Unit Two: Energy and Sustainability (ESS, C, P and B)

The Big Picture

Modern Humans have been on the planet for a significant amount of time. They have learnt how to use energy and they have modified their environment to sustain their increasingly complex lives. The need and use of energy brings its own complexities, so an understanding is needed to formulate reasoned positions for the production and consumption of energy. Students need to understand how energy is used in everyday life, how it is consumed both directly and indirectly. They will explore how energy flows through a system and how the resources are recycled and the processes involved. They will assess and evaluate the impact of chemical weathering and deposition, as well as ocean acidification. How sustainable are the systems we use to harness energy? What are the alternatives?

Key course objectives / SOLO checklist

Topic	Checklist of Understanding	Done	Revise	Can teach
Energy Consumption & Fossil Fuels	I can state what energy is.			
	I can describe what is meant by energy consumption.			
	I can explain how energy is used in everyday life.			
	I can describe the direct use of energy in everyday life, e.g. lighting heating, fuel for transport etc.			
	I can describe how energy is consumed indirectly.			
	I can explain how indirect consumption of energy is associated with the production of consumer goods, energy required to build homes and infrastructure, energy for transporting goods and growing food etc.			
	I can compare direct and indirect use of energy in everyday life.			
	I can review what is meant by a fossil fuel (coal, crude oil, natural gas).			
	I can explain what happens to the levels of CO_2 in the atmosphere with the burning of fossil fuels.			
	I can describe the greenhouse effect using ideas about energy and radiation: • Earth's surface absorbs visible light from sun, temp increases, emits infrared radiation. • Greenhouse gases (including CO_2) absorb infrared and gain vibrational energy which increases kinetic energy therefore temp of atmosphere.			
	I can name common greenhouse gases (CO_2, CH_4, N_2O, CFCs & HFCs)			
	I can describe some effects of the greenhouse effect (local & global).			
Extension	I can reflect on the efficiency of energy use directly and indirectly.			
	I can theorise about some of the problems we face in the future if we don't use energy more efficiently.			
	I can examine data to evaluate evidence of climate change.			
Enrichment	I can describe what carbon capture is and how it could reduce atmospheric carbon dioxide.			
	I can conduct an energy survey and reflect on how much energy my household uses.			
	I can reflect on some of the practices I could do to use less energy.			
	I can evaluate the wider impact of climate change.			
Organic Chemistry	I can state what organic chemistry is			
	I can explain how fractional distillation works and how it is used to separate different substances within crude oil.			
	I can recognise homologous series of hydrocarbons: alkanes, alkenes, alkynes, cycloalkanes, cycloalkenes.			
	I can state what a functional group is and recognise functional groups			

	of the homologous series listed above.			
	I can general formulae to recognise members of homologous series.			
	I can state what a saturated hydrocarbon is.			
	I can state what an unsaturated hydrocarbon is.			
	I can write the names of hydrocarbons using the IUPAC naming system for substances up to 8 carbons in the parent chain (straight and branched alkanes and alkenes, *simple only (no branches): cycloalkanes, cycloalkenes, alkynes*)			
	I can describe the molecular, condensed and structural formulae of hydrocarbons with up to 8 carbons in the parent chain.			
	I can use given information to predict names of hydrocarbons and infer molecular, condensed and structural formulae.			
	I can draw and identify structural isomers for hydrocarbons, including chain isomers and position isomers.			
	I can use IUPAC naming system to write names for structural isomers, using naming convention for alkyl groups and numbering system for position of substituents			
	I can define terms viscosity, volatility and flammability in relation to hydrocarbons.			
	I can describe the trends in physical properties of hydrocarbons (melting point and boiling point, viscosity, volatility, flammability).			
	I can predict the outcome of combustion involving hydrocarbons.			
	I can write and balance molecular equations for complete combustion reactions of hydrocarbons.			
Extension	I can describe and give examples of functional group isomers as a category of structural isomers.			
	I can describe geometric isomers and give examples of them. How do they differ from structural isomers? How does the geometry affect the properties of hydrocarbons?			
Enrichment	I can research the aromatic hydrocarbons and how they are used in industry.			
Energy Changes	I can state what is meant by endothermic and exothermic reactions.			
	I can describe the energy changes (ΔH) that occur during endothermic and exothermic reactions using +/-.			
	I can use the terms systems and surroundings to relate the energy transfer during a reaction.			
	I can contrast the differences between endothermic and exothermic reactions, in terms of temperature change and energy transfer.			
	I can define and describe activation energy (E_A) as the energy required for reactants to be able to react.			
	I can state the key features of a catalyst (increases rate of reaction, takes part in reaction but not consumed so can be reused).			
	I can describe how a catalyst speeds up a chemical reaction (reduction of E_A so greater proportion of reactants can react).			
	I can draw and analyse energy profile diagrams, including use of: reactants and products, ΔH positive or negative, E_a forward and reverse, transition state, with and without a catalyst.			
	I can write equations for reactions that involve energy changes.			
	I can identify exothermic and endothermic reactions from quantitative experimental data.			
	I can use data from reactions to compare fuels.			
Extension	I can describe and explain how catalytic cracking is used to convert long chain alkanes into a range of useful products.			
	I can describe the difference between homogeneous and			

	heterogeneous catalysis.			
Enrichment	I can explain how catalysts are used to reduce emissions from vehicle engines.			
	I can describe what a catalyst inhibitor is, and how it effects a catalysed reaction.			
Nuclear Energy	I can recall a description of Bohr's model of the atom.			
	I can recall what is meant by atomic number, atomic mass, protons, neutrons (Year 9)			
	I can definitions of nucleons, strong nuclear force, electromagnetic force, radioactive decay			
	I can relate knowledge of strong nuclear force and (counters) electromagnetic force to the stability of nucleus. I can relate binding energy to stability of a nucleus and relate to nuclei becoming radioactive.			
	I can describe the different types of radiation (alpha, beta and gamma) and explain the differences between them.			
	I can identify specific materials that stop the different types of radiation.			
	I can write and balance nuclear reactions for radioactive decay			
	I can state what a half-life is and explain that different isotopes have different levels of stability.			
	I can interpret half-life graphs that measure mass, number of nuclei, percentage and activity (counts per sec/becquerels)			
	I can draw decay graphs given data and use the graph to calculate half-life.			
	I can describe what fission and fusion are and explain the differences between them			
	I can predict energy changes as a result of fission and fusion reactions.			
	I can write and balance nuclear reactions for fission and fusion reactions			
	I can state what is meant by mass defect in a fission/fusion reaction and how it relates to the energy released in the reaction			
	I can describe the relationship between mass and energy using E = mc2.			
	I can describe mass defect and binding energy and their relationship.			
	I can describe the main components of nuclear power stations. In particular, reactor vessel (encases and prevents radiation from escaping), the control rods (function in controlling nuclear reactions), fuel rods, steam generator (heat exchanger + turbine + generator), moderator (slows neutrons eg graphite or heavy water).			
	I can explain, in simple terms, how nuclear power stations work to generate electricity. A nuclear reactor is a device in which nuclear reactions are generated, and the chain reaction is controlled to release large amount of steady heat, thereby producing energy.			
	I can describe an uncontrolled reaction in terms of neutrons escaping too quickly to maintain a chain reaction, resulting in the rapid release of nuclear energy, causing an explosion. Contrast this with a controlled reaction.			
	I can analyse some advantages and disadvantages of using nuclear energy to generate electricity.			
Extension	I can discuss how radioisotopes are used in medicine.			
	I can perform quantitative analysis of mass defect and binding energy			
	Evaluate, with reference to empirical evidence, claims about heating processes, nuclear reactions and electrical technologies			
Enrichment	I can generalise about the work of Niels Bohr.			

	I can theorise about the impact of different sources of radiation used in everyday life.			
	I can reflect on nuclear power as an alternative energy source. What considerations would need to be made?			
5 weeks, Biological Sciences (Diseases) Term 4 Weeks 1-5 Program will be handed out separately				
EXAM	Covers all content before this point.			
The Carbon Cycle	I can define biogeochemical cycle as a concept describing how chemical elements (e.g., nitrogen, carbon) or molecules (e.g. water) are transformed and stored by both biological and geological components in the Earth's biosphere.			
	I can state the main forms of carbon in carbon cycle.			
	I can describe the main processes in the carbon cycle (respiration, photosynthesis, weathering, erosion, dissolving, deposition, fossilisation, extraction, volcanic eruptions, carbon fixation into carbon sinks).			
	I can explain how solar energy is transformed into chemical potential energy through the process of photosynthesis.			
	I can explain how the structure of plants is adapted to the process of photosynthesis.			
	I can explain how the structure of leaves are adapted to the process of photosynthesis.			
	I can state the word and chemical equation for photosynthesis.			
	I can state what respiration is.			
	I can compare and contrast the similarities and differences between aerobic respiration and photosynthesis.			
	I can organise the carbon cycle into a poster (electronic or paper). Emphasise the biological, chemical, geological or all three components of the carbon cycle.			
Extension	I can explain the process light dependent and light independent stages of photosynthesis.			
	I can hypothesise as to why intermittent light produces a greater rate of photosynthesis than continuous light.			
	I can describe what photorespiration is and compare the differences between C3 and C4 plants.			
	I can explain the processes of glycolysis, the Krebs Cycle and the electron transport chain in the generation of ATP during aerobic respiration.			
Enrichment	I can reflect on the importance of plants for the survival of animals.			
	I can hypothesise what will happen if plants are not managed well in Australia.			
	I can consider what may be done to preserve plants or increase productivity.			