamps b diodes c thermistors d LDRs P10.17 Core Practical: Construct electrical circuits to: a investigate the relationship between potential difference, current and resistance for a resistor and a filament lamp b test series and parallel circuits using resistors and filament lamps P10.22 Recall that, when there is an electric current in a resistor, there is an energy transfer which heats the resistor P10.23 Explain that electrical energy is dissipated as thermal energy in the surroundings when	dimensional representations of 3D objects Understand that y = mx + c represents a linear relationship Plot two variables from experimental or other data Determine the slope and intercept of a linear graph	- crop spraying: insecticide particles given a charge to make the spray spread out evenly and attract to the crop. - photocopier: oppositely charged copying plate and toner used to make the ink 'stick' to the paper. Dangers of static electricity e.g. - refuelling - lightening All dangerous due to the build up of charge on objects causing electric shock/ignition of combustible materials. Gold leaf electroscope, Van de Graaf generator to demonstrate build up of charge – sparks. Volta's experiment with frogs legs. Static sparks causing ignition of combustible materials and/or electric shock. Recap knowledge of current and voltage from Y8 - Current as a flow of charge (electrons) around a circuit. - Current is measured in amps with an ammeter.	Electrostatic field *('Field' from Proto-Germanic 'felthan' meaning flat land)* Electric field Field lines Force field *('Force' from Latin 'fortis' meaning strong/firm)* Point charge *('Point' from Old French 'pointe' meaning the sharp end of a sword)*

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	an electrical current does work against electrical resistance P10.24 Explain the energy transfer (in 10.22 above) as the result of collisions between electrons and the ions in the lattice **P10.25 (Higher Tier only) Explain ways of reducing unwanted energy transfer through low resistance wires** P10.26 Describe the advantages and disadvantages of the heating effect of an electric current P10.27 Use the equation: energy transferred (joule, J) = current (ampere, A) × potential difference (volt, V) × time (second, s) E = I x V x t	Make calculations of the energy changes associated with changes in a system, recalling or selecting the relevant equations for mechanical, electrical, and thermal processes; thereby express in quantitative form and on a common scale the overall redistribution of energy in the system Substitute numerical values into algebraic equations using	- Voltage as potential difference in energy across a component. - Potential difference is measured in volts with a voltmeter. Resistance as how difficult it is for current to flow. - Resistance is measured in Ohms (Ω). - Fixed resistors have a fixed resistance - Variable resistors can have their resistance changed. - All components in a circuit have some resistance. Ohm's Law: Voltage (V) = current (A) x resistance (Ω) When using a fixed resistance the relationship between current and potential difference is directly proportional. Recap components from year 8 - Non-renewable energy as resources that are being used quicker than they are being replaced. E.g. coal, oil, natural gas, nuclear	

	P10.28 Describe power as the energy transferred per second and recall that it is measured in watt P10.29 Recall and use the equation: power (watt, W) = energy transferred (joule, J) ÷ time taken (second, s) P = E / t P10.30 Explain how the power transfer in any circuit device is related to the potential difference across it and the current in it P10.31 Recall and use the equations: electrical power (watt, W) = current (ampere, A) × potential difference (volt, V) P = I x V electrical power (watt, W) = current squared (ampere^2, A^2) × resistance (ohm, Ω) $P = I^2 \times R$	appropriate units for physical quantities Make calculations using ratios and proportional reasoning to convert units and to compute rates Apply the equations relating p.d., current, quantity of charge, resistance, power, energy, and time Apply the equations relating p.d., current, quantity of charge, resistance, power, energy, and time	- Renewable energy as resources that will not run out. Electricity enters out home via a series of cables called the national grid. Units of electricity kWh. Electricity meters measure the amount of electricity used per household. - Calculating the cost of running different appliances. Examine an electricity bill and calculate cost. Smart meters can be used to monitor electricity consumption more accurately.	

