Contents

WJEC GCSE in Additional Applied Science

For Examination from 2008

SUMMARY OF ASSESSMENT

Unit/Code	Assessment	Assessment Opportunities
Unit 1 (681) Developing Scientific Skills in applied contexts	**Internally assessed 67%** Portfolio: The unit is assessed through a portfolio of evidence. Teachers must use internal assessments set within appropriate applied contexts which enable students to meet the assessment evidence requirements as specified in the unit.	June
Unit 2 (682) Science at Work in applied contexts	**Externally assessed 33%** Written Paper: Foundation Tier paper (45 mins) Grades G-C Higher Tier paper (45 mins) Grades D-A* The examination papers will assess candidates' knowledge and understanding across the unit content within appropriate applied contexts.	January and June

1 GCSEs IN VOCATIONAL SUBJECTS : AN INTRODUCTION

GCSEs in vocational subjects are vocationally-related qualifications which cover Levels 1 and 2 (Foundation and Intermediate) of the National Qualifications Framework. They have been designed to:

- provide an introduction to a broad vocational area;
- enable progression to further education, training or employment;
- be available at Key Stage 4 and post-16.

The main features of the qualification are:

- it is equivalent in size to one conventional GCSE;
- it normally comprises two units, with one assessed internally (subject to moderation) and one externally;
- individual unit results are available, reported on a uniform mark scale (UMS).

The provision of GCSEs in vocational subjects contributes to the quality and coherence of provision nationally by:

- complementing other qualifications offered at levels 1 and 2 of the national framework - such as vocational qualifications currently approved under Section 96, NVQs, conventional GCSEs;
- building on consultation with teachers, NTOs and subject associations about provision in this area, and providing an important rung on the vocational ladder;
- supporting the combination of vocational and academic studies for both pre- and post-16 students.

The **aims** of GCSEs in vocational subjects are:

- to widen participation in vocationally-related learning pre-16;
- to equip students with some of the skills they will need in the workplace, or in further education or training and enable them to make valid personal choices upon completion of the qualification:
- to provide a range of teaching, learning and assessment styles to motivate students to achieve the best they can, and to empower students to take charge of their own learning and development;
- to encourage post-16 students to try a vocationally-related course, where perhaps another programme has previously not proved appropriate;
- to raise attainment at levels 1 and 2/foundation and intermediate levels of the National Framework of Qualifications.

2 GCSE IN ADDITIONAL APPLIED SCIENCE : AN INTRODUCTION

Criteria

This qualification has been designed to meet the General Criteria for GCSE (as set out in *The Statutory Regulation of External Qualifications 2004*), the requirements of the National Curriculum Orders for Science for England and Wales, and the Subject Criteria for GCSE Science (March 2005). Assessment for these qualifications is carried out according to a Code of Practice published by the regulatory authorities (2004/5).

All GCSE qualifications are reported on from A* to G, where A* is the highest grade. As a single award Additional Applied Science will be reported on a scale from A* to G. Candidates who fail to reach the minimum standard for a grade to be awarded are recorded as U (unclassified) and do not receive a qualification certificate.

Rationale/Context

The GCSE in *Additional Applied Science* is about the science used by people in a wide variety of contexts in everyday life and in jobs. It is also about management of time and resources, working alongside others, and effective and unambiguous communication between scientists and with other people who are not experts. Such skills are central to the effectiveness of the scientist.

This specification will enable students to develop a broad knowledge and understanding of the science sector. It builds on the skills and knowledge acquired in GCSE Science and is an alternative to GCSE Additional Science. It will then prepare students for further study on a vocational course in science, or in a science-related subject, or prepare for employment or further training in industry.

