GCSE APPLIED SCIENCE

4861

Scheme of Work

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Introduction

The AQA scheme of work for GCSE Applied Science is intended as an overview for Applied Science teachers to check and prepare their own schemes of work and lesson plans. The scheme of work is neither exhaustive nor prescriptive; it is one suggested scheme among many others available.

It is envisaged that teachers will tailor the scheme to use within their own centres, for example by adding their own preferred activities and resources. Factors that should be considered when doing this include:

- resources available in the centre
- number of teachers delivering the course
- location of centre and type of work places available in the area
- type of student on the course.

Note: There are no 'Learning Objectives' that are assessed only in the Higher Tier paper.

In this suggested scheme of work the course content is divided into 12 teaching modules. These modules form the **core** of the course and are based primarily on the examined unit (Unit 2). Those modules that link some common teaching themes from other units are expanded to show the links. The entire two-year course is covered using this approach. The **expanded core** gives details of each module.

Centres are encouraged to deliver the course as an integrated programme and not as individual units. By delivering the course in this way the assessment of the practical tasks in Unit 3 and Unit 4 may take place as part of the overall teaching programme and need not be treated as a discrete, unrelated exercise.

Centres are also encouraged to deliver the course in terms of 'What scientists do' and 'The way that they do it', together with the skills, knowledge and understanding required.

Within the tasks undertaken in Unit 3, candidates are assessed on some laboratory skills, which may be developed over a period of time. These skills are concerned with:

- producing and using risk assessments
- using standard procedures
- handling scientific equipment and materials
- recording and analysing scientific data.

It is expected that candidates will be able to use these skills when completing the investigations in Unit 4.

Centres may wish to consider an introduction to the course covering the basic requirements listed above. This may be possible at the end of Year 9 following the Key Stage 3 tests.

An alternative starting point may be considered using Module 12, thus providing a basic appreciation of health and safety aspects when working in the laboratory.

Module 12 may be delivered as part of a work experience programme at the end of Year 10 or at the beginning of Year 11.

In this scheme of work, criteria from each unit have been taken from the specification. These are listed in the 'Learning Objectives' column of the expanded core.

THE CORE			
Module	**Based on**	**Module title**	**Possible links with other units**
Module 1	Unit 2	**THE HEALTHY BODY** • Cells • Circulatory and respiratory systems • Homeostasis • Genetics and inheritance	**Unit 4 – How medical scientists monitor living organisms to eg monitor the performance of a person in a mental or physical activity.** **Candidates need to be able to:** • monitor an organism for a particular purpose • produce a plan for the investigation • carry out the investigation, recording relevant data • analyse the results and explain what they show • evaluate the investigation • describe a useful application of the investigation.
Module 2	Unit 2	**THE UNHEALTHY BODY** • Disease and illness • Prevention of illness and disease • Diagnosis and treatment • The body at risk	**Unit 3 – How microbiologists investigate living organisms.** **Candidates need to be able to:** • set up a light microscope ready to use, choosing a suitable objective lens for the task • prepare samples for an investigation, including making a temporary slide and using a staining technique. **Candidates need to:** • understand the importance of aseptic techniques and be able to use these techniques to culture microorganisms and dispose of them safely • investigate the effects of antimicrobial agents on microorganisms **or** set up a culture that will produce a useful product, such as a food substance.

Module	Based on	Module title	Possible links with other units
Module 3	Unit 2	**AGRICULTURAL SCIENCE** • Agriculture and farming • Selective breeding and genetic engineering	**Unit 3 – How microbiologists investigate living organisms.** **Candidates need to:** • understand the importance of aseptic techniques and be able to use these techniques to culture microorganisms and dispose of them safely • investigate the effects of antimicrobial agents on microorganisms **or** set up a culture that will produce a useful product, such as a food substance. **Unit 4 – How biologists monitor living organisms to, eg, improve the yield of plants or microorganisms.** **Candidates need to be able to:** • monitor an organism for a particular purpose • produce a plan for the investigation • carry out the investigation, recording relevant data • analyse the results and explain what they show • evaluate the investigation • describe a useful application of the investigation.
Module 4	Unit 2	**USING SCIENCE IN ENVIRONMENTAL MANAGEMENT** • Extraction of resources • Energy resources • The Earth and environmental management	