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	P10.32 Describe how, in different domestic devices, energy is transferred from batteries and the a.c. mains to the energy of motors and heating devices P10.33 Explain the difference between direct and alternating voltage P10.34 Describe direct current (d.c.) as movement of charge in one direction only and recall that cells and batteries supply direct current (d.c.) P10.35 Describe that in alternating current (a.c.) the movement of charge changes direction P10.36 Recall that in the UK the domestic supply is a.c., at a frequency of 50 Hz and a voltage of about 230 V P10.42 Describe, with examples, the relationship between the power ratings for domestic electrical appliances and the changes in stored energy when they are in use	Plot two variables from experimental or other data Use ratios, fractions and percentages. Construct and interpret frequency tables and diagrams, bar charts and histograms.		

	P10.37 Explain the difference in function between the live and the neutral mains input wires P10.38 Explain the function of an earth wire and of fuses or circuit breakers in ensuring safety P10.39 Explain why switches and fuses should be connected in the live wire of a domestic circuit P10.40 Recall the potential differences between the live, neutral and earth mains wires P10.41 Explain the dangers of providing any connection between the live wire and earth **Separate Sciences only** P11.1 Explain how an insulator can be charged by friction, through the transfer of electrons P11.2 Explain how the material gaining electrons becomes negatively charged and the material losing electrons is left with an equal positive charge			

	P11.3 Recall that like charges repel and unlike charges attract P11.4 Explain common electrostatic phenomena in terms of movement of electrons, including: a shocks from everyday objects b lightning c attraction by induction such as a charged balloon attracted to a wall and a charged comb picking up small pieces of paper P11.5 Explain how earthing removes excess charge by movement of electrons P11.6 Explain some of the uses of electrostatic charges in everyday situations, including insecticide sprayers P11.7 Describe some of the dangers of sparking in everyday situations, including fuelling cars, and explain the use of earthing to prevent dangerous build-up of charge	Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects		

	P11.8 Define an electric field as the region where an electric charge experiences a force P11.9 Describe the shape and direction of the electric field around a point charge and between parallel plates and relate the strength of the field to the concentration of lines P11.10 Explain how the concept of an electric field helps to explain the phenomena of static electricity			
CP10 (SP12) Magnetism and the Motor Effect CP11 (SP13) Electromagnetic Induction Year 11 Paper 6 (2)	**Magnetism and the Motor Effect** P12.1 Recall that unlike magnetic poles attract and like magnetic poles repel P12.2 Describe the uses of permanent and temporary magnetic materials including cobalt, steel, iron and nickel P12.3 Explain the difference between permanent and induced magnets	Visualise and represent 2D and 3D forms, including two dimensional	**Year 7** Bar magnet- Showing a magnetic field with iron filings Describe magnetic field including NS poles Permanent and temporary magnets CC: Earth's magnetic field and use of compasses over time Magnetising a nail and observing strength and duration **Year 8** Recap from year 7 - Magnetism is force produced by magnets.	Core *"heart or inmost part of anything" from Latin cor "heart* Magnet *"variety of magnetite characterized by its power of attracting iron and steel," mid-15c. (earlier magnes, late 14c.* Permanent *"enduring, unchanging, unchanged, lasting or intended to last indefinitely," early 15c., from Old French permanent, parmanent (14c.)* Induced *from Latin inducere "lead into, bring in, introduce, conduct; persuade; suppose, imagine," from in- "into, in, on, upon" (from PIE root ***en** "in") + ducere "to lead" Electro-magnetic sense first recorded 1777* Temporary *"lasting only for a time," 1540s, from Latin temporarius "of seasonal character*

