AQA
GCSE Science 2011

GCSE Science: Biology

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B1.1 Keeping Healthy	Boardworks presentation
evaluate information about the effect of food on health	**Diet, Exercise and Health**
evaluate information about the effect of lifestyle on development of disease	**Diet, Exercise and Health / Blood Pressure / Heart Disease**
analyse and evaluate claims made by slimming programmes, and slimming products.	
B1.1.1 Diet and exercise	
a) A healthy diet contains the right balance of the different foods you need and the right amount of energy. Carbohydrates, fats and proteins are used by the body to release energy and to build cells. Mineral ions and vitamins are needed in small amounts for healthy functioning of the body. A person is malnourished if their diet is not balanced. This may lead to a person being overweight or underweight. An unbalanced diet may also lead to deficiency diseases or conditions such as Type 2 diabetes.	**Diet, Exercise and Health**
b) A person loses mass when the energy content of the food taken in is less than the amount of energy expended by the body. Exercise increases the amount of energy expended by the body.	**Diet, Exercise and Health**
c) The rate at which all the chemical reactions in the cellsof the body are carried out (the metabolic rate) varies with the amount of activity you do and the proportion of muscle to fat in your body. Metabolic rate may be affected by inherited factors.	**Diet, Exercise and Health**
d) Inherited factors also affect our health; for example cholesterol level.	**Blood Pressure**
e) People who exercise regularly are usually healthier than people who take little exercise.	**Diet, Exercise and Health**
B1.1.2 How our bodies defend themselves against infectious diseases	
relate the contribution of Semmelweiss in controlling infection to solving modern problems with the spread of infection in hospitals	**Combatting Infection**
explain how the treatment of disease has changed as a result of increased understanding of the action of antibiotics and immunity	**Combatting Infection**
evaluate the consequences of mutations of bacteria and viruses in relation to epidemics and pandemics	**Combatting Infection**
evaluate the advantages and disadvantages of being vaccinated against a particular disease.	**Immunisation**
a) Microorganisms that cause infectious disease are called pathogens.	**Causes of Disease**
b) Bacteria and viruses may reproduce rapidly inside the body and may produce poisons (toxins) that make us feel ill. Viruses damage the cells in which they reproduce.	**The Body's Defenses**
c) The body has different ways of protecting itself against pathogens.	**The Body's Defenses**
d) White blood cells help to defend against pathogens by: - ingesting pathogens - producing antibodies, which destroy particular bacteria or viruses - producing antitoxins, which counteract the toxins released by the pathogens.	**The Body's Defenses**
e) The immune system of the body produces specific antibodies to kill a particular pathogen. This leads to immunity from that pathogen. In some cases, dead or inactivated pathogens stimulate antibody production. If a large proportion of the population is immune to a pathogen, the spread of the pathogen is very much reduced.	**The Body's Defenses**
f) Semmelweiss recognised the importance of handwashing in the prevention of spreading some infectious diseases. By insisting that doctors washed their hands before examining patients, he greatly reduced the number of deaths from infectious diseases in his hospital.	**Combatting Infection**
g) Some medicines, including painkillers, help to relieve the symptoms of infectious disease, but do not kill the pathogens.	**Combatting Infection**
h) Antibiotics, including penicillin, are medicines that help to cure bacterial disease by killing infectious bacteria inside the body. Antibiotics cannot be used to kill viral pathogens, which live and reproduce inside cells. It is important that specific bacteria should be treated by specific antibiotics. The use of antibiotics has greatly reduced deaths from infectious bacterial diseases. Overuse and inappropriate use of antibiotics has increased the rate of development of antibiotic resistant strains of bacteria.	**Combatting Infection**
i) Many strains of bacteria, including MRSA, have developed resistance to antibiotics as a result of natural selection. To prevent further resistance arising it is important to avoid over-use of antibiotics.	**Combatting Infection**

j) Mutations of pathogens produce new strains. Antibiotics and vaccinations may no longer be effective against a new resistant strain of the pathogen. The new strain will then spread rapidly because people are not immune to it and there is no effective treatment. Higher Tier candidates should understand that: - antibiotics kill individual pathogens of the nonresistant strain - individual resistant pathogens survive and reproduce, so the population of the resistant strain increases - now, antibiotics are not used to treat nonserious infections, such as mild throat infections, so that the rate of development of resistant strains is slowed down.	**Combatting Infection**
k) The development of antibiotic-resistant strains of bacteria necessitates the development of new antibiotics.	**Combatting Infection**
l) People can be immunised against a disease by introducing small quantities of dead or inactive forms of the pathogen into the body (vaccination). Vaccines stimulate the white blood cells to produce antibodies that destroy the pathogens. This makes the person immune to future infections by the microorganism. The body can respond by rapidly making the correct antibody, in the same way as if the person had previously had the disease. MMR vaccine is used to protect children against measles, mumps and rubella.	**Immunisation**
m) Uncontaminated cultures of microorganisms are required for investigating the action of disinfectants and antibiotics. For this: - Petri dishes and culture media must be sterilised before use to kill unwanted microorganisms - inoculating loops used to transfer microorganisms to the media must be sterilised by passing them through a flame - the lid of the Petri dish should be secured with adhesive tape to prevent microorganisms from the air contaminating the culture.	**Combatting Infection**
B1.2 Nerves and hormones	
evaluate the benefits of, and the problems that may arise from, the use of hormones to control fertility, including In Vitro Fertilisation (IVF)	**Hormones and Fertility**
evaluate the use of plant hormones in horticulture as weed killers and to encourage the rooting of plant cuttings.	**Plant Hormones**
B1.2.1 The nervous system	
a) The nervous system enables humans to react to their surroundings and coordinate their behaviour.	**The Nervous System**
b) Cells called receptors detect stimuli (changes in the environment). Receptors and the stimuli they detect include: - receptors in the eyes that are sensitive to light - receptors in the ears that are sensitive to sound - receptors in the ears that are sensitive to changes in position and enable us to keep our balance - receptors on the tongue and in the nose that are sensitive to chemicals and enable us to taste and to smell - receptors in the skin that are sensitive to touch, pressure, pain and to temperature changes.	**The Nervous System**
c) Light receptor cells, like most animal cells, have a nucleus, cytoplasm and cell membrane.	**The Nervous System**
d) Information from receptors passes along cells (neurones) in nerves to the brain. The brain coordinates the response. Reflex actions are automatic and rapid. They often involve sensory, relay and motor neurones.	**The Nervous System**
e) Candidates should understand the role of receptors, sensory neurones, motor neurones, relay neurones, synapses and effectors in simple reflex actions. In a simple reflex action: - impulses from a receptor pass along a sensory neurone to the central nervous system - at a junction (synapse) between a sensory neurone and a relay neurone in the central nervous system, a chemical is released that causes an impulse to be sent along a relay neurone - a chemical is then released at the synapse between a relay neurone and motor neurone in the central nervous system, causing impulses to be sent along a motor neurone to the organ (the effector) that brings about the response - the effector is either a muscle or a gland, a muscle responds by contracting and a gland responds by releasing (secreting) chemical substances.	**Reflex Reactions**

B1.2.2 Control in the human body	
a) Internal conditions that are controlled include: - the water content of the body – water leaves the body via the lungs when we breathe out and via the skin when we sweat to cool us down, and excess water is lost via the kidneys in the urine - the ion content of the body – ions are lost via the skin when we sweat and excess ions are lost via the kidneys in the urine - temperature – to maintain the temperature at which enzymes work best - blood sugar levels – to provide the cells with a constant supply of energy.	**Homeostasis / Controlling Water Content**
b) Many processes within the body are coordinated by chemical substances called hormones. Hormones are secreted by glands and are usually transported to their target organs by the bloodstream.	**Hormones and Fertility**
c) Hormones regulate the functions of many organs and cells. For example, the monthly release of an egg from a woman's ovaries and the changes in the thickness of the lining of her womb are controlled by hormones secreted by the pituitary gland and by the ovaries.	**Hormones and Fertility**
d) Several hormones are involved in the menstrual cycle of a woman. Hormones are involved in promoting the release of an egg: - follicle stimulating hormone (FSH) is secreted by the pituitary gland and causes eggs to mature in the ovaries. It also stimulates the ovaries to produce hormones including oestrogen - luteinising hormone (LH) stimulates the release of eggs from the ovary - oestrogen is secreted by the ovaries and inhibits the further production of FSH.	**Hormones and Fertility**
e) The uses of hormones in controlling fertility include: - giving oral contraceptives that contain hormones to inhibit FSH production so that no eggs mature - oral contraceptives may contain oestrogen and progesterone to inhibit egg maturation - the first birth-control pills contained large amounts of oestrogen. These resulted in women suffering significant side effects - birth-control pills now contain a much lower dose of oestrogen, or are progesterone only - progesterone-only pills lead to fewer side effects - giving FSH and LH in a 'fertility drug' to a woman whose own level of FSH is too low to stimulate eggs to mature, for example in In Vitro Fertilisation (IVF) treatment - IVF involves giving a mother FSH and LH to stimulate the maturation of several eggs. The eggs are collected from the mother and fertilised by sperm from the father. The fertilised eggs develop into embryos. At the stage when they are tiny balls of cells, one or two embryos are inserted into the mother's uterus (womb).	**Hormones and Fertility**
B1.2.3 Control in plants	
a) Plants are sensitive to light, moisture and gravity: - their shoots grow towards light and against the force of gravity - their roots grow towards moisture and in the direction of the force of gravity.	**Plant Hormones**
b) Plants produce hormones to coordinate and control growth. Auxin controls phototropism and gravitropism (geotropism).	**Plant Hormones**
c) The responses of plant roots and shoots to light, gravity and moisture are the result of unequal distribution of hormones, causing unequal growth rates.	**Plant Hormones**
d) Plant growth hormones are used in agriculture and horticulture as weed killers and as rooting hormones.	**Plant Hormones**
B1.3 The use and abuse of drugs	
evaluate the effect of statins in cardiovascular disease	**Drug Misuse and Addiction / Blood Pressure / Heart Disease**
evaluate different types of drugs and why some people use illegal drugs for recreation	**Drug Misuse and Addiction**
evaluate claims made about the effect of prescribed and non-prescribed drugs on health	**Drug Misuse and Addiction**
consider the possible progression from recreational drugs to hard drugs	**Drug Misuse and Addiction**
evaluate the use of drugs to enhance performance in sport and to consider the ethical implications of their use	**Drug Misuse and Addiction**

B1.3.1 Drugs	
a) Scientists are continually developing new drugs.	**Drug Development**
b) When new medical drugs are devised, they have to be extensively tested and trialled before being used. Drugs are tested in a series of stages to find out if they are safe and effective. New drugs are extensively tested for toxicity, efficacy and dose: - in the laboratory, using cells, tissues and live animals - in clinical trials involving healthy volunteers and patients. Very low doses of the drug are given at the start of the clinical trial. If the drug is found to be safe, further clinical trials are carried out to find the optimum dose for the drug. In some double blind trials, some patients are given a placebo, which does not contain the drug. Neither the doctors nor the patients know who has received a placebo and who has received the drug until the trial is complete.	**Drug Development**
c) Candidates should be aware of the use of statins in lowering the risk of heart and circulatory diseases.	**Drug Development**
d) Thalidomide is a drug that was developed as a sleeping pill. It was also found to be effective in relieving morning sickness in pregnant women. Thalidomide had not been tested for use in pregnant women. Unfortunately, many babies born to mothers who took the drug were born with severe limb abnormalities. The drug was then banned. As a result, drug testing has become much more rigorous. More recently, thalidomide has been used successfully in the treatment of leprosy and other diseases.	**Drug Development**
e) Candidates should be aware of the effects of misuse of the legal recreational drugs, alcohol and nicotine. Candidates should understand that the misuse of the illegal recreational drugs ecstasy, cannabis and heroin may have adverse effects on the heart and circulatory system.	**Drug Misuse and Addiction / Heart Disease**
f) Cannabis is an illegal drug. Cannabis smoke contains chemicals which may cause mental illness in some people.	**Drug Misuse and Addiction**
g) The overall impact of legal drugs (prescribed and nonprescribed) on health is much greater than the impact of illegal drugs because far more people use them.	**Drug Misuse and Addiction**
h) Drugs change the chemical processes in people's bodies so that they may become dependent or addicted to the drug and suffer withdrawal symptoms without them. Heroin and cocaine are very addictive.	**Drug Misuse and Addiction**
i) There are several types of drug that an athlete can use to enhance performance. Some of these drugs are banned by law and some are legally available on prescription, but all are prohibited by sporting regulations. Examples include stimulants that boost bodily functions such as heart rate; and anabolic steroids which stimulate muscle growth.	**Drug Misuse and Addiction**

B1.4 Interdependence and adaptation	
suggest how organisms are adapted to the conditions in which they live	**Adaptation**
observe the adaptations, eg body shape, of a range of organisms from different habitats	**Adaptation**
develop an understanding of the ways in which adaptations enable organisms to survive	**Adaptation**
suggest the factors for which organisms are competing in a given habitat	**Competition**
evaluate data concerned with the effect of environmental changes on the distribution and behaviour of living organisms.	**Environmental Change and its Effects**

B1.4.1 Adaptations	
a) To survive and reproduce, organisms require a supply of materials from their surroundings and from the other living organisms there.	**Competition**
b) Plants often compete with each other for light and space, and for water and nutrients from the soil.	**Competition**
c) Animals often compete with each other for food, mates and territory.	**Competition**
d) Organisms, including microorganisms have features (adaptations) that enable them to survive in the conditions in which they normally live.	**Adaptation**
e) Some organisms live in environments that are very extreme. Extremophiles may be tolerant to high levels of salt, high temperatures or high pressures.	**Adaptation**

f) Animals and plants may be adapted for survival in the conditions where they normally live, eg deserts, the Arctic. Animals may be adapted for survival in dry and arctic environments by means of: - changes to surface area - thickness of insulating coat - amount of body fat - camouflage. Plants may be adapted to survive in dry environments by means of: - changes to surface area, particularly of the leaves - water-storage tissues - extensive root systems.	**Adaptation**
g) Animals and plants may be adapted to cope with specific features of their environment, eg thorns, poisons and warning colours to deter predators.	**Adaptation**
B1.4.2 Environmental change	
a) Changes in the environment affect the distribution of living organisms.	**Environmental Change and its Effects**
b) Animals and plants are subjected to environmental changes. Such changes may be caused by living or non-living factors such as a change in a competitor, or in the average temperature or rainfall.	**Environmental Change and its Effects**
c) Living organisms can be used as indicators of pollution: - lichens can be used as air pollution indicators, particularly of the concentration of sulfur dioxide in the atmosphere - invertebrate animals can be used as water pollution indicators and are used as indicators of the concentration of dissolved oxygen in water.	**Measuring Environmental Change**
d) Environmental changes can be measured using nonliving indicators such as oxygen levels, temperature and rainfall.	**Measuring Environmental Change**
B1.5 Energy and biomass in food chains	
interpret pyramids of biomass and construct them from appropriate information.	**Energy Transfers in Food Chains**
B1.5.1 Energy in biomass	
a) Radiation from the Sun is the source of energy for most communities of living organisms. Green plants and algae absorb a small amount of the light that reaches them. The transfer from light energy to chemical energy occurs during photosynthesis. This energy is stored in the substances that make up the cells of the plants.	**Energy Transfers in Food Chains**
b) The mass of living material (biomass) at each stage in a food chain is less than it was at the previous stage. The biomass at each stage can be drawn to scale and shown as a pyramid of biomass.	**Energy Transfers in Food Chains**
c) The amounts of material and energy contained in the biomass of organisms is reduced at each successive stage in a food chain because: - some materials and energy are always lost in the organisms' waste materials - respiration supplies all the energy needs for living processes, including movement. Much of this energy is eventually transferred to the surroundings.	**Energy Transfers in Food Chains**
B1.6 Waste materials from plants and animals	
evaluate the necessity and effectiveness of schemes for recycling organic kitchen or garden waste.	**Decay**

B1.6.1 Decay processes	
a) Living things remove materials from the environment for growth and other processes. These materials are returned to the environment either in waste materials or when living things die and decay.	**Decay**
b) Materials decay because they are broken down (digested) by microorganisms. Microorganisms are more active and digest materials faster in warm, moist, aerobic conditions.	**Decay**
c) The decay process releases substances that plants need to grow.	**Decay**
d) In a stable community, the processes that remove materials are balanced by processes that return materials. The materials are constantly cycled.	**Decay**
B1.6.2 The carbon cycle	
a) The constant cycling of carbon is called the carbon cycle. In the carbon cycle: - carbon dioxide is removed from the environment by green plants and algae for photosynthesis - the carbon from the carbon dioxide is used to make carbohydrates, fats and proteins, which make up the body of plants and algae - when green plants and algae respire, some of this carbon becomes carbon dioxide and is released into the atmosphere - when green plants and algae are eaten by animals and these animals are eaten by other animals, some of the carbon becomes part of the fats and proteins that make up their bodies - when animals respire some of this carbon becomes carbon dioxide and is released into the atmosphere - when plants, algae and animals die, some animals and microorganisms feed on their bodies - carbon is released into the atmosphere as carbon dioxide when these organisms respire - by the time the microorganisms and detritus feeders have broken down the waste products and dead bodies of organisms in ecosystems and cycled the materials as plant nutrients, all the energy originally absorbed by green plants and algae has been transferred - combustion of wood and fossil fuels releases carbon dioxide into the atmosphere.	**The Carbon Cycle**
B1.7 Genetic variation and its control	
interpret information about cloning techniques and genetic engineering techniques	**Genetic Engineering**
make informed judgements about the economic, social and ethical issues concerning cloning and genetic engineering, including genetically modified (GM) crops.	**Genetic Engineering**
B1.7.1 Why organisms are different	
a) The information that results in plants and animals having similar characteristics to their parents is carried by genes, which are passed on in the sex cells (gametes) from which the offspring develop.	**Similarity and Variation**
b) The nucleus of a cell contains chromosomes. Chromosomes carry genes that control the characteristics of the body.	**Similarity and Variation**
c) Different genes control the development of different characteristics of an organism.	**Similarity and Variation**
d) Differences in the characteristics of different individuals of the same kind may be due to differences in: - the genes they have inherited (genetic causes) - the conditions in which they have developed (environmental causes) - or a combination of both.	**Similarity and Variation**
B1.7.2 Reproduction	
a) There are two forms of reproduction: - sexual reproduction – the joining (fusion) of male and female gametes. The mixture of the genetic information from two parents leads to variety in the offspring - asexual reproduction – no fusion of gametes and only one individual is needed as the parent. There is no mixing of genetic information and so no genetic variation in the offspring. These genetically identical individuals are known as clones.	**Cloning**
b) New plants can be produced quickly and cheaply by taking cuttings from older plants. These new plants are genetically identical to the parent plant.	**Cloning**

