OCR 21st Century GCSE Science 2011

GCSE Science: Biology

Module B1: You and your genes	Boardworks presentation
B1.1 What are genes and how do they affect the way that organisms develop?	
1. recall that instructions to control how an organism develops and functions are found in the nucleus of its cells and are called genes	**Similarity and Variation**
2. understand that genes are instructions for a cell that describe how to make proteins	**Similarity and Variation**
3. recall that proteins may be structural (eg collagen) or functional (eg enzymes such as amylase)	**Similarity and Variation**
4. understand that genes are sections of very long DNA molecules that make up chromosomes in the nuclei of cells	**Similarity and Variation**
5. understand that some characteristics are determined by genes (eg dimples), some are determined by environmental factors (eg scars), and some are determined by a combination of genes and the environment (eg weight)	**Similarity and Variation**
6. understand that many characteristics are determined by several genes working together (eg eye colour).	**Similarity and Variation**
B1.2 Why can people look like their parents, brothers and sisters, but not be identical to them?	
1. recall that body cells contain pairs of chromosomes and that sex cells contain only one chromosome from each pair	**Inheritance**
2. understand that chromosomes in a pair carry the same genes in the same place, but that there may be different versions of genes called alleles	**Inheritance**
3. recall that an individual usually has two alleles for each gene	**Inheritance**
4. understand that in an individual the two alleles of each gene can be the same **(homozygous)** or different **(heterozygous)**	**Inheritance**
5. understand that during sexual reproduction genes from both parents come together and produce variation in the offspring	**Inheritance** **Cloning**
6. understand that offspring have some similarities to their parents because of the combination of maternal and paternal alleles in the fertilised egg	**Similarity and Variation**
7. understand that different offspring from the same parents can differ from each other because they inherit a different combination of maternal and paternal alleles	**Inheritance** **Cloning**
8. understand that an allele can be dominant or recessive, and that: a. an individual with one or both dominant alleles (in a pair of alleles) will show the associated dominant characteristic b. an individual with one recessive allele (in a pair of alleles) will not show the associated recessive characteristic c. an individual with both recessive alleles (in a pair of alleles) will show the associated recessive characteristic	**Inheritance**
9. recall that human males have XY sex chromosomes and females have XX sex chromosomes	**Inheritance**
10. understand that the sex-determining gene on the Y chromosome triggers the development of testes, and that in the absence of a Y chromosome ovaries develop	**Inheritance**
11. use and interpret genetic diagrams (family trees and Punnett squares) showing: a. the inheritance of single gene characteristics with a dominant and recessive allele b. the inheritance of sex chromosomes	**Inheritance**
12. understand that the term genotype describes the genetic make-up of an organisms (the combination of alleles), and the term phenotype describes the observable characteristics that the organism has.	**Inheritance**
B1.3 How can and should genetic information be used? How can we use our knowledge of genes to prevent disease?	
1. understand that a small number of disorders are caused by faulty alleles of a single gene, including Huntington's disease and cystic fibrosis	**Inherited Diseases**
2. understand that disorders may be caused by dominant alleles (eg Huntington's disease) or recessive alleles (eg cystic fibrosis)	**Inherited Diseases**
3. recall the symptoms of Huntington's disease and cystic fibrosis, to include: a. Huntington's disease – late onset, tremor, clumsiness, memory loss, inability to concentrate, mood changes b. cystic fibrosis – thick mucus, difficulty breathing, chest infections, difficulty in digesting food	**Inherited Diseases**
4. understand that a person with one recessive allele (in a pair of alleles) will not show the symptoms of the disorder, but is a carrier and can pass the recessive allele to their children	**Inherited Diseases**
5. interpret through genetic diagrams (family trees and Punnett squares) the inheritance of a single gene disorder, including the risk of a child being a carrier	**Inherited Diseases**

6. describe uses of genetic testing for screening adults, children and embryos, limited to: a. testing embryos for embryo selection (pre-implantation genetic diagnosis) b. predictive testing for genetic diseases c. testing an individual before prescribing drugs	**Inherited Diseases**
7. understand that testing adults and fetuses for alleles that cause genetic disorders has implications that need to be considered, including: a. risk of miscarriage as a result of cell sampling for the genetic test b. using results that may not be 100% reliable, including false positives and false negatives c. whether or not to have children at all d. whether or not a pregnancy should be terminated e. whether other members of the family should be informed	**Inherited Diseases**
8. understand the implications of testing embryos for embryo selection prior to implantation	**Inherited Diseases**
9. understand the implications of the use of genetic testing by others (for example, for genetic screening programmes by employers and insurance companies).	**Inherited Diseases**

B1.4 How is a clone made?	
1. recall that bacteria, plants and some animals can reproduce asexually to form clones (individuals with identical genes)	**Cloning**
2. understand that any differences between clones are likely to be due only to environmental factors	**Cloning**
3. understand that clones of plants occur naturally when plants produce bulbs or runners	**Cloning**
4. understand that clones of animals occur: a. naturally, when cells of an embryo separate (identical twins) **b. artificially, when the nucleus from an adult body cell is transferred to an empty unfertilised egg cell**	**Cloning**
5. understand that there are different types of stem cells: a. adult stem cells which are unspecialised cells that can develop into many, but not all, types of cells b. embryonic stem cells which are unspecialised cells that can develop into any type of cell	**Cloning**
6. understand that, as a result of being unspecialised, stem cells from embryos and adults offer the potential to treat some illnesses	**Cloning**
7. understand that the majority of cells of multicellular organisms become specialised during the early development of the organism.	**Cloning**

Module B2: Keeping healthy

B2.1 How do our bodies resist infection?	
1. understand that symptoms of an infectious disease are caused by damage done to cells by microorganisms or the poisons (toxins) they produce	**The Body's Defenses**
2. understand why, in suitable conditions such as those inside a human body, microorganisms (eg bacteria and viruses) can reproduce rapidly to produce very large numbers	**The Body's Defenses**
3. calculate the population growth of microorganisms given appropriate data	**The Body's Defenses**
4. understand that white blood cells are part of the body's immune system and can destroy microorganisms by engulfing and digesting them or by producing antibodies	**The Body's Defenses**
5. understand that antibodies recognise microorganisms by the antigens that they carry on their surface, that different microorganisms have different antigens, and that a different antibody is therefore needed to recognise each different type of microorganism	**The Body's Defenses**
6. understand that once the body has made the antibody to recognise a particular microorganism, memory cells can make that antibody again very quickly, therefore protecting against that particular microorganism in the future (immunity).	**The Body's Defenses**