This specification encourages a student-centred approach to learning, together with the opportunity to apply knowledge in a vocationally relevant way. The approach to the qualification is to give the candidate increasing ownership and responsibility as the work progresses. The approach to learning followed in this programme will allow the candidate to contextualise the learning process in a meaningful way. The unitisation of the programme will allow candidates to become aware of the importance of each of the two units, and results in each unit are reported. However, the specification also encourages an appreciation of how the knowledge, understanding and skills developed in one unit impacts upon, and are used in another, together with an awareness that these inter-relationships are what happens in the 'real' world.

The specification links with units from other GCSEs in vocational subjects, such as *Engineering, Manufacturing* and *Health and Social Care*, and with some NVQs, such as *Laboratory and Associated Technical Activities* and *Laboratory Technicians: Working in Education*. Level 2 NVQs are required as part of a Foundation Modern Apprenticeship.

Aims

The specification will give students opportunities to:

- develop their interest in, and enthusiasm for, science;
- develop a critical approach to scientific evidence and methods;
- acquire and apply skills, knowledge and understanding of how science works and its essential role in society;
- acquire scientific skills, knowledge and understanding necessary for progression to further learning.

Title and Certification

This specification will be shown on a certificate as WJEC GCSE in *Additional Applied Science.* Candidates who gain grades G to D will have achieved an award at Level 1 of the National Qualifications Framework. Candidates who gain grades C to A* will have achieved an award at Level 2 of the National Qualifications Framework.

Prior Learning

Students embarking on a GCSE in *Additional Applied Science* should have achieved a general educational level equivalent to Level 3 of the National Curriculum or Entry Level 3 in the National Qualifications Framework. They would find the following learning, skills and aptitudes helpful:

* basic proficiency in literacy
* basic proficiency in numeracy
* some aptitude for computers
* some motivation to work independently

Although there is no specific requirement for prior learning, this specification builds upon the Programmes of Study for Science in Key Stages 1-3.

Progression

This specification is intended to offer opportunities for progression through a variety of routes, e.g. GCE or AVCE; training, e.g. Modern Apprenticeships or NVQs; or employment.

Curriculum Cymreig

The specification framework also allows the use of the Welsh context for course designers in Wales to draw on local examples and priorities, thereby allowing development of the curriculum Cymreig. This allows for the consideration of local sensitivities, views and difficulties and also reflects the possible differences in approach to solutions which take place in Wales.

A specification is available, through the medium of Welsh, as are question papers. In addition, opportunities for the development of Key Skills are provided, especially communication, either through the medium of English or Welsh.

Overlap/Restrictions on Entry (if any)

The classification code for this specification is 1340. Centres should be aware that candidates who enter for more than one GCSE qualification with the same classification code will have only one grade (the highest) counted for the purpose of the School and College Performance Tables.

Candidates with Particular Requirements

Details of the special arrangements and special consideration for candidates with particular requirements are contained in the Joint Council for Qualifications document*:* Access Arrangements and Special Consideration: Regulations and Guidance relating to Candidates who are Eligible for Adjustments in Examinations. Copies of this document are available from the WJEC.

Other Issues

As with other qualifications within the National Qualifications Framework, the general criteria for GCSEs in vocational subjects require opportunities for the development of students' awareness of spiritual, moral, social and cultural issues to be identified, as well as of Citizenship (a mandatory programme of study within the National Curriculum for England) and European and Environmental Initiatives. This specification provides a range of opportunities to develop such awareness, and these are signposted in Appendix A. However, it should be noted that this signposting serves only to indicate possible opportunities; it is assumed that, in practice, consideration of these issues will be prompted by the particular context of work on the unit, and will be related to students' own backgrounds and circumstances.

3 CONTENT

For each of the two units, you will find the following information:

About this unit	A brief description for the student of the content, purpose and vocational relevance of the unit.
What you need to learn	The knowledge, skills and understanding students will need to apply to meet the requirements of the portfolio or external assessment.
How you will be assessed	An outline of the form of assessment, the evidence needed for internally assessed units, and how units are marked and reported.
Guidance for teachers	Guidance on delivery in the applied context.