c) Modern cloning techniques include: - tissue culture – using small groups of cells from part of a plant - embryo transplants – splitting apart cells from a developing animal embryo before they become specialised, then transplanting the identical embryos into host mothers - adult cell cloning – the nucleus is removed from an unfertilised egg cell. The nucleus from an adult body cell, eg a skin cell, is then inserted into the egg cell. An electric shock then causes the egg cell to begin to divide to form embryo cells. These embryo cells contain the same genetic information as the adult skin cell. When the embryo has developed into a ball of cells, it is inserted into the womb of an adult female to continue its development.	**Cloning**
d) In genetic engineering, genes from the chromosomes of humans and other organisms can be 'cut out' using enzymes and transferred to cells of other organisms.	**Genetic Engineering**
e) Genes can also be transferred to the cells of animals, plants or microorganisms at an early stage in their development so that they develop with desired characteristics. - new genes can be transferred to crop plants - crops that have had their genes modified in this way are called genetically modified crops (GM crops) - examples of genetically modified crops include ones that are resistant to insect attack or to herbicides - genetically modified crops generally show increased yields.	**Genetic Engineering**
f) concerns about GM crops include the effect on populations of wild flowers and insects, and uncertainty about the effects of eating GM crops on human health.	**Genetic Engineering**

B1.8 Evolution	
interpret evidence relating to evolutionary theory	**Evolution**
suggest reasons why Darwin's theory of natural selection was only gradually accepted	**Evolution**
identify the differences between Darwin's theory of evolution and conflicting theories, such as that of Lamarck	**Evolution**
suggest reasons for the different theories.	**Evolution**

B1.8.1 Evolution	
a) Darwin's theory of evolution by natural selection states that all species of living things have evolved from simple life forms that first developed more than three billion years ago.	**Evolution**
b) The theory of evolution by natural selection was only gradually accepted because: - the theory challenged the idea that God made all the animals and plants that live on Earth - there was insufficient evidence at the time the theory was published to convince many scientists - the mechanism of inheritance and variation was not known until 50 years after the theory was published.	**Evolution**
c) Other theories, including that of Lamarck, are based mainly on the idea that changes that occur in an organism during its lifetime can be inherited. We now know that in the vast majority of cases this type of inheritance cannot occur.	**Evolution**
d) Studying the similarities and differences between organisms allows us to classify living organisms into animals, plants and microorganisms, and helps us to understand evolutionary and ecological relationships. Models allow us to suggest relationships between organisms.	**Classifying Organisms**
e) Evolution occurs via natural selection: - individual organisms within a particular species may show a wide range of variation because of differences in their genes - individuals with characteristics most suited to the environment are more likely to survive to breed successfully - the genes that have enabled these individuals to survive are then passed on to the next generation.	**Evolution**
f) Where new forms of a gene result from mutation there may be relatively rapid change in a species if the environment changes.	**Evolution**

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GCSE Science 2011

GCSE Science: Chemistry

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C1.1 The fundamental ideas in chemistry	Boardworks presentation
C1.1.1 Atoms	
a) All substances are made of atoms. A substance that is made of only one sort of atom is called an element. There are about 100 different elements. Elements are shown in the periodic table. The groups contain elements with similar properties.	Introducing Atoms
b) Atoms of each element are represented by a chemical symbol, eg O represents an atom of oxygen, and Na represents an atom of sodium.	Introducing Atoms
c) Atoms have a small central nucleus, which is made up of protons and neutrons and around which there are electrons.	Introducing Atoms
d) The relative electrical charges are as shown: Proton +1 Neutron 0 Electron –1	Introducing Atoms
e) In an atom, the number of electrons is equal to the number of protons in the nucleus. Atoms have no overall electrical charge.	Introducing Atoms
f) All atoms of a particular element have the same number of protons. Atoms of different elements have different numbers of protons.	Introducing Atoms
g) The number of protons in an atom of an element is its atomic number. The sum of the protons and neutrons in an atom is its mass number.	Introducing Atoms
h) Electrons occupy particular energy levels. Each electron in an atom is at a particular energy level (in a particular shell). The electrons in an atom occupy the lowest available energy levels (innermost available shells). Candidates may answer questions in terms of either energy levels or shells *(structure of first 20 elements)*	Introducing Atoms
C1.1.2 The Periodic table	
a) Elements in the same group in the periodic table have the same number of electrons in their highest energy level (outer electrons) and this gives them similar chemical properties.	Introducing Atoms
b) The elements in Group 0 of the periodic table are called the noble gases. They are unreactive because their atoms have stable arrangements of electrons.	Introducing Atoms
C1.1.3 Chemical reactions	
a) When elements react, their atoms join with other atoms to form compounds. This involves giving, taking or sharing electrons to form ions or molecules. Compounds formed from metals and non-metals consist of ions. Compounds formed from non-metals consist of molecules. In molecules the atoms are held together by covalent bonds.	Chemical Reactions
b) Chemical reactions can be represented by word equations or by symbol equations.	Chemical Reactions
c) No atoms are lost or made during a chemical reaction so the mass of the products equals the mass of the reactants.	Chemical Reactions
C1.2 Limestone and building materials	
consider and evaluate the environmental, social and economic effects of exploiting limestone and producing building materials from it	Calcium Carbonate
evaluate the developments in using limestone, cement and concrete as building materials, and their advantages and disadvantages over other materials.	Calcium Carbonate
C1.2.1 Calcium carbonate	
a) Limestone, mainly composed of the compound calcium carbonate ($CaCO_3$), is quarried and can be used as a building material.	Calcium Carbonate
b) Calcium carbonate can be decomposed by heating (thermal decomposition) to make calcium oxide and carbon dioxide.	Calcium Carbonate
c) The carbonates of magnesium, copper, zinc, calcium and sodium decompose on heating in a similar way.	Calcium Carbonate
d) Calcium oxide reacts with water to produce calcium hydroxide, which is an alkali that can be used in the neutralisation of acids.	Calcium Carbonate
e) A solution of calcium hydroxide in water (limewater) reacts with carbon dioxide to produce calcium carbonate. Limewater is used as a test for carbon dioxide. Carbon dioxide turns limewater cloudy.	Calcium Carbonate
f) Carbonates react with acids to produce carbon dioxide, a salt and water. Limestone is damaged by acid rain.	Calcium Carbonate
g) Limestone is heated with clay to make cement. Cement is mixed with sand to make mortar and with sand and aggregate to make concrete.	Calcium Carbonate

C1.3 Metals and their uses

consider and evaluate the social, economic and environmental impacts of exploiting metal ores, of using metals and of recycling metals	Metals and the Environment
evaluate the benefits, drawbacks and risks of using metals as structural materials.	Properties of Metals

C1.3.1 Extracting metals

a) Ores contain enough metal to make it economical to extract the metal. The economics of extraction may change over time.	Extracting Metals by Reduction
b) Ores are mined and may be concentrated before the metal is extracted and purified.	Extracting Metals by Reduction
c) Unreactive metals such as gold are found in the Earth as the metal itself but most metals are found as compounds that require chemical reactions to extract the metal.	Extracting Metals by Reduction
d) Metals that are less reactive than carbon can be extracted from their oxides by reduction with carbon, for example iron oxide is reduced in the blast furnace to make iron. *(Details of the blast furnace are not required.)*	Extracting Metals by Reduction
e) Metals that are more reactive than carbon, such as aluminium, are extracted by electrolysis of molten compounds. The use of large amounts of energy in the extraction of these metals makes them expensive.	Extracting Metals by Electrolysis
f) Copper can be extracted from copper-rich ores by heating the ores in a furnace (smelting). The copper can be purified by electrolysis. The supply of copper-rich ores is limited.	Extracting Metals by Reduction / Extracing Metals by Electrolysis
g) New ways of extracting copper from low grade ores are being researched to limit the environmental impact of traditional mining. Copper can be extracted by phytomining, or by bioleaching.	Metals and the Environment
h) Copper can be obtained from solutions of copper salts by electrolysis or by displacement using scrap iron.	Metals and the Environment
i) Aluminium and titanium cannot be extracted from their oxides by reduction with carbon. Current methods of extraction are expensive because – there are many stages in the processes – large amounts of energy is needed.	Extracting Metals by Electrolysis
j) We should recycle metals because extracting them uses limited resources and is expensive in terms of energy and effects on the environment.	Metals and the Environment

C1.3.2 Alloys

a) Iron from the blast furnace contains about 96% iron. The impurities make it brittle and so it has limited uses.	Alloys
b) Most iron is converted into steels. Steels are alloys since they are mixtures of iron with carbon. Some steels contain other metals. Alloys can be designed to have properties for specific uses. Low carbon steels are easily shaped, high carbon steels are hard, and stainless steels are resistant to corrosion.	Alloys
c) Most metals in everyday use are alloys. Pure copper, gold, iron and aluminium are too soft for many uses and so are mixed with small amounts of similar metals to make them harder for everyday use.	Alloys

C1.3.3 Properties and uses of metals

a) The elements in the central block of the periodic table are known as transition metals. Like other metals they are good conductors of heat and electricity and can be bent or hammered into shape. They are useful as structural materials and for making things that must allow heat or electricity to pass through them easily.	Properties of metals
b) Copper has properties that make it useful for electrical wiring and plumbing.	Properties of metals
c) Low density and resistance to corrosion make aluminium and titanium useful metals.	Properties of metals

C1.4 Crude oil and fuels

evaluate the impact on the environment of burning hydrocarbon fuels	Fossil Fuels and the Environment
consider and evaluate the social, economic and environmental impacts of the uses of fuels	Reducing Pollution
evaluate developments in the production and uses of better fuels, for example ethanol and hydrogen	Alternative Fuels
evaluate the benefits, drawbacks and risks of using plant materials to produce fuels.	Alternative Fuels

C1.4.1 Crude oil

a) Crude oil is a mixture of a very large number of compounds. — **Crude Oil**

b) A mixture consists of two or more elements or compounds not chemically combined together. The chemical properties of each substance in the mixture are unchanged. It is possible to separate the substances in a mixture by physical methods including distillation. — **Crude Oil**

c) Most of the compounds in crude oil consist of molecules made up of hydrogen and carbon atoms only (hydrocarbons). Most of these are saturated hydrocarbons called alkanes, which have the general formula CnH2n+2 — **Crude Oil**

C1.4.2 Hydrocarbons

a) Alkane molecules can be represented in the following forms:
– C_2H_6 Candidates should know that in displayed structures – represents a covalent bond. — **Fractional Distillation**
– *(display formula)*

b) The many hydrocarbons in crude oil may be separated into fractions, each of which contains molecules with a similar number of carbon atoms, by evaporating the oil and allowing it to condense at a number of different temperatures. This process is fractional distillation. — **Fractional Distillation**

c) Some properties of hydrocarbons depend on the size of their molecules. These properties influence how hydrocarbons are used as fuels. — **Hydrocarbon Fuels**

C1.4.3 Hydrocarbon fuels

a) Most fuels, including coal, contain carbon and/or hydrogen and may also contain some sulfur. The gases released into the atmosphere when a fuel burns may include carbon dioxide, water (vapour), carbon monoxide, sulfur dioxide and oxides of nitrogen. Solid particles (particulates) may also be released. — **Combustion / Incomplete Combustion / Fossil Fuels and the Environment**

b) The combustion of hydrocarbon fuels releases energy. During combustion the carbon and hydrogen in the fuels are oxidised. — **Combustion**

c) Sulfur dioxide and oxides of nitrogen cause acid rain, carbon dioxide causes global warming, and solid particles cause global dimming. — **Fossil Fuels and the Environment**

d) Sulfur can be removed from fuels before they are burned, for example in vehicles. Sulfur dioxide can be removed from the waste gases after combustion, for example in power stations. — **Reducing the Environmental Impact of Fossil Fuels**

e) Biofuels, including biodiesel and ethanol, are produced from plant material. There are economic, ethical and environmental issues surrounding their use. — **Alternative Fuels**

C1.5 Getting useful substances from oil

evaluate the social and economic advantagesand disadvantages of using products from crude oil as fuels or as raw materials for plastics and other chemicals — **Cracking Hydrocarbons**

evaluate the social, economic and environmental impacts of the uses, disposal and recycling of polymers — **Polymers and the Environment**

evaluate the advantages and disadvantages ofmaking ethanol from renewable and nonrenewable sources. — **Ethanol**

C1.5.1 Obtaining useful substances from crude oil

a) Hydrocarbons can be broken down (cracked) to produce smaller, more useful molecules. This process involves heating the hydrocarbons to vaporise them. The vapours are either passed over a hot catalyst or mixed with steam and heated to a very high temperature so that. thermal decomposition reactions then occur. — **Cracking Hydrocarbons**

b) The products of cracking include alkanes and unsaturated hydrocarbons called alkenes. Alkenes have the general formula C_nH_{2n}. — **Cracking Hydrocarbons**

c) Unsaturated hydrocarbon molecules can be represented in the following forms:
– C_3H_6 — **Cracking Hydrocarbons**
– (display formula)

d) Alkenes react with bromine water, turning it from orange to colourless. — **Cracking Hydrocarbons**

e) Some of the products of cracking are useful as fuels. — **Cracking Hydrocarbons / Hydrocarbon Fuels**

C1.5.2 Polymers

a) Alkenes can be used to make polymers such as poly(ethene) and poly(propene). In these reactions, many small molecules (monomers) join together to form very large molecules (polymers). For example: *(display formulae showing ethene changing to polyethene)* — Making Polymers

b) Polymers have many useful applications and new uses are being developed, for example: new packaging materials, waterproof coatings for fabrics, dental polymers, wound dressings, hydrogels, smart materials, including shape memory polymers. — Making Polymers

c) Many polymers are not biodegradable, so they are not broken down by microorganisms and this can lead to problems with waste disposal. — Properties and Uses of Polymers

d) Plastic bags are being made from polymers and cornstarch so that they break down more easily. Biodegradable plastics made from cornstarch have been developed. — Polymers and the Environment

C1.5.3 Ethanol

a) Ethanol can be produced by hydration of ethene with steam in the presence of a catalyst. — Ethanol

b) Ethanol can also be produced by fermentation using renewable resources. This can be represented by:
sugar -> carbon dioxide + ethanol — Ethanol

C1.6 Plant oils and their uses

evaluate the effects of using vegetable oils in foods and the impacts on diet and health — Plant Oils

evaluate the use, benefits, drawbacks and risks of emulsifiers in foods. — Emulsifiers

C1.6.1 Vegetable oils

a) Some fruits, seeds and nuts are rich in oils that can be extracted. The plant material is crushed and the oil removed by pressing or in some cases by distillation. Water and other impurities are removed. — Plant Oils

b) Vegetable oils are important foods and fuels as they provide a lot of energy. They also provide us with nutrients — Plant Oils

c) Vegetable oils have higher boiling points than water and so can be used to cook foods at higher temperatures than by boiling. This produces quicker cooking and different flavours but increases the energy that the food releases when it is eaten. — Plant Oils

C1.6.2 Emulsions

a) Oils do not dissolve in water. They can be used to produce emulsions. Emulsions are thicker than oil or water and have many uses that depend on their special properties. They provide better texture, coating ability and appearance, for example in salad dressings, ice creams, cosmetics and paints. — Emulsions

b) Emulsifiers have hydrophilic and hydrophobic properties. — Emulsions

evaluate the use, benefits, drawbacks and risks of emulsifiers in foods. — Emulsions

C1.6.3 Saturated and unsaturated oils

a) Vegetable oils that are unsaturated contain double carbon-carbon bonds. These can be detected by reacting with bromine water. — Plant Oils

b) Vegetable oils that are unsaturated can be hardened by reacting them with hydrogen in the presence of a nickel catalyst at about 60 °C. Hydrogen adds to the carbon–carbon double bonds. The hydrogenated oils have higher melting points so they are solids at room temperature, making them useful as spreads and in cakes and pastries. — Plant Oils

C1.7 Changes in the Earth and its atmosphere

recognise that the Earth's crust, the atmosphere and the oceans are the only source of minerals and other resources that humans need	Rocks as Resources
explain why Wegener's theory of crustal movement (continental drift) was not generally accepted for many years	Plate Tectonics
explain why scientists cannot accurately predict when earthquakes and volcanic eruptions will occur	Volcanoes and Earthquakes
explain and evaluate theories of the changes that have occurred and are occurring in the Earth's atmosphere	Evolution of the Atmosphere
explain and evaluate the effects of human activities on the atmosphere	Changing the Atmosphere
describe why we do not know how life was first formed	Evolution of the Atmosphere

C1.7.1 The Earth's crust

a) The Earth consists of a core, mantle and crust, and is surrounded by the atmosphere.	Plate Tectonics
b) The Earth's crust and the upper part of the mantle are cracked into a number of large pieces (tectonic plates).	Plate Tectonics
c) Convection currents within the Earth's mantle driven by heat released by natural radioactive processes cause the plates to move at relative speeds of a few centimetres per year.	Plate Tectonics
d) The movements can be sudden and disastrous. Earthquakes and/or volcanic eruptions occur at the boundaries between tectonic plates.	Plate Tectonics / Volcanoes and Earthquakes

C1.7.2 The Earth's atmosphere

a) For 200 million years, the proportions of different gases in the atmosphere have been much the same as they are today: – about four-fifths (80%) nitrogen – about one-fifth (20%) oxygen – small proportions of various other gases, including carbon dioxide, water vapour and noble gases.	Earth's Atmosphere
b) During the first billion years of the Earth's existence there was intense volcanic activity. This activity released the gases that formed the early atmosphere and water vapour that condensed to form the oceans.	Evolution of the Atmosphere
c) There are several theories concerning how the atmosphere was formed. One theory suggests that during this period, the Earth's atmosphere was mainly carbon dioxide and there would have been little or no oxygen gas (like the atmospheres of Mars and Venus today). There may also have been water vapour and small proportions of methane and ammonia.	Evolution of the Atmosphere
d) There are many theories as to how life was formed billions of years ago.	Evolution of the Atmosphere
e) One theory as to how life was formed involves the interaction between hydrocarbons, ammonia and lightning. Candidates should be aware of the Miller-Urey experiment and the "primordial soup' theory, but they should know that this is not the only theory.	Evolution of the Atmosphere
f) Plants and algae produced the oxygen that is now in the atmosphere.	Evolution of the Atmosphere
g) Most of the carbon from the carbon dioxide in the air gradually became locked up in sedimentary rocks as carbonates and fossil fuels.	Evolution of the Atmosphere
h) The oceans also act as a reservoir for carbon dioxide but increased amounts of carbon dioxide absorbed by the oceans has an impact on the marine environment.	Evolution of the Atmosphere
i) Nowadays the release of carbon dioxide by burning fossil fuels increases the level of carbon dioxide in the atmosphere.	Changing the Atmosphere
j) Air is a mixture of gases with different boiling points and can be fractionally distilled to provide a source of raw materials used in a variety of industrial processes.	Earth's Atmosphere

AQA
GCSE Science 2011

GCSE Science: Physics

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P1.1 The transfer of energy by heating processes and the factors that affect the rate at which that energy is transferred	Boardworks presentation
compare ways in which energy is transferred in and out of objects by heating and ways in which the rates of these transfers can be varied	**Thermal Radiation**
evaluate the design of everyday appliances that transfer energy by heating, including economic considerations	**Particles and Energy Transfer**
evaluate the effectiveness of different types of material used for insulation, including U-values and economic factors including payback time	**Insulation**
evaluate different materials according to their specific heat capacities.	**Specific Heat Capacity**
P1.1.1 Infrared radiation	
a) All objects emit and absorb infrared radiation.	**Thermal Radiation**
b) The hotter an object is the more infrared radiation it radiates in a given time.	**Thermal Radiation**
c) Dark, matt surfaces are good absorbers and good emitters of infrared radiation.	**Thermal Radiation**
d) Light, shiny surfaces are poor absorbers and poor emitters of infrared radiation.	**Thermal Radiation**
e) Light, shiny surfaces are good reflectors of infrared radiation	**Thermal Radiation**
P1.1.2 Kinetic theory	
a) The use of kinetic theory to explain the different states of matter.	**Particles and Energy Transfer**
b) The particles of solids, liquids and gases have different amounts of energy.	**Particles and Energy Transfer**
P1.1.3 Energy transfer by heating	
a) The transfer of energy by conduction, convection, evaporation and condensation involves particles, and how this transfer takes place.	**Particles and Energy Transfer**
b) The factors that affect the rate of evaporation and condensation.	**Particles and Energy Transfer**
c) The rate at which an object transfers energy by heating depends on: - surface area and volume - the material from which the object is made - the nature of the surface with which the object is in contact.	**Particles and Energy Transfer**
d) The bigger the temperature difference between an object and its surroundings, the faster the rate at which energy is transferred by heating.	**Particles and Energy Transfer**
P1.1.4 Heating and insulating buildings	
a) U-values measure how effective a material is as an insulator.	**Insulation**
b) The lower the U-value, the better the material is as an insulator.	**Insulation**
c) Solar panels may contain water that is heated by radiation from the Sun. This water may then be used to heat buildings or provide domestic hot water.	**Energy from the Sun**
d) The specific heat capacity of a substance is the amount of energy required to change the temperature of one kilogram of the substance by one degree Celsius. $E = m \times c \times \theta$ E is energy transferred in joules, J m is mass in kilograms, kg θ is temperature change in degrees Celsius, ℃ c is specific heat capacity in J / kg ℃	**Specific Heat Capacity**

P1.2 Energy and efficiency

compare the efficiency and cost effectiveness of methods used to reduce 'energy consumption' — **Insulation**

describe the energy transfers and the main energy wastages that occur with a range of appliances — **Energy Transformations and Efficiency**

interpret and draw a Sankey diagram. — **Energy Transformations and Efficiency**

P1.2.1 Energy transfers and efficiency

a) Energy can be transferred usefully, stored, or dissipated, but cannot be created or destroyed. — **Energy Transformations and Efficiency**

b) When energy is transferred only part of it may be usefully transferred, the rest is 'wasted'. — **Energy Transformations and Efficiency**

c) Wasted energy is eventually transferred to the surroundings, which become warmer. The wasted energy becomes increasingly spread out and so becomes less useful. — **Energy Transformations and Efficiency**

d) To calculate the efficiency of a device using:
efficiency = useful energy out (×100%)
total energy in and efficiency = useful power out (×100%) total power in — **Energy Transformations and Efficiency**