B2.2 What are vaccines and antibiotics and how do they work?	
1. understand that vaccinations provide protection from microorganisms by establishing memory cells that produce antibodies quickly on reinfection	**Immunization**
2. recall that a vaccine usually contains a safe form of a disease-causing microorganism	**Immunization**
3. understand why, to prevent epidemics of infectious diseases, it is necessary to vaccinate a high percentage of a population	**Immunization**
4. understand that vaccines and drugs (medicines) can never be completely risk-free, since individuals have varying degrees of side effects to them	**Immunization**
5. understand that due to genetic differences, people react differently to drugs and vaccines	**Immunization**
6. understand that chemicals called antimicrobials can be used to kill, or inhibit, bacteria, fungi and viruses	**Combatting Infection**
7. recall that antibiotics are a type of antimicrobial that are effective against bacteria but not viruses	**Combatting Infection**
8. recall that over a period of time bacteria and fungi may become resistant to antimicrobials	**Combatting Infection**
9. understand that random changes (mutations) in the genes of these microorganisms sometimes lead to varieties which are less affected by antimicrobials	**Combatting Infection**
10. understand that to reduce antibiotic resistance we should only use antibiotics when necessary and always complete the course	**Combatting Infection**
11. understand that new drugs and vaccines are first tested for safety and effectiveness using animals and human cells grown in the laboratory	**Drug Development**
12. understand that human trials may then be carried out: a. on healthy volunteers to test for safety b. on people with the illness to test for safety and effectiveness	**Drug Development**
13. describe and explain the use of 'open-label', 'blind' and 'double-blind' human trials in the testing of a new medical treatment	**Drug Development**
14. understand the importance of long-term human trials	**Drug Development**
15. understand the ethical issues related to using placebos in human trials.	**Drug Development**

B2.3 What factors increase the risk of heart disease?	
1. describe the role of the heart as a double pump in the circulatory system	**Heart Disease**
2. understand why heart muscle cells need their own blood supply	**Heart Disease**
3. understand how the structure of arteries, veins and capillaries is related to their function	**Heart Disease**
4. recall that heart rate can be measured by recording the pulse rate	**Blood Pressure**
5. recall that blood pressure measurements record the pressure of the blood on the walls of the artery	**Blood Pressure**
6. recall that a blood pressure measurement is given as two numbers, the higher value when the heart is contracting and the lower value when the heart is relaxed	**Blood Pressure**
7. understand that 'normal' measurements for factors such as heart rate and blood pressure are given within a range because individuals vary	**Blood Pressure**
8. understand how fatty deposits in the blood vessels supplying the heart muscle can produce a 'heart attack'	**Blood Pressure**
9. understand that heart disease is usually caused by lifestyle factors and/or genetic factors	**Heart Disease**
10. recall that lifestyle factors that can increase the risk of heart disease include: a. poor diet b. stress c. cigarette smoking d. misuse of drugs	**Heart Disease**
11. recall that regular moderate exercise reduces the risk of developing heart disease	**Diet, Exercise and Health**
12. relate differences in lifestyle factors in the UK and non-industrialised countries to the prevalence of heart disease	**Heart Disease**
13. understand that factors that can increase the risk of heart disease are identified via epidemiological and large scale genetics studies	**Heart Disease**
14. assess levels of heart disease risk, and actions that could be taken to reduce risk, when provided with lifestyle and genetic data	
15. recall that high blood pressure increases the risk of heart disease	**Blood Pressure / Heart Disease**
16. understand that the misuse of drugs (eg Ecstasy, cannabis, nicotine and alcohol) can have an adverse effect on health, including heart rate and blood pressure, increasing the risk of a heart attack.	**Heart Disease**

B2.4 How do our bodies keep a healthy water balance?	
1. understand that nervous and hormonal communication systems are involved in maintaining a constant internal environment (homeostasis)	Homeostasis
2. understand that automatic control systems throughout the body maintain a range of factors at steady levels and that this is required for cells to function properly	Homeostasis
3. understand that these control systems have: a. receptors to detect changes in the environment b. processing centres to receive information and coordinate responses automatically c. effectors to produce the response	The Nervous System
4. understand the principle of negative feedback	
5. recall that negative feedback between the effector and the receptor of a control system reverses any changes to the system's steady state	The Nervous System
6. understand that a balanced water level is important for maintaining the concentration of cell contents at the correct level for cell activity	Controlling Water Content
7. understand that water levels are controlled by balancing gains from drinks, food and respiration and losses through sweating, breathing, faeces and the excretion of urine	Controlling Water Content
8. understand that the kidneys play a vital role in balancing levels of water, waste and other chemicals in the blood	Controlling Water Content
9. understand that the kidneys balance water levels by producing dilute or concentrated urine as a response to concentration of blood plasma, which is affected by external temperature, exercise level and intake of fluids and salt	Controlling Water Content
10. recall that concentration of urine is controlled by a hormone called ADH, which is released into the bloodstream by the pituitary gland	Controlling Water Content
11. understand how ADH secretion is controlled by negative feedback	Controlling Water Content
12. understand that alcohol results in the production of a greater volume of more dilute urine, **due to ADH suppression**, which can lead to dehydration and adverse effects on health	Controlling Water Content
13. understand that the drug Ecstasy results in a smaller volume of less dilute urine, **due to increased ADH production**	Controlling Water Content

Module B3: Life on Earth

B3.1 Systems in balance – how do different species depend on each other?	
1. understand that a species is a group of organisms that can breed together to produce fertile offspring	Classifying Organisms
2. understand that adaptation of living organisms to their environment increases the species' chance of survival by making it more likely that individuals will survive to reproduce	Adaptation
3. recall, and recognise when given relevant data, examples of how different organisms are adapted to their environment, and explain how the adaptations increase the organism's chance of surviving to successfully reproduce	Adaptation
4. understand that living organisms are dependent on the environment and other species for their survival	Competition
5. understand that there is competition for resources between different species of animals or plants in the same habitat	Competition
6. relate changes affecting one species in a food web to the impact on other species that are part of the same food web	Interdependence / Environmental Change and its Effects
7. explain the interdependence of living organisms by using food webs	Interdependence / Environmental Change and its Effects
8. understand that a change in the environment may cause a species to become extinct, for example, if: a. the environmental conditions change beyond its ability to adapt b. a new species that is a competitor, predator or disease organism of that species is introduced c. another species (animal, plant or microorganism) in its food web becomes extinct	Environmental Change and its Effects
9. understand that nearly all organisms are ultimately dependent on energy from the Sun	Energy Transfers in Food Chains
10. recall that plants absorb a small percentage of the Sun's energy for the process of photosynthesis	Energy Transfers in Food Chains
11. recall that this absorbed energy is stored in the chemicals which make up the plants' cells	Energy Transfers in Food Chains

12. understand that energy is transferred between organisms in an ecosystem: a. when organisms are eaten b. when dead organisms and waste materials are fed on by decay organisms (decomposers and detritivores)	**Energy Transfers in Food Chains** / **Decay**
13. explain how energy passes out of a food chain at each stage via heat, waste products and uneaten parts, limiting the length of food chains	**Energy Transfers in Food Chains**
14. calculate from given data the percentage efficiency of energy transfer at different stages of a food chain	**Energy Transfers in Food Chains**
15. understand how carbon is recycled through the environment to include the processes of combustion, respiration, photosynthesis and decomposition	**The Carbon Cycle**
16. understand the importance of the role of microorganisms in the carbon cycle	**The Carbon Cycle**
17. understand how nitrogen is also recycled through the environment in the processes of: a. nitrogen fixation to form nitrogen compounds including nitrates b. conversion of nitrogen compounds to protein in plants and animals c. transfer of nitrogen compounds through food chains d. excretion, death and decay of plants and animals resulting in release of nitrates into the soil e. uptake of nitrates by plants f. denitrification	**The Nitrogen Cycle**
18. understand the importance of the role of microorganisms in the nitrogen cycle, including decomposition, nitrogen fixation and denitrification	**Decay** / **The Nitrogen Cycle**
19. interpret simple diagrams of the carbon cycle and nitrogen cycle	**The Carbon Cycle** / **The Nitrogen Cycle**
20. understand how environmental change can be measured using non-living indicators, including nitrate levels, temperature and carbon dioxide levels	**Measuring Environmental Change**
21. understand how climate and environmental change can be measured using living indicators, including phytoplankton, lichens and aquatic river organisms such as mayfly larvae	**Measuring Environmental Change**
22. interpret data obtained from living and non-living indicators to investigate environmental change.	**Measuring Environmental Change**
B3.2 How has life on Earth evolved?	
1. recall that life on Earth began about 3500 million years ago	**Evolution**
2. understand that life on Earth (including species that are now extinct) evolved from very simple living things	**Evolution**
3. understand that there is variation between individuals of the same species and that some of this variation is genetic so can be passed on to offspring	**Evolution**
4. understand that genetic variation is the result of changes that occur in genes (mutations)	**Evolution**
5. understand that mutated genes in sex cells can be passed on to offspring and may occasionally produce new characteristics	**Evolution**
6. understand the process of natural selection in terms of the effects of genetic variation and competition on survival and reproduction, leading to an increase in the number of individuals displaying beneficial characteristics in later generations	**Evolution**
7. describe the similarities and differences between natural selection and selective breeding	**Evolution**
8. interpret data on changes in a species in terms of natural selection	**Evolution**
9. understand how the combined effect of mutations, environmental changes, natural selection and isolation can produce new species in the process of evolution	**Evolution**
10. understand that evidence for evolution is provided by the fossil record and from analysis of similarities and differences in the DNA of organisms	**Classifying Organisms** / **Evolution**
11. understand that Darwin's theory of evolution by natural selection was the result of many observations and creative thought and why it is a better scientific explanation than Lamarck's (e.g. fits with advances in understanding of genetics, no evidence or mechanism for inheritance of acquired characteristics).	**Evolution**

B3.3 What is the importance of biodiversity?	
1. understand that organisms are classified into groups according to similarities and differences in characteristics including: a. physical features (eg flowers in flowering plants and the skeleton in vertebrates) b. DNA	**Classifying Organisms**
2. understand that organisms are classified at different levels, and that these levels can be arranged in an order progressing from large groups containing many organisms with a small number of characteristics in common (e.g. kingdom) to smaller groups containing fewer organisms with more characteristics in common (e.g. species)	**Classifying Organisms**
3. understand that the classification of living and fossil organisms can help to: a. make sense of the enormous diversity of organisms on Earth b. show the evolutionary relationships between organisms	**Classifying Organisms**
4. understand that biodiversity refers to the variety of life on Earth including: a. the number of different species b. the range of different types of organisms, eg plants, animals and microorganisms c. the genetic variation within species	**Environmental Change and its Effects**
5. understand why biodiversity is important for the future development of food crops and medicines	
6. understand that the rate of extinction of species is increasing and why this is likely to be due to human activity	**Environmental Change and its Effects**
7. understand that maintaining biodiversity to ensure the conservation of different species is one of the keys to sustainability	**Environmental Change and its Effects / Sustainability**
8. understand that sustainability means meeting the needs of people today without damaging the Earth for future generations	**Sustainability**
9. understand that large-scale monoculture crop production is not sustainable because it does not maintain biodiversity	**Sustainability**
10. describe and explain how sustainability can be improved, for example in the use of packaging materials, by considering the materials used, energy used and pollution created	**Sustainability**
11. understand why it is preferable to decrease the use of some materials, including packaging materials, even when they are biodegradable, because of: a. use of energy in their production and transport b. slow decomposition in oxygen deficient landfill sites.	**Sustainability**