Module	Based on	Module title	Possible links with other units
Module 5	Unit 2	**CHEMICAL BUILDING BLOCKS AND THEIR USE IN PRODUCING USEFUL PRODUCTS** • Atoms, molecules and ions • Chemical symbols • Chemical bonding • Useful mixtures in the home	**Unit 4 – How chemists make new useful products.** **Candidates need to be able to:** • describe the factors that affect how quickly a reaction occurs • explain the terms actual yield, theoretical yield and percentage yield • prepare a pure, dry product using a named type of chemical reaction • explain the underlying chemistry involved in the reaction • explain the use of the product and industrial importance of the reaction • know the type of reaction used • measure the actual yield of the product • present the product in a suitable sample tube, with its name, date of preparation and relevant hazard warnings • write a balanced chemical equation to describe the reactions, given the formulae of reactants and products • calculate the mass of product that could be obtained from a specified amount of reactant (theoretical yield) • calculate the percentage yield of a reaction from the theoretical yield and actual mass of product obtained • calculate the costs of making a given amount of product.

Module	Based on	Module title	Possible links with other units
Module 6	Unit 2	**THE SCIENCE OF MATERIALS USED FOR CONSTRUCTION** • Limestone • Metals • Other materials (polymers, ceramics, composites)	**Unit 3 – How materials scientists investigate the properties of materials.** **Candidates need to compare:** • the thermal conductivities of a range of materials • the densities of a range of materials • the strengths of materials of different size, shape and composition.
Module 7	Unit 3	**USEFUL ANALYSIS** • Qualitative analysis • Quantitative analysis	
Module 8	Unit 2	**THE EFFECTIVE USE OF ENERGY IN THE HOME** • Using energy • Using energy efficiently	**Unit 3 – How materials scientists investigate the properties of materials.** **Candidates need to investigate how:** • the nature, length and thickness of materials influence electrical resistance • current varies with voltage in a range of devices.

Module	Based on	Module	Possible links with other units
Module 9	Unit 2	**USING SCIENCE IN TRANSPORT** • Forces, movement and transportation • Fuel for transport	**Unit 4 – The advantages of using machines in the workplace.** **Candidates need to be able to:** • identify a mechanical machine used in the workplace and explain how it works, and be able to: - measure the applied force and the force produced by the machine - calculate the amount by which the machine multiplies force - calculate the work done by the machine and its efficiency - describe the advantages and disadvantages of friction in machines.

Module	Based on	Module title	Possible links with other units
Module 10	Unit 2	**USING SCIENCE IN COMMUNICATION AND OTHER ELECTRONIC DEVICES** • Communication devices	**Unit 4 – The function of components in devices that electronic/electrical engineers make and test.** **Candidates need to be able to:** • assemble and assess the effectiveness of **one** electrical or electronic device by: – selecting the components needed – safely assembling them to build the device – testing the assembled device under conditions of normal use – evaluating the performance of the device and commenting on its fitness for purpose • describe the function of the electrical or electronic device that they have made • explain the functions of the following components in the electrical or electronic device: – power source – processor – input components – output components.
Module 11	Unit 1	**INVESTIGATING SCIENCE AT WORK** • Investigating scientific workplaces	
Module 12	Unit 1	**HEALTH AND SAFETY IN SCIENCE** • Investigating health and safety in scientific workplaces • Hazards and risks • First aid • Fire prevention	

THE EXPANDED CORE	
MODULE 1: THE HEALTHY BODY	
Topic	**Learning Objectives**
Cells	**Candidates need to be able to:** • describe living organisms as being made up of chemical compounds, and the cell as the common feature of all organisms • describe the main features of animal cells (nucleus, cytoplasm, cell membrane) • explain how substances enter and leave cells by diffusion and osmosis • describe how the process of respiration releases energy (glucose + oxygen → carbon dioxide + water) • describe the differences in the structures of some cells that enable them to carry out their functions (red blood cells, white blood cells, nerve cells).
Circulatory and respiratory systems	**Candidates need to be able to:** • describe the structure of the human circulatory system, including the function of the heart (a pump) and the composition and function of the blood (red blood cells, white blood cells, platelets, plasma) • describe the structure of the thorax (trachea, lungs, intercostal muscles, ribs, diaphragm, diaphragm muscles) • explain how ventilation of the lungs occurs and understand the pressure changes involved.
Homeostasis	**Candidates need to be able to:** • explain how the body maintains a constant temperature (by sweating and changing the diameter of capillaries) • describe how chemical substances called hormones control many processes within the body. Hormones are secreted by glands and are transported to their target organs in the bloodstream • explain how the hormone insulin controls blood glucose levels (production by the pancreas, conversion of glucose to glycogen by the liver) • describe how cells called receptors detect stimuli (changes in the environment) • give examples of receptor cells that detect stimuli (light, sound, smell, taste, touch) • describe how information from receptors passes along cells (neurones) to the brain • describe how an impulse is sent along a neurone to the effector (muscle or gland) that brings about the response (contraction or release of a chemical).