P1.3 The usefulness of electrical appliances

compare the advantages and disadvantages of using different electrical appliances for a particular application
consider the implications of instances when electricity is not available. — **Using Electricity**

P1.3.1 Transferring electrical energy

a) Examples of energy transfers that everyday electrical appliances are designed to bring about. — **Using Electricity**

b) The amount of energy an appliance transfers depends on how long the appliance is switched on and its power. — **Using Electricity**

c) To calculate the amount of energy transferred from the mains using: $E = P \times t$
E is energy transferred in kilowatt-hours, kWh
P is power in kilowatts, kW
t is time in hours, h
This equation may also be used when:
E is energy transferred in joules, J
P is power in watts, W
t is time in seconds, s — **Using Electricity**

d) To calculate the cost of mains electricity given the cost per kilowatt-hour. — **Using Electricity**

P1.4 Methods we use to generate electricity

evaluate different methods of generating electricity	**Evaluating Energy Resources**
evaluate ways of matching supply with demand, either by increasing supply or decreasing demand	**Evaluating Energy Resources**
compare the advantages and disadvantages of overhead power lines and underground cables.	**Electricity Distribution**

P1.4.1 Generating electricity

a) In some power stations an energy source is used to heat water. The steam produced drives a turbine that is coupled to an electrical generator. Energy sources include: - the fossil fuels (coal, oil and gas) which are burned to heat water or air - uranium and plutonium, when energy from nuclear fission is used to heat water - biofuels that can be burned to heat water.	**Power Stations / Energy Resources**
b) Water and wind can be used to drive turbines directly.	**Energy Resources**
c) Electricity can be produced directly from the Sun's radiation.	**Energy from the Sun**
d) In some volcanic areas hot water and steam rise to the surface. The steam can be tapped and used to drive turbines. This is known as geothermal energy.	**Energy Resources**
e) Small-scale production of electricity may be useful in some areas and for some uses, eg hydroelectricity in remote areas and solar cells for roadside signs.	**Energy Resources**
f) Using different energy resources has different effects on the environment. These effects include: - the release of substances into the atmosphere - the production of waste materials - noise and visual pollution - the destruction of wildlife habitats.	**Evaluating Energy Resources**

P1.4.2 The National Grid

a) Electricity is distributed from power stations to consumers along the National Grid.	**Electricity Distribution**
b) For a given power increasing the voltage reduces the current required and this reduces the energy losses in the cables.	**Electricity Distribution**
c) The uses of step-up and step-down transformers in the National Grid.	**Electricity Distribution**

P1.5 The use of waves for communication and to provide evidence that the universe is expanding

compare the use of different types of waves for communication	**Communicating with Visible Light and Infrared**
evaluate the possible risks involving the use of mobile phones	**Communicating with Radio Waves and Microwaves**
consider the limitations of the model that scientists use to explain how the universe began and why the universe continues to expand.	**The Origin of the Universe**

P1.5.1 General properties of waves

a) Waves transfer energy.	**Wave Properties**
b) Waves may be either transverse or longitudinal.	**Wave Properties**
c) Electromagnetic waves are transverse, sound waves are longitudinal and mechanical waves may be either transverse or longitudinal.	**Wave Properties**
d) All types of electromagnetic waves travel at the same speed through a vacuum (space).	**Wave Properties**
e) Electromagnetic waves form a continuous spectrum.	**Wave Properties**
f) Longitudinal waves show areas of compression and rarefaction.	**Wave Properties**
g) Waves can be reflected, refracted and diffracted.	**Reflection, Refraction and Diffraction**
h) Waves undergo a change of direction when they are refracted at an interface.	**Reflection, Refraction and Diffraction**

i) The terms frequency, wavelength and amplitude.	**Wave Properties**
j) All waves obey the wave equation: $v = f \times \lambda$ v is speed in metres per second, m/s f is frequency in hertz, Hz λ is wavelength in metres, m	**Wave Properties**
k) Radio waves, microwaves, infrared and visible light can be used for communication.	**Communicating with Visible Light and Infrared**

P1.5.2 Reflection

a) The normal is a construction line perpendicular to the reflecting surface at the point of incidence.	**Reflection, Refraction and Diffraction**
b) The angle of incidence is equal to the angle of reflection.	**Reflection, Refraction and Diffraction**
c) The image produced in a plane mirror is virtual, upright and laterally inverted.	**Reflection, Refraction and Diffraction**

P1.5.3 Sound

a) Sound waves are longitudinal waves and cause vibrations in a medium, which are detected as sound.	**Wave Properties**
b) The pitch of a sound is determined by its frequency and loudness by its amplitude.	**Wave Properties**
c) Echoes are reflections of sounds.	**Wave Properties**

P1.5.4 Red-shift

a) If a wave source is moving relative to an observer there will be a change in the observed wavelength and frequency. This is known as the Doppler effect.	**The Origin of the Universe**
b) There is an observed increase in the wavelength of light from most distant galaxies. The further away the galaxies are, the faster they are moving, and the bigger the observed increase in wavelength. This effect is called 'red-shift'.	**The Origin of the Universe**
c) How the observed red-shift provides evidence that the universe is expanding and supports the 'Big Bang' theory (that the universe began from a very small initial 'point').	**The Origin of the Universe**
d) Cosmic microwave background radiation (CMBR) is a form of electromagnetic radiation filling the universe. It comes from radiation that was present shortly after the beginning of the universe.	**The Origin of the Universe**
e) The 'Big Bang' theory is currently the only theory that can explain the existence of CMBR.	**The Origin of the Universe**