UNIT 1 : DEVELOPING SCIENTIFIC SKILLS IN APPLIED CONTEXTS

About this unit

In this unit you will learn about the skills needed to carry out experiments and to work in the laboratory, industry and commercial work place. You will learn about:

- working safely in science
- carrying out practical tasks, involving the following skills:
  - following standard procedures;
  - handling scientific equipment and materials;
  - recording and analysing scientific data;

  and in the areas of
  - sports science;
  - forensic science;
  - food science.

Scientists classify things (e.g. materials and organisms), obtain or make things (e.g. testing chemicals, obtaining products from organisms), and monitor and control changes (e.g. chemical reactions, the activities of organisms). In their work, they use a wide range of materials and scientific equipment. They need to be able to work with scientific equipment, apparatus and materials correctly.

Scientists carry out experiments, making measurements and observations, either in a laboratory or 'in the field'. They use a wide range of materials and equipment. Often they follow standard procedures. At other times, scientists have to devise procedures for themselves. Sometimes the unexpected happens, and they have to deal with this.

This unit is assessed through portfolio work.

The background setting for this unit is described below.

Working safely in science

Scientific work can be dangerous, yet accidents among scientists are rare. This is because scientists are always aware of the hazards they deal with, and of the need to work safely.

- You must be able to work safely and prevent accidents in the laboratory or wherever you are doing your scientific work.
- You must show that you know what to do if an accident happens.
- You must be able to use different types of sources; and be able to justify and evaluate their usefulness.

Hazards and risks

Potential hazards in scientific workplaces include:

- careless behaviour;
- not using equipment properly;
- not using protective and safety equipment;
- not following correct procedures;
- the possible risks that may arise from:
    - chemical substances classified as toxic, flammable, corrosive, oxidising and irritant;
    - microorganisms;
    - utilities (gas and electricity).

It is important that you are aware that workplaces are governed by health and safety regulations.

What you need to learn

1. Working Safely in Science

You need to be able to:

1.1 Laboratory Safety

- identify hazard warning signs and understand their significance;
- identify the symbols for biological, chemical and physical hazards, including radioactive substances, and know their associated risks;
- follow health and safety procedures;
- use 'hazcards' to identify chemical hazards.

You need to

- carry out health and safety checks in the workplace;
- be aware of the need to carry out risk assessments for activities performed in the workplace.

You need to find out:

- what can be done to prevent accidents from hazards in a scientific workplace;
- which emergency procedures to follow if an accident from these hazards happens;
- about how unwanted or waste materials, including radioactive substances, are disposed of safely;
- what procedures must be followed to report an accident in the workplace.

1.2 First aid

Common injuries in laboratories are;

- heat burns and scalds,
- chemical burns,
- injury from breathing in fumes,
- swallowing chemicals,
- electric shock,
- cuts,
- damage to the eyes from particles or chemicals.

For **each** of these injuries, **you need to know:**

- the basic first aid to give;
- the situations in which it would be dangerous to give first aid.

You need to find out:

- 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.

1.3 Fire prevention

In places of work, including your school or college, there are fire regulations. These regulations are to ensure that the numbers of casualties in fires are kept to a minimum.

You need to know:

- what must be done if **you** hear a fire alarm or smoke alarm;
- what must be done if **you** find a fire e.g. at home or at work;
- how fire doors operate; where they are put; why they are used and how they work;
- how to identify the different types of fire extinguishers:
  a. water,
  b. carbon dioxide,
  c. dry powder,
  d. foam,
  e. fire-blanket
- what these extinguisher are used for - the different types of fire and reasons why they are used;
- about the use and operation of automatic sprinkler systems.

2. Carrying out practical tasks

You will perform a range of practical tasks to develop the following skill areas. While carrying out this work, you need to think about how the techniques or skills which you use could be applied or useful in the workplace.

