GCSE ADDITIONAL APPLIED SCIENCE

4863

Scheme of Work

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Introduction

The AQA Scheme of Work for GCSE Additional Applied Science is intended as an overview for 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.

It has been assumed that most centres will deliver this course primarily in Year 11, having first delivered a GCSE 'core science' course. Centres are strongly advised that, in order to complete the course, teaching of the programme should begin immediately following any GCSE 'core science' examinations that students will have taken towards the end of Year 10.

In this suggested scheme of work the course content is divided into 18 teaching modules, based primarily on the examined unit (Unit 2). The first two modules are based on Unit 1. The majority of modules 3–18 have natural links to Unit 3, which are indicated in the scheme of work. Using this approach, the entire course may be covered.

Centres are strongly 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 investigation tasks in Unit 3 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, students are assessed on some laboratory skills, which may be developed over a period of time. These skills are concerned with:

- planning
- risk assessment
- collecting, recording and using data and observations to make conclusions
- evaluating.

Students put the investigation into an appropriate context by:

- describing its purpose in relation to the particular vocational option selected
- explaining how a particular type of scientist may interpret and use the results of their investigation.

Centres may wish to consider an introduction to the course using modules 1 and 2. This approach may be useful for those who wish to use the January moderation period for at least one unit.

Although modules 3–18 follow the order of the specification it is not necessary to deliver them in this order. Some centres may wish to consider using the January moderation period for the Unit 3 portfolio work, in which case Unit 2 should be delivered in an order that would allow for this. However, centres are strongly advised to allow students perhaps to complete more than one investigation in Unit 3 so that they can develop fully the skills required.

In this Scheme of Work, criteria from Unit 1 and Unit 2 have been taken from the specification and are listed in the 'Learning Objectives' column. There are no separate learning objectives for Unit 3.

WORKING SAFELY IN SCIENCE		
Module	**Learning Objectives**	**Notes**
Module 1: Health and safety in science	**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 followed if an accident from these hazards happens. **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 • why it is useful to have a first aid qualification • the names of organisations which give training for first aid qualifications and how to contact these organisations. **Candidates need to know:** • the basic first aid to give in the case of: heat burns and scalds, chemical burns, breathing in fumes and swallowing chemicals, electric shock, damage to eyes by particles or chemicals • the situations in which it would be dangerous to give first aid • 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.	Modules 1 and 2 form the entire content of **Unit 1** and could form an introduction to the course at the end of Year 10. They could: • contribute to part of a work experience programme • make use of any student employment • be delivered in conjunction with a specific area of the course. Whilst it would be preferable to use vocational areas associated with units 2 and 3 (ie food science, forensic science or sports science) this is not essential and should not be viewed as either a restriction or a necessity

Module	Learning Objectives	Notes
Module 2: Investigating science at work	**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.	

FOOD SCIENCE

Module	Learning Objectives	Notes
Module 3: What is the purpose of nutrients in food?	**Candidates need to know:** • that the human body requires a variety of nutrients in order to carry out the vital functions of life: respiration, movement, growth and repair of body tissue • the function of carbohydrates, saturated and unsaturated fats, proteins • the function of vitamins A, B, C, D and K • the function of the minerals iron, calcium, phosphorus and zinc • symptoms of any deficiencies of vitamins within the human body: A, B, C and D • examples of foods that are good sources of nutrients.	
Module 4: What do food scientists consider a healthy diet?	**Candidates need to know:** • the health risks of eating too much saturated fat, sugar and salt (heart disease, diabetes and high blood pressure in later life) • the importance of fibre in the diet • the importance of controlling the overall energy intake (energy requirements of different individuals, dieting). **Candidates should be able to use data, theories and explanations to:** • comment on the nutritional value of food • consider the impact of marketing, fast food and lifestyle on diet and health.	This will be tested in **Unit 2** by providing information (as data or text) to interpret.

FOOD SCIENCE		
Module	Learning Objectives	Notes
Module 5: Why do food manufacturers use additives?	**Candidates need to know:** • the function of and examples of additives: antioxidants, flavourings and flavour enhancers, colourings, preservatives, sweeteners, thickeners • some advantages of using additives (improved taste, appearance and shelf life) • some disadvantages of using additives (toxic nature of some preservatives, hyperactivity linked to tartrazine).	
Module 6: How does a food analyst test the quality of our food?	**Candidates need to be able to:** • interpret food labels, including 'sell by' dates, quantities and energy values of nutrients and other components of food including food additives • *carry out qualitative food tests for starch, fat, protein, reducing sugar and acidity* • *carry out quantitative tests on food and food supplement: moisture content, suspended matter, acidity, vitamin C content, iron content.* **Candidates should be able to use data, theories and explanations to:** • evaluate qualitative and quantitative analysis of food • consider the social and economic impact of information about the long-term harmful effects of eating certain types of food or food containing certain types of additive.	Best treated by using real labels for candidates to interpret. Could form the starting point for a **Unit 3** food science investigation. *These techniques could be used as part of a food science investigation for the **Unit 3** portfolio. The complete analysis and comparison of a range of foodstuffs (eg a range of fruit juices) could form a major investigation.* Will be tested in **Unit 2** by providing information (as data or text) to interpret. Some parts of a **Unit 3** investigation may also include these skills.

FOOD SCIENCE		
Module	Learning Objectives	Notes
Module 7: How do food scientists use and control microorganisms in our food?	**Candidates need to be able to:** • describe the use of bacteria, yeast and other fungi in food production (bread, wine, beer, yoghurt and cheese). **Candidates need to know:** • examples of bacteria that cause food poisoning (campylobacter, E. coli, salmonella) • optimum conditions for the growth of bacteria (warmth, moisture, food source) • the common symptoms of food poisoning (stomach pains, vomiting, diarrhoea) • how food preparation areas are kept free of bacteria (personal hygiene, disinfectants, detergent, sterilisation, disposal of waste, control of pests eg insects, mice) • some examples of the ways in which the growth of bacteria is slowed down or stopped (refrigeration, freezing, heating, drying, salting, pickling). **Candidates should be able, when provided with appropriate information, to:** • consider the problems of contamination of food products which have led to product recalls or health scares. **Candidates need to be able to:** • *carry out tests on food products to determine the level of bacteria in the food* • *use aseptic techniques to swab areas to detect presence of bacteria* • *complete serial dilutions to do accurate bacterial count* • *make streak plates to identify the types of bacteria present.*	Will be tested in **Unit 2** by providing information (as data or text) to interpret. *These tests and techniques could be used as part of a food science investigation for the **Unit 3** portfolio.*

FOOD SCIENCE		
Module	Learning Objectives	Notes
Module 8: Which type of food production is better for us?	**Candidates need to:** • understand that as crops grow they remove essential nutrients from the soil and that these nutrients need to be replaced • know that plants need the minerals nitrates, phosphates, potassium and magnesium, which they obtain from soil, for healthy growth • describe how intensive farming increases crop yields by using artificial fertilisers, pesticides, herbicides and fungicides • describe how intensive farming increases meat production by using controlled environments (eg hens, pigs) • describe how organic farming uses the alternative methods of natural fertilisers, natural pesticides and mechanical methods of eliminating weeds in crop production • describe how organic farming keeps animals under more natural conditions. **Candidates should be able to assess the applications and implications of science when:** • comparing the advantages and disadvantages of both types of farming (food quality, cost, animal welfare, effect on environment). **Candidates need to be able to:** • *plan and assess how well a plant has grown under various conditions.*	Will be tested in **Unit 2** by providing information (as data or text) to interpret. *Could be used to form a major investigation for the **Unit 3** portfolio.*

FORENSIC SCIENCE		
Module	Learning Objectives	Notes
Module 9: How does the Scenes of Crime Officer record, collect and store evidence?	**Candidates need to be able to:** • describe how to avoid the contamination of evidence at a crime scene • *describe how to take appropriate samples from large quantities of materials* • *describe how to collect and record forensic samples: broken glass, fibres, soil, fingerprints, blood* • *describe a suitable technique to make a permanent record of a mark or impression found at the scene of a crime* • *describe a suitable technique to reveal, lift and store a fingerprint left by a suspect at the scene of a crime* • *make measurements to enable a comparison of crime scene marks and impressions with real objects* • recognise the three distinctive types of fingerprint pattern (loop, arch, whorl). **Candidates should be able to use data, theories and explanations to:** • suggest why an inappropriate collection or sampling technique may lead to uncertainty about the validity and reliability of evidence • suggest which measurements or distinctive features could be used to make a comparison • state whether there is a possible match between two different samples using distinctive marks or impressions.	*These techniques could be used as part of a forensic investigation for the **Unit 3** portfolio.* Will be tested in **Unit 2** by providing information (as data or text) to interpret. Candidates may also use supplied data to compare and match in their **Unit 3** portfolio.

FORENSIC SCIENCE		
Module	Learning Objectives	Notes
Module 10: How do forensic scientists use chemical tests?	**Candidates need to be able to:** • describe the structure of ionic compounds as consisting of a giant lattice held together by strong forces of attraction between positively charged and negatively charged ions (eg sodium chloride) • explain why ionic compounds have high melting points • recall that many substances that are obtained from living materials are organic compounds with covalent bonding • name some simple covalent compounds, given their formulae, and state the formula, given the name of the compound (carbon dioxide – CO_2, water – H_2O, ethanol – C_2H_5OH, glucose – $C_6H_{12}O_6$) • understand that, although the covalent bonds between the atoms in a molecule are strong, the forces between the molecules are weak • explain why covalent compounds have low melting points and boiling points • *describe how to detect the presence of Na^+, K^+, Ca^{2+} and Cu^{2+} ions using flame tests* • *describe how to test the solubility of a compound in water* • *describe how to obtain a clear solution for use in further tests* • *describe how to use of universal indicator paper to measure the pH of a solution* • *describe the use of precipitation reactions to detect the presence of Ca^2 , Cu^2 , Fe^{2+}, Fe^{3+}, Pb^{2+}, Cl^- and $SO4^{2-}$ ions* • *describe the reaction of CO_3^{2-} ions with dilute acid* • *describe the test for carbon dioxide using limewater* • *describe the test for ethanol using acidified potassium dichromate solution and outline the use of this reaction in the original breathalyser* • *describe the test for glucose using Benedict's solution* • *describe the separation of coloured mixtures using thin layer and paper chromatography with both water and non-aqueous solvents* • explain why different colours in the mixture are carried different distances by the solvent and how this observation can be used to match the mixture with known samples or identify the substances present in the mixture.	*These tests could be used as part of a forensic investigation for the **Unit 3** portfolio.* *This technique could be used as part of a forensic investigation for the **Unit 3** portfolio.*

FORENSIC SCIENCE		
Module	Learning Objectives	Notes
Module 10 (continued)	**Candidates should be able to use data, theories and explanations to:** • state whether an ionic compound is soluble in water • write the formula for an ionic compound • name the product of a precipitation reaction • draw conclusions about the identity of substances when given the results of a series of chemical tests. **Candidates should be able to assess the applications of science when:** • suggesting ways to improve the accuracy and reliability of the evidence being collected.	Will be tested in **Unit 2** by providing information (as data or text) to interpret. Candidates may also use these skills in their **Unit 3** portfolio. Candidates will also be expected to use the skills of evaluation in their **Unit 3** portfolio.
Module 11: How do forensic scientists use biological tests?	**Candidates need to know and understand:** • the composition of blood (red blood cells, white blood cells, platelets, plasma) • the four main blood groups: A, B, AB and O • that DNA is located in the nucleus of the cell • that DNA is unique to the individual (except identical twins) • that children inherit their DNA from their parents • how charged particles move in an electric field and how this movement can be used to separate them (eg in order to produce a DNA profile). **Candidates should be able to use data, theories and explanations to:** • draw conclusions from the results of blood tests and DNA profiling.	Will be tested in **Unit 2** by providing information (as data or text) to interpret. This type of data could be supplied for candidates to interpret in their **Unit 3** investigation.

FORENSIC SCIENCE		
Module	Learning Objectives	Notes
Module 12: How do forensic scientists use physical tests?	**Candidates need to be able to:** • *describe the distinctive features of fibres, bullets, seeds and soil that enable samples to be matched* • describe how light is refracted at a glass surface • *describe the procedure to measure the refractive index of a glass block* • describe how the refractive index of a glass fragment is determined. **Candidates should be able to use data, theories and explanations to:** • describe the distinctive feature of pollen grains and layers of paint.	*These techniques could be used as part of a forensic investigation for the **Unit 3** portfolio.* Will be tested in **Unit 2** by providing information (as data or text) to interpret.
Module 13: How do forensic scientists use databases?	**Candidates need to be able to:** • give a method to record a witness description (artist impression, identikit) • describe the type of information stored in the databases used in forensic investigations • explain how databases can be searched to find possible matches or to exclude a suspect from an investigation.	
Module 14: How do forensic scientists interpret tests and evidence?	**Candidates should be able to use data, theories and explanations to:** • suggest why instrumental techniques provide more precise and reliable evidence than that obtained from simple laboratory experiments • state whether observable features indicate a link between a suspect and the scene of a crime • interpret data and state whether there is a high probability that a suspect is linked to the scene of a crime • draw conclusions based on the facts and state whether, on the basis of the evidence, a suspect may have been present at a crime scene or may have committed a crime.	Will be tested in **Unit 2** by providing information (as data or text) to interpret. In the **Unit 3** report resulting from their investigation candidates must be able to demonstrate that they can interpret forensic data correctly. Their conclusions should not only be scientific, resulting from investigations, but also state if these conclusions would prove the guilt of a suspect.