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GCSE Science: Chemistry

C1: Air Quality	Boardworks presentation
C1.1 Which chemicals make up air, and which ones are pollutants? How do I make sense of data about air pollution?	
C1.1.1 recall that the atmosphere (air) that surrounds the Earth is made up mainly of nitrogen, oxygen and argon, plus small amounts of water vapour, carbon dioxide and other gases	Earth's Atmosphere
C1.1.2 understand that air is a mixture of different gases consisting of small molecules with large spaces between them	Earth's Atmosphere
C1.1.3 recall that the relative proportions of the main gases in the atmosphere are approximately 78% nitrogen, 21% oxygen and 1% argon	Earth's Atmosphere
C1.1.4 understand that other gases or particulates may be released into the atmosphere by human activity or by natural processes (eg volcanoes), and that these can affect air quality	Evolution of the Atmosphere
C1.1.5 understand how the Earth's early atmosphere was probably formed by volcanic activity and consisted mainly of carbon dioxide and water vapour	Evolution of the Atmosphere
C1.1.6 understand that water vapour condensed to form the oceans when the Earth cooled	Evolution of the Atmosphere
C1.1.7 explain how the evolution of photosynthesising organisms added oxygen to, and removed carbon dioxide from, the atmosphere	Evolution of the Atmosphere
C1.1.8 explain how carbon dioxide was removed from the atmosphere by dissolving in the oceans and then forming sedimentary rocks, and by the formation of fossil fuels	Evolution of the Atmosphere
C1.1.9 understand how human activity has changed the composition of the atmosphere by adding: a. small amounts of carbon monoxide, nitrogen oxides and sulfur dioxide to the atmosphere b. extra carbon dioxide and small particles of solids (eg carbon) to the atmosphere	Changing the Atmosphere
C1.1.10 understand that some of these substances, called pollutants, are directly harmful to humans, and that some are harmful to the environment and so cause harm to humans indirectly	Changing the Atmosphere
C1.2 What chemical reactions produce air pollutants? What happens to these pollutants in the atmosphere?	
C1.2.1 recall that coal is mainly carbon	Combustion
C1.2.2 recall that petrol, diesel fuel and fuel oil are mainly compounds of hydrogen and carbon (hydrocarbons)	Combustion
C1.2.3 understand that, when fuels burn, atoms of carbon and/or hydrogen from the fuel combine with atoms of oxygen from the air to produce carbon dioxide and/or water (hydrogen oxide)	Combustion
C1.2.4 understand that a substance chemically combining with oxygen is an example of oxidation, that loss of oxygen is an example of reduction, and that combustion reactions therefore involve oxidation	Combustion
C1.2.5 recall that fuels burn more rapidly in pure oxygen than in air	Combustion
C1.2.6 recall that oxygen can be obtained from the atmosphere and can be used to support combustion (eg in oxy-fuel welding torches)	Combustion
C1.2.7 recall that in a chemical reaction the properties of the reactants and products are different	Chemical Reactions
C1.2.8 understand that atoms are rearranged during a chemical reaction	Chemical Reactions
C1.2.9 interpret representations of the rearrangement of atoms during a chemical reaction	Chemical Reactions
C1.2.10 understand that during the course of a chemical reaction the numbers of atoms of each element must be the same in the products as in the reactants, thus conserving mass	Chemical Reactions
C1.2.11 understand how sulfur dioxide is produced if the fuel that is burned contains any sulfur	Incomplete Combustion
C1.2.12 understand how burning fossil fuels in power stations and for transport pollutes the atmosphere with: a. carbon dioxide and sulfur dioxide b. carbon monoxide and particulate carbon (from incomplete burning) c. nitrogen oxides (from the reaction between atmospheric nitrogen and oxygen at the high temperatures inside engines)	Fossil Fuels and the Environment
C1.2.13 relate the formulae for carbon dioxide CO_2, carbon monoxide CO, sulfur dioxide SO_2, nitrogen monoxide NO, nitrogen dioxide NO_2 and water H_2O to visual representations of their molecules	Fossil Fuels and the Environment

C1.2.14 understand that nitrogen monoxide NO is formed during the combustion of fuels in air, and is subsequently oxidised to nitrogen dioxide NO2 (NO and NO2 are jointly referred to as 'NOx')	**Fossil Fuels and the Environment**
C1.2.15 understand that atmospheric pollutants cannot just disappear, they have to go somewhere: a. particulate carbon is deposited on surfaces, making them dirty b. sulfur dioxide and nitrogen dioxide react with water and oxygen to produce acid rain c. carbon dioxide is used by plants in photosynthesis d. carbon dioxide dissolves in rain water and in sea water.	**Fossil Fuels and the Environment**
C1.3 What choices can we make personally, locally, nationally or globally to improve air quality?	
C1.3.1 understand how atmospheric pollution caused by power stations that burn fossil fuels can be reduced by: a. using less electricity b. removing sulfur from natural gas and fuel oil c. removing sulfur dioxide and particulates from the flue gases emitted by coal-burning power stations	**Reducing Pollution**
C1.3.2 understand how the acid gas sulfur dioxide is removed from flue gases by wet scrubbing: a. using an alkaline slurry eg a spray of calcium oxide and water b. using sea water	**Reducing Pollution**
C1.3.3 understand that the only way of producing less carbon dioxide is to burn less fossil fuels	**Reducing Pollution**
C1.3.4 understand how atmospheric pollution caused by exhaust emissions from motor vehicles can be reduced by: a. burning less fuel, for example by having more efficient engines b. using low sulfur fuels c. using catalytic converters (in which nitrogen monoxide is reduced to nitrogen by loss of oxygen, and carbon monoxide is oxidised to carbon dioxide by gain of oxygen) d. adjusting the balance between public and private transport e. having legal limits to exhaust emissions (which are enforced by the use of MOT tests)	**Reducing Pollution**
C1.3.5. understand the benefits and problems of using alternatives to fossil fuels for motor vehicles, limited to biofuels and electricity.	**Alternative Fuels**

C2: Material Choices

C2.1 How do we measure the properties of materials and why are the results useful?	
C2.1.1 interpret information about how solid materials can differ with respect to properties such as melting point, strength (in tension or compression), stiffness, hardness and density	**Properties of Metals**
C2.1.2 relate properties to the uses of materials such as plastics, rubbers and fibres	**Properties of Metals**
C2.1.3 relate the effectiveness and durability of a product to the materials used to make it	**Properties of Metals**
C2.1.4 interpret information about the properties of materials such as plastics, rubbers and fibres to assess the suitability of these materials for particular purposes	**Properties of Metals**
C2.2 Why is crude oil important as a source of new materials such as plastics and fibres?	
C2.2.1 understand that the materials we use are chemicals or mixtures of chemicals, and include metals, ceramics and polymers	**Making Polymers**
C2.2.2 understand that materials can be obtained or made from living things, and give examples such as cotton, paper, silk and wool	**Making Polymers**
C2.2.3 understand that there are synthetic materials that are alternatives to materials from living things	**Making Polymers**
C2.2.4 understand that raw materials from the Earth's crust can be used to make synthetic materials	**Making Polymers**
C2.2.5 interpret representations of rearrangements of atoms during a chemical reaction	**Making Polymers**
C2.2.6 understand that in a chemical reaction the numbers of atoms of each element must be the same in the products as in the reactants	**Making Polymers**

C2.2.7 understand that crude oil consists mainly of hydrocarbons, which are chain molecules of varying lengths made from carbon and hydrogen atoms only	Crude Oil
C2.2.8 recall that only a small percentage of crude oil is used for chemical synthesis and that most is used as fuels	Alternative Fuels
C2.2.9 understand that the petrochemical industry refines crude oil by separating the hydrocarbons into fractions of different chain lengths, to produce fuels, lubricants and the raw materials for chemical synthesis	Fractional Distillation
C2.2.10 relate the size of the forces between hydrocarbon molecules to the size of the molecules	Fractional Distillation
C2.2.11 relate the strength of the forces between hydrocarbon molecules in crude oil to the amount of energy needed for them to break out of a liquid and form a gas, and to the temperature at which the liquid boils	Making Polymers
C2.2.12 understand that some small molecules called monomers can join together to make very long molecules called polymers, and that the process is called polymerisation	Properties and Uses of Polymers
C2.2.13 recall two examples of materials that, because of their superior properties, have replaced materials used in the past.	Properties and Uses of Polymers

C2.3 Why does it help to know about the molecular structure of materials such as plastics and fibres?