2.1 Following standard procedures

Standard procedures provide explicit instructions on how to carry out an experiment. They are often called 'protocols' or 'standard operating procedures'. Their use means that when you see the results, you know exactly how the observations and measurements were made, no matter who did it, or where it was done. For instance when water quality is tested by the Environment Agency. Such procedures are important to show that checking is always being done in the same way and this may be a legal requirement in some areas of industry.

When following a standard procedure, you need to be able to:

- read the procedure, and check to see if there is anything you do not understand;
- carry out a health and safety check of your working area;
- carry out a risk assessment specific to the activity you are doing;
- set out your work area and collect together the equipment and materials you need;
- follow the instructions one step at a time;

- make accurate observations or measurements, using instruments which give the appropriate precision;
- identify possible sources of error and repeat observations and measurements, when necessary, to improve reliability.

2.2 Handling scientific equipment and materials

There are certain practical skills that scientists carry out every day and practising them will help to improve your accuracy and build your confidence. It will also help you to use other, less familiar, equipment and materials. You will need to become familiar with general laboratory equipment and to carry out general operations carefully and accurately.

You need to know how to:

- recognise and use the standard laboratory equipment and glassware provided;
- prepare equipment safely for use, including data logging equipment where appropriate;
- use appropriate equipment to obtain more reliable/accurate data;
- calibrate instruments, when necessary.

2.3 Recording and analysing scientific data

Standard procedures usually tell you how to obtain and record observations and measurements and what to do with them. However, you should know some basic methods for recording and presenting data, and for carrying out calculations. ICT should be used, where appropriate, in this work. It is also important that you think about the results you obtain, and are able to interpret them.

You need to be able to:

- present data in tables, bar charts, histograms, pictograms, pie charts, graphs and other visual images, as appropriate;
- use appropriate headings, labels or annotations in the tables etc., e.g. column headings in tables;
- recognise when it is more appropriate to repeat readings – in most instances repeating is essential;
- carry out simple numerical calculations on the data;
- analyse and interpret your results using the data collected; making use of graphs and other visual images as appropriate;
- evaluate your investigation and suggest improvements.

Your practical tasks will be in the areas of Sports Science, Forensic Science and Food Science.

3. Sports Science

People involved in sport, whether in leisure centres, gyms or training elite athletes, need to know about health and fitness, and understand how the body functions whilst involved in sport and exercise activities. Successful sports people depend on being able to achieve a high level of performance. Sports scientists need to know about the physiological changes that take place during any exercise, so that a fitness programme can be developed to help the athlete become fit and also to maintain fitness. Performance can also be affected by the materials and equipment used in a particular sport.

You could include one or more of the following:

- the development of fitness programmes;
- monitoring the changes that take place in the body during and after exercise;
- taking baseline measurements such as height, weight, BMI, heart rate, ventilation rate, total lung capacity and the tidal volume, and monitoring these physiological changes during and after exercise;
- the calculation of recovery rate after differing amounts of aerobic exercise;
- developing an appropriate diet for those involved in particular sports and calculating their energy requirements;
- measuring and identifying the effect of training on an athlete's reaction time;
- a study on the effect of frictional forces on different materials;
- analysis of the absorbency and insulating properties of different materials;
- testing the tensile strength of different materials;
- testing the resistance to wear of different materials;
- analysing the effect of weathering and chemical corrosion of different materials.

4. Forensic Science

Forensic scientists use scientific techniques to identify and match substances and objects. Most of the work of the Forensic Science service is done to help police investigate crimes, but forensic methods can be used for other purposes: e.g. to study archaeological specimens, to investigate the cause of an industrial or road accident, or to show whether or not people are related. Many types of materials and objects need to be investigated, so a wide variety of methods is used. The results often have to be used as evidence in a court of law, so accuracy and reliability are very important as are careful analysis, attention to detail, and careful reporting of observations and results.

There is a variety of scientific techniques that could be used in your practical work, and you could include one or more of the following:

- using suitable technique(s) to obtