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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.	Magnification Cell division and mitosis Organisation of specialised cells into tissues Structure of the skeleton Muscles	Neurons- structure and adaptation. Nervous system structure and function. Brain structure and regions. **Brain and spinal cord problems**
		Structure of bacteria Bacterial culture using agar- aseptic technique Uses of microorganisms- fermentation, yoghurt, digestive health.	Importance of bacteria in the human digestive system 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
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	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.
		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.

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		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* • *identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution*	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.

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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. 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. **Assessing pollution with indicator species**

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Year 7 biology 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 Role of organelles above Plant cell structure to include organelles above plus: • Cell wall • Chloroplast • Vacuole	Explaining the difference between those 2 cell structures Hooke and discovery (and naming) of cells	Organism *(organic)* Organelle *(latin- organ- instrument)* Nucleus *(latin- kernel of a nut)* Cytoplasm *(cyto-cell, plasm as in plasm-fluid)* Cell wall 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)* 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	Microscope *(micro-small, scope-instrument for seeing)* Magnification *(magnificare- make greater)* Focus *(point of convergence-fireplace)* Resolution *(breaking into parts)* Lens *(from lentil shape!)* Articles:	

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		Calculating total magnification – eyepiece x objective lens		History of the Cell: Discovering the Cell | National Geographic Society Intro to cells (article) | Khan Academy	
7B3	**What is DNA?**	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, Wilkins and Franklin	DNA *(deoxy-one less oxygen, nucleic- nucleus, acid)* Chromosome *(chroma- colour as it was seen when took up stain)* Double Helix *(a spiral thing)* Base *(bottom/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**	Structure of bacterium: • Size compared with eukaryotic • Highlight lack of nucleus • Cell wall • Chromosomal DNA • Plasmid • Some have flagella Examples of Unicellular Organisms Roles of differentiated/ specialised cells in multicellular organisms including: • Egg • Sperm • red blood cell • root hair	Comparison of size of prokaryotic and eukaryotic cells. Comparing unicelluar and multicellular organisms Opportunity to view various unicellular organisms under microscope (pond water)	Unicellular *(uni- having one only- unicycle, unisex, unique)* Multicellular *(multi- many)* Bacterium/ bacteria as plural *(Greek- bakterion- small rod)* Plasmid *(from plasm)* Chromosomal DNA Flagellum *(Latin-whip)* Specialised cell Differentiated *(different)* Articles: Unicellular vs. Multicellular | National Geographic Society Cells and the Versatile Functions of Their Parts | National Geographic Society	

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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 Safety Comparison of results Sources of error Estimation of coverage	Aseptic technique *(a- not- asexual, atypical, septic- Latin septikos- rotten, putrid)* Sterile *(French- not producing fruit)* Agar plate *(from name of algae)* Petri dish *(after German bacteriologist)* Microorganism *(small, living thing)* Articles: Role of microbes in human health and disease (genome.gov) Using Microorganisms in Food Production - ScienceAid	
7B6	**How can we use microorganisms?**	MRS GREN and respiration (word equation only) Stating the importance of bacteria in human digestive system Principles of Fermentation- reaction details. Making yoghurt Only some bacteria are pathogenic	Yeast culture to show CO_2 produced, linking to being alive How does biotechnology improve our lives?	Fermentation *(Latin- ferment)* Fungi *(Latin- mushroom)* Yeast *(Germanic- froth)* Egestion *(Latin- to discharge)* Biotechnology *(Bio- living, technology)* Reactants *(thing that reacts)* Products *(Latin- something produced)* Reaction (re- back against (the action)) 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 • Testis • Sperm duct • Scrotum • Prostate Female structure names and function • Uterus (highlight lining) • Ovaries • Vagina	FGM Model of the female external and internal female genitals Detail to link with PSHE	Penis *(French-tail)* Vagina *(Latin-sheath, scabbard)* Genitals *(Latin- genitalis-birth)* Sperm *(French-esperme-seed)* Egg Testis *(Latin- witness as in testimony)* Sperm Duct *(vas deferens- vas- vessel)* Semen *(Latin-seed)* Glands (Latin- glans-acorn) Scrotum *(Latin-scortum-a hide made of skin)* Ovary *(Latin-ovum-egg)* Oviduct (Ovum-egg, duct-tube)	

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		• Cervix • Oviduct		Uterus *(Latin-womb,belly)* Cervix (Latin-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?**	Changes during puberty- to include: • pubic hair • changes in body shape • voice deepening • causes of acne, body odour linked to need for hygiene Hormones controlling these changes (Oestrogen, Progesterone, testosterone)		Hormone *(Greek- hormone- which sets in motion)* Puberty *(Latin- pubertatem- age of maturity)* Adolescence *(Latin/old French- youth)* Menstrual Cycle (Latin-monthly) Menopause (Latin- monthly, cease) Oestrogen *(Greek-gen- to bring about, estrus- madness, impulsiveness!!)* Progesterone *(pro- for, gestare- tto carry about)* Testosterone *(see testis)* Articles: Adolescent Development (clevelandclinic.org)	

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7B9	**What is fertilisation?**	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. 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. The menstrual cycle: • Overview and purpose • Events during 28 day cycle- thickening of uterus lining, ovulation, menstruation) Menopause STIs and contraception • Types and how they prevent fertilisation	Ensure sex is explicit, not gender Assisted Reproduction Therapy Contraception	Fertilisation *(French-make 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	

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		Mid biology review lesson			
7B10	**How do plants reproduce?**	Flower structure to include the: • Stigma and stamen • Stamen • Ovary • Anther and filament • Petals and sepals Pollination methods including: • Bees/ insects • Wind/ water • Artificial Pollen tube formation and fertilisation. Seed formation and dispersal. Importance of plant reproduction in human food security inc loss of bees etc.	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 *(Involving sex)* Asexual *(A-not as in atypical, asymmetric)* Anther *(from Greek Anthos-flower)* Pollen *(Latin- mill dust- fine flour)* Pollination *(ation- action noun)* 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	
7B11	**Why don't plants eat?**	Define autotroph and heterotroph Process of photosynthesis: • Construction and recall of simple word equation. • Highlight need for light energy to make this reaction happen.	Hydroponics/eden project homework/article opportunity	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)*	

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		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		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?**	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.	To what limit? Which is the biggest factor? Nature vs nurture argument Measurement of 2 factors and construction of bar chart/ histogram. Twin study	Environmental *(French- environ- around)* Genetic *(Greek- genetikos- origins of)* Continuous *(Latin- following after another)* Discontinuous *(dis-not)* Variation *(French- variacion- difference)* Genes *(From Greek genea- generation/race)* Inherit *(old French- to make someone an heir)* Mutation *(French and Latin- a process of changing)* Characteristic *(Greek- character)* Articles: Biodiversity | National Geographic Society Nature vs. Nurture: Genes or Environment? (verywellmind.com)	
7B13	**How are living things classified?**	Definition of a species Hierarchy of taxonomy: • Kingdom • Phylum • Class • Order • Family • Genus	Other systems e.g. Domains Specimen jars and observational skills Use of keys in classification	Classification *(put into a class)* Kingdom (state of the King) Species *(Latin- a particular sort or type)* Binomial *(Latin- having two names)* Specimen *(Latin- indication/ mark/ evidence)* Vertebrate *(Latin- joint or articulation of the body)* Invertebrate *(in- not or without)*	

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		• 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.		(Viviparous) *(Latin- bringing forth alive)* (Oviparous) *(Latin- 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, habitat, community, and population. 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,	Research techniques Internet research skills Reliability of sources (e.g. mermaids, tree squids, drop bears)	Adaptation *(Latin- to have adjusted)* Habitat *(Latin- habitare- to live in)* Environment *(French- environ- around)* Camouflage *(20th century Parisian slang- to disguise)* Competition *(Latin- rivalry- link to school House/ spots competitions)* Predator *(Latin- to rob)* Prey *(Latin- booty/plunder)* Articles: Prehistoric Animal Adaptations | National Geographic Society Response and Adaptation by Plants to Flooding Stress | Annals of Botany | Oxford Academic (oup.com)	

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		claws or talons, sharp beak or teeth. • Prey- eyes on side of head, camouflage, behaviour eg burrowing.			
7B15	**Where do living things live?**	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	Human activity as a biotic factor. Link to pollution, conservation and our effect on the planet/ local ecosystem. Exploration and observation skills	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)* 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 *(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)* 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)* 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 Real life examples of how processed data from these investigations would be useful e.g. monitoring the effect of a	Practical use (on Longrun or school field) of Quadrats and transects. Use of Systematic and random sampling Observation methods (hides, drones, cameras)	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)* Articles:	

		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) Human effects on interdependence- e.g. overfishing.		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					

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Year 8 biology - Lesson/ Composite sequences.

Code	Lesson/ composite title	Substantive knowledge/ components	Disciplinary knowledge	Disciplinary literacy– Keywords *(etymology)* and linked articles	Cultural Capital/ Personal Development
8B1	**How can we view cells?**	Define magnification as the number of times larger an image appears than the original size Define resolution as the smallest distance between 2 points that can still be seen as 2 points. Conversion between mm, µm, nm. Calculating magnification using the equation magnification = image size/actual size. Compare resolution and magnification of electron and light microscopes.	Using a microscope to view and estimate sizes of cells using a scale bar – field of view.	Magnification – (French *'magnificare'* – esteem greatly) – act of making larger Resolution – (French *'resolucioun'*) breaking into parts, clarity of image. Microscopes – (Latin *'micro'* – small, *'scopium'* – instrument for seeing). Cells – (Latin *'cella'* small room) Small units which make up organisms. History of the Cell: Discovering the Cell | National Geographic Society The world's largest bacteria are visible to the naked eye | Natural History Museum (nhm.ac.uk)	
8B2	**How does one cell become many cells?**	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	Viewing different stages of mitosis slides or images.	Mitosis – (Greek *'mitos'* warp thread, *'osis'* act) Cellular division which creates clones. Chromosome – (Greek *'chroma'*, meaning colour, and *'soma'*, meaning body) A large bundle of DNA containing many genes. Diploid – (Greek *'diploos'* – double) having two sets of chromosomes.	

		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		Interphase – (Latin *'inter'*) between. DNA replicates before cell division. Prophase – (Greek *'prophasis'* – that which appears) Nucleus dissolves, DNA appears. Metaphase – (Greek *'meta'* – changed, *'phase'* – stage) Chromosomes line up and spindle fibres attach. Anaphase – (Greek *'an'* – backwards, *'phase'* – stage) Chromosomes are pulled towards poles. Telophase – (Greek *'telo'* – the end, *'phase'* – stage) New nuclei form around chromosomes. Cytokinesis – (Greek *'cyto'* – cell, *'kinesis'* – to move) – New cells cleave apart. blastocyst_article.pdf (sciencejournalforkids.org) Do immortal animals exist? - BBC Bitesize	
8B3	**How does an embryo develop?**	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. 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:	Viewing under microscopes	Meiosis – (Greek *'mei'* make smaller, *'osis'* biological condition) – Haploid gamete cells are made. Mitosis – (Greek *'mitos'* warp thread, *'osis'* act) Cellular division which creates clones. Stem cells - (German *'Stammzelle'*) Undifferentiated cells which give rise to specialised cells. Gamete – (Greek *'gamein'* – to take a wife/marry) – Sex cells, sperm and egg.	

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		A foetus collects nutrients, oxygen and water from a mother's blood using a placenta. It travels to and from the placenta by the umbilical cord. It lies in an amniotic sac full of fluid so it has freedom to move and protection from injury. Key stages: 4 weeks – Hearts beats. 8 weeks – now called a foetus. Human features 3 months – all body parts in place 5 months – hair, nails, eyelashes 7 months – brain very active 9 months – fully developed.	Use of ultrasounds	Haploid – (Greek '*haploos'* – single) singe set of unpaired chromosomes. Embryo – (Greek '*embryon'* a young one) Embryo before 8 weeks of pregnancy. Foetus – (Latin *'fetus'* hatching of young) embryo after 8 weeks of pregnancy. Placenta – (Grek '*plakoenta'* Flat plate) Organ which attached embryo to wall of uterus. Zygote – (Greek '*zygotos'* has a yolk) Fertilised egg cell. Umbilical – (Latin '*umbilicus'* Navel) Tube from the foetus navel to the placenta. Navel – (Proto-Germanic - *nabalan*) Belly button. Gestation – (Latin '*gestationem'* to bear or carry) carrying a foetus in the womb. Pregnancy – (Latin '*pre'* before, '*gnasci'* born) Period of foetus growth in the womb. First Human-Monkey Chimeras Developed in China | The Scientist Magazine® (the-scientist.com) Synthetic human embryos created in groundbreaking advance | Biology | The Guardian	
8B4	**How is a baby born?**	Process of birth 1- Amniotic sac bursts (water breaking) 2- Muscles in the wall contract to push the baby out	Time in labour different for all women.	Contraction – (Latin *'contractionem'* shortening) Tensing of the uterus muscles to open cervix.	

		3- The muscles in the cervix relax and widen. Infant nutrition: Up to 1, babies predominately rely on a mother's milk (can also be formula). Weening from 6 months	Risks of labour and child birth. Advice on weening is debated and often changes.	Uterus – (Latin '*uterus*' womb, belly) Female organ of gestation. Cervix – (Latin '*cervix*' neck) The entrance to the cervix into the vagina. Vagina – (Latin '*vagina*' sheath/scabbard) sexual passage of the female (discussion sexism). Ape 'midwives' spotted helping female bonobos give birth | New Scientist Giving birth two million years ago was 'relatively easy' - BBC News	
8B5	**Why do we look different?**	(Retrieval from year 7) 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. **Using Punnett squares to determine the chance of inheriting a characteristic.**	Coins and masking tape	Variation – (Latin '*variatonem*' a difference) Differences between organisms. Mitochondria – (Greek '*mytos*' thread, '*khondrion*' little granules) Organelle releasing energy through aerobic respiration. Inheritance – (Latin '*hereditaire*' to inherit) Passing characteristics to offspring through DNA. Characteristic – (Greek '*kharakter*' symbol) physical properties of an organism. Gene – (Proto-Indo-European (PIE) root '*gene*', to give birth (e.g., generation, genesis)) A sequence of DNA coding for a characteristic. Allele (allelomorph) – (Greek '*al*' other, '*morph*' form) Different versions of a gene.	

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				Do you love or loathe coffee? Your genes may be to blame. | National Geographic The Y Chromosome Is Vanishing. A New Sex Gene Could Be The Future of Men : ScienceAlert	
8B6	**What are organs and systems?**	Definition of tissues, organs and organ systems. Naming organs and organ systems. Example of the hierarchy e.g. rods/cones – retina – eye ball – nervous system. Plants also have this hierarchy of organisation with an example…	**Torso Model and model of the eye**	Cells – (Latin '*cella*' small room) Small units which make up organisms. Organ – (Greek 'organon' to make or do) A collection of tissues that carries out a specific function. Heart – (Proto-Germanic '*hertan*') Organ that pumps blood around the body. Lungs – (German '*lunge*' light organ) Organ which exchanges gases between the air and the blood. Kidney – (Old English '*cwid*' womb, '*ey*' egg) Organ which filters the blood and produces urine. Tissue – (Latin '*texere*' woven) A group of cells with a similar function. Neurone – (Greek '*neura*' bowstring) A nerve cell. Palisade cell – (Latin '*Palus*', meaning stake, like in a wooden stake wall) Leaf cell adapted for photosynthesis. Found on the top of leaves. Man gets genetically-modified pig heart in world-first transplant - BBC News	

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				Artificial intelligence can now pick out transplant organs 'more effectively than what human doctors can see' | Science & Tech News | Sky News	
8B7	**Do snakes have backbones?**	Endo, Exo and hydrostatic skeletons. Comparison of endoskeletons and exoskeletons with examples. Function of the human skeleton for support, protection, movement, making red blood cells. Bones consist of living and non-living parts. Bone marrow makes up part of the living part and this is where red blood cells are formed. Bones joined with ligaments e.g. the cruciate ligament Label key parts of the human skeleton including – skull, spine, ribcage, pelvis, femur, humerus	Images of x-rays	Bones – (Proto-Germanic *'bainan'* Hard animal tissue) Hard structures of the body, forming skeleton. Skeleton – (Greek *'skeletos'* Dried up) Hard framework of body Ligaments – (Latin *'ligamentum'* to bind) Band of tough tissue holding bone to bone. Tendon – (PIE *'ten-on'* something stretched) Stretched tissue attaching bone to muscle. Skull – (old English *'sciell'* shell) The bony framework of the head. Spine – (Latin *'spina'* prickle) Backbone. Ribs – (PIE *'rebh'* to cover) Long thin bones encasing the vital organs. Pelvis – (Greek *'pelike'* bowl) Bowl shaped bones at the base of the spine/top of legs. Femur – (Latin *'femur'*, meaning upper thigh) Thigh bone. Humerus – (Latin *'Humerus'*, Shoulder) Long bone of the upper arm. Did the Human Hand Evolve as a Lean Mean Bone-Smashing Machine? | Smart News | Smithsonian Magazine	

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				How Old Is Cancer? At Least as Old as the Start of the Dinosaurs, Fossil Shows | HISTORY – Bone cancer in a prehistoric tortoise	
8B8	**Do mussels have muscles?**	Skeleton would be useless without muscles – working in partnership. Muscles are tissues. Tissues are made up of specialised cells working together Muscle cells contain lots of mitochondria Different types of muscle: Skeletal – attached to bones. Smooth – found in the walls of internal organs e.g. blood vessels. Cardiac – found in the walls of the heart. Muscles contract and relax. Antagonistic pairs e.g. biceps and triceps. Muscles attached to bones by tendons. Examples of different types of joints: Immovable joint – cranium Slightly movable – vertebrate Freely movable e.g. Hinge joint – Elbow Ball-and-socket – Shoulder/hip Model of elbow joint.	Demo dissection of chicken wing	Antagonistic – (Greek *'antagonistes'* battle) Muscles which act in opposition. Muscle - (Latin *'musculus',* meaning muscle, itself derived from *'mus',* meaning little mouse, perhaps because the shape and movement of muscles resembles mice) Contractible animal tissue consisting of bundles of fibres. Joint – (Latin *'iunctus'* meaning connected) A part of a body where two bones meet and move in contact with one another Cartilage – (Latin *'cartilagenem'* for cartilage) A hard, stiff, and smooth connective or structural tissue. Found at the end of long bones in joints, or in structures such as the eyes, nose, and ribs. It is similar in consistency to plastic. BBC NEWS | Science/Nature | Tendons play key role in running Why Aren't Humans "Knuckle-Walkers"? | Lab Manager	
8B8i	**Mid-topic questions**	See PowerPoint for questions. Content covered is from the above lessons			

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8B9	**Stop calling ventilation respiration (please)**	Structure of the lungs • Trachea • Bronchus • Bronchioles • Alveoli Process of breathing Inhaling involves – diaphragm contracts, intercostal muscles contract, volume of thorax increases, pressure decreases Exhaling involves – diaphragm relaxes, intercostal muscles relax, volume of 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	Lung volume spirometers Make a model of the lung using plastic cups, balloons and straws	Alveoli – (PIE – '*aulo*' cavity) Air sacs of the lungs for gaseous exchange. Trachea – (Greek '*trakheia arteria*', meaning rough artery) A flexible tube connecting the mouth to the bronchi that is supported by rings of cartilage. Air flows through it. Bronchus/Bronchi – (Greek '*bronkhos*, meaning windpipe or throat) Tubes that connect the trachea to the bronchioles. Air flows through them. Bronchiole – (Diminutive of bronchus) Small tubes that connect the bronchi to the alveoli. Air flows through them. Diaphragm – (Greek '*Diaphragma*', meaning barricade) A sheet of smooth muscle below the lungs that contracts and relaxes to assist breathing. Diffusion – (French '*diffundere*' to scatter) Particles passively move from high to low concentration. Mammals Can Use Their Intestines to Breathe | The Scientist Magazine® (the-scientist.com) What's the longest a human can hold their breath underwater? | BBC Science Focus Magazine	
8B10	**How does oxygen reach our cells?**	The circulatory system includes the heart and blood vessels		Circulation – (Latin '*circulare*' circle) The movement of blood around the body.	

		Heart as a pump that pushes blood around the circulatory 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)		Artery – (Greek '*arteria'*, meaning artery) An elastic, thick-walled blood vessel that transports blood from the heart under high pressure. Capillary – (Latin '*capillaris'*, meaning hair-like) Tiny blood vessels with one cell-thick walls. Site of exchange of substances between the blood and body cells. Vein – (Latin *'vena'* Blood vessel) A thin-walled blood vessel with valves that transports blood back to the heart under low pressure. Haemoglobin – (Greek '*haimos*', meaning blood, and '*globulin'*, meaning blob) A protein that oxygen binds to on red blood cells. Spinach Leaf Transformed Into Beating Human Heart Tissue | National Geographic Landmark pig heart transplant was a big leap forward in 2022 | New Scientist	
8B11	**What happens to the food we eat?**	Main food groups with sources and functions • Protein – growth and repair. Fish, meats, pulses. • Fat – energy and insulation. Oils, butter, dairy, meats. • Carbohydrates – energy. Pasta, rice, potatoes. • Fibre – aids digestive transit. Wholegrains cereals. • Vitamins (e.g. vitamin B/C) and minerals (e.g. calcium/potassium) – Maintain	**Food tests** Protein – biuret Fats – ethanol emulsion Carbohydrates (starch) – iodine Reducing sugars/glucose – Benedict's	Digestion – (Latin '*dis'* apart, *'gerere'* carry) Process of breaking down and absorbing nutrients. Enzyme – (Greek '*enzymos'* leavened) Globular proteins which speed up chemical reactions in the body. Nutrition – (Latin '*nutritionem'* nourishing) Organisms absorb food and build into living tissue.	

		healthy processes and structures. Fruit and veg. • Water – needed for bodily processes and structures Organs involved in the digestive system and their function: • Mouth – Mechanical break-down of food. Mixes food with saliva (contains enzymes which break down carbohydrates) • Oesophagus – Pushes food down to the stomach (peristalsis – links to smooth muscle) • Stomach – Contains hydrochloric acid (contains enzymes that break down proteins) • Liver – produces bile to neutralise stomach acid and emulsify lipids. • Small intestine – absorbs nutrients • (contains enzymes that break down lipids and carbohydrates) • Large intestine – absorbs water • Rectum – stores faeces • Anus – ring of muscle allows egestion. 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 Probiotic bacteria in the intestines. Useful bacteria which aids digestion and fights off harmful bacteria e.g. lactobacillus which is		Fat – (PIE '*peie*' to swell) Macronutrient for deep energy store and insulation. Carbohydrates – (Chem: 'Carbo' Carbon, from the Latin '*carbonem*', meaning coal, 'Hydro' Hydrogen, from the Greek '*hydros*' and '*gen*', meaning to create (give birth to) water, '-ate' Oxygen, from the practice of ending Latin nouns in '*-atus*') Macronutrient for energy. Protein – (Greek '*proteios*' first quality) Macronutrient for growth and repair. Fibre – (Latin '*filum*' a thread) non-digestible food group made from plant cell walls, healthy digestive transit. Vitamins – (Latin '*vita*' life, '*amine*' presence of NH_3 group, derived from 'ammonia', itself derived from the initial discovery of ammonia salts near a ruined Libyan temple to Zeus-Ammon (like the word 'ammonite') Compounds needed for healthy body processes. Minerals – (Latin '*minerale*' something mined) inorganic substance needed to build body structures. Lipids – (Greek '*lipos*' grease) another word for 'fat'. Oesophagus – (Greek '*osein*' to carry, '*phagos*' to eat) food pipe from throat to stomach. Peristalsis – (Greek '*peri*' through, '*stalsis*' constriction)	

		found in yogurt and helps digest lactose. Bifidobacterium found in dairy products, helps with IBS.		Contraction of smooth muscle to move food through digestive system. Liver – (German '*leber',* possibly from PIE '*leip-*', meaning to stick, or fat) organ in the body which breaks down toxins. Bile – (Celtic '*bystel*') Substance which neutralises stomach acid and emulsifies fats. Intestine – (Latin '*intestinus*' internal) Lower part of the digestive system. Rectum – (PIE '*reg-*' to straighten) Final part of the large intestine which stores faeces. Anus – (Latin '*anus*' ring) Ring of muscle through which faeces are egested. Bowel – (Latin '*botellus*' sausage) The large intestine. Probiotic – (Greek '*pro*' before, Latin '*bioticus*' life) Drinks containing live beneficial bacteria. Egestion – (Latin '*egestio*' to discharge) Removing faeces from the body. - Poor diets damaging children's health, warns UNICEF - Unicef UK What does the appendix do? finally an answer! (news-medical.net)	
8B12		Balanced diet proportions including water. Deficiency diseases as a result of malnutrition		Diet – (French '*diete*') the food one eats.	

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	What are the effects of poor diet and lifestyle?	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 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. Effects of drugs Stimulants e.g. nicotine, amphetamines Depressants e.g. alcohol, heroine Painkillers e.g. paracetamol, morphine Hallucinogens e.g. laughing gas, magic mushrooms.	CVD leading cause of death in the world – 17.9 million in 2021 Caffeine and reaction times.	Deficiency – (Latin '*deficentia*' to fail) to eat too little of a required nutrient. Malnutrition – (Latin '*malus*' bad, '*nutritionem*' nourishing) Condition caused by consuming the too much or too little of a nutrient. Symptoms – (Greek '*syn*' together, '*piptein*' to fall) Observable characteristic of a disease. Nutrients – (Latin '*nutriens*' to nourish) substances from food required by the body. Lactose – (Latin '*lac*' milk, '*osus*' full of) Sugar in milk. Environment – (Latin '*en*' in, '*viron*' circle, '*-ment*' result of) Conditions in which an organism lives. Obesity – (Latin '*ob*' because of, '*ese*' food) Having excess body fat. Cirrhosis – (Greek '*kirros*' yellow, '*osis*' condition) Disease of the liver. Dehydration – (Latin '*de*' down, Greek '*hydro*' water) Condition where body has too little water. Cardiovascular – (Greek '*Kardia*' Heart, Latin '*vascularis*' vessels) System including heart and blood vessels. Blood – (PIE '*bhel*' to thrive) fluid which circulates in blood vessels.	

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				Behaviour – (Old English '*be'* about, '*havour'* to possession) The actions of an organism. Stimulant – (Latin '*stimulus'* pointed stick, '*ant'* agent) A drug which increases nervous activity. Depressant – (Latin '*deprimere'* press down, '*ant'* agent) A drug which reduces nervous activity. Painkiller – A drug which relieves pain. Hallucinogen – (Latin '*alucinari'* dream, 'gen' to make) A drug which induces false experiences. Coordination – (Latin '*coordinare'* arrange) To control one's fine movements. Poor diets damaging children's health, warns UNICEF - Unicef UK Australia to prescribe MDMA and psilocybin for PTSD and depression in world first (nature.com) – but is it actually safe?	
8B13	Can DNA contain diseases?	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. Other inherited diseases to include cystic fibrosis (recessive) and Huntington's (dominant). Punnet squares to show probability of inheritance for these 2 inherited diseases.		Disease – (Latin 'dis' not, 'ease' comfort) Disorder of structure or function in the body. 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. 18 Common Genetic Disorders: 4 Types, Symptoms, Causes &	

				Human Genome (medicinenet.com) Cystic fibrosis chronicle: Why has the often-deadly CF gene not passed out of the human genome? And what new treatments are being developed? - Genetic Literacy Project	
8B14	**How can diseases spread?**	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)	How STI spreads – phenolphthalein demo Finger dabs – with different soaps (salty water, soap, had gel, control). Investigation into how effective washing hands is.	Microorganism – (Latin '*micro*' small) A living thing visible only through a microscope. Pathogen – (Greek '*pathos*' disease, '*gen*' to make) A microorganism which causes disease. Bacteria – (Greek '*bakterion*' small rod) Microorganism with cell wall but no nucleus or mitochondria. Virus – (Proto-Italian '*weis-o*' poison) Microscopic non-living entity which causes disease. Fungi – (Greek '*sphongos*' sponge) Spore producing organisms which feed on organic matter. Protist – (Greek 'proto' first) Single celled organism. Transmission – (Latin '*transmissio*' send across) To spread a pathogen from person to person. Hygiene – (Greek '*hygies*' healthy) Conditions for maintaining health and preventing disease. Physical – (Latin '*physica*' of nature, '*al*' relating to)	

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				Structures which are tangible or concrete. Chemical – (Greek '*khymatos'* to pour, '*al'* related to) substances which react with pathogens. Mucus – (Latin '*mucus'* slime) Thick sticky substance secreted by the body. Saliva – (Latin '*saliva'* spittle) Liquid containing amylase secreted by the mouth. Cordyceps zombie fungus takes over ants' bodies (nationalgeographic.com) Climate Change Bringing More Than Heat — Malaria And Dengue On The Rise (forbes.com)	
8B15	**How do organisms interact?**	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.	**Building Webs**	Biomass – (Greek '*bios'* life, '*massa'* lump) The dry organic matter in an organism. Producer – (Latin '*producere'* to bring forth) An organism that gets its energy from the sun/free-floating chemicals. Consumer – (Latin '*consumere'*, to eat) An organism that gets its energy from eating other organisms. Energy – (Greek '*energos'* active) Needed to make anything happen. Ecology of the Amazon rainforest (mongabay.com) Can ancient food webs help predict biodiversity collapse? | Natural History Museum (nhm.ac.uk)	

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8B16	**How do plants photosynthesise?**	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	**Testing a leaf for starch** **Pond weed investigating light as limiting factor**	Photosynthesis – (Greek '*photo*' light, 'synthesis' putting together) Chemical reaction in chloroplasts where glucose is made from carbon dioxide and water in the presence of sunlight. Chloroplast – (Greek '*chloros*', meaning green, and '*plastos*', meaning formed, molded) An organelle that carries out photosynthesis. Waxy cuticle – (Latin '*cuticula*' skin) Waxy layer on the outside of a leaf. Epidermis – (Greek '*epi-*' outer and '*dermis*' skin) The outer layer of cells covering an organism. Mesophyll – (Greek '*mesos*' meaning middle, and '*phyll*', meaning leaf) Tissues of the plant located in-between the epidermis. Stomata – (Greek '*stoma*' mouth) Openings on the bottom of a leaf that allow gases in or out. Guard cells – (Old French '*garder*', which is a corruption of Proto-Germanic '*wardon*', meaning to guard) Cells that can contract or relax to open or close stomata, controlling the flow of gases such as oxygen, carbon dioxide, or water vapour into or out of a leaf. Red light photosynthesis - - Diamond Light Source	

				Chemists discover why photosynthetic light-harvesting is so efficient | MIT News | Massachusetts Institute of Technology	
8B16i	**End of topic questions**	See PowerPoint for questions. Content covered is from the above lessons			

Year 9 biology composite / lesson sequence

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Purple indicates content for set 1s only

Code	Lesson/ composite title	Substantive knowledge/ components	Disciplinary knowledge	Disciplinary literacy- Keywords *(etymology)* and linked articles	Cultural Capital/ Personal Development
9B1	**What can you remember about cells?**	Recap plant and animal cells Recap these cells can differentiate into specialised cells Recap specialised cells to include; red blood cells, root hair cells, egg cell, sperm cell Introduce the function and adaptations of; • Palisade cells-lots of chloroplasts • Sensory neurone-myelin sheath • Cells with microvilli-large surface area • Ciliated epithelial cells-cilia on the surface which move substances along	Use of microscopes to calculate magnification and actual size of specialised cells	Cell (Latin '*cella*', as in room-monastery/prison) Organelle (Latin- '*organ*'- instrument) Nucleus (Latin- '*nucleus*' kernel of a nut) Cytoplasm (Greek '*cytos*'-cell, '*plasm*' as in fluid) Cell membrane (Latin- '*membrana*' - a writing skin) Chloroplast (Greek '*chloro-*' pale green, '*plast-*' granule) Vacuole (Latin- diminutive of '*vacuus*'- empty) Neurone (Greek '*neura*' bowstring) A nerve cell Myelin sheath (Greek – '*myelos*' innermost part) Microvilli (Greek '*mikros*' very small, '*villus*' hair) History of the Cell: Discovering the Cell | National Geographic Society The world's largest bacteria are visible to the naked eye | Natural History Museum (nhm.ac.uk)	
9B2	**How are substances transported?**	Recap diffusion as the movement of particles from high concentration to low concentration Concentration gradient 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.	Diffusion demo with jelly Diffusion practical with agar Osmosis in potatoes	Concentration (Latin '*con*' together, 'centrum' middle) Gradient (Latin '*gradi*' to walk) Passive (Latin '*passivus*' capable of feeling pain) Does not need energy input Diffusion (Latin '*diffusus*' to pour away) Osmosis (Latin '*endosmose*' inwards passage of fluid through a membrane) Osmotic Diarrhea: Symptoms, Causes, Treatments (healthline.com)	

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				Scientists Create Artificial Cells That Mimic Living Cells' Ability to Capture, Process, and Expel Material (nyu.edu)	
9B3	**How are substances transported in plants?**	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. Translocation – movement of sucrose around the plant via the phloem **Tropisms in plants.** **Positive phototropism – growth towards light** **Negative phototropism – growth away from light** **Auxins move away from light and cause the elongation of cells in roots.**	Potometers for transpiration Coloured celery to show transpiration Stomata under the microscope Transpiration Circus	Photosynthesis (from Greek '*photo-*' light + '*synthese*' to make) Adaptation (Latin '*adaptare*' to adjust) Epidermis (Greek '*epidermis*' the outer skin) Palisade (Latin '*palus*' for stake) Transpiration (Latin '*trans*' "across, beyond, on the other side of, to go beyond + '*spirare*' to breathe) Stomata (Greek '*stoma*' (genitive '*stomatos*') mouth; mouthpiece; talk, voice; mouth of a river; any outlet or inlet) Xylem (from Greek '*xylon*' wood) Translocation (Latin '*trans*' "across, beyond, on the other side of, to go beyond + Latin '*locatio*' position, place; fact or condition of being in a particular place) Phloem (Greek '*phloos*' for tree bark) Potometer (Greek '*potos*' for drink, flow) Transpiration in Plants | Nature Time to dip a gardening toe into quirky hydroponics | Gardens | The Guardian	
9B4	**What are 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 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	Starch and amylase at different temperatures and pH Focus on variables	Enzyme (Greek '*enzymos*' leavened) Protease (Latin '*proto*' first, '*ine*' like, '*ase*' to do with enzymes) Amino (containing an amine group, from the name for the Egyptian god Amon) Amylase (Latin '*amylum*' starch, '*ase*' to do with enzymes) Synthesis (Greek '*synthesis*' - putting together)	

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				New super-enzyme eats plastic bottles six times faster | Plastics | The Guardian Lactose tolerance evolved in Europeans thanks to famine and disease | BBC Science Focus Magazine	
9B5	**How is our body adapted for food absorption?**	Recap digestive organs from year 8 to include; mouth, oesophagus, stomach, small intestine, large intestine, rectum, anus, liver and pancreas Small intestines contain specialised cells micro-villi, large surface area, thin walls, short diffusion distance, moist lining and good blood supply	Model gut- test for glucose and starch (recap tests from year 8)	Oesophagus (Greek '*oisophagus'* carry and eat) Stomach (Greek '*stoma'* opening) Intestine (Latin '*intestinum'* meaning gut) Anus (Latin '*anus'* meaning ring) Liver (German '*Leber'* liver) Pancreas (Greek '*pankreas'* sweetbread) Villi (Latin '*villus'* hair) Diffusion (Latin '*diffusus'* to pour away) Digestion: Anatomy, physiology, and chemistry (medicalnewstoday.com) Artificial pancreas successfully trialled for use by type 2 diabetes patients | University of Cambridge	
9B6	**How does blood travel around our body?**	Recap Circulatory system from year 8 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.	Heart Dissection (DEMO or PRAC check with Paul) White and red blood cell microscope slides? (check with prep)	Atrium (Latin '*atrium'* first main room) Ventricle (Latin '*ventriculus'* little belly) Aorta (Greek '*aorte',* a strap to hang from) Vena cava (Latin '*vena'* vein, '*cava'* hollow) Pulmonary (Latin '*pulmo'* lungs) Artery (Greek '*arteria'* arteries, wind pipe) Vein (Latin '*vena'* blood vessel) Platelets (Diminuitive adaptation of Latin '*platus'* – little plate) US faces worst blood shortage in over a decade amid pandemic | US healthcare | The Guardian 5 Animals Whose Blood Isn't Red | HowStuffWorks	

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9B7	**What is respiration?**	Recap respiratory system from year 8 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	Blow into limewater Respiration Circus	Asthma (Greek '*azein*' "breathe hard,") Bronchitis ('*bronchia*' "the bronchial tubes"***-itis*** "inflammation.") Respiration (Latin *'respirare'* to breathe) Emphysema (Greek '*emphysema*' "swelling, inflation") Aerobic (Greek 'aero- ' air + 'bios' life) Anaerobic (Greek '*an-*' without + '*aēr*' air + '*bios*' life) Asthma (who.int) Chief Medical Officer for England on vaping - GOV.UK (www.gov.uk)	
9B8	**How does exercise effect our bodies?**	Short term effects of exercise to include; increased heart, breathing and respiratory rates Long term affects to include; build-up of lactic acid and oxygen debt	Measuring heart and breathing rates with stop clocks Oximeters and Lung volume practical/peak flow meters? CalcuLating cardiac output	Cardiac (Greek '*kardia*' heart) Glucose (Greek *'gleukos'* meaning a type of sweet wine) Lactic (Greek '*laktos*' meaning milk – lactic means procured from milk in the chemical name lactic acid, which is so called because it was obtained from sour milk Altitude Training: Does It Work and How to Do (healthline.com) Scientists discover why Sherpas are superhuman climbers | CNN	
Mid topic review					
9B9	**How do we respond to our environment?**	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 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	Pin practical Ruler drop reaction time Stimuli circus – knee jerk reaction, pupil reaction, smell reaction, touch reaction, taste reaction, sound reaction	Spine Latin '*spina*' backbone Neurones (Greek '*neura*' bowstring) A nerve cell Stimulus (Latin '*stimulus*' a goad, a pointed stick) Receptor (Latin '*recipere*' to hold) Impulse (Latin '*in-*' into, in, on, upon + '*pellere*' to push, drive)	

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		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.		Myelin Sheath Disorders: Types, Causes, Symptoms, and Treatments (healthline.com) Octopuses Not Only Feel Pain Physically, But Emotionally Too, First Study Finds : ScienceAlert	
9B10	**What is the brain?**	Brain structure and regions Medulla oblongata – connects brain to spinal cord. Controls reflexes such as sneezing, vomiting, swallowing Cerebellum – controls balance and posture, 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 **Problems with the brain and spinal cord** - **Nerve damage causes loss of feeling in legs** - **Damage in neck can lead to quadriplegia** - **Brain tumours (caused by cancer cells) can squash parts of the brain and stop them working** - **Can be treated with chemotherapy or radiotherapy**	• Phineas Gage • Brain models	Brain (Proto-Germanic '*Bragnan'* brain) Medulla oblongata (influenced by Latin '*medius'* middle) Reflex (Latin '*reflexus'* a bending back) Cerebellum (Latin '*cerebellum'* a small brain) Cerebral cortex (Latin *'cortex'* outer shell, husk) Hemisphere (Greek '*hēmisphairion'*, from '*hēmi-*' half) 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	
9B11	**What do hormones do?**	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.	Menstrual Cycle bracelets/Reproductive models	Hormone (Greek '*hormon'* that which sets in motion) Endocrine (from '*endo-*' in + Latinized form of Greek '*krinein'* to separate, distinguish (from PIE root ***krei-* to	

		Pituitary gland secretes growth hormone and FSH and LH. Thyroid which releases thyroxine Adrenal gland releases adrenalin Pancreas releases insulin Testes releases testosterone Ovaries release progesterone and oestrogen **Negative feedback of thyroxine to regulate metabolism.** 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 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	Show types of contraception	sieve). Denoting glands having an internal secretion. Pituitary (Latin '*pituitarius*' mucous) Taken as the name for the gland because it was believed that it channelled mucus to the nose Thyroid (from Greek (*thyreoeides)* shield-shaped) Adrenal (Latin '*ad-*' + '*renalis*' of the kidneys) Testes (Latin '*testis*' testicle, although can also mean witness) Ovaries (Latin '*ovum*' egg) Menstrual (Latin 'menstrualis' "monthly,") Oestrogen (Greek '*oistros*' passion + Greek '*gen*' to create) Progesterone (Latin '*gestare*', literally "to carry about", on notion of "substance which favours gestation.") Artificial (from '*artificium*' a work of art; skill; theory, system) Reproductive (French '*re-*' meaning again + Latin '*producere*' bring forth) Contraception (contra – against conception) Adrenaline Anxiety: What Is It, And How Can You Manage It? (healthmatch.io) Male contraceptive pill prototype stops sperm swimming - BBC News The weird reasons there still isn't a male contraceptive pill - BBC Future	
9B12	**How can we modify an organism?**	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.	Dolly the sheep Cloning practical using geraniums (can the students take them home?) or strawberry plants in the summer	Species (Latin '*species*' a particular sort, kind, or type) Offspring (literally "those who spring off (someone)," from of "away, away from") Hybrid (Variant of Latin '*ibrida*' mongrel)	

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		Example to include the process of modifying bacteria to produce insulin - **Restriction enzymes cut the insulin gene and plasmid** - **Leaving unpaired bases 'sticky ends'** - **Ligase joins them together** 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, to grow lots of new individuals quickly and cheaply.	Super cows https://youtu.be/IDN-QeVhQTc	Characteristics (Greek '*kharaktēristikos'* related to a unique mark (character/*kharakter*) Genetic (from Greek '*genesis'* origin) Genome (portmanteau of gene (from Greek '*gen'* to create) + chromosome (Greek '*chroma'* colour + '*soma'* body)) Cloning (Greek '*klados'* sprout, young branch, offshoot of a plant) Nucleus (Latin '*nucleus'* kernel of a nut) Zygote (Greek '*zygotos'* -yoked) Surrogate (Latin '*surrogatus'* put in another's place, substitute) Genetically Modified Organisms | National Geographic Society New Human Embryo Models Spark Needless Controversy - Scientific American	
9B13	**How do organisms evolve?**	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. Antibiotic resistance used as evidence for evolution	Bird seed practical Human Skull models Charles Darwin and his voyage Fossils Tank (into year 7 scheme or year 9?)	Evolution (Latin '*evolutionem'* unrolling (of a book)) Fossil (Latin 'fossilis' dug up) *Ardipithecus* (Latin '*ardi'* for ground + Greek '*pithecus'* ape) *Australopithecus* (Latin '*australo-'* Southern + Greek *'pithecus'* ape) *Homo* (Latin for man) *habilis* (Latin for handy) *erectus* (Latin for upright, elevated) *sapiens* (Latin for thinking) Extinction (Latin *extinctus/exstinctus* to put out, quench; go out, die out; kill, destroy) human evolution | History, Stages, Timeline, Tree, Chart, & Facts | Britannica	

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				Is there any evidence that humans are still evolving? (medicalnewstoday.com)	
9B14	**How do species interact?**	Define Interdependence – organisms depend on each other for survival Define biodiversity - is 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 **Assessing pollution using indicator species** - **Lichens** - **Black spot fungus**	Indicator species Work of ecologists and case studies (articles)	Interdependence (inter – between. Dependence "reliance, confidence, trust.") Biodiversity (bio – living. Diversity - "variety) Ecosystem (Portmanteau of 'ecology' (Greek '*ekoi*' house/dwelling + '*logia*' study of) and 'system' (Greek '*systema*', meaning system)) Eutrophication (Greek '*eutrophos*' well-nourished) Bioaccumulation (Greek '*bios*' living + Latin '*accumulationem*' to heap something up) Conservation (Latin '*conservationem*' (nominative '*conservatio*') a keeping, preserving, conserving) Gene (Greek '*gen*' give birth, beget) Knepp Safaris Ecological tipping points could occur much sooner than expected, study finds | Environment | The Guardian Will We Ever Get A Jurassic Park? | IFLScience	**Microplastics**
9B15	**How can we use microorganisms?**	Recap Microorganisms as very small living things Focus on not all microorganisms cause disease Anaerobic respiration in yeast produces ethanol and carbon dioxide Uses of biotechnology to include; • Food production (Quorn production, cheese, yoghurt, fermentation for the production of alcohol) • Bio vs non-bio washing powders • Biofuels • Farming	Food production What is Biotechnology? | BIO	Microorganism (very small living thing) Pathogen (Greek '*pathos*' illness + '*gen*' creating/giving birth to) Bacterium/bacteria (Greek '*baktron*' small rod) Virus (Proto-Italic '*weisos*' poison) Fungus/Fungi (Latin '*fungus*' mushroom) Fermentation (Latin '*fermentum*' leaven, yeast; drink made of fermented barley)	

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				Yeast (Proto-Indo-European '*yes-*' meaning to froth) Alcohol (Arabic *'al-kuhul'* meaning kohl, a fine metallic powder used to darken the eyelids) Use of Microorganisms as Important Household / Industrial Products (yourarticlelibrary.com) Sourdough Starters, How They Work (foodunfolded.com) Does the microbiome hold the key to chronic fatigue syndrome? | Medical research | The Guardian	
9B16	**How are we protected from microorganisms?**	Recap chemical and physical barriers from year 8 Microorganisms as pathogens Immune system – • Exposure to pathogen • Antigens trigger an immune response which causes the 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 Antibiotic resistance used as evidence for evolution	Fleming and his penicillin discovery Antibiotics practical – (Link back to tissue culture)	Pathogens (Greek '*pathos'* illness + *'gen'* creating/giving birth to) Immune (Latin '*immunitatem'* meaning exempt from public service) Antigen (from antibody (see etymology below) + Greek '*gen'* to create) Lymphocytes (Latin '*lympha*' clear water + Greek '*cytos'* a cell) Antibody (Latin '*anti-*' against + Old High German '*botah'* body Vaccination (from vaccine (adj.) "pertaining to cows, from cows") Antibiotics (Latin '*anti-*' against + Greek '*bios'* of life) Physical and Chemical Barriers | The Immune System (nigerianscholars.com) Anatomical and Physico-chemical barriers of immune system - Online Biology Notes	
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 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 changes in the shape of the active site B1.9 Explain the effects of temperature, substrate concentration and pH on enzyme activity	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. 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 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	**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 **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	Organelle *(latin- organ- instrument)* Nucleus *(latin- kernel of a nut)* Cytoplasm *(cyto- cell, plasm as in plasm- fluid)* Cell wall 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)* Microscope *(micro-small, scope- instrument for seeing)* Magnification *(magnificare- make greater)* Focus *(point of convergence-fireplace)* Resolution *(breaking into parts)* Lens *(from lentil shape!)* Unicellular *(uni- having one only- unicycle, unisex, unique)* Multicellular *(multi- many)* Bacterium/ bacteria as plural *(Greek- bakterion- small rod)* Plasmid *(from plasm)* Chromosomal DNA Flagellum *(Latin-whip)* Specialised cell Differentiated *(different)* Enzyme *(Greek 'enzymos' leavened)* Protease *(latin 'proto' first, 'ine' like, 'ase'enzyme)* Amino *(containing an amine group)* Amylase *(latin 'amylum' starch, 'ase' enzyme)* Synthesis *(Greek - putting together)* 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)*

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	Transport B1.15 Explain how substances are transported into and out of cells, including by diffusion, osmosis and active transport **Separate Sciences Only** B1.14 Explain how the energy contained in food can be measured using calorimetry	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. 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.	**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. **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 **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.	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 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)

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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 B2.3 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 B2.8 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 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	B2.7 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 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	**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 -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 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	Sexual *(Involving sex)* Asexual *(A-not as in atypical, asymmetric)* Zygote*(Greek Zygotos -yoked)* Mitosis – (Greek 'mitos' warp thread, 'osis' act) Cellular division which creates clones Diploid – (greek 'diploos' – double) having two sets of chromosomes Interphase – 'inter' between. DNA replicates before cell division Prophase – (Greek 'prophasis' – that which appears) Nucleus dissolves, DNA appears. Metaphase – (Greek 'meta' – changed, 'phase' – stage) Chromosomes line up and spindle fibres attach Anaphase – (Greek 'an' – backwards, 'phase' – stage) Chromosomes are pulled towards poles Telophase – (Greek 'telo' – the end, 'phase' – stage) New nuclei form around chromosomes Cytokinesis – (Greek 'cyto' – cell, 'kinesis' – to move) – New cells cleave apart Stem cells - (German 'Stammzelle') Undifferentiated cells which give rise to specialised cells Spine *Latin spina "backbone,"* Neurones *(Greek 'neura' bowstring) A nerve cell* Stimulus *(Latin stimulus "a goad, a pointed stick," figuratively "a sting, a pang; incitement, spur,")* Receptor Impulse *(in- "into, in, on, upon" + pellere "to push, drive")* Medulla oblongata (influenced by *medius* "middle.") Reflex *(Latin reflexus "a bending back,")* Cerebellum (*Latin cerebellum "a small brain,")* Cerebral cortex *("outer shell, husk;")* Hemisphere *(Greek hēmisphairion, from hēmi- "half")* 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)*

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	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 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		**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 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, 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.	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 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

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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 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 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 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	Following method- controlling temperature- precipitation as separation technique- DNA Extraction 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 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)	**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. 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 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	Meiosis – (Greek ‘mei’ make smaller, ‘osis’ biological condition) – Haploid gamete cells are made Fertilisation *(French-make productive)* Haploid *(Greek Haploos - Single)* Diploid *(Greek Diploos - Double)* Gamete *(PIE root gem – to marry)* Zygote*(Greek Zygotos -yoked)* Sexual *(Involving sex)* Asexual *(A-not as in atypical, asymmetric)* DNA *(deoxy-one less oxygen, nucleic- nucleus, acid)* Chromosome *(chroma- colour as it was seen when took up stain)* Double Helix *(a spiral thing)* Base *(bottom/foundation)* Environmental *(French- environ- around)* Genetic *(Greek- genetikos- origins of)* Continuous *(Latin- following after another)* Discontinuous *(dis-not)* Variation *(French- variacion- difference)* Genes *(From Greek genea- generation/race)* Inherit *(old French- to make someone an heir)* Mutation *(French and Latin- a process of changing)* Characteristic *(Greek- character)* Variation – (Latin ‘variatonem’ a difference) Differences between organisms Characteristic – (Greek ‘kharakter’ symbol) physical properties of an organism Gene – (PIE ‘gen-‘ give birth) A sequence of DNA coding for a characteristic Allele (allelomorph) – (Greek ‘al’ other, ‘morph’ form) Different versions of a gene Disease – (Latin ‘dis’ not, ‘ease’ comfort) Disorder of structure or function in the body 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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	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 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 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 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		discontinuous- can be easily observed and only have certain values. **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. 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)

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	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 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	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		
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 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	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 diagrams, bar charts and histograms Plot and draw appropriate graphs, selecting appropriate scales for axes- Data analysis opportunity linked to Genetic Engineering/ Selective Breeding	**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: • 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.	Classification *(put into a class)* Kingdom (state of the King) Species *(Latin- a particular sort or type)* Binomial *(Latin- having two names)* Specimen *(Latin- indication/ mark/ evidence)* Vertebrate *(Latin- joint or articulation of the body)* Invertebrate *(in- not or without)* (Viviparous) *(Latin- bringing forth alive)* (Oviparous) *(Latin- that produces eggs)* Domain *(French domaine-belonging to a Lord)* Eukarya *(Greek eu-true/well, karyon-nucleus- truly have a nucleus)* Archaea *(Latin from Greek- primitive)* Bacteria as plural *(Greek- bakterion- small rod)* Adaptation *(Latin- to have adjusted)* Habitat *(Latin- habitare- to live in)* Environment *(French- environ- around)* Camouflage *(20th century Parisian slang- to disguise)* Competition *(Latin- rivalry- link to school House/ spots competitions)* Predator *(Latin- to rob)* Prey *(Latin- booty/plunder)* Autotroph *(Auto- self, troph- pertaining to food)*

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	B4.10 Describe genetic engineering as a process which involves modifying 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 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 demands of a growing human population, including use of fertilisers and biological control	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 population/ food supply and demand	• 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. 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) 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	Heterotroph *(Hetero- Greek- different)* Species *(Latin species "a particular sort, kind, or type")* Offspring *(literally "those who spring off (someone)," from of "away, away from")* Hybrid *(ariant of ibrida "mongrel,")* Characteristics 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)* Zygote *(Greek Zygotos -yoked)* Surrogate *(Latin surrogatus "put in another's place, substitute,")* Evolution *(Latin evolutionem (nominative evolution) "unrolling (of a book))* Fossil *(Latin fossilis "dug up,")* Ardipithicus ramidus *(Afar language- Ardi-ground/floor, ramid- root, pithicus-Greek-ape)* Australopithicus *(Greek-southern ape)* Homo habilis (Homo-man, habilis "handy"-link to tools) Homo erectus *(erectus "upright, elevated")* Homo sapiens *(sapiens- intelligent)* extinction *(Latin extinctus/exstinctus "to put out, quench; go out, die out; kill, destroy")* 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 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

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			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. 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 Antibiotic resistance used as evidence for evolution	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)
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, many forms of cancer, some lung and liver diseases and diseases influenced by nutrition	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.	Bacterium/ bacteria as plural *(Greek- bakterion- small rod)* Plasmid *(from plasm)* Chromosomal DNA Flagellum *(Latin-whip)* Aseptic technique *(a- not- asexual, atypical, septic- Latin septikos- rotten, putrid)* Sterile *(French- not producing fruit)* Agar plate *(from name of algae)* Petri dish *(after German bacteriologist)* Microorganism *(small, living thing)* Probiotic – (Latin 'pro' before, 'bioticus' life) Drinks containing live beneficial bacteria Microorganism – (Latin 'micro' small) A living thing visible only through a microscope

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	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 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 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	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 and lung cancer, alcohol consumption and cirrhotic liver disease.	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) 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 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	Pathogen – (Greek 'pathos' disease, 'gen' to make) A microorganism which causes disease Bacteria – (Greek 'bakterion' small rod) Microorganism with cell wall but no organelles Virus – (Pro-italian 'weis-o' poison) Microscopic non-living entity which causes disease Fungi – (Greek 'sphongos' sponge) Spore producing organisms which feed on organic matter Protist – (Greek 'proto' first) Single celled organism Transmission – (Latin 'transmissio' send across) To spread a pathogen from person to person Hygiene – (Greek 'hygies' healthy) Conditions for maintaining health and preventing disease Physical – (Latin 'physica' of nature, 'al' relating to) Structures which are tangible or concrete Chemical – (Greek 'khymatos' to pour, 'al' related to) substances which react with pathogens Mucus – (Latin 'mucus' slime) Thick sticky substance secreted by the body Saliva – (Latin 'saliva' spittle) Liquid containing amylase secreted by the mouth Diet – (French 'diete') the food one eats Deficiency – (Latin 'deficentia' to fail) to eat too little of a required nutrient Malnutrition – (Latin 'malus' bad, 'nutritionem' nourishing) Condition caused by consuming the too much or too little of a nutrient Symptoms – (Greek 'syn' together, 'piptein' to fall) Observable characteristic of a disease Nutrients – (Latin 'nutriens' to nourish) substances from food required by the body Lactose – (Latin 'lac' milk, 'osus' full of) Sugar in milk Environment – (Latin 'en' in, 'viron' circle, '-ment' result of) Conditions in which an organism lives Obesity – (Latin 'ob' because of, 'ese' food) Having excess body fat Circulation – (Latin 'circulare' circle) The movement of blood around the body Haemoglobin – a protein that oxygen binds to on red blood cells Cirrhosis – (Greek 'kirros' yellow, 'osis' condition) Disease of the liver

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	b chemical defence, including lysozymes and hydrochloric acid B5.13 Explain the role of the specific immune 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 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 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	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 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 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-	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 • 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 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	Dehydration – (Latin 'de' down, 'hydor' water) Condition where body has too little water Cardiovascular – (Greek 'Kardia' Heart, Latin 'vascularis' vessels) System including heart and blood vessels Blood – (PIE 'bhel' to thrive) fluid which circulates in blood vessels Behaviour – (Old English 'be' about, 'havour' to possession) The actions of an organism Stimulant – (Latin 'stimulus' pointed stick, 'ant' agent) A drug which increases nervous activity Depressant – (Latin 'deprimere' press down, 'ant' agent) A drug which reduces nervous activity Coordination – (Latin 'coordinare' arrange) To control ones fine movements Alveoli – (PIE – 'aulo' cavity) Air sacs of the lungs for gaseous exchange Diffusion – (French 'diffundere' to scatter) Particles move from high to low concentration Pathogens *(pathogene, "disease-producing micro-organism,")* Immune Antigen *(German Antigen, from French antigène (1899), from anti(body))* Lymphocytes *(lympho- "lymph" + **-cyte** "a cell.")* Antibody Vaccination *(from vaccine (adj.) "pertaining to cows, from cows")* Antibiotics *(from anti- "against" + biotique "of (microbial) life,")* Asthma *(from azein "breathe hard,")* Bronchitis *(bronchia "the bronchial tubes"-**itis** "inflammation.")* Emphysema *Greek emphysema "swelling, inflation")* Aerobic *(Greek aero- "air" + bios "life,")* Anaerobic *(an- "without" aēr "air" + bios "life,")* Lactic *("procured from milk," in the chemical name lactic acid, which is so called because it was obtained from sour milk* Atrium *(latin – first main room)* Ventricle *(latin 'ventriculus' little belly)*

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	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 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 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	measure radius and CALCULATE C/S AREA EXPLICITLY 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. 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.	• 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 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	Aorta *(latin a strap to hang from)* Vena cava *(latin 'vena' vein, 'cava' hollow)* Pulmonary *(latin 'pulmo' lungs)* Artery *(Greek 'arteria' wind pipe)* Vein *(latin 'vena' blood vessel)* Platelets *(English – little plate)* 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 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)
CB6 Plant Structures	B6.1 Describe photosynthetic organisms as the main producers of food and therefore biomass		**Year 7** Plant cell structure to include:	Organism *(organic)* Organelle *(latin- organ- instrument)*

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and their Functions **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 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 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	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? 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	• Nucleus • Membrane • Cytoplasm • Ribosome • 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. • 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	Nucleus *(latin- kernel of a nut)* Cytoplasm *(cyto-cell, plasm as in plasm- fluid)* Cell wall 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,")* 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

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	B6.12 Explain the effect of environmental factors on the rate of water uptake by 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, 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	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 πr2- Leaf adaptation Plot, draw and interpret appropriate graphs- Graphs to show effects of hormones (concentration etc) in yield/ fruiting times etc.	**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. 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	Intro to cells (article) | Khan Academy Response and Adaptation by Plants to Flooding Stress | Annals of Botany | Oxford Academic (oup.com) 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
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 **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**	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. Construct and interpret frequency tables and diagrams, bar charts and histograms. Translate	**Year 7** Male structure names and function to include: • Penis • Testis • Sperm duct • Scrotum • Prostate Female structure names and function • Uterus (highlight lining) • Ovaries • Vagina • Cervix • Oviduct Changes during puberty- to include: • pubic hair • changes in body shape	Penis *(French-tail)* Vagina *(Latin-sheath, scabbard)* Genitals *(Latin- genitalis-birth)* Sperm *(French-esperme-seed)* Egg Testis *(Latin- witness as in testimony)* Sperm Duct *(vas deferens- vas- vessel)* Semen *(Latin-seed)* Glands (Latin- glans-acorn) Scrotum *(Latin-scortum-a hide made of skin)* Ovary *(Latin-ovum-egg)* Oviduct (Ovum-egg, duct-tube) Uterus *(Latin-womb,belly)* Cervix (Latin-neck) Prostate *(Greek prostates- a leader standing in front)* Erection *(Latin-to stand up)*

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	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 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** **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	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- 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 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 more	• 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. 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 • 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	Hormone *(Greek- hormone- which sets in motion)* Puberty *(Latin- pubertatem- age of maturity)* Adolescence *(Latin/old French- youth)* Menstrual Cycle (Latin-monthly) Menopause (Latin- monthly, cease) Oestrogen *(Greek-gen- to bring about, estrus- madness, impulsiveness!!)* Progesterone *(pro- for, gestare- tto carry about)* Testosterone *(see testis)* Obesity – (Latin 'ob' because of, 'ese' food) Having excess body fat Disease – (Latin 'dis' not, 'ease' comfort) Disorder of structure or function in the body 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 Hormone *(Greek hormon "that which sets in motion,")* Endocrine *(from **endo-** in + Latinized form of Greek krinein "to separate, distinguish" (from PIE root ***krei-** "to sieve,"* thus "discriminate, distinguish"). Denoting glands having an internal secretion. Pituitary *(Latin pituitarius "mucous," Taken as the name for the gland because it was believed that it channeled mucus to t*he nose Thyroid *(from Greek thyreoeides "shield-shaped")* Adrenal *(from **ad-** + renalis "of the kidneys," from Latin renes "kidneys")* Testes Ovaries Menstrual *(Latin menstrualis "monthly,")* Oestrogen Progesterone *(Latin gestare, literally "to carry about", on notion of "substance which favors gestation.")* Artificial *(from artificium "a work of art; skill; theory, system,")* Contraception *(contra – against conception)* Articles:

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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 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 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	complex equation- Calculation of BMI and evaluation of health risks associated Ethics and challenges of organ transplantation- rejection, prioritisation etc.	• LH stimulates ovulation • Progesterone maintains the uterus lining If the egg is fertilised the progesterone levels remain 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	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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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 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 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 respiration in living organisms	Calculate surface area : volume ratios. Calculate areas of triangles and rectangles, surface areas and volumes of cubes- 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 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 frequency tables and diagrams, bar charts and histograms. Plot, draw and interpret appropriate graphs- Core Practical: Investigate the rate of respiration in living organisms		

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	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	Understand and use the symbol ∝, Solve simple algebraic equations- Fick's Law		
CB9 Ecosystems and Material Cycles **Year 11** *(Paper 2)*				

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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 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. Properties of metals	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 with burning and the action of acid on bicarbonate of soda*	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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		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		

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		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

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Year 7 chemistry lesson/composite sequence

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?**	Solids, liquids and gases State changes as examples of physical changes Basic particle diagrams	Drawing a table State of matter circus Research on different elements	State *(state of your room – condition)* Matter *(from the latin'materia' substance from which something is made)* Particles *(from the latin - a bit or fragment)* Energy *(active, action)* Physical Change *(from the latin 'natural')* Properties *(characteristics unique to that)* Solids *(from the Old French 'firm, dense, compact')* Liquids *(able to flow)* Gases *(from Greek khaos"empty space")* Temperature *(reference to taking your temperature – how hot or cold you are)* Boiling *(to bubble up)* Evaporation *(disperse in vapour or steam)* Condensation *(action or state of making or becoming more dense, link to windows are Bunsen burners used)* Melting *(Old English-meltan 'become liquid through heat' - link to chocolate in the sun)* Freezing *(turn to ice – link to water in a freezer)* Sublimation *(from Latin sublīmō 'I raise, I elevate'* Deposition *(to deposit – link to beaches – sand)* Vibrate *(move to andfro, link to musical instruments)* 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'. Examples to include the diffusing of smells and observing the diffusion	Modelling Pupil modelling	Fluid *– Fluid movement in Dance/'Our plans are still fluid' (flow easily, no fixed shape, change easily)* Diffusion - *Similar in meaning to spreading* Gradient - *Gradient of roads, road signs showing gradients, the degree of a slope* Brownian motion -*Named after Botanist Robert Brown. Random movement of particles in fluids (liquids and gases)* Articles:	

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		of potassium permanganate in water. Factors affecting diffusion (the effect of temperature on the rate diffusion) Brownian motion - random movement of particles originally observed in pollen grains.		Brownian motion | physics | Britannica Brownian motion | Nature	
7C3	**What is the universe made of?**	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	It's a model! Size of atom Greeks Scale of the universe model	Atom *(Ancient Greek átomos, " indivisible)* Nucleus *(Latin nucleus ("kernel, core"), a diminutive of nux("nut")* Proton *(Greek prōton, neuter of prōtos"first" - link to hydrogen as first element)* Electron *(link to electricity – flow of)* Neutron *(from neutral)* Nucleon *(from nuclear "of or like the nucleus of a cell")* 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. 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		Element *(From latin elementum "rudiment, first principle, matter in its most basic form")* Molecule *(extremely minute particle)* Formula *(Words used in ceremony or ritual, "a rule, method")* Pure *(unmixed, unadulterated, homogeneous)* Melting point *(From latin pungere "to prick, pierce")* Boiling point *(To bubble up, ferment, gush. From latin pungere "to prick, pierce")* Density *(Quality of being very close or compact)* Articles: Elements and new discoveries (birmingham.ac.uk) Oddball star could be home to long-sought superheavy elements | New Scientist	

		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			
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 - to excite, provoke)* Corrosive *(From Old French corroder - to wear away)* Harmful *(From old English haermian - to hurt, injure)* Toxic *(Latin toxicus - poisoned)* Flammable *(Latin flammare - to set on fire. Able - capable of)* Explosive *(Explode - drive out with violence and sudden noise. ive - tending to/pertaining to)* Pressure *(Latin pressura - action of pressing)* Acid *(Latin acidus - sour, sharp, tart)* Articles:	
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.	Linking irreversible reactions to chemical reactions Measurement of temperature change, colour change and effervescence (Describe what you would see) Examples of chemical reactions	Reaction *(re- back against (the action))* Reversible *(Reverse - opposite/turned backward. ible - capable of)* Irreversible *(ir - not/opposite of (reversable))* Reactant *(thing that reacts)* Product *(Latin- something produced)* Effervescence *(Latin -to boil up, boil over)* Burning - *(be on fire, be consumed by fire)* Observation *(Latin - a watching over, observance, investigation)*	

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		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.	Forming word equations correctly (arrow **not** equals sign) Burning magnesium	Articles: The Conservation of Matter During Physical and Chemical Changes | National Geographic Society	
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. Alkalis are soluble bases. Universal indicator and the pH scale used to identify acids and bases.	Universal indicator testing household substances Measuring pH	Acid - *(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 - *(neutral no positive or negative effect)* Indicator - *(Latin - 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 basic. Litmus paper as an example of a pH indicator. Colour changes	Water to wine demo Making red cabbage indicator	Indicator - *(Latin - to point out, show)* Litmus paper *(Lit - to dye, stain, colour. Mus - moss (Litmus is made from dyes extracted from lichens))* Filter *(piece of felt through which liquid is strained)*	

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		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 (known acid, known neutral, known base)	Articles: Come clean: What's the difference between shampoo and shower gel? | New Scientist	
7C9	**Types of reaction**	Identification of different reactions including: Metal + acid --> Salt + hydrogen (test for hydrogen - squeaky pop) Metal carbonate + acid --> salt + carbon dioxide + water (test for carbon dioxide - bubble through lime water) Combustion Fuel + oxygen --> Water + carbon dioxide Metal + Oxygen --> Metal oxide (flame testing) Neutralisation Acid + Base --> Salt + water	More opportunities to write word equations	Reaction *(re- back against (the action))* Reactants *(thing that reacts)* Products *(Latin- something produced)* Combustion *(Latin comburere - to burn up, consume)* 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, crust, mantle. Earth is made up plates (like pieces of a jigsaw) that are constantly moving. Plate movements can be: Destructive - two plates pushing towards each other. Constructive - two plates move apart.	Prediction and precaution Land mass to water mass	Crust *(Latin crusta - rind, crust, shell, bark)* Mantle *("become covered with a coating" (of liquids))* Tectonic *(of or relating to building or construction)* Destructive *(tending to destroy)* Constructive *(Con - together/with. struere - to pile up)* Magma *(Greek magma - thick unguent, ointment)* Molten *(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	

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		Conservative - two move along side each other Effects of plate movement can cause Earthquakes, tsunamis and volcanos.		NASA's InSight Reveals the Deep Interior of Mars – NASA's Mars Exploration Program Continental Drift versus Plate Tectonics | National Geographic Society	
7C12	**Rocks**	Rocks can be identified by their grains, size, shape, crystals, texture, minerals, permeability, whether they are porous or not. Types of rocks to include - igneous, sedimentary, metamorphic.	Quarrying Properties linking to uses Concrete and cement	Sedimentary *(sediment - a settling, sinking down. Ary - connected with)* Metamorphic *(exhibiting change in form or structure)* Igneous *(Latin igneus "of fire, fiery; on fire; burning hot)* Permeable *(Latin permeabilis "that can be passed through, passable,")* Porous *(Latin porus "an opening")* Crystals *(Greek *kreus- "to begin to freeze, form a crust.)* Lava *(Latin lavare "to wash" (Originally applied in Italian to flash flood rivulets after downpours, then to streams of molten rock from Vesuvius.))* 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. 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	Why is the record incomplete? How are discoveries made? Paleontology	Transportation *(act of transporting)* Deposition Latin *(to lay aside)* Sedimentation *(sediment - a settling, sinking down)* 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	

		environment was like and how the organism lived. Fossil record can show how an organism has evolved over time.			
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. 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.		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).* 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.	Challenges of recycling balanced with need	Finite *(Latin - to limit/comes to an end)* Infinite *(Latin. In - not/opposite. Finite - to limit/comes to an end)* Renewable *(re - again, new - resume/revive, able - to be done)* Non-renewable *(non - not, re - again, new - resume/revive, able - to be done)* Recycling *(re - back, cycle - circulating/circular)* Articles: Plastics recycling: challenges and opportunities (nih.gov) Sustainable use of phosphorus: A finite resource - ScienceDirect Throwaway culture: The truth about recycling | New Scientist	

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		Recycling methods for plastic, metal, paper, glass.			
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 (*Tropos - turning (Greek), sphere - ball/globe)* Mesosphere *(Mesos - middle (Greek), sphere - ball/globe)* Thermosphere *(Thermos - heat (Greek), sphere - ball/globe)* Exosphere *(Exo- outside/external/beyond (Greek), sphere - ball/globe)* Atmosphere *(Atmos - vapour (Greek), sphere - ball/globe)* Composition *(Latin - put together)* Mixture *(Latin - 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 • Fossilisation	Our role in the carbon cycle Interactions How we influence the balance of carbon	Photosynthesis *(Photo* – Greek *light, synthesis - putting together.)* Respiration – *(Latin re- again and spirare (to draw breath)* Decomposition – *(de - the opposite of, composition - to put together)* Decomposers *- break down organic matter (same as above)* 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)* Articles: Carbon Sources and Sinks | National Geographic Society	

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		Concept of 'Carbon neutral' (no **net** release of carbon dioxide into the atmosphere) and biofuels (a fuel from living matter)			
7C18	**How do we choose a material**	Retrieval from previous lessons about fuels and recycling. 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).	Composite – from the word composition (more than one).	
7C19	**Review 2**				

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Year 8 chemistry - Lesson/Composite sequences.

Code	Lesson/ composite title	Substantive knowledge/ components	Disciplinary knowledge	Disciplinary literacy– Keywords *(etymology)* and linked articles	Cultural Capital/ Personal Development
8C1	**What is the structure of an atom?**	• 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.		Atom *(Ancient Greek átomos, " indivisible)* Nucleus *(Latin nucleus ("kernel, core"), a diminutive of nux("nut")* Proton *(Greek prōton, neuter of prōtos"first" - link to hydrogen as first element)* Electron *(link to electricity – flow of)* Neutron *(from neutral)* Nucleon *(from nuclear "of or like the nucleus of a cell")* 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")* Energy *(active, action)* Articles: https://byjus.com/jee/atomic-structure/ https://www.sciencedirect.com/topics/earth-and-planetary-sciences/atomic-structure	

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8C2	**What is the periodic table?**	• 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.	Idea that the periodic table has changed over time. Link number of electrons in outer shell to group number	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)*	
8C3	**What is a compound?**	• 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	Use of molymods to model compounds	Compound *(something produced by the combination of two or more ingredients)* Bond *("anything that binds, fastens, or confines,")* Mixture Latin mixtus- blend more than one element- state of confusion Reaction *(re- back against (the action))* Articles: https://www.reference.com/science/compound-science-c93bb683d7673ac8 The Most Important Chemical Compounds (famousscientists.org) STRETCH: https://www.science.org/content/blog-post/these-are-real-compounds	

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8C4	**How can we represent a reaction?**	• 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 • Identify whether a symbol equation is balanced or unbalanced.	Observation of properties of iron (shiny, magnetic), sulphur (yellow, dull, powder, brittle) and iron sulphide. Observation iron sulphide cannot be separated back into elements easily with magnet. Practice to carry out throughout subsequent topics	Reactant *(thing that reacts)* Product *(Latin- something produced)* Reaction *(re- back against (the action))* Formula *(Words used in ceremony or ritual, "a rule, method")* Articles: https://www.sciencenewsforstudents.org/article/new-coating-metals-could-cut-engine-wear https://www.thoughtco.com/amazing-chemical-reactions-604050#:~:text=10%20Amazing%20Chemical%20Reactions%201%20CaesiumFluoride%20%2F%20Wikimedia,below%20its%20normal%20freezing%20point.%20More%20items...%20 https://interestingengineering.com/19-most-fascinating-chemical-reactions-that-prove-science-is-cool	

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8C5	**How do acids react with metals and their compounds?**	• 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	Use of indicators to monitor changes Recap tests for hydrogen and carbon dioxide (Y7) Construction of symbol equations to represent reactions and practice identifying whether an equation is balanced or unbalanced.	Indicator - *(Latin - to point out, show)* Acid - *(Latin acidus - sour, sharp, tart)* Effervescence *(Latin -to boil up, boil over)* Salt 14th C- resembling common salt Hydrogen *(Hydro meaning "water," Gen meaning producing, yielding)* Carbon dioxide Equation *(an equal distribution, a sharing in common)* Articles: https://www.epa.gov/acidrain/what-acid-rain https://www.nationalgeographic.com/environment/article/acid-rain#:~:text=Acid%20rain%20describes%20any%20form%20of%20precipitation%20that,generally%20has%20a%20pH%20between%204.2%20and%204.4. STRETCH: https://www.acs.org/content/dam/acsorg/education/resources/highschool/chemmatters/articlesbytopic/acidsandbases/chemmatters-april1983-swimming-pool.pdf	

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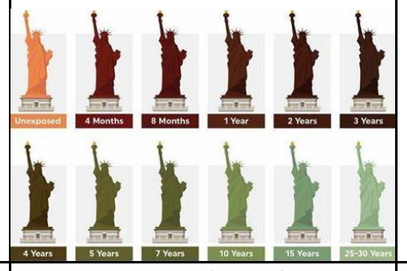
8C6	**Which is the most reactive metal?**	Definition of reactivity - how likely an element is to undergo a chemical reaction Use of the reactivity series to understand displacement reactions. • potassium • sodium • calcium • magnesium • aluminium • **Carbon** • zinc • iron • **Hydrogen** • copper • silver • gold A displacement reaction defined as when a more reactive substance takes the place of a less reactive substance from its compound.	Predicting and observing displacement reactions. Practice writing chemical equations and checking whether they are balanced or unbalanced.	Reactivity *(Repercussive, echoing, a sense not obsolete, re "against" the action – re-action)* Observation *(Latin - a watching over, observance, investigation)* Compare *(from com "with, together" + par "equal)* Contrast *(to fight against, to withstand)* Articles: https://www.thoughtco.com/why-statue-of-liberty-is-green-4114936 https://bitwiseacademy.com/why-the-statue-of-liberty-changing-color/ 	
8C7	**How do rocks change?**	Description of the Rock Cycle. To include: Identification of different processes involved in sedimentary rock formation linked to layers and grains (retrieval): • Erosion • Weathering		Transportation *(act of transporting)* Deposition Latin *(to lay aside)* Sedimentation *(sediment - a settling, sinking down)* Sedimentary *(sediment - a settling, sinking down. Ary - connected with)* Metamorphic *(exhibiting change in form or structure)*	

		• Transportation • Deposition • Sedimentation • Compaction • Cementation. Processes – rock is melted underground to form magma. This cools to form igneous rocks. Metamorphic rocks are formed by heat, pressure or both.	Cooling of salol at different temperatures to create different crystal sizes, use of hand lens to observe crystal size.	Igneous *(Latin igneus "of fire, fiery; on fire; burning hot)* Magma *(Greek magma - thick unguent, ointment)* Compaction *(with, together, to fix, fasten)* Cementation *(substance that hardens as it dries, used to bind)* Erosion *(to gnaw away, consume)* Weathering *(wear away by exposure)* Articles: https://www.nationalgeographic.org/encyclopedia/rock-cycle/ https://www.rockseeker.com/types-of-rocks/ https://www.thoughtco.com/rock-identification-tables-1441174 https://sciencebriefss.com/geology/exactly-why-is-the-rock-cycle-important/	
8C7b	**Mid-topic review**				

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8C8	**Why do substances change state?**	• Energy changes involved in change of state • Interpretation of cooling/heating curve: - 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. • 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	Cooling curve of octadecanoic acid	Solids *(from the Old French 'firm, dense, compact')* Liquids *(able to flow)* Gases *(from Greek khaos"empty space")* Melting *(Old English- meltan 'become liquid through heat' - link to chocolate in the sun)* Boiling *(to bubble up)* State *(state of your room – condition)* Particles *(from the latin - a bit or fragment)* Energy *(active, action)* Articles: https://www.nationalgeographic.org/article/conservation-matter-during-physical-and-chemical-changes/12th-grade/ https://www.nationalgeographic.org/article/changes-matter-physical-vs-chemical-changes/ STRETCH: https://www.scienceinschool.org/article/2021/states-matter-phase-transitions/ https://www.thermal-engineering.org/what-is-triple-point-of-water-definition/	

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8C9	**What is a solution?**	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 Idea that some substances are more soluble in water than others Increasing temperature can increase solubility	Investigation into the solubility of salt	Solute *(leu - to loosen, divide, cut apart)* Solvent *(able to pay all one owes)* Solution *(a solving or being solved)* Dissolve *(to break up, disunite, separate into parts)* Soluble (Latin- may be loosened or dissolved) Insoluble (In-not, soluble) Articles: **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**	
8C10	**How can we separate a mixture?**	Best completed over 3 or 4 lessons. 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,	1. Separation of rock salt 2. Separating ink 3. Chromatography (3 lessons sequence) Equipment: - Filter funnel - Flask - Delivery tube - Evaporating basin	Filtrate (15c- piece of felt through which liquid is strained) Distillate *(distill - to drop, trickle, drip, fall in drops)* Condense *(dense, thick, crowded)* Chromatography *(colour writing)* Articles:	

		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. **Chromatography** - Technique used to separate dies and inks. - Understand that different substances travels to different distances on the chromatography paper. - Sketch and label a diagram of chromatography		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 **STRETCH:** https://academic.oup.com/chromsci/article/40/10/538/534455?searchresult=1	

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8C11	**How do we separate fuels?**	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 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)	Fractional distillation demo - Observing the properties of the different fractions of crude oil	Fuel - *(material for burning)* Fractional distillation *(Fraction - to break, distillation - to trickle down in minute drops).* Articles: **https://www.nature.com/articles/069410a0** **https://www.sciencedirect.com/topics/chemistry/fractional-distillation**	

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8C12	**What is combustion?**	- 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.	Chip pan fire demo linked to fire safety in the home. Observing complete and incomplete combustion of methane.	Combustion *(Latin comburere - to burn up, consume)* Articles: **https://www.sciencedirect.com/science/article/pii/S1540748920305010** **https://www.sciencedirect.com/topics/engineering/spontaneous-combustion#:~:text=Spontaneous%20combustion%20is%20the%20tendency%20of%20coal%20to,all%20coals%20have%20a%20propensity%20for%20spontaneous%20combustion.** **WARNING – CHECK FIRST** **https://paranormalpeopleonline.com/spontaneous-human-combustion/** **https://www.livescience.com/42080-spontaneous-human-combustion.html**	

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8C13	**What affects the rate of a reaction?**	Idea of successful collisions: Particles much collide with enough energy in order to react. 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	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)* Articles: **https://www.science.org/doi/10.1126/science.1174885**	
8C14	**What is a catalyst?**	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	Investigation into the effectiveness of two different catalysts – manganese oxide and zinc oxide.	Catalyst (Latin/Greek- katalysis- dissolution/ break apart) Articles: https://www.sciencenewsforstudents.org/article/explainer-catalyst-chemistry https://www.torquecars.com/articles/catalysts.php	
8C14b	**End of topic review**				

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Year 9 chemistry - Lesson/Composite sequences.

Code	Lesson/ composite title	Substantive knowledge/ components Purple indicates content for set 1s only	Disciplinary knowledge	Disciplinary literacy– Keywords *(etymology)* and linked articles	Cultural Capital/ Personal Development
9C1	**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	Use of melting/boiling point to predict the state of the substance. Vibrating plate demo.	Particles *(from the latin - a bit or fragment)* State *(state of your room – condition)* Kinetic *(keie- to set in motion)* Energy *(active, action)*	
9C2	**How close are particles together?**	• Recap of keywords; soluble, solute, solution, saturated and solvent • 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)	Practice of concentration calculations Preparation of a solution to a named concentration	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*	
9C3	**What is solubility?**	• 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	Ethanol and water video (50ml of each = 97ml). Practical investigation into how temperature affect solubility	Solute *(leu - to loosen, divide, cut apart)* Solvent *(able to pay all one owes)* Solution *(***leu-*** "to loosen, divide, cut apart)*	

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		• 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	Practical tests to confirm solubility rules, involving dissolving in cold/warm water, stirring etc. – Salt and water	Dissolve *(to break up, disunite, separate into parts)* Soluble (Latin- may be loosened or dissolved) Insoluble (In-not, soluble) Saturated *(full up)*	
9C4	**What can we learn from the periodic table?**	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	How do we model the atom? How does the model of the atom relate to the periodic table? How has the periodic table changed? – Mendeleev's periodic table	Atom *(Ancient Greek átomos, " indivisible)* Nucleus *(Latin nucleus ("kernel, core"), a diminutive of nux("nut")* Proton *(Greek prōton, neuter of prōtos"first" - link to hydrogen as first element)* Electron *(link to electricity – flow of)* Neutron *(from neutral)* Nucleon *(from nuclear "of or like the nucleus of a cell")* 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")* Energy *(active, action)* Articles: https://byjus.com/jee/atomic-structure/ https://www.sciencedirect.com/topics/earth-and-planetary-sciences/atomic-structure	

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9C4	**How can we model the atom?**	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	Atom *(Ancient Greek átomos, " indivisible)* Nucleus *(Latin nucleus ("kernel, core"), a diminutive of nux("nut")* Proton *(Greek prōton, neuter of prōtos"first" - link to hydrogen as first element)* Electron *(link to electricity – flow of)* Neutron *(from neutral)* Charge *(chargier "to load, to burden)* Orbit (*orbita, wheel track, beaten path, rut, course)*	
9C6	**How do atoms differ?**	• 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.	Prediction of charge depending on group number	Element *(From latin elementum "rudiment, first principle, matter in its most basic form")* Isotope (*literally "having the same place," from Greek isos "equal")* Ion *("to go.")* Charge *("a load, a weight,")* Articles: https://www.livescience.com/topics/elements https://www.thetoptens.com/coolest-elements-periodic-table/ https://www.thoughtco.com/what-is-the-coolest-element-606686#:~:text=What%20Is%20the%20Coolest%20Element%3F%201%20Plutonium.%20Pretty,different%20conditions.%204%20Lithium.%20...%205%20Gallium.%20	
9C7	**What is an ionic bond?**	• Forms 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	Use of molymod/ionic models/magnets to demonstrate ionic lattices Construction of dot and cross diagrams	Electrostatic *(electro – electricity, sta – make or be firm)* Ionic *to go* Lattice *(crossing or interlacing of laths, bars)*	

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9C8	**What is a covalent bond?**	• Forms 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 • Properties of covalent molecules – low melting & boiling points, do not conduct electricity. Linked to, strong force within molecule but weak forces between molecules.	Construction of dot and cross diagrams Practical tests to compare ionic and covalent bonding e.g. salt and sugar; melting point, conduction of electricity as solid/in solution.	Covalent *(co – together, valens – strong powerful)* Molecule *(mole – unit of molecular quantity, cule – small, little)*	
9C9	**What is a metallic bond?**	• 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.	Practical tests to investigate metallic properties.	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)*	
9C10 Mid-topic review		Recap of Yr9 chemistry composites to date: 1. What is kinetic theory? 2. How close are particles together? 3. What is solubility? 4. What can we learn from the periodic table? 5. How has the model of the atom changed? 6. How do atoms differ? 7. What is an ionic bond? 8. What is a covalent bond? 9. What is a metallic bond?			
9C11	**What do chemical equations show?**	• 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	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	Chemical *from latin route alchimicus* Reaction *(re- back against (the action))* Irreversible *(ir - not/opposite of (reversable))* Effervescence *(Latin -to boil up, boil over)* Thermal *from the greek therme meaning to heat*	

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		• Appreciation of different types of reaction to include: displacement, thermal decomposition, combustion, neutralisation.	Application of the state symbols to a balanced equation – explanation of (aq) Write word and balanced symbol equations for thermal decomposition reactions	Decomposition *(de - the opposite of, composition - to put together)* Equation *(an equal distribution, a sharing in common)*	
9C12	**What is an acid?**	• 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	Dissociate *from latin dissociatus to separate from companionship* Concentrated *to bring to a common centre* Dilute *from latin dilutus to weaken/remove the strength* Neutralisation *to counter balance*	
9C13	**What is displacement reaction?**	• 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.	Demonstration with large copper turnings and silver nitrate Prediction of when a reaction will occur Construction of word equation Construction of balanced symbol equations Use of spotting tile to analyse displacement reactions and test predictions	Element from Latin *elementum* "rudiment, first principle, matter in its most basic form Compound *compounen,* "to put together, to mix, to combine; to join, couple together," from Old French *compondre* Displacement – The action of moving something from its place or position	
9C14	**What are end/exothermic reactions?**	• 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	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*	
9C15	**What is a fuel?**	• Recap from Yr7&8: ○ Fire triangle ○ Fossil Fuels ○ Crude oil production ○ Fractional Distillation of crude oil	Class Practical – which fuels is the best? Prediction and drawing of alkane and alkene molecules using	Fuel *(material for burning)* Energy *(active, action)* Flammable *from latin flammare meaning to set on fire*	

		• 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 • **Shorter chain hydrocarbons in higher demand. Use of cracking to break long chain alkanes into shorter chain hydrocarbons**.	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.	Hydrocarbon *containing hydrogen and carbon* Alkane Alkene Saturated *from latin saturatus meaning to fill full* Unsaturated *un-meaning not* Homologous *from Greek homologos meaning of one mind*	

9C16	**What problems can burning fuels cause?**	• Recp 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
			Risk and need for CO detector.
			
			Public health effects of air pollution linked to asthma.
			
			Carbon footprint and carbon neutrality
				Combustion *(Latin comburere - to burn up, consume)*
				Climate *climat – region or part of Earth*
				Pollution *from latin polluere meaning to soil, defile or contaminate*
				
				Articles:
				https://www.theguardian.com/environment/2020/dec/16/girls-death-contributed-to-by-air-pollution-coroner-rules-in-landmark-case	

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		• Solutions including green energy, recycling, electric vehicles, carbon neutrality.			
9C17	**How has the atmosphere changed?**	• 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.	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"* Photosynthesis *from photo- "light" + synthese "synthesis"*	

9C18	**How do we obtain a metal?**	• Recap:
		  ○ 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.
				Ore *from old English ora which relates to eorp meaning ground, soil, earth*
				Extract *from latin extractus Ex meaning out of and tract meaning draw*
				Unreactive *un- meaning not*
				Reduction reduccioun, "a restoring to a former state
				Oxidation *from oxygen*	

9C19	**What is electrolysis?**	• 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
		• Definition of electrolysis as a method of splitting an ionic substance using an electric current
			Electrolysis of brine, including chlorine test with damp blue litmus	Electrolysis *electro from electricity lysis to loosen or set free/split*
				Cathode
				Anode
				Electrolyte *lytos means loosed*	

		• 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 • **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.**		Current *that which runs or flows from the old French corant*	
9C20	**End of Topic Review**	Recap of all Yr9 chemistry composites: 1. What is kinetic theory? 2. How close are particles together? 3. What is solubility? 4. What can we learn from the periodic table? 5. How has the model of the atom changed? 6. How do atoms differ? 7. What is an ionic bond? 8. What is a covalent bond? 9. What is a metallic bond? 11. What do chemical equations show 12. what is an acid? 13. What is a displacement reaction? 14. What are endothermic and exothermic reactions? 15. What is a fuel? 16. What are the problems with burning fuels? 17. How has the atmosphere changed? 18. How do we obtain a metal? 19. What is electrolysis?			

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KS4 Lesson sequence

YEAR 10 map of topics taught (detailed knowledge map as seen in Biology is work in progress)						
2023-24	**AUTUMN**		**SPRING**		**SUMMER**	
SUBJECT	**FIRST HALF**	**SECOND HALF**	**FIRST HALF**	**SECOND HALF**	**FIRST HALF**	**SECOND HALF**
GCSE SCIENCE (Please note, classes may cover topics in a different order)	**Biology** Key concepts in Biology (Paper 1 & 2) Cells and control (Paper 1) Genetics (Paper 1) Natural selection (Paper 1) **Additional topics for separate students only:** Food tests The brain The eye Sexual and Asexual reproduction Protein synthesis Mendel/Alleles Virus life cycles		**Chemistry 1** States of matter (Paper 3) Separation techniques (Paper 3) Atomic structure (Paper 3 & 4) The periodic table (Paper 3 & 4) Bonding (Paper 3 & 4) Acids and Alkalis (Paper 3) Calculations involving Masses (Paper 3 & 4) **Additional topics for separate students only:** Yields Atom economy Concentrations Titrations Molar volume of gases Chemical cells and fuel cells	**Physics 1** Motion (Paper 5) Forces and Motions (Paper 5) Conservation of Energy (Paper 5) Waves (Paper 5) Light and the EM spectrum (Paper 5) Radioactivity (Paper 5) **Additional topics for separate students only:** Ears and hearing Infrasound Ultrasound Ray diagrams Lenses Nuclear energy Nuclear fission	**Assessments:** Midterm assessments (in class) Formal examinations: Year 10 progress assessment	

	Plants diseases and defences Monoclonal antibodies		Nuclear fusion	

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YEAR 11 map of topics taught (detailed knowledge map as seen in Biology is work in progress)						
2023-24	**AUTUMN**		**SPRING**		**SUMMER**	
SUBJECT / YEAR	**FIRST HALF**	**SECOND HALF**	**FIRST HALF**	**SECOND HALF**	**FIRST HALF**	**SECOND HALF**
SCIENCE **(Please note, classes may cover topics in a different order)**	**Biology 2** Plant structures and functions (Paper 2) Animals coordination and homeostasis (Paper 2) Exchange and transports in animals (Paper 2) Ecosystem and material cycles (Paper 2) **Additional topics for separate students only:** Plant hormones and adaptations Uses of plant hormones Thermoregulation Osmoregulation The kidneys Assessing pollution Food security Rates of decomposition	**Chemistry 2** Electrolysis (Paper 3) Metal reactions (Paper 3) Groups in the periodic table (Paper 4) Rates of reaction (Paper 4) Heat energy and chemical reactions (Paper 4) Fuels (Paper 4) Earth and atmosphere (Paper 4) **Additional topics for separate students only:** Transition metals Corrosion Electroplating Alloying Hydrocarbons Alcohols and carboxylic acids Polymers	**Physics 2** Energy and work (Paper 6) Forces and their effects (Paper 6) Electricity and circuits (Paper 6) Magnetism (Paper 6) Electromagnetic induction (Paper 6) Particle model (Paper 6) Forces and matter (Paper 6) **Additional topics for separate students only:** Rotational forces Static electricity Dangers and uses of static electricity Gas temperature and volume Pressure in fluids	Assessments: Midterm assessments (in class) GCSE Examinations: Paper 1 & 2 (Biology) Paper 3 & 4 (Chemistry) Paper 5 & 6 (Physics)	

		Qualitative analysis Bulk and surface properties of matter Nanoparticles	Pressure and up thrust	

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Composite	KS2: Previous knowledge	Year 7	Year 8	Year 9 Purple indicates content 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 Upthrust/ buoyancy- floating and sinking 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. Demonstration of standing wave with Ruban's tube.	
		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

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	• *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 Shadow formation. Definitions of translucent, transparent and opaque.	Law of reflection Refraction Lenses Pinhole cameras Use of a protractor	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 energy resources Sankey diagrams Energy efficiency - use of "Energy saving" appliances. Isotopes as a store of nuclear energy.	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.	

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		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. Is there life on other planets	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

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		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 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 Practically applying newton meter to everyday situations	Force *physical strength, fortitude, push, pull.* 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	
7P2	**What is the resultant force?**	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	Balance *scales, apparatus for weighing by comparison of mass, state of equilibrium* Resultant *total/overall force* 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 Measuring the extension of a spring plus one other material (linking to plastics)	Calibration and accuracy of measurement	Meter *Greek - (metreo) to measure, count or compare* Newton *after Isaac Newton* Calibrate *determine the relative value of* Measure	

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				Unit 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 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	Speed Distance Relative Average 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 What each type of line and gradient show	Pupils are able to draw and interpret simple distance time graphs	Gradient Axis Articles:	
7P6	**How can we go faster?**	Air resistance and friction as forces which oppose motion High performance cars/athletes have ways of overcoming this	RAF spinners Wallpaper paste Linking to bloodhound	Friction a *chafing, rubbing, Sense of "resistance to motion"* resistance Lubrication Oppose 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	

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7P7	**What are waves?**	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	Longitudinal Transverse Amplitude Wavelength Crest "*highest part of a helmet," crest of a wave* Trough *wooden vessel, tray, hollow vessel, canoe* Transfer Matter *having mass* Articles: What causes waves in the ocean? | New Scientist	
7P8	**How does sound travel?**	Sound definitions including frequency, pitch and volume – 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	Volume Pitch Frequency Vibrations Collisions 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?**	Luminous and non-luminous objects 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	Source Opaque Translucent Transparent Luminous Reflection Scattering Shadow Articles: Amazing animal super senses - BBC Science Focus Magazine Electromagnetic spectrum | New Scientist	
7P11	**How is heat transferred?**	Conduction Convection Radiation Link and revision of states of matter	Conduction rods Convection Tube Absorption of radiation (coloured tubes) Tectonic plates revision	Conduction: *A leading, guidance, to lead or bring together* Convection: *Act of carrying or conveying, of bringing together* Radiation:	

		Examples to include central heating and solar energy	Cultural capital: Insulation of houses/money saving	*Act or process of emitting light, a shining* Particles: *Pars: A part, piece, division* *PArticles: A bit or fragment, small part or division of a while, minute portion of matter* Vibrate: *Vibratus, set in tremulous motion, move quickly to and fro, quiver, tremble, shake* Collide: *Com: with, together* *Laedere: to strike, injure by striking* *Collide: To strike together forcibly* Heat: *Haetan: to make hot, to become hot* Thermal: *Having to do with hot springs* 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 Energy transfers: • Mechanical • Heating (conduction, convection and radiation) • Light • Sound • Electrical	Energy circus using it to identify the stores and transfers The energy circus will include a broken microphone with a diagram for how it works. (Broken to see inside of it).	Energy Store Transfer Potential Articles: energy | Definition, Types, & Examples | Britannica Could traffic noise be converted into useful energy? - BBC Science Focus Magazine Conservation of energy - AccessScience from McGraw-Hill Education	
7P13			Construction of simple circuit	Electricity:	

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	How can I build a circuit?	Simple circuit components and energy transfers involved e.g. buzzer, bulb Concept of complete circuits Circuit diagrams	Observation of above Circuit repairs Representing concepts as diagrams	*Electricity – From Elekron (electron) meaning "shining light"* Conductor: *One who leads or guides* Insulator: *Make into an island, to place in an isolated situation* Battery: *From bombardment to unit of artillery, then "Electrical cell" showing discharges of electricity* Circuit: *A circumference, a journey around something.* *A space enclosed within certain limits.* *Arrangement by which a current is kept up between two poles.* 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?**	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	Mains electricity: *Main – Power, strength, force, to have power* *Electricity – From Elekron (electron) meaning "shining light"* Plug: *To close tightly, fill or stop* Fuse: *Combustible cord or tube for lighting an explosive device* Current: *Running, flowing, moving along, to run* Articles: Fire Caused by a Phone Charger | National Home Repairs (repairmyhome.co.uk)	
7P15	**What is magnetism?**	Bar magnet Describe magnetic field including NS poles Permanent and temporary magnets	Creating a magnetic field with iron filing CC: Earth's magnetic field and use of compasses over time Magnetising a nail and observing strength and duration	Magnet: *The power of attracting iron and steel (cobalt, nickel, iron)* Domain: *Territory over which dominion is exerted* Attract: *To draw to* Repel:	

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				To drive away, remove Permanent*:* *Enduring, unchanging, unchanged, lasting or intended to last* Field*:* *Open land to attract iron and steel (cobalt, nickel, iron)* Compass*:* *Com (together) pass (a pace, step, route)* Pole*:* *Axis of rotation* 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	
7P16	**What is a day, month, year, season?**	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	Tangible effects on earth e.g. tides	Season: *Old friench saison "season, date, right moment, appropriste time"* *Also satio "sowing, planting"* Tidal bulge: *Tidal: tidal wave. High water.* *Bulge: "wallet, leather bag" then bhelgh "to swell"* Axis: *1540s "imaginary motionless straight line around which a body rotates"* *Latin "axle, pivot"* Hemisphere: *From hemysperie referring to the celestial sphere.* *Hemi: half* *Sphaira: sphere* 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**	Scale and organisation of space.	Pluto reclassified as dwarf planet	Solar: *Pertaining to the sun*	

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		Composition of Solar System- order of planets. Facts and conditions of each planet	How do we study other planets including satellites/ probes/rovers	Year: *That which makes a complete cycle* Day: *Period during which the sun is above the horizon* Orbit: *Revolve round in an orb* Crater: *"Large bowl from which red wine mixed with water was served to guest", to "bowl-shaped mouth of a volcano"* Atmosphere: *Atmos: vapor, steam* *Vaporous air, then gaseous envelop surrounding the earth* Celestial: *Ciel: sky* *Celestial: Heavenly, sky blue, pertaining to the sky, bright, clear* Composition: *Action of combining, make-up, agreement, putting together, connecting, arranging* 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**				

Year 8 physics - Lesson/ Composite sequences.

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Code	Lesson/ composite title	Substantive knowledge/ components	Disciplinary knowledge	Disciplinary literacy– Keywords *(etymology)* and linked articles	Cultural Capital/ Personal Development
8P1	**What are forces?**	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 - 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	Using a Newton meter to measure the force of different objects. Investigating different forces. Force circus	Force *physical strength, fortitude, push, pull.* Newtons *after Isaac Newton* Air resistance *physical opposition by force; difficulty, trouble* Water resistance *physical opposition by force; difficulty, trouble* Upthrust Friction *chafing, rubbing, Sense of "resistance to motion"* Static electricity Magnetism *latin attractive power or influence* Free-body digrams Resultant forces *total/overall force* Water effect: Why is it hard to put on gloves when your hands are wet? | New Scientist	
8P2	**What are mass, weight & gravity?**	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	Comparison of gravitational field strength on different planets Effect of forces/weight on roller coasters. G-force	Gravitational field *force that gives weight to objects* Gravity *downward acceleration of terrestrial bodies due to gravitation of the Earth* Orbit *revolve round in an orb* Force *physical strength, fortitude, push, pull.*	

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		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. 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.	Investigating the mass and weight of different masses. Drawing a graph to describe the relationship between mass and weight.	Let's learn about gravity | Science News for Students Weight *downward force of a body, heaviness* Mass *French masse "lump, heap, pile* Gravity *downward acceleration of terrestrial bodies due to gravitation of the Earth* Here's What It Looks Like When G-Force Knocks You Out | Live Science Maxed out: How many gs can you pull? | New Scientist	
8P3	**What is pressure?**	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.	Students calculate how much pressure they exert on the Earth. Everyday examples eg camels feel, snow shoes, stiletto heels	Pressure *Latin pressura "action of pressing"* Force *physical strength, fortitude, push, pull.* Area *Latin area "level ground, open space,"*	

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		Pressure measured in N/m^2			
8P4	**What is atmospheric 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	Kinetic theory model. Demonstrating collisions with sides of a container. Demonstrating gas pressure. Other demonstrations Collapsing bottle, collapsing can, Magdeburg hemispheres.	Gas *from Greek khaos"empty space"* Collisions *Com: with, together* *Laedere: to strike, injure by striking* *Collide: To strike together forcibly* Atmospheric Pressure | National Geographic Society	
8P5	**How is pressure caused 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. 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.	Adaptations of deep sea animals. Shape of dams Deep sea exploration (linked article)	Pressure *Latin pressura "action of pressing"* Depth Weight Fluid *"capable of flowing,"* Why Nasa is exploring the deepest oceans on Earth - BBC Future (embedded in powerpoint)	

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8P6	**How can we explore space?**	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. - 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 Earth and learn more about our home planet. Arguments against exploring space could include:	Research most recent space exploration projects and findings. Live footage from the ISS	Solar system The future of spaceflight—from orbital vacations to humans on Mars (nationalgeographic.com)	

		• 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.			
8P7	**How fast?**	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.	Speed calculations Application of speed cameras	Speed *"rapidity of movement, quickness, swiftness"* Distance Time Distance-time graphs Gradient *"steep slope of a road or railroad"*	
8P8	**What is acceleration?**	Acceleration as a rate of change of speed Calculating acceleration Acceleration = change in velocity/time A = v-u/t Acceleration is measured in m/s^2		Acceleration *ad "to" celerare "hasten"* Velocity *Latin velocitatem "swiftness, speed"* Scientists Say: Acceleration | Science News for Students	

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8P9	**How can we show acceleration?**	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.	Velocity *Latin velocitatem "swiftness, speed"* Acceleration *ad "to" celerare "hasten"* Distance Time Scientists Say: Acceleration | Science News for Students	
8P9i	**Mid topic review**	Recap of Y8 composites: 8P1 What are forces? 8P2 What are mass, weight & gravity? 8P3 What is pressure? 8P4 What is atmospheric pressure? 8P5 How is pressure caused in liquids? 8P6 How can we explore space? 8P7 How fast? 8P8 What is acceleration? 8P9 How can we show acceleration?			
8P10	**What are waves?**	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.	Draw and label simple wave diagram. Demonstrate waves in a large flat bottomed tank/tray and ripple tank with double dipper. Use of sig gen (real and/or virtual) to show amplitude, frequency and wavelength.	Wave *Old English wafian "to fluctuate"* Transverse Longitudinal Superposition *Latin superpositionem "a placing over"* Interference Constructive *com "with, together" + struere "to pile up"*	

		- Transverse wave as particles moving at a right angle to the direction of the wave 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.		Destructive *Latin destruere "to tear down, demolish"* Constructive and Destructive Sound Waves - Science News (weebly.com)	
8P11	**How can we measure the speed of a wave?**	Recap of frequency - Frequency as the number of waves per second	Use of ripple tank to measure wavelength and frequency.	Frequency *"rate of recurrence"* Wavelength Media	

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		- Frequency is measured in Hertz (Hz) Wave speed can be calculated by Wave speed = frequency x wavelength Use of v = fλ Waves travel at different speeds through different media.	Ruben's tube – measuring speed of sound in methane (optional).	Planes travelling at five times the speed of sound could be with us by the end of the century | Daily Mail Online United plans supersonic passenger flights by 2029 - BBC News Physicists have discovered the ultimate speed limit of sound | New Scientist	
8P12	**How do we hear?**	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.	Use of sig gen + loudspeaker and/or online hearing test to demonstrate hearing range. Compare to other animals. Model ear	Vibrations *Vibratus, set in tremulous motion, move quickly to and fro, quiver, tremble, shake* Frequency *"rate of recurrence"* Ear canal *"tubular passage in the body through which fluids or solids pass;"* Ear drum Cochlea *Latin cochlea "snail shell,"* Auditory nerve *Latin auditorius "pertaining to hearing,"* Deafness and hearing loss: Causes, symptoms, and treatments (medicalnewstoday.com)	

		- 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.			
8P13	**When is sound a problem?**	Sound level is measured in decibels (dB) Ear damage can cause hearing loss, possible causes including: The ear 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.	Decibels *unit of power level in measuring sound. Named after telephone pioneer Alexander Graham Bell* Insulation Noise Pollution | National Geographic Society (embedded in lesson)	

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8P14	**How can we use sound?**	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.	Ultrasound: antenatal scanning, sonar, detecting cracks in structures Infrasound: Animal communication: elephants, hippos, giraffes using infrasound, studying the structure of the Earth	Ultrasound *ultra- "beyond"* Infrasound *Latin infra "below, under, beneath"* Sonar Sound Waves Aid Brain Tumor Treatment | The Scientist Magazine® (the-scientist.com) Identification of infrasonic and seismic components of tremors in single-station records: application to the 2013 and 2018 events at Ioto Island, Japan | Earth, Planets and Space | Full Text (springeropen.com)	
8P15	**How does light travel?**	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 - Opaque objects do not allow light to pass through Reflection.		Luminous *Latin luminosus "shining, full of light, conspicuous"* Non-luminous *non-not* Transparent *transparere "show light through,"* Translucent Opaque *Latin opacus "shaded, in the shade, shady, dark, darkened, obscure,"* Reflection *Latin reflexionem literally "a bending back,"* Incident ray Reflected ray Angle of incident Angle of refraction Normal line Refraction *"to bend or break the natural course of. Latin refractus "to break up,"* Interface	

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		- Light reflects evenly off smooth surfaces e.g. mirrors. - Constructionn 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 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	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.	Refracted ray Angle of refraction Lens *Latin lens "a lentil," on analogy of the double-convex shape* Converging *Latin convergere "to incline together"* Diverging *Latin divergere "go in different directions,"* Focal point *"of or pertaining to a focus"* Focal length Pinhole camera Let's learn about light | Science News for Students Now You See It... Testing Out Light Refraction - Scientific American	

		- Focal length as the distance between the focal point and the centre of the lens - Converging lenses bend the light rays towards each other - 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	Build and use pinhole cameras to create an image on a screen.		
8P16	**What is energy?**	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, sound, heating, light, electrical. Energy transfer diagrams to show how energy can be transferred. E.g. in a simple circuit, newtons cradle.	Energy circus – identify energy stores and transfers. Newton's cradle.	Energy *active, action* Sankey diagram Efficiency Could traffic noise be converted into useful energy? - BBC Science Focus Magazine Conservation of energy - AccessScience from McGraw-Hill Education	

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		Use of Sankey diagrams to show energy transfers. Including the identification of useful and wasted energy. Refer back to conservation of energy.	Appliance energy ratings. Calculating the efficiency of different appliances.		
8P17	**What are energy resources?**	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 atoms break down. 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	Steam engine. Renewable energy circus.	Non-renewable *non - not, re - again, new - resume/revive, able - to be done* Fossil *Latin fossilis "dug up"* fuels *material for burning* Coal Oil Natural gas Nuclear Renewable *re - again, new - resume/revive, able - to be done* Solar *Pertaining to the sun* Wind turbine *Latin turbine "spinning top, eddy, whirlwind, that which whirls"* Tidal power Wave power Hydroelectricity *hydro- "water" + electric.* Geothermal *Greek geo – Earth. Thermal – heat* Can China's coal capital transform itself into a solar mecca? (nationalgeographic.com) Climate explained: why does geothermal electricity count as renewable? (theconversation.com)	Hinkley Point

		- 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 - 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			
8P18	**How can we save energy?**	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.	Kingspan practical demo. The effect of home insulation on saving energy and money. How a vacuum flask reduces conduction, convection and radiation	Conduction *A leading, guidance, to lead or bring together* Convection *Act of carrying or conveying, of bringing together* Radiation *Act or process of emitting light, a shining* Insulation Home insulation: how can it cut energy bills? - BBC News (in powerpoint)	

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		- 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.	Testing insulation practical – investigation into how good an insulator different materials are.	Insulation - Why Is It Important? | GreenMatch	
8P19	**What is static electricity?**	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.	Van de Graaf generator, Wimshurst demo. Rubbing balloon and sticking to wall simulation or real balloon. Investigation into electrical charges: Conduction rods practical	Charge Static electricity Attract *ad "to" + trahere "to pull, draw"* Repel *re- "back" + pellere "to drive, strike"* The Shocking Truth Behind Static Electricity | Live Science Static Electricity: An Unpredictable and Often Overlooked Hazard | AXA XL	
8P20	**What is electricity?**	Recap simple circuits from Y7 - circuit symbols - 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.		Electricity *Electricity – From Elekron (electron) meaning "shining light"* Circuit *A circumference, a journey around something. A space enclosed within certain limits. Arrangement by which a current is kept up between two poles.* Series Parallel Current *Running, flowing, moving along, to run*	

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		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 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.	Amps *named for French physicist André-Marie Ampère* Potential difference Volts The shocking ways wild animals use electricity (nationalgeographic.com)	
8P21	**What are the different types of magnets?**	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.	Making and investigation into the factors affecting the strength of electromagnets. - How the voltage affects the strength of an electromagnet - How the number of turns in a coil affects the strength of electromagnets.	Magnetism *Latin magnetismus "personal charm, attractive power or influence"* Current *Running, flowing, moving along, to run* Electromagnet *electr- "electrical, electricity,"* Solenoid *"coil of insulated wire carrying an electrical current and having magnetic properties,"*	

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		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. - The number of turns in the coil will make an electromagnet stronger.	Uses of electromagnetism e.g. in microphones and in scrap yards.	Electromagnetism | New Scientist A three-dimensional self-consistent computer simulation of a geomagnetic field reversal | Nature	
8P21i	**End of topic review**	Recap of Y8 composites: 8P1 What are forces? 8P2 What are mass, weight & gravity? 8P3 What is pressure? 8P4 What is atmospheric pressure? 8P5 How is pressure caused in liquids? 8P6 How can we explore space? 8P7 How fast? 8P8 What is acceleration? 8P9 How can we show acceleration? 8P10 What are waves? 8P11 How can we measure the speed of a wave? 8P12 How do we hear? 8P13 When is sound a problem? 8P14 How can we use sound? 8P15 How does light travel?			

		8P16 What is energy? 8P17 What are energy resources? 8P18 How can we save energy? 8P19 What is static electricity? 8P20 What is electricity? 8P21 What are the different types of magnets?			

Year 9 Lesson/ Composite sequences.

Code	Lesson/ composite title	Substantive knowledge/ components Purple indicates content for set 1s only	Disciplinary knowledge	Disciplinary literacy– Keywords *(etymology)* and linked articles	Cultural Capital/ Personal Development
9P1	**What is density?**	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) Relate density of an object to its ability to float. - An object less dense that water will float.	**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.**	Density *"quality of being very close or compact,"* Mass *French masse "lump, heap, pile'* Volume Upthrust *treud- "push, press"* Buoyancy *Spanish boyante, "to float"* Float *Old English flotian "to rest on the surface of water"* Sink *Old English sincan "become submerged, go under, subside"* Shipping Science: Building a Boat That Can Carry Cargo - Scientific American	

		- 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.			
9P2	**What are vectors and scalars?**	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)**	Vector *"to go, move, transport in a vehicle"* Scalar Magnitude *Latin magnitudo "greatness of size or extent,"* Direction *Latin directionem "a making straight, a straight line, a directing (toward something),"* Speed *"rapidity of movement, quickness, swiftness"* Distance Time Mass *French masse "lump, heap, pile'* Velocity *Latin velocitatem "swiftness, speed"* Displacement Force *physical strength, fortitude, push, pull.* What Are Vectors, and How Are They Used? - Scientific American	
9P3	**What can a velocity time graph tell me?**	Recap distance time graphs from Y7/Y8; - Graphs to show stationary and constant speed objects	**Interpreting and calculating distance**	Velocity *Latin velocitatem "swiftness, speed"* Acceleration *ad "to" celerare "hasten"*	

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		- 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	**travelled from velocity-time graphs.**	Distance Time	
9P4	**What is Newton's 1st Law?**	Recap forces from Y7/Y8; - 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.	**Brief biography of Isaac Newton.** **Air track, Newton's cradle demo.** **Balancing masses on ruler prac.**	External force *physical strength, fortitude, push, pull.* Newtons *after Isaac Newton* Stationary stacionarie, "having no apparent motion" (in reference to planets) Balanced *state of equilibrium* Unbalanced *un-not, state of equilibrium* What is inertia? | New Scientist	

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		Balanced forces produce a resultant force of zero, therefore no acceleration/change in motion. Unbalanced forces change the speed or direction of an object.			
9P5	**What is Newton's 2nd Law?**	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).**	Force *physical strength, fortitude, push, pull.* Mass *French masse "lump, heap, pile'* Acceleration *ad "to" celerare "hasten"* Why not race in the rain? - Deseret News	
9P6	**What is Newton's 3rd 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.**	Action-reaction Equal *Latin aequalis "uniform, identical, equal,"* Opposite *Latin oppositus "standing against, opposed, opposite,"* Force *physical strength, fortitude, push, pull.* Equilibrium *Latin aequilibrium "an even balance; a horizontal position,"* Newton's Third Law of Motion and the Concept of Momentum (wondriumdaily.com)	

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9P7	**How do we apply Newton's Laws?**	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.	**Measuring reaction times.** **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.**	Stopping distance Thinking distance Braking distance Reaction time *"action in resistance or response to another action or power,"* Crumple zones *crumplen, "press into irregular folds, rumple, wrinkle,"* The Physics of a Car Collision (thoughtco.com)	**F1 cars** **Crash test dummies** **MOT**
9P8	**How can we describe waves?**	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.	**Slinky** **Ripple tank to measure wavelength and frequency.**	Wave *Old English wafian "to fluctuate"* Speed *"rapidity of movement, quickness, swiftness"* Distance Time Frequency *"rate of recurrence"* Wavelength *Old English wafian "to fluctuate"* *Old English lengðu "property of being long or extended in one direction*	

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		- Labelling a wave diagram: amplitude, wavelength, frequency, period. 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)		The Physics of Surfing (Part One: Dropping In) | Popular Science (popsci.com)	
9P9	**What are seismic waves?**	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.	**Research information on earthquake strength and damage caused.**	Seismic wave *Greek seismos "a shaking, shock; an earthquake,"* Seismographs Primary *primarie, "earliest, most basic, first in time or sequence;"* Secondary *Latin secundarius "pertaining to the second class, inferior,"* AI detects hidden earthquakes (stanford.edu) What can machine learning tell us about the solid Earth? (stanford.edu)	
9P10	**How do we get coloured light?**	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. - 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)	**Herschell used a prism and thermometer to investigate infrared radiation.** **Ray boxes and prisms to split white light.**	Refraction *Latin refractionem "to bend or break the natural course of"* Frequency *"rate of recurrence"* Wavelength *Old English wafian "to fluctuate"* *Old English lengðu "property of being long or extended in one direction* Colour Absorb *Latin absorbere "to swallow up, devour,"* Reflect *from re- "back" + flectere "to bend"* rainbow | National Geographic Society	

		- 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.			
9P11	**What is the electromagnetic spectrum?**	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)	**Electromagnetism circus.**	Electromagnetic *electr-, word-forming element meaning "electrical, electricity," magnes Meaning "capable of being attracted by a magnet"* Spectrum Radio wave Microwave *Greek smikros "small" (small compared to radio waves)* Infrared *infra "low, below," red* Visible *Latin visibilis "that may be seen,"* Ultraviolet *ultra - beyond violet* X-ray *X, algebraic symbol for an unknown quantity suggest that the exact nature of the rays was unknown* Gamma Mysterious radio burst from space is unusually close—and especially baffling (nationalgeographic.com) What is mobile phone radiation and how safe is it? - ABC News	

		- Gamma: Cancer treatments and to 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.			
9P12	**How can we explore the universe?**	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.	**Examine images from Hubble and James Webb telescopes.** **New Horizons space probe to study Pluto.**	Gravitational pull Nebula *Latin nebula "mist, vapor, fog, smoke, exhalation,"* Protostar Main sequence star Red giant White dwarf Black dwarf Red supergiant Supernova *Latin nova "star that suddenly increases in brightness then slowly fades,"* Neutron star Black hole *Old English holian "to hollow out, scoop out,"* Space Probes | National Geographic Society	

		- 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 left overs 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**			
9P13	**What is energy efficiency?**	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. - Energy transfers include: Mechanical, sound, heating, light, electrical.	**Efficiency ratings on home appliances.**	Energy *active, action* Joules *in recognition of British physicist James P. Joule* Efficiency How to save energy at home - BBC Future	

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		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			
9P14	**What is ionising radiation?**	Recap structure of the atom. Ionising radiation as the emission of high energy subatomic particles or waves which have the ability to ionise atoms (by removing electrons) Background radiation - 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 -.	**Use of radioactivity kit.**	Ionising *to form an ion. Ion - ienai "to go," So called because ions move toward the electrode of opposite charge.* Radiation *radiacion, "act or process of emitting light,"* Decay *"to decrease,"* Alpha *First nuclear radiation to be discover* Beta *second to be discovered* Gamma Becquerels *named after Antoine Henri Becquerel, the French physicist* Geiger-muller *named after Hans Geiger and Walther Müller* What is nuclear medicine? In diagnosis, in treatment, and more (medicalnewstoday.com)	

		- 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 - 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. **Definition of Half-life as the time it takes for half the number of unstable nuclei to decay/for the activity of a sample to half.**			
9P15	**How can we use static electricity?**	Recap ideas on static from Y8. - Static electricity is caused by the movement of electrical charge (electrons), when two insulators are rubbed together.	**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**	Static Charge Attract *ad "to" + trahere "to pull, draw"* Repel *re- "back" + pellere "to drive, strike"* Static Electricity: An Unpredictable and Often Overlooked Hazard | AXA XL	

		- 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.	**materials and/or electric shock.**		
9P16	**What is resistance?**	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. - Voltage as potential difference in energy across a component.	**Measuring current and voltage in a circuit to calculate resistance.** **Investigate how varying resistance affects the current and voltage in a circuit.**	Current *Running, flowing, moving along, to run* Potential difference Resistance Ohms *named after German physicist Georg S. Ohm*	

		- 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.			
9P17	**How do we pay for electricity?**	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 - 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.	**Examine an electricity bill and calculate cost.** **Smart meters can be used to monitor electricity consumption more accurately.**	Electricity *Electricity –* *From Elekron (electron) meaning "shining light"* Energy prices and their effect on households - Office for National Statistics (ons.gov.uk)	

		- Calculating the cost of running different appliances.			
9P17	**How do motors work?**	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. **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).**	Magnetism *Latin magnetismus "personal charm, attractive power or influence"* Magnetic field Current *Running, flowing, moving along, to run* Force *physical strength, fortitude, push, pull.* Uniform *from uni- "one"+ forma "form"* Types of Motors and How They Work (for Commercial and Industrial Applications) (thomasnet.com)	

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KS4 Lesson sequence

YEAR 10 map of topics taught (detailed knowledge map as seen in Biology is work in progress)								
2023-24	**AUTUMN**		**SPRING**			**SUMMER**		
SUBJECT	**FIRST HALF**	**SECOND HALF**	**FIRST HALF**	**SECOND HALF**		**FIRST HALF**	**SECOND HALF**	
GCSE SCIENCE (Please note, classes may cover topics in a different order)	**Biology** Key concepts in Biology (Paper 1 & 2) Cells and control (Paper 1) Genetics (Paper 1) Natural selection (Paper 1) **Additional topics for separate students only:** Food tests The brain The eye		**Chemistry 1** States of matter (Paper 3) Separation techniques (Paper 3) Atomic structure (Paper 3 & 4) The periodic table (Paper 3 & 4) Bonding (Paper 3 & 4) Acids and Alkalis (Paper 3) Calculations involving Masses (Paper 3 & 4) **Additional topics for separate students only:** Yields Atom economy Concentrations	**Physics 1** Motion (Paper 5) Forces and Motions (Paper 5) Conservation of Energy (Paper 5) Waves (Paper 5) Light and the EM spectrum (Paper 5) Radioactivity (Paper 5) **Additional topics for separate students only:** Ears and hearing Infrasound	**Assessments:** Midterm assessments (in class) Formal examinations: Year 10 progress assessment		

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	Sexual and Asexual reproduction Protein synthesis Mendel/Alleles Virus life cycles Plants diseases and defences Monoclonal antibodies	Titrations Molar volume of gases Chemical cells and fuel cells	Ultrasound Ray diagrams Lenses Nuclear energy Nuclear fission Nuclear fusion	

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YEAR 11 map of topics taught (detailed knowledge map as seen in Biology is work in progress)						
2023-24	**AUTUMN**		**SPRING**		**SUMMER**	
SUBJECT / YEAR	**FIRST HALF**	**SECOND HALF**	**FIRST HALF**	**SECOND HALF**	**FIRST HALF**	**SECOND HALF**
SCIENCE **(Please note, classes may cover topics in a different order)**	**Biology 2** Plant structures and functions (Paper 2) Animals coordination and homeostasis (Paper 2) Exchange and transports in animals (Paper 2) Ecosystem and material cycles (Paper 2) **Additional topics for separate students only:** Plant hormones and adaptations Uses of plant hormones Thermoregulation Osmoregulation The kidneys Assessing pollution Food security Rates of decomposition	**Chemistry 2** Electrolysis (Paper 3) Metal reactions (Paper 3) Groups in the periodic table (Paper 4) Rates of reaction (Paper 4) Heat energy and chemical reactions (Paper 4) Fuels (Paper 4) Earth and atmosphere (Paper 4) **Additional topics for separate students only:** Transition metals Corrosion Electroplating Alloying Hydrocarbons Alcohols and carboxylic acids Polymers	**Physics 2** Energy and work (Paper 6) Forces and their effects (Paper 6) Electricity and circuits (Paper 6) Magnetism (Paper 6) Electromagnetic induction (Paper 6) Particle model (Paper 6) Forces and matter (Paper 6) **Additional topics for separate students only:** Rotational forces Static electricity Dangers and uses of static electricity Gas temperature and volume Pressure in fluids	Assessments: Midterm assessments (in class) GCSE Examinations: Paper 1 & 2 (Biology) Paper 3 & 4 (Chemistry) Paper 5 & 6 (Physics)	

		Qualitative analysis Bulk and surface properties of matter Nanoparticles	Pressure and up thrust	