SPORTS SCIENCE		
Module	Learning Objectives	Notes
Module 15: How does the 'fit' body work?	**Candidates need to be able to:** • describe the structure of the human cardiovascular system • describe the function of the heart and lungs in providing glucose and oxygen to the muscles • describe the physiological changes that occur during exercise (linked to breathing and heart rate) • describe how the structure of the thorax enables ventilation of the lungs • describe how respiration may be aerobic or anaerobic depending on the availability of oxygen, and that 'oxygen debt' may occur in muscles • describe how humans maintain a constant body temperature (by sweating and changing the diameter of capillaries) • explain why humans need to maintain the correct amount of water in the body (water loss through urine and sweat) • describe how the blood glucose levels are controlled (by the hormones insulin and glucagon) • describe the antagonistic action of muscles (biceps and triceps).	
Module 16: What baseline measurements does a sports scientist use?	**Candidates should be able to take baseline measurements of:** • *the heart rate (pulse) and the breathing rate at rest/during exercise and how to monitor the recovery rate immediately after exercise* • *the vital capacity and tidal volume of the lungs using a spirometer* • *the glucose content of blood and urine using a dip-stick method* • *the strength of a muscle using the grip test method.* **Candidates should be able to use data, theories and explanations to:** • suggest suitable measurements to take in order to monitor physiological changes during exercise • explain the importance of taking accurate and reliable measurements • calculate pulse and breathing rate.	*These measurements could be used as part of a sports science investigation for the **Unit 3** portfolio.* Will be tested in **Unit 2** by providing information (as data or text) to interpret. In planning for the **Unit 3** report, candidates may wish to suggest suitable measurements and discuss the importance of reliability and accuracy.

SPORTS SCIENCE		
Module	Learning Objectives	Notes
Module 17: How does the sports nutritionist help improve athletic performance?	**Candidates need to be able to:** • describe how the daily energy requirements for an individual depend on the mass of the individual (weight) and that these requirements increase during exercise • explain that Body Mass Index is an indicator of ideal weight • describe methods used to record dietary habits of individuals (24 hour dietary recall and diet diaries) • *calculate:* – *basic daily energy requirements (BER) (for every kg of body mass 1.3 Kcal are required every hour)* – *Body Mass Index (weight/height^2)* • explain why athletes increase their intake of complex carbohydrates (bread, pasta, rice) before competing (increase glycogen stores in the muscles) • explain why some athletes eat a diet high in protein (build muscles) • describe the composition of isotonic sports drinks (water, glucose and electrolytes). **Candidates should be able to assess the applications and implications of science when:** • comparing and contrasting a normally balanced diet with that for a person competing in sport • comparing and contrasting a range of different diets and suggest their suitability for an athlete.	*These calculations could be used as part of a sports science investigation for the **Unit 3** portfolio.* Will be tested in **Unit 2** by providing information (as data or text) to interpret.

SPORTS SCIENCE		
Module	Learning Objectives	Notes
Module 18: Why is the choice of material important in sports equipment?	**Candidates need to be able to:** • explain why sports clothing (including footwear) needs to be lightweight, durable and comfortable • explain why friction is important in the design of sports equipment (grip on soles of shoes, aerodynamics of cycle helmet) • give examples of materials (wood, metal, polymer, ceramic, composite) used to make sports equipment (eg clubs, racquets, bicycle frames, protective equipment) • give the characteristic properties of metals (high tensile strength, thermal conductivity, flexibility, hardness) • give the characteristic properties of polymers (low density, flexibility, low thermal conductivity) • give the characteristic properties of ceramics (high melting point, low thermal conductivity) • explain the properties of composites in terms of the properties of their components • give examples of different types of materials (natural: cotton, leather) (synthetic: polyester, lycra) used for sports clothing • describe the advantages and disadvantages of synthetic materials compared with natural materials • *describe how different properties of materials are desirable for different clothing and equipment:* – *low density for increasing speed* – *smooth for aerodynamic shapes* – *high tensile strength for materials providing support* – *thermal insulation to help maintain body temperature* – *large surface area for cooling* – *flexibility for comfortable equipment and clothing* – *shock absorbent materials for footwear.* **Candidates should be able to use data, theories and explanations to:** • select appropriate materials for sports clothing, equipment and footwear and be able to explain why the different properties are important.	*These properties could be used to test a range of sports clothing and equipment to find the best materials, to form a major sports science investigation for the **Unit 3** portfolio. As a result of their investigation candidates should be able to give scientific reasons for the selection of appropriate materials.* Will be tested in **Unit 2** by providing information (as data or text) to interpret.