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	P12.4 Describe the shape and direction of the magnetic field around bar magnets and for a uniform field, and relate the strength of the field to the concentration of lines P12.5 Describe the use of plotting compasses to show the shape and direction of the field of a magnet and the Earth's magnetic field P12.6 Explain how the behaviour of a magnetic compass is related to evidence that the core of the Earth must be magnetic P12.7 Describe how to show that a current can create a magnetic effect around a long straight conductor, describing the shape of the magnetic field produced and relating the direction of the magnetic field to the direction of the current P12.8 Recall that the strength of the field depends on the size of the current and the distance from the long straight conductor	representations of 3D objects Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Opportunity for devising a method – electromagnets. Visualise and represent 2D and 3D forms, including two	- Magnetic materials are iron, nickel and cobalt. - A magnetic field is the area around a magnet where it can affect magnetic materials. Permanent magnets always have a magnetic field around them. Induced magnets are temporary. The are only magnetic when within the magnetic field of another magnet. A current carrying a wire will produce a magnetic field around it. This produces an electromagnet. - Electromagnets are temporary. They can be turned on and off. - A solenoid (coil of wire) amplifies the magnetic field. To produce a magnetic field similar to one produced around a bar magnet. - An iron core makes the electromagnet stronger. - An increased current/voltage will make an electromagnet stronger.	Magnetic *1610s, literal but poetic (Donne), "having the properties of a magnet;" it is attested from 1630s in the figurative meaning "having powers of attraction"* Magnetic Field Magnetic Material Plotting Compass Electromagnet *"magnet which owes its magnetic properties to electric current," 1822* Solenoid from French *solénoïde*, from Greek *sōlēnoeidēs* "pipe-shaped Carbon Brush Fleming's left-hand rule Flux Originally "excessive flow" (of blood or excrement) Density *c. 1600, "quality of being very close or compact," from French densité (16c.)* Magnetic Flux Density Motor Effect Commutator *from Latin commutare (see **commute** (v.)). From 1880 as "contrivance for varying the strength of an electric current."* Split-ring commutator Tesla *"unit of magnetic flux density," 1960, from Nikola Tesla* Diaphragm *From 1650s as "a partition" of any kind, "something which divides or separates;" 1660s in the special sense "thin piece of metal" serving some purpose*

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	P12.9 Explain how inside a solenoid (an example of an electromagnet) the fields from individual coils: a add together to form a very strong almost uniform field along the centre of the solenoid b cancel to give a weaker field outside the solenoid **P12.10 (Higher Tier only) Recall that a current carrying conductor placed near a magnet experiences a force and that an equal and opposite force acts on the magnet** **P12.11 (Higher Tier only) Explain that magnetic forces are due to interactions between magnetic fields** **P12.12 (Higher Tier only) Recall and use Fleming's left-hand rule to represent the relative directions of the force, the current and the magnetic field for cases where they are mutually perpendicular** **P12.13 (Higher Tier only) Use the equation:**	dimensional representations of 3D objects Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Make calculations using ratios and proportional reasoning to convert units and to compute rates	- The number of turns in the coil will make an electromagnet stronger. **Year 9** Recap on magnetism and electromagnetism from Y7+8 - Magnetism as a force - Magnetic field as the space around a magnetic where a magnet can attract magnetic materials. - Shape of a magnetic field around a bar magnet - A current carrying a wire will produce a magnetic field around it. This produces an electromagnet. Uniform magnetic fields - A uniform magnetic field is produced between two magnets. A current flowing through a wire produces a magnetic field around the wire. Motor effect - a wire carrying a current will experience a force when in a uniform magnetic field.	Current *c. 1300, curraunt, "running, flowing, moving along"* Alternating Current Direct Current Alternator Carbon Brush Dynamo *short for dynamo-machine, from German dynamoelektrischemaschine "dynamo-electric machine," coined 1867 by its inventor, German electrical engineer Werner Siemans* Generator *from past participle stem of generare "to bring forth"* Induce Loudspeaker Microphone *1680s, "ear trumpet for the hard-of-hearing," coined from Greek mikros "small" (see **micro-**) + phōnē "sound,"* Potential Difference (p.d.) Voltage *"electromotive force reckoned in volts," 1882, from **volt** + **-age**.* Slip Ring National Grid Primary Coil Secondary Coil Transformer *c. 1600, "one who or that which transforms," agent noun from **transform** (v.). Meaning "device to reduce electrical currents" is from 1882.* Step-down Transformer Step-up Transformer Transmission Lines