Topic	Learning Objectives
Genetics and inheritance	**Candidates need to know:** • that the nucleus of a cell contains chromosomes • that chromosomes carry genes that control the characteristics of the body • that genes have different forms called alleles, which produce different characteristics • the mechanism of monohybrid inheritance where there are dominant and recessive alleles. **Candidates need to be able to:** • explain that differences in the characteristics of individuals may be due to genetic causes or environmental causes or a combination of both. **Candidates should be able to use data, theories and explanations to:** • evaluate the use of current research in the treatment of genetic disorders.

MODULE 2: THE UNHEALTHY BODY

Topic	Learning Objectives
Disease and illness	**Candidates need to know:** • that bacteria and viruses make us feel ill when they reproduce rapidly in the body (cell damage and production of toxins) • that diseases are likely to occur if large numbers of pathogens enter the body as a result of unhygienic conditions or contact with infected people. **Candidates need to be able to:** • name some examples of diseases caused by microorganisms (measles, mumps, rubella, tuberculosis) • describe how platelets help to form a barrier to infection through a cut • describe how white blood cells help to defend against pathogens.

Topic	Learning Objectives

Prevention of illness and disease	**Candidates need to be able to:**
	• give examples of a range of methods of protecting against infection by harmful microorganisms
	  – personal hygiene (washing hands, protective clothing)
	  – sterilisation (gamma rays, high temperature)
	  – disinfectants (chemicals used on surfaces)
	  – antiseptics (chemicals used on skin)
	• explain how vaccination protects humans from infection by specific microorganisms (MMR, TB, polio).
	Candidates should be able to use data, theories and explanations to:
	• evaluate the advantages and disadvantages of being vaccinated against a particular disease
	• explain how the occurrence of some diseases has changed as a result of increased use of vaccinations.

Diagnosis and treatment	**Candidates need to know:** • the characteristic properties of X-rays (penetration) that enable them to be used to diagnose medical disorders • the characteristics and properties of the three main types of nuclear radiation emitted by radioactive sources (alpha particles, beta particles and gamma rays) • the uses of high-energy radiation and the dangers associated with its use.

Topic	Learning Objectives
The body at risk	**Candidates need to know:** • that certain foods are considered healthy (fresh fruit and vegetables) and an excess of others is considered unhealthy (saturated fat, salt, sugar) • that disease may be treated with medicines that contain useful drugs (eg penicillin is an antibiotic, aspirin is anti-inflammatory) • that some medicines, including painkillers, help to relieve the symptoms of disease, but do not kill the pathogens (eg aspirin, paracetamol) • that some bacteria, but not viruses, may be killed by antibiotics • that some bacteria develop resistance to, or may not be easily treated by, antibiotics (eg MRSA) • examples of recreational drugs that may harm the body (alcohol, nicotine, antidepressants, amphetamines, barbiturates, heroin, cocaine) • that some people may become dependent on or addicted to recreational drugs because they change some of the chemical processes in the body, and these people suffer withdrawal symptoms without them (eg nicotine in tobacco) • that tobacco smoke contains substances that cause diseases of the respiratory and circulatory systems • that tobacco smoke also contains carbon monoxide, which reduces the oxygen-carrying capacity of the blood • that alcohol affects the nervous system by slowing down reactions (loss of self-control and long-term damage to the liver and brain). **Candidates should be able to use data, theories and explanations to:** • compare the impact of legal (alcohol and tobacco) and illegal drugs on the body • explain the link between smoking and respiratory and circulatory diseases. **Candidates should be able to assess the implications of science when:** • considering the issues of testing new drugs.

MODULE 3: AGRICULTURAL SCIENCE	
Topic	**Learning Objectives**
Agriculture and farming	**Candidates need to be able to:** • describe the differences in the structures of some plant cells that enable them to carry out their function (leaf cell, root hair cell) • describe the similarities and differences between animal and plant cells (chloroplasts, cell wall, large vacuole) • describe how intensive farming increases crop yields by using artificial fertilisers, pesticides, herbicides and fungicides, and increases meat production by using controlled environments • describe how organic farming uses the alternative methods of natural fertilisers, natural pesticides and mechanical methods of eliminating weeds in crop production and keeps animals under more natural conditions • identify useful products that can be made from living things and name the organism used to produce a particular product • describe the use of bacteria, yeast and other fungi in food and medicine production (bread, beer, wine, cheese, yoghurt) and antibiotics (eg penicillin). **Candidates need to understand:** • how plants make food by photosynthesis and how the rate of photosynthesis may be changed in horticulture in commercial glass houses (carbon dioxide + water → glucose + oxygen) • why plants need, among other things, the minerals (nitrate, phosphate, potassium and magnesium) which they obtain from soil for healthy growth. **Candidates need to know:** • that nitrates are required for proteins, which are needed for cell growth, and that magnesium is required for chlorophyll. **Candidates should be able to assess the applications and implications of science when:** • comparing the advantages and disadvantages of both types of farming. **Candidates should be able to use data, theories and explanations to:** • evaluate the effect on the environment of the continued use of artificial fertilisers, pesticides, herbicides and fungicides, and the effect of other factors associated with intensive farming (eg field size, monoculture).

Topic	Learning Objectives
Selective breeding and genetic engineering	**Candidates need to be able to:** • explain that selective breeding involves selecting the parents with desired traits, crossing them, selecting from their offspring, and then repeating the process over several generations • explain that genetic engineering involves the transfer of 'foreign' genes into the cells of animals or plants at an early stage in their development so that they develop with desired characteristics. **Candidates should be able to assess the applications and implications of science when:** • making informed judgements about the economic, social and ethical issues concerning cloning and genetic engineering and suggest possible long-term evolutionary problems, eg seedless fruits.

MODULE 4: USING SCIENCE IN ENVIRONMENTAL MANAGEMENT

Topic	Learning Objectives
Extraction of resources	**Candidates need to be able to:** • classify materials as elements, compounds or mixtures • give examples of substances used straight from the ground (gold, sulfur, limestone and marble) • describe how some substances are separated before use (salt from rock salt, fractional distillation of crude oil) • give examples of reducing agents for the extraction of metals (carbon and carbon monoxide) • describe how a metal may be made from its oxide by reduction (iron from iron oxide and lead from lead oxide). **Candidates should be able to assess the applications and implications of science when:** • considering and evaluating the social, economic and environmental impacts of exploiting metal ores.

Topic	Learning Objectives
Energy resources	**Candidates need to:** • know that fossil fuels (natural gas, oil, coal) are useful energy resources • appreciate the problems of burning fossil fuels (global warming and its effect on climate, limited deposits) • know that nuclear fuels and renewable energy resources (wind, solar, hydroelectric, wave, tidal) may be used as alternatives to fossil fuels • appreciate the problems of using nuclear fuels (problems of radioactive emissions, disposal of waste) and of using renewable sources (unreliability and possible effects on the environment) **Candidates need to know:** • how electricity is generated from the burning of fossil fuels.
The Earth and environmental management	**Candidates need to know:** • that changes in the Earth's atmosphere were originally produced from gases escaping from the Earth's interior and that gases were changed by the emergence of green plants. **Candidates need to be able to use data to:** • explain the position of the Earth in the solar system. **Candidates should be able to assess the applications and implications of science when:** • evaluating the effects of human activity on the Earth based on environmental measurements • evaluating changes to the composition of water and air as a consequence of industrial and geological activity • evaluating the environmental effects over time of pollution and waste disposal • evaluating the environmental impact over time of energy production and comparing the advantages and disadvantages of using alternative energy sources.