C2.3.1 understand that it is possible to produce a wide range of different polymers with properties that make them each suited to a particular use	Properties and Uses of Polymers
C2.3.2 understand how the properties of polymers depend on how their molecules are arranged and held together	Properties and Uses of Polymers
C2.3.3 relate the strength of the forces between the molecules in a polymer to the amount of energy needed to separate them from each other, and therefore to the strength, stiffness, hardness and melting point of the solid	Properties and Uses of Polymers
C2.3.4 understand how modifications in polymers produce changes to their properties (see C2.1), to include modifications such as: a. increased chain length b. cross-linking c. the use of plasticizers **d. increased crystallinity.**	Properties and Uses of Polymers

C2.4 What is nanotechnology and why is it important?

C2.4.1 recall that nanotechnology involves structures that are about the same size as some molecules	
C2.4.2 recall that nanotechnology is the use and control of structures that are very small (1 to 100 nanometres in size)	
C2.4.3 understand that nanoparticles can occur naturally (for example in seaspray), by accident (for example as the smallest particulates from combustion of fuels), and by design	
C2.4.4 understand that nanoparticles of a material show different properties compared to larger particles of the same material, and that one of the reasons for this is the much larger surface area of the nanoparticles compared to their volume	
C2.4.5 understand that nanoparticles can be used to modify the properties of materials, and give examples including: a. the use of silver nanoparticles to give fibres antibacterial properties b. adding nanoparticles to plastics for sports equipment to make them stronger	
C2.4.6 understand that some nanoparticles may have harmful effects on health, and that there is concern that products with nanoparticles are being introduced before these effects have been fully investigated	Chemicals and the Environment

C3: Chemicals in our lives – risks and benefits

C3.1 What were the origins of minerals in Britain that contribute to our economic wealth?

C3.1.1 understand that geologists explain most of the past history of the surface of the Earth in terms of processes than can be observed today	Plate Tectonics
C3.1.2 understand that movements of tectonic plates mean that the parts of ancient continents that now make up Britain have moved over the surface of the Earth	Plate Tectonics
C3.1.3 understand that geologists use magnetic clues in rocks to track the very slow movement of the continents over the surface of the Earth	Plate Tectonics
C3.1.4 understand that the movements of continents means that different rocks in Britain formed in different climates	Rocks as Resources

C3.1.5 understand how processes such as mountain building, erosion, sedimentation, dissolving and evaporation have led to the formation of valuable resources found in England including coal, limestone and salt	Rocks as Resources
C3.1.6 understand how geologists study sedimentary rocks to find evidence of the conditions under which they were formed, to include: a. fossils b. shapes of water borne grains compared to air blown grains c. presence of shell fragments d. ripples from sea or river bottom	Rocks as Resources
C3.1.7 understand that chemical industries grow up where resources are available locally, eg salt, limestone and coal in north west England	Rocks as Resources
C3.2 Where does salt come from and why is it so important?	Salt
C3.2.1 recall the importance of salt (sodium chloride) for the food industry, as a source of chemicals and to treat roads in winter	Salt
C3.2.2 recall that salt can be obtained from the sea or from underground salt deposits	Salt
C3.2.3 understand how underground salt can be obtained by mining, or by solution in water	Salt
C3.2.4 understand why the method used to obtain salt may depend on how the salt is to be used	Salt
C3.2.5 understand how the methods of obtaining salt can have an impact on the environment	Salt
C3.2.6 recall the advantages of adding salt to food as flavouring and as a preservative	Salt
C3.2.7 recall the health implications of eating too much salt	Salt
C3.2.8 be able to evaluate data related to the content of salt in food and health	Salt
C3.2.9 understand that Government departments, such as the Department of Health and the Department for Environment, Food and Rural Affairs, have a role in: a. carrying out risk assessments in relation to chemicals in food b. advising the public in relation to the effect of food on health.	Salt
C3.3 Why do we need chemicals such as alkalis and chlorine and how do we make them?	
C3.3.1 understand that, even before industrialisation, alkalis were needed to neutralise acid soils, make chemicals that bind natural dyes to cloth, convert fats and oils into soap and to manufacture glass	
C3.3.2 recall that traditional sources of alkali included burnt wood or stale urine	
C3.3.3 understand that alkalis neutralise acids to make salts	Acids and Alkalis
C3.3.4 recall that soluble hydroxides and carbonates are alkalis	Acids and Alkalis
C3.3.5 predict the products of the reactions of soluble hydroxides and carbonates with acids	Acids and Alkalis
C3.3.6 understand that increased industrialisation led to a shortage of alkali in the nineteenth century	
C3.3.7 recall that the first process for manufacturing alkali from salt and limestone using coal as a fuel released large volumes of an acid gas (hydrogen chloride) and created great heaps of waste that slowly released a toxic and foul smelling gas (hydrogen sulfide)	
C3.3.8 understand that pollution problems can sometimes be solved by turning wastes into useful chemicals	
C3.3.9 understand that oxidation can convert hydrogen chloride to chlorine, and that the properties of a compound are completely different from the elements from which it is made	
C3.3.10 recall that chlorine is used to kill microorganisms in domestic water supplies and as a bleach	
C3.3.11 understand how the introduction of chlorination to treat drinking water made a major contribution to public health	
C3.3.12 interpret data about the effects of polluted water on health and the impact of water treatment with chlorine to control disease	
C3.3.13 recall that there may be disadvantages of chlorinating drinking water, including possible health problems from traces of chemicals formed by reaction of chorine with organic materials in the water	
C3.3.14 understand that an electric current can be used to bring about chemical change and make new chemicals through a process called electrolysis	Electrolysis of Solutions
C3.3.15 recall that chlorine is now obtained by the electrolysis of salt solution (brine)	Electrolysis of Solutions
C3.3.16 recall examples of important uses by industry of the sodium hydroxide, chlorine and hydrogen produced by electrolysis of brine	Electrolysis of Solutions
C3.3.17 interpret data about the environmental impact of the large scale electrolysis of brine	Electrolysis of Solutions

C3.4 What can we do to make our use of chemicals safe and sustainable?	
C3.4.1 understand that there is a large number of industrial chemicals with many widespread uses, including consumer products, for which there is inadequate data to judge whether they are likely to present a risk to the environment and/or human health	Chemicals and the Environment
C3.4.2 understand that some toxic chemicals persist in the environment, can be carried over large distances, and may accumulate in food and human tissues	Chemicals and the Environment
C3.4.3 recall that PVC is a polymer that contains chlorine as well as carbon and hydrogen	Making Polymers
C3.4.4 understand that the plasticizers used to modify the properties of PVC can leach out from the plastic into the surroundings where they may have harmful effects	Making Polymers
C3.4.5 understand that a Life Cycle Assessment (LCA) involves consideration of the use of resources including water, the energy input or output, and the environmental impact, of each of these stages: a. making the material from natural raw materials; b. making the product from the material; c. using the product; d. disposing of the product	Chemicals and the Environment
C3.4.6 when given appropriate information from a Life Cycle Assessment (LCA), compare and evaluate the use of different materials for the same purpose	Chemicals and the Environment

OCR 21st Century GCSE Science 2011

GCSE Science: Physics

Module P1: The Earth in the Universe	Boardworks presentation
P1.1 What do we know about the place of the Earth in the Universe?	
1. recall that the Earth is one of 8 planets moving in almost circular paths round the Sun which, together with other smaller objects orbiting the Sun (asteroids, dwarf planets, comets) and moons orbiting several planets, make up the solar system	**The Solar System**
2. describe the principal differences between planets, moons, the Sun, comets and asteroids including their relative sizes and motions	**The Solar System**
3. understand that the solar system was formed over very long periods from clouds of gases and dust in space, about 5 thousand million years ago	**The Solar System**
4. recall that the Sun is one of thousands of millions of stars in the Milky Way galaxy	**The Universe**
5. recall that there are thousands of millions of galaxies, each containing thousands of millions of stars, and that all of these galaxies make up the Universe	**The Universe**
6. put in order and recall the relative sizes of: the diameters of the Earth, the Sun, the Earth'sorbit, the solar system, the Milky Way, the distance from the Sun to the nearest star, and the distance from the Milky Way to the nearest galaxy	**The Universe**
7. understand that all the evidence we have about distant stars and galaxies comes from the radiation astronomers can detect	**The Universe**
8. recall that light travels through space (a vacuum) at a very high but finite speed, 300 000 km/s	**Exploring Space**
9. recall that a light-year is the distance travelled by light in a year	**Exploring Space**
10. understand that the finite speed of light means that very distant objects are observed as they were in the past, when the light we now see left them	
11. understand how the distance to a star can be measured using parallax (qualitative idea only)	
12. understand how the distance to a star can be estimated from its relative brightness	
13. understand that light pollution and other atmospheric conditions interfere with observations of the night sky	**The Universe**
14. explain why there are uncertainties about the distances of stars and galaxies with reference to the nature and difficulty of the observations on which these are based and the assumptions made in interpreting them	
15. understand that the source of the Sun's energy is the fusion of hydrogen nuclei	**Stars**
16. understand that all chemical elements with atoms heavier than helium were made in stars	**Stars**
17. understand that the redshift in the light coming from them suggests that distant galaxies are moving away from us	**The Origin of the Universe**
18. understand that (in general) the further away a galaxy is, the faster it is moving away from us	**The Origin of the Universe**
19. understand how the motions of galaxies suggests that space itself is expanding	**The Origin of the Universe**
20. recall and put in order the relative ages of the Earth, the Sun, and the Universe	**The Origin of the Universe**
21. recall that scientists believe the Universe began with a 'big bang' about 14 thousand million years ago	**The Origin of the Universe**
22. understand that the ultimate fate of the Universe is difficult to predict because of difficulties in measuring the very large distances involved and the mass of the Universe, and studying the motion of very distant objects.	**The Origin of the Universe**
P1.2 What do we know about the Earth and how it is changing?	
1. understand how rocks provide evidence for changes in the Earth (erosion and sedimentation, fossils, folding)	**Plate Tectonics**
2. understand that continents would be worn down to sea level by erosion, if mountains were not being continuously formed	**Plate Tectonics**
3. understand that the rock processes seen today can account for past changes	**Plate Tectonics**
4. understand that the age of the Earth can be estimated from, and must be greater than, the age of its oldest rocks, which are about 4 thousand million years old	**The Origin of the Universe**
5. understand Wegener's theory of continental drift and his evidence for it (geometric fit of continents and their matching fossils and rock layers)	**Plate Tectonics**
6. understand how Wegener's theory accounts for mountain building	**Plate Tectonics**
7. understand reasons for the rejection of Wegener's theory by geologists of his time (movement of continents not detectable, too big an idea from limited evidence, simpler explanations of the same evidence, Wegener an outsider to the community of geologists)	**Plate Tectonics**
8. understand that seafloor spreading is a consequence of movement of the mantle (convection due to heating by the core)	**Plate Tectonics**
9. recall that seafloors spread by a few centimetres a year	**Plate Tectonics**

10. understand how seafloor spreading and the periodic reversals of the Earth's magnetic field can explain the pattern in the magnetisation of seafloor rocks on either side of the oceanic ridges	**Plate Tectonics**
11. understand that earthquakes, volcanoes and mountain building generally occur at the edges of tectonic plates	**Earthquakes**
12. understand how the movement of tectonic plates causes earthquakes, volcanoes and mountain building, and contributes to the rock cycle	**Earthquakes**
13. recall that earthquakes produce wave motions on the surface and inside the Earth which can be detected by instruments located on the Earth's surface	**Earthquakes**
14. recall that earthquakes produce: a. P-waves **(longitudinal waves)** which travel through solids and liquids b. S-waves **(transverse waves)** which travel through solids but not liquids	**Earthquakes**
15. describe the difference between a transverse and longitudinal wave	**Earthquakes**
16. understand how differences in the wave speeds and behaviour of P-waves and S-waves can be used to give evidence for the structure of the Earth	**Earthquakes**
17. in relation to waves, use the equation: distance = wave speed x time (metres, m) (metres per second, m/s) (seconds, s)	**Earthquakes**
18. draw and label a diagram of the Earth to show its crust, mantle and core	**Plate Tectonics**
19. recall that a wave is a disturbance, caused by a vibrating source, that transfers energy in the direction that the wave travels, without transferring matter	**Wave Properties**
20. recall that the frequency of waves, in hertz (Hz), is the number of waves each second that are made by the source, or that pass through any particular point	**Wave Properties**
21. recall that the wavelength of waves is the distance between the corresponding points on two adjacent cycles	**Wave Properties**
22. recall that the amplitude of a wave is the distance from the maximum displacement to the undisturbed position	**Wave Properties**
23. draw and interpret diagrams showing the amplitude and the wavelength of waves	**Wave Properties**
24. use the equation: wave speed = frequency x wavelength (metres per second, m/s) (hertz, Hz) (metres, m)	**Wave Properties**
25. understand that for a constant wave speed the wavelength of the wave is inversely proportional to the frequency.	**Wave Properties**

Module P2: Radiation and life

P2.1 What types of electromagnetic radiation are there? What happens when radiation hits an object?

1. interpret situations in which one object affects another some distance away in terms of a general model of electromagnetic radiation: a. one object (a source) emits radiation b. the radiation travels outwards from the source and can be reflected, transmitted or absorbed (or a combination of these) by materials it encounters c. radiation may affect another object (a detector) some distance away, when it is absorbed	**The Electromagnetic Spectrum**
2. understand that light is one of a family of radiations, the electromagnetic spectrum	**The Electromagnetic Spectrum**
3. understand that a beam of electromagnetic radiation transfers energy in 'packets' called photons	**Photons**
4. understand that the higher the frequency of an electromagnetic radiation, the more energy is transferred by each photon	**Photons**
5. list the electromagnetic radiations in order of the energy transferred by each photon, or in order of frequency: radio waves, microwaves, infrared, red visible light violet, ultraviolet, X-rays, gamma rays	**The Electromagnetic Spectrum**
6. recall that all types of electromagnetic radiation travel at exactly the same, very high but finite, speed through space (a vacuum) of 300 000 km/s	**The Electromagnetic Spectrum**

7. understand that the energy arriving at a square metre of surface each second is a useful measure of the strength (or 'intensity') of a beam of electromagnetic radiation	**Photons**
8. understand that the energy transferred to an absorber by a beam of electromagnetic radiation depends on both the number of photons arriving and the energy of each photon	**Photons**
9. understand that the intensity of a beam of electromagnetic radiation decreases with distance from the source and **explain why, in terms of the ever increasing surface area it reaches and its partial absorption by the medium it travels through**	**Photons**
10. understand that some electromagnetic radiations (ultraviolet radiation, X-rays, gamma rays) have enough energy to change atoms or molecules, which can initiate chemical reactions	**Ionizing Radiation**
11. recall that high energy ultraviolet radiation, X-rays and gamma rays can cause ionisation	**Ionizing Radiation**
12. understand that the electromagnetic radiations which are ionising are those with high enough photon energy to remove an electron from an atom or molecule (ionisation).	**Ionizing Radiation**

P2.2 Which types of electromagnetic radiation harm living tissue and why?	
1. understand that the heating effect of absorbed radiation can damage living cells	**Heating with Microwaves and Infrared**
2. relate the heating effect when radiation is absorbed to its intensity and duration	**Heating with Microwaves and Infrared**
3. understand that some people have concerns about health risks from low intensity microwave radiation, for example from mobile phone handsets and masts, though the evidence for this is disputed	**Communicating with Radio Waves and Microwaves**
4. understand that some microwaves are strongly absorbed by water molecules and so can be used to heat objects containing water	**Heating with Microwaves and Infrared**
5. understand that the metal cases and door screens of microwave ovens reflect or absorb microwave radiation and so protect users from the radiation	**Heating with Microwaves and Infrared**
6. recall that some materials (radioactive materials) emit ionising gamma radiation all the time	**Ionizing Radiation**
7. understand that with increased exposure to ionising radiation, damage to living cells increases eventually leading to cancer or cell death	**Ionizing Radiation**
8. understand that the ozone layer absorbs ultraviolet radiation, emitted by the Sun, producing chemical changes in that part of the atmosphere	**Ultraviolet Radiation**
9. understand that the ozone layer protects living organisms from some of the harmful effects of ultraviolet radiation	**Ultraviolet Radiation**
10. recall that sun-screens and clothing can be used to absorb some of the ultraviolet radioation from the Sun	**Ultraviolet Radiation**
11. recall that physical barriers absorb some ionising radiation, for example: X-rays are absorbed by dense materials so can be used to produce shadow pictures of bones in our bodies or of objects in aircraft passengers' luggage, and radiographers are protected from radiation by dense materials such as lead and concrete.	**Ionizing Radiation**

P2.3 What is the evidence for global warming, why might it be occurring, and how serious a threat is it?	
1. understand that all objects emit electromagnetic radiation with a principal frequency that increases with temperature	**Climate Change**
2. recall that the Earth is surrounded by an atmosphere which allows some of the electromagnetic radiation emitted by the Sun to pass through	**Climate Change**
3. recall that this radiation warms the Earth's surface when it is absorbed	**Climate Change**
4. understand that the radiation emitted by the Earth, which has a lower principal frequency than that emitted by the Sun, is absorbed or reflected back by some gases in the atmosphere; this keeps the Earth warmer than it would otherwise be and is called the greenhouse effect	**Climate Change**
5. recall that one of the main greenhouse gases in the Earth's atmosphere is carbon dioxide, which is present in very small amounts	**Climate Change**
6. recall that other greenhouse gases include methane, present in very small amounts, and water vapour	**Climate Change**
7. interpret simple diagrams representing the carbon cycle	**Climate Change**
8. use the carbon cycle to explain: a. why, for thousands of years, the amount of carbon dioxide in the Earth's atmosphere was approximately constant b. that some organisms remove carbon dioxide from the atmosphere by photosynthesis (eg green plants) and many organisms return carbon dioxide to the atmosphere by respiration as part of the recycling of carbon c. why during the past two hundred years, the amount of carbon dioxide in the atmosphere has been steadily rising	**Climate Change**

9. recall that the rise in atmospheric carbon dioxide is largely the result of: a. burning increased amounts of fossil fuels as an energy source b. cutting down or burning forests to clear land	**Climate Change**
10. understand that computer climate models provide evidence that human activities are causing global warming	**Climate Change**
11. understand how global warming could result in: a. it being impossible to continue growing some food crops in particular regions because of climate change b. more extreme weather events, d**ue to increased convection and larger amounts of water vapour in the hotter atmosphere** c. flooding of low lying land due to rising sea levels, caused by melting continental ice and expansion of water in the oceans.	**Climate Change**

P2.4 How are electromagnetic waves used in communications?