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	force on a conductor at right angles to a magnetic field carrying a current (newton, N) = magnetic flux density (tesla, T or newton per ampere metre, N/A m) × current (ampere, A) × length (metre, m) **F = B x I x l** **Separate Sciences only** P12.14 Explain how the force on a conductor in a magnetic field is used to cause rotation in electric motors **Electromagnetic Induction** P13.10 Use the power equation (for transformers with100% efficiency): potential difference across primary coil (volt, V) × current in primary coil (ampere, A) = potential difference across secondary coil (volt, V) × current in secondary coil (ampere, A) $V_p \times I_p = V_s \times I_s$	Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Make calculations using ratios and proportional reasoning to convert units and to compute rates Make calculations of the energy changes associated with changes in a system, recalling or selecting the relevant equations for mechanical, electrical, and thermal processes; thereby express in	**Flemmings left hand rule used to identify the direction of a force.** **Magnetic flux density (magnetic field strength)** **Force = magnetic field strength x current x length** Build a model motor. Demo 'kicking wire' (in large magnet). Electricity enters out home via a series of cables called the national grid. Ohm's Law: Voltage (V) = current (A) x resistance (Ω) When using a fixed resistance the relationship between current and potential difference is directly proportional.	Coulomb *named for French chemist Charles-Augustin de Coulomb (1736-1806), who devised a method of measuring electrical quantity* Power *c. 1300, pouer, "ability; ability to act or do; strength, vigor, might,"*

	P13.2 (Higher Tier only) Recall the factors that affect the size and direction of an induced potential difference, and describe how the magnetic field produced opposes the original change **P13.5 (Higher Tier only) Explain how an alternating current in one circuit can induce a current in another circuit in a transformer** **P13.6 (Higher Tier only) Recall that a transformer can change the size of an alternating voltage** P13.8 Explain why, in the national grid, electrical energy is transferred at high voltages from power stations, and then transferred at lower voltages in each locality for domestic uses as it improves the efficiency by reducing heat loss in transmission lines P13.9 Explain where and why step-up and step-down transformers are	quantitative form and on a common scale the overall redistribution of energy in the system Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Visualise and represent 2D and 3D		

	used in the transmission of electricity in the national grid **Separate Sciences only** P13.1 Explain how to produce an electric current by the relative movement of a magnet and a conductor: a on a small scale in the laboratory b in the large-scale generation of electrical energy P13.3 Explain how electromagnetic induction is used in alternators to generate current which alternates in direction (a.c.) and in dynamos to generate direct current (d.c.) P13.4 Explain the action of the microphone in converting the pressure variations in sound waves into variations in current in electrical circuits, and the reverse effect as used in loudspeakers and headphones P13.7 Use the turns ratio equation for transformers to calculate either the missing voltage or the missing number of turns:	forms, including two dimensional representations of 3D objects Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Apply the equations linking the p.d.s and numbers of turns in the two coils of a transformer, to the currents and the power transfer involved, and relate these to the advantages of power transmission at high voltages Make calculations of the energy changes associated with changes in a system, recalling or selecting the relevant		

	p.d across primary coil / p.d across secondary coil = no. turns in primary coil / no. turns in secondary coil $V_p / V_s = N_p / N_s$ P13.11 Explain the advantages of power transmission in highvoltage cables, using the equations in 10.29, 10.31, 13.7P and 13.10	equations for mechanical, electrical, and thermal processes; thereby express in quantitative form and on a common scale the overall redistribution of energy in the system		
CP12 (SP14) Particle Model **CP13 (SP15) Forces and Matter** Year 11 Paper 6 (2)	**Particle Model** P14.1 Use a simple kinetic theory model to explain the different states of matter (solids, liquids and gases) in terms of the movement and arrangement of particles P14.2 Recall and use the equation: density (kilogram per cubic metre, kg/m3) = mass (kilogram, kg) ÷ volume (cubic metre, m3) p = m / V P14.4 Explain the differences in density between the different states of matter in terms of the arrangements of the atoms or molecules	Calculate areas of triangles and rectangles, surface areas and volumes of cubes Apply the relationship between density, mass and volume to changes where mass is conserved Visualise and represent 2D and 3D forms, including two dimensional	**Year 7** Solids, liquids and gases State changes as examples of physical changes Basic particle diagrams Thermal and Elastic Potential as energy stores Making a newton meter Measuring the extension of a spring plus one other material (linking to plastics) **Year 8** Energy changes involved in change of state - Interpretation of cooling/heating curve:	**Particle Model** Change of state (Latin *status* "a station, position, place; way of standing, posture; order, arrangement, condition") Chemical change Compress (Latin *compressus*, past participle of *compressare* "to press together") Conserved (Latin *conservare* "to keep, preserve, keep intact, guard") Density (Latin *densitas* "thickness") Kinetic theory (Greek *kinētikos* "moving, putting in motion") Physical change (Latin *physica* "study of nature") State of matter (Latin *materia* "substance from which something is made") Sublimation (Medieval Latin *sublimationem* (nominative *sublimatio*) "refinement, deliverance," literally "a lifting up")

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	P14.5 Describe that when substances melt, freeze, evaporate, boil, condense or sublimate mass is conserved and that these physical changes differ from some chemical changes because the material recovers its original properties if the change is reversed P14.3 Core Practical: Investigate the densities of solid and liquids P14.6 Explain how heating a system will change the energy stored within the system and raise its temperature or produce changes of state P14.7 Define the terms specific heat capacity and specific latent heat and explain the differences between them P14.10 Explain ways of reducing unwanted energy transfer through thermal insulation	representations of 3D objects Apply the relationship between density, mass and volume to changes where mass is conserved Make calculations of the energy changes associated with changes in a system, recalling or selecting	- Identification of a solid, liquid and gas. - Identify where a substance is melting/evaporating - Explanation of plateaus to be kept as: the temperature remains constant because the substance is changing state. Definition of a mixture as two or more substances that are not strongly joined Differences in curves of pure substances vs mixtures Thermal and Elastic Potential as Energy Stores Pressure as how much something is 'pushing' on something else. Calculation of pressure: Pressure = force / area If a force is applied over a large area the pressure will be smaller. If a force is applied over a small area the pressure will be larger. Pressure measured in N/m^2 Students calculate how much pressure they exert on the Earth. Everyday examples eg camels feel, snow shoes, stiletto heels	Specific heat capacity (Old English *hætu*, *hæto* "heat, warmth, quality of being hot; fervor, ardor," Old French *capacité* "ability to hold") Specific latent heat Temperature (Latin *temperatura* "a tempering, moderation") Thermal energy (Greek *therme* "heat, feverish heat," Greek *energeia* "activity, action, operation") Absolute zero (Italian zero "empty space, desert, naught") Kelvin Kinetic energy (Greek *kinētikos* "moving, putting in motion") Pascal Pressure (Old French *presseure* "oppression; torture; anguish; press") Gas pressure (Greek *khaos* "empty space," Old French *presseure* "oppression; torture; anguish; press") Work done