MODULE 5: CHEMICAL BUILDING BLOCKS AND THEIR USE IN PRODUCING USEFUL PRODUCTS

Topic	Learning Objectives
Atoms, molecules and ions	**Candidates need to be able to:** • describe the structure of the atom in terms of numbers of protons, neutrons and electrons • explain the difference between atoms, molecules and ions. **Candidates need to know:** • that atoms of a particular element have the same number of protons (atomic number).
Chemical symbols	**Candidates need to know:** • the chemical symbols for the elements listed in Appendix D (specification page 92) • know the chemical formulae for the simple molecules listed in Appendix D (specification page 93). **Candidates need to be able to:** • write symbol equations for the chemical reactions in the unit (eg extraction of metals from ores, combustion of hydrocarbons, chemicals from limestone). **Candidates should be able to use data to:** • write the chemical formulae of some simple ionic compounds.
Chemical bonding	**Candidates need to know:** • the characteristic properties of metals and non-metals (electrical conductivity, density, melting point, appearance). **Candidates need to be able to:** • explain that compounds with small molecules (covalent bonding) have low boiling points (water, methane, carbon dioxide) • explain that compounds with ionic bonding (eg sodium chloride) or giant molecules (eg silica) have high melting points and boiling points. **Candidates should be able to use data and theories to:** • explain the differences in the physical properties of compounds in terms of the types of forces of attraction between the particles in the structure.

Topic	Learning Objectives
Useful mixtures in the home	**Candidates need to be able to:** • describe the composition of a solution, suspension, gel, emulsion, foam and aerosol • give an example of each type of mixture and explain why its composition makes it useful • know examples of solvents other than water, eg organic solvents used in paints, and ethanol used in cosmetics and toiletries • explain the changes that occur when some mixtures are left undisturbed or are left open to the atmosphere (settling of suspension, escape of gas from solution, evaporation of solvent, separation of emulsion).

MODULE 6: THE SCIENCE OF MATERIALS USED FOR CONSTRUCTION

Topic	Learning Objectives
Limestone	**Candidates need to know:** • the chemical formulae of limestone, calcium oxide and calcium hydroxide • the meanings of the terms endothermic reaction and exothermic reaction. **Candidates need to be able to:** • give some uses of limestone in the building industry • describe the conversion of limestone into quicklime and quicklime into slaked lime • outline the manufacturing processes for the production of quicklime, cement and glass • describe the composition and use of mortar and concrete. **Candidates should be able to use data, theories and explanations to:** • evaluate the environmental, social and economic effects of producing building materials from limestone.

Topic	Learning Objectives
Metals	**Candidates need to know:** • the characteristic properties of metals (eg electrical conductivity, malleability and hardness) and be able to relate them to their uses. **Candidates need to be able to:** • give examples of metals (copper, lead, aluminium) and metal alloys (steel, brass, solder) used in construction • describe some uses of metals in the building industry.
Other materials (polymers, ceramics, composites)	**Candidates need to know:** • the characteristic properties of polymers (eg flexibility, behaviour on heating, poor conductors of heat and electricity) and be able to relate their properties to their uses • the characteristic properties of ceramics (eg brittle, high melting point) and be able to relate their properties to their uses. **Candidates need to be able to:** • classify materials as metals, polymers, ceramics and composites • describe the uses of these materials in the building industry and their advantages and disadvantages over naturally occurring materials • explain the properties of composites in terms of the properties of their components and be able to relate their properties to their uses. **Candidates should be able use data to:** • find the physical properties of materials. **Candidates should be able to use data, theories and explanations to:** • select materials for making a particular product, given a specification for the product • evaluate the developments in modern building materials, and their advantages and disadvantages compared with traditional materials.

MODULE 7: USEFUL ANALYSIS	
Topic	**Learning Objectives**
Qualitative analysis	**Candidates need to be able to:** • carry out qualitative chemical tests for eg Na^+, K^+, Ca^{2+}, Cu^{2+}, Pb^{2+}, Fe^{2+}, Cl^-, SO_4^{2-}, CO_3^{2-} ions using reagents and/or flame tests • draw appropriate conclusions from their results.
Quantitative analysis	**Candidates need to be able to:** • prepare solutions of specified concentrations using the units g/dm^3 and mol/dm^3 • carry out titrations • carry out calculations to determine the concentration of a substance in solution.