1. understand that electromagnetic radiation of some frequencies can be used for transmitting information, since: a. some radio waves and microwaves are not strongly absorbed by the atmosphere so can be used to carry information for radio and TV programmes b. light and infrared radiation can be used to carry information along optical fibres because the radiation travels large distances through glass without being significantly absorbed	**Communicating with Visible Light and Infrared / Communicating with Radio Waves and Microwaves**
2. recall that information can be superimposed on to an electromagnetic carrier wave, to create a signal	**Communicating with Radio Waves and Microwaves**
3. recall that a signal which can vary continuously is called an analogue signal	**Analogue and Digital Signals**
4. recall that a signal that can take only one of a small number of discrete values (usually two) is called a digital signal	**Analogue and Digital Signals**
5. recall that sound and images can be transmitted digitally (as a digital signal)	**Analogue and Digital Signals**
6. recall that, in digital transmission, the digital code is made up from just two symbols, '0' and '1'	**Analogue and Digital Signals**
7. understand that this coded information can be carried by switching the electromagnetic carrier wave off and on to create short bursts of waves (pulses) where '0' = no pulse and '1' = pulse	**Analogue and Digital Signals**
8. recall that when the waves are received, the pulses are decoded to produce a copy of the original sound wave or image	**Analogue and Digital Signals**
9. understand that an important advantage of digital signals over analogue signals is that if the original signal has been affected by noise it can be recovered more easily and explain why	**Analogue and Digital Signals**
10. recall that the amount of information needed to store an image or sound is measured in bytes (B)	**Analogue and Digital Signals**
11. understand that, generally, the more information stored the higher the quality of the sound or image	**Analogue and Digital Signals**
12. understand that an advantage of using digital signals is that the information can be stored and processed by computers	**Analogue and Digital Signals**

Module P3: Sustainable energy – Ideas about Science

P3.1 How much energy do we use?

1. understand that the demand for energy is continually increasing and that this raises issues about the availability of energy sources and the environmental effects of using these sources	**Evaluating Energy Resources**
2. recall the main primary energy sources that humans use: fossil fuels (oil, gas, coal), nuclear fuels, biofuels, wind, waves, and radiation from the Sun	**Energy Resources**
3. understand why electricity is called a secondary energy source	**Power Stations**
4. understand that power stations which burn fossil fuels produce carbon dioxide which contributes to global warming and climate change	**Evaluating Energy Resources**
5. understand that when electric current passes through a component (or device), energy is transferred from the power supply to the component and/or to the environment	**Energy Transformations and Efficiency**
6. recall that the power (in watts, W) of an appliance or device is a measure of the amount of energy it transfers each second, ie the rate at which it transfers energy	**Using Electricity**

7. use the following equation to calculate the amount of energy transferred in a process, in joules and in kilowatt hours: energy transferred = power × time (joules, J) (watts, W) (seconds, s) (kilowatt hours, kWh) (kilowatts, kW) (hours, h)	**Using Electricity**
8. use the following equation to calculate the rate at which an electrical device transfers energy: power = voltage × current (watts, W) (volts, V) (amperes, A)	**Using Electricity**
9. understand that a joule is a very small amount of energy, so a domestic electricity meter measures the energy transfer in kilowatt hours	**Using Electricity**
10. calculate the cost of energy supplied by electricity given the power, the time and the cost per kilowatt hour	**Using Electricity**
11. interpret and process data on energy use, presented in a variety of ways	**Energy Transformations and Efficiency**
12. interpret and construct Sankey diagrams to show understanding that energy is conserved	**Energy Transformations and Efficiency**
13. use the following equation in the context of electrical appliances and power stations: efficiency = energy usefully transferred/total energy supplied x 100% - Candidates will be expected to consider / calculate efficiency as a decimal ratio and as a percentage	**Energy Transformations and Efficiency**
14. suggest examples of ways to reduce energy usage in personal and national contexts.	**Evaluating Energy Resources**

P3.2 How can electricity be generated?	
1. understand that electricity is convenient because it is easily transmitted over distances and can be used in many ways	**Power Stations**
2. recall that mains electricity is produced by generators	**Power Stations**
3. understand that generators produce a voltage across a coil of wire by spinning a magnet near it	**Power Stations**
4. understand that the bigger the current supplied by a generator, the more primary fuel it uses every second	**Power Stations**
5. understand that in many power stations a primary energy source is used to heat water; the steam produced drives a turbine which is coupled to an electrical generator	**Power Stations**
6. label a block diagram showing the basic components and structures of hydroelectric, nuclear and other thermal power stations	**Energy Resources**
7. understand that nuclear power stations produce radioactive waste	**Evaluating Energy Resources**
8. understand that radioactive waste emits ionising radiation	**Ionizing Radiation**
9. understand that with increased exposure to ionising radiation, damage to living cells increases eventually leading to cancer or cell death	**Ionizing Radiation**
10. understand the distinction between contamination and irradiation by a radioactive material, and explain why contamination by a radioactive material is more dangerous than a short period of irradiation from the radioactive material	**Energy Resources**
11. understand that many renewable sources of energy drive the turbine directly eg hydroelectric, wave and wind	**Energy Resources**
12. interpret a Sankey diagram for electricity generation and distribution that includes information on the efficiency of energy transfers	**Power Stations**
13. recall that the mains supply voltage to our homes is 230 volts	**Electricity Distribution**
14. understand that electricity is distributed through the National Grid at high voltages to reduce energy losses.	**Electricity Distribution**

P3.3 Which energy sources should we choose?

1. discuss both qualitatively and quantitatively (based on given data where appropriate), the effectiveness of different choices in reducing energy demands in:
a. domestic contexts
b. work place contexts
c. national contexts

Evaluating Energy Resources

2. understand that the choice of energy source for a given situation depends upon a number of factors including:
a. environmental impact
b. economics
c. waste produced
d. carbon dioxide emissions

Evaluating Energy Resources

3. describe advantages and disadvantages of different energy sources, including non-renewable energy sources such as:
a. fossil fuels
b. nuclear
and renewable energy sources such as:
c. biofuel
d. solar
e. wind
f. water (waves, tides, hydroelectricity)
g. geothermal

Evaluating Energy Resources

4. interpret and evaluate information about different energy sources for generating electricity, considering:
a. efficiency
b. economic costs
c. environmental impact
d. power output and lifetime.

Evaluating Energy Resources

5. understand that to ensure a security of electricity supply nationally, we need a mix of energy sources.

Evaluating Energy Resources