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	P14.8 Use the equation: change in thermal energy (joule, J) = mass (kilogram, kg) × specific heat capacity (joule per kilogram degree Celsius, J/kg °C) × change in temperature (degree Celsius, °C) $\Delta Q = m \times c \times \Delta\theta$ P14.9 Use the equation: thermal energy for a change of state (joule , J) = mass (kilogram, kg) × specific latent heat (joule per kilogram, J/kg) $Q = m \times L$ P14.11 Core Practical: Investigate the properties of water by determining the specific heat capacity of water and obtaining a temperature-time graph for melting ice P14.12 Explain the pressure of a gas in terms of the motion of its particles P14.13 Explain the effect of changing the temperature of a gas on the velocity of its particles and hence on the pressure produced by a fixed mass of gas at constant volume (qualitative only)	the relevant equations for mechanical, electrical, and thermal processes; thereby express in quantitative form and on a common scale the overall redistribution of energy in the system Apply the relationship between change in internal energy of a material and its mass, specific heat capacity and temperature change to calculate the energy change involved; apply the relationship between specific latent heat and mass to calculate the energy change involved in a change of state Plot two variables from experimental or other data	Gas Pressure: Recap states of matter from Y7. - Particle diagrams of solids, liquids and gases. - Naming state changes between solids liquids and gases (melting, evaporating, condensing, freezing, sublimation, deposition) Gas pressure caused by particles colliding with the sides of a container. - The more particles the higher the pressure as there are more collisions. - Pressure can be measured in N/m^2 or Pascals (Pa) - Atmospheric pressure is 100,000 Pa Pressure in liquids: Pressure is a measure of the force on a unit of surface area. Pressure is exerted by all fluids (liquids and gases) Pressure depends on the depth of the fluid. The deeper something is the more weight (force) is above you to exert pressure.	**Forces and Matter** Direct proportion (Latin directus "straight," Latin proportionem (nominative proportio) "comparative relation, analogy") Elastic (Latin elasticus, from Greek elastos "ductile, flexible") Extension (Latin extensionem/extentionem (nominative extensio/extentio) "a stretching out) Inelastic (in "not, opposite of, without, Latin elasticus, from Greek elastos "ductile, flexible") Linear relationship (Latin linearis "belonging to a line") Non-linear relationship (non "not, lack of," Latin linearis "belonging to a line") Spring constant (Old English springan "to leap, leap up, jump," Latin constantem (nominative constans) "standing firm, stable, steadfast, faithful") Work done Atmospheric pressure (Old French presseure "oppression; torture; anguish; press") Density (Latin densitas "thickness," from densus "thick, dense") Fluid (Latin fluidus "fluid, flowing, moist") Pressure (Old French presseure "oppression; torture; anguish; press") Normal (Late Latin normalis "in conformity with rule, normal") Displace (dis "lack of, not," Old French placer "to place," from place "place, spot")

	P14.14 Describe the term absolute zero, −273 °C, in terms of the lack of movement of particles P14.15 Convert between the kelvin and Celsius scales **Separate Sciences only** P14.16 Explain that gases can be compressed or expanded by pressure changes P14.17 Explain that the pressure of a gas produces a net force at right angles to any surface P14.18 Explain the effect of changing the volume of a gas on the rate at which its particles collide with the walls of its container and hence on the pressure produced by a fixed mass of gas at constant temperature P14.19 Use the equation: $P_1 \times V_1 = P_2 \times V_2$	Recognise and use expressions in decimal form. Magnitude of negative numbers. Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects Apply the relationship between pressure and volume to changes where mass is conserved	e.g. at sea level you have more air above you than at the top of a mountain. Pressure is greater in liquids than in gases because the density of particles is greater in liquids. Pressure in a fluid acts in all directions. **Year 9** What is Kinetic Theory? Recap of particle arrangements in solids, liquids and gases as well as changes of state from Y7 & 8. Link between temperature and kinetic energy therefore energy increase as substances move from solids → liquid → gas. Increase in energy causes attractive forces between particles to be overcome so particles move further apart Recap of keywords; soluble, solute, solution, saturated and solvent	Upthrust (Old Norse þrysta "to thrust, force, press")

	to calculate pressure or volume for gases of fixed mass at constant temperature P14.20 Explain why doing work on a gas can increase its temperature, including a bicycle pump **Forces and Matter** P15.1 Explain, using springs and other elastic objects, that stretching, bending or compressing an object requires more than one force P15.2 Describe the difference between elastic and inelastic distortion P15.5 Describe the difference between linear and non-linear relationships between force and extension P15.6 Core Practical: Investigate the extension and work done when applying forces to a spring P15.3 Recall and use the equation for linear elastic distortion	Understand that y = mx + c represents a linear relationship Change the subject of an equation Substitute numerical values into algebraic equations using appropriate units for physical quantities Solve simple algebraic equations Translate information between graphical and numeric form Understand that y = mx + c represents a linear relationship	Define concentration as the number of particles of solute in a certain volume of solvent Use of concentration (g/dm^3) = mass (g) / volume (dm^3) Use of mass (g) = concentration (g/dm^3) x volume (dm^3) Use of volume (dm^3) = mass (g) / concentration (g/ dm^3) Converting between cm^3 and dm^3 (÷1000) Converting between kg and g (x1000) Density as the mass per unit volume of a substance measured in kg/m^3 - Solids are the most dense state of matter because there more particles in a given volume Calculation of density - density (kg/m^3) = mass (Kg) / volume (m^3) - Volume of regular shaped objects can be calculated using volume = length x width x height. - Volume of irregular shaped objects can be found using eureka cans (displacement cans)	

	including calculating the spring constant: force exerted on a spring (newton, N) = spring constant (newton per metre, N/m) × extension (metre, m) F = k × x P15.4 Use the equation to calculate the work done in stretching a spring: energy transferred in stretching (joule, J) = 0.5 × spring constant (newton per metre, N/m) × (extension (metre, m)) E = ½ x k x x^2 **Separate Sciences only** P15.7 Explain why atmospheric pressure varies with height above the Earth's surface with reference to a simple model of the Earth's atmosphere P15.8 Describe the pressure in a fluid as being due to the fluid and atmospheric pressure	Plot two variables from experimental or other data Determine the slope and intercept of a linear graph Calculate relevant values of stored energy and energy transfers; convert between newton-metres and Joules Use ratios, fractions and percentages	Relate density of an object to its ability to float. - An object less dense that water will float. - An object more dense than water will sink Buoyancy as the ability to float in a liquid. Upthrust as the upwards force that keeps an object floating. Use of density blocks to calculate volume and density of regular shapes. Eureka cans to calculate the volume of irregular objects. Investigate how density affects buoyancy in water. Thermal and Elastic Potential as Energy Stores	

	P15.9 Recall that the pressure in fluids causes a force normal to any surface P15.10 Explain how pressure is related to force and area, using appropriate examples P15.11 Recall and use the equation: pressure (pascal, Pa) = force normal to surface (newton, N) ÷ area of surface (square metre, m2) P = F / A P15.12 Describe how pressure in fluids increases with depth and density P15.13 Explain why the pressure in liquids varies with density and depth P15.14 Use the equation to calculate the magnitude of the pressure in liquids and calculate the differences in pressure at different depths in a liquid: pressure due to a column of liquid (pascal, Pa) = height of column	Make calculations using ratios and proportional reasoning to convert units and to compute rates Use ratios, fractions and percentages Use ratios, fractions and percentages Calculate the differences in pressure at different depths in a liquid Change the subject of an equation Substitute numerical values into algebraic equations using appropriate units for physical quantities Solve simple algebraic equations Visualise and represent 2D and 3D forms, including two dimensional		

	(metre, m) × density of liquid (kilogram per cubic metre, kg/m3) × gravitational field strength (newton per kilogram, N/kg) P = h × ρ × g P15.15 Explain why an object in a fluid is subject to an upwards force (upthrust) and relate this to examples including objects that are fully immersed in a fluid (liquid or gas) or partially immersed in a liquid P15.16 Recall that the upthrust is equal to the weight of fluid displaced P15.17 Explain how the factors (upthrust, weight, density of fluid) influence whether an object will float or sink	representations of 3D objects Visualise and represent 2D and 3D forms, including two dimensional representations of 3D objects		