MODULE 8: THE EFFECTIVE USE OF ENERGY IN THE HOME	
Topic	**Learning Objectives**
Using energy	**Candidates need to be able to:** • explain why an appropriate source of energy is selected for a particular task (natural gas, oil, mains electricity, batteries) • recall and use the formula: power (watt) = voltage (volt) × current (ampere) to calculate the power of an electrical circuit • calculate the current through an appliance from its power and the potential difference of the supply, and from this determine the size of the fuse needed for the appliance • describe the use of fuses and circuit breakers to protect the users of faulty electrical appliances • carry out simple calculations using the formula: $\text{power} = \frac{\text{energy}}{\text{time}}$ to calculate power in watts (W) and to calculate the energy usage in kilowatt-hour (kWh) for electrical appliances • calculate the costs of using different electrical appliances using the formula: total cost = number of kilowatt-hours × cost per kilowatt-hour.

Topic	Learning Objectives
Using energy efficiently	**Candidates need to know:** • the advantages to the user, and to society, of making and using devices with high efficiency, by considering the benefits of low energy lamps compared with filament lamps • understand the meaning of the term *efficiency* when applied to simple energy transfers in electrical appliances. **Candidates need to be able to:** • describe how heat is transferred by conduction, convection and radiation • explain how to minimise heat loss in the home • calculate the percentage efficiency of a device using the formula: $\% \text{ efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}} \times 100$ **Candidates should be able to use data, theories and explanations to:** • evaluate the effectiveness and cost-effectiveness of methods used to reduce domestic energy consumption.

MODULE 9: USING SCIENCE IN TRANSPORT

Topic	Learning Objectives
Forces, movement and transportation	**Candidates need to be able to:** • recall and use the formula: $\text{speed (m/s)} = \frac{\text{distance travelled (m)}}{\text{time (s)}}$ to calculate the speed, distance travelled, or journey time, for a vehicle moving with a steady speed in a straight line • recall and use the formula: $\text{acceleration (m/s}^2\text{)} = \frac{\text{change in velocity (m/s)}}{\text{time taken for change (s)}}$ for vehicles moving in a straight line with a steady acceleration. • describe how the stopping distance of a vehicle depends on: – the distance the vehicle travels during the driver's reaction time – the distance the vehicle travels under braking force • explain how the overall stopping distance is affected by: – the speed of the vehicle – the type of road surface – the driver's reaction time – the weather conditions (eg wet / icy roads, poor visibility) – the condition of the vehicle's brakes and tyres – how heavily loaded the vehicle is • appreciate that tiredness, drugs and alcohol may affect a driver's reaction time • describe how transport safety can be improved by providing information and carrying out tests on vehicles and drivers. **Candidates should be able to use data, theories and explanations to:** • evaluate the impact of environmental factors, improvements in technology and changes in rules and regulations on transport safety.

Topic	Learning Objectives
Fuel for transport	**Candidates need to know:** • that petrol and diesel are fuels obtained from crude oil • that the compounds in crude oil consist of molecules made up of hydrogen and carbon atoms only (hydrocarbons) • the meaning of the term *efficiency* when applied to energy transfers in mechanical systems • the advantages of developing the use of alternative fuels (eg hydrogen, gasohol) to replace fossil fuels used for transport. **Candidates need to be able to:** • describe how, in processes of energy transfer, energy is conserved but tends to spread out and become less useful • write symbol equations for the combustion of hydrocarbon fuels and explain the patterns in the equations • explain how incomplete combustion results in lower energy output and the formation of toxic combustion products (carbon monoxide and soot). **Candidates should be able to use data, theories and explanations to:** • evaluate the social, economic and environmental impacts of the uses of fuels for transport • compare the energy content of different fuels • evaluate developments in the production and use of better fuels.

MODULE 10: USING SCIENCE IN COMMUNICATION AND OTHER ELECTRONIC DEVICES

Topic	Learning Objectives
Communication devices	**Candidates need to know:** • that electromagnetic radiation travels as waves and moves energy from one place to another • that the number of waves per second produced by a source is called the frequency and is measured in hertz (Hz) • that the higher the frequency of the wave, the higher the energy of the wave • the different types of waves that make up the electromagnetic spectrum (gamma rays, X-rays, ultraviolet, visible light, infrared, microwaves, radio waves). **Candidates need to be able to:** • describe the uses of different types of waves in communication devices: – radio waves – TV and radio – microwaves – mobile phones – infrared – remote control for TV and DVD players – visible light – fibreoptic cables • describe the change in frequency when a wave source is moved away from an observer • describe the evidence for the expanding universe provided by observations using telescopes. **Candidates should be able to use data, theories and explanations to:** • explain how the uses of different types of waves depend on their properties. **Candidates should be able to assess the applications and implications of science when:** • evaluating the social and environmental impact of the use of communication devices • evaluating the possible hazards associated with the use of different types of electromagnetic radiation.

MODULE 11: INVESTIGATING SCIENCE AT WORK

Topic	Learning Objectives
Investigating scientific workplaces	**Candidates need to:** • identify local, national and international businesses and service providers that use science • identify and describe the types of scientific activity that are carried out • describe the importance of the activity to society or the community • find out where organisations are located and why • put the employees into one of three classes: major, significant and small users of science • identify the job titles and qualifications of the people who perform them • find out what skills are used by the people employed • find out what skills scientists need in addition to their qualifications • find out what careers are available in science and science-related areas.

MODULE 12: HEALTH AND SAFETY IN SCIENCE

Topic	Learning Objectives
Investigating health and safety in scientific workplaces	**Candidates need to find out about:** • health and safety checks in the workplace • risk assessments for activities performed in the workplace • what can be done to prevent accidents from hazards in a scientific workplace • emergency procedures to be followed if an accident from these hazards happens.

Topic	Learning Objectives
Hazards and risks	**Candidates need to be able to:** • identify hazard warning signs • identify biological, chemical and physical hazards, including radioactive substances, and their associated risks • follow health and safety procedures • understand the use of risk assessments. **Candidates need to find out:** • about the safety measures employed for handling radioactive materials and the procedures adopted to ensure that people who work with radioactive materials are not exposed to unacceptable risk • about how unwanted or waste materials, including radioactive substances, are disposed of safely.
First aid – heat burns and scalds – chemical burns – breathing in fumes – swallowing chemicals – electric shock – cuts – damage to eyes by particles or chemicals	**For each of these injuries, candidates need to know:** • the basic first aid to give • the situations in which it would be dangerous to give first aid. **Candidates need to find out:** • why it is useful to have a first aid qualification • the names of organisations that give training for first aid qualifications and how to contact these organisations.
Fire prevention	**Candidates need to know:** • what must be done if they hear a fire alarm or smoke alarm • what must be done if they find a fire • how fire doors function • why different types of fire extinguisher (water, carbon dioxide, dry powder, foam, a fire-blanket) are used on different types of fire • about the use of automatic sprinkler systems.

Teaching Plan

There are many possible routes through the course, one of which is shown in the plan below.

Using this plan it should be possible to deliver the Unit 3 portfolio material ready for submission by the second deadline date in Year 10. Unit 1 may then be submitted by the first deadline date in Year 11 and the remaining portfolio unit (Unit 4) by the second deadline date in Year 11.

Those wishing to use both examination opportunities in Year 11 for Unit 2 should consider submitting the Unit 1 portfolio later to enable more time for the delivery of Unit 2.

Year 10 Modules

Module	Unit	Notes
Module 12 Health and Safety in Science	Unit 1	Could form an introduction to the course or be delivered in conjunction with Module 11.
Module 2 The Unhealthy Body	Unit 2/3	These modules could be delivered in any order.
Module 3 Agricultural Science	Units 2/3/(4)	
Module 6 The Science of Materials Used for Construction	Unit 2/3	
Module 7 Useful Analysis	Unit 3	
Module 8 The Effective Use of Energy in the Home	Unit 2/3	
Module 11 Investigating Science at Work	Unit 1	Could be delivered in conjunction with Module 12. At the end of Year 10 or beginning of Year 11.

Year 11 Modules		
Module	Unit	Notes
Module 1 The Healthy Body	Units 1/4/(3)	These modules could be delivered in any order.
Module 4 Using Science in Environmental Management	Unit 2/3	
Module 5 Chemical Building Blocks and Their Use in Producing Useful Products	Units 2/4	
Module 9 Using Science in Transport	Unit 2	
Module 10 Using Science in Communication and Other Electronic Devices	Units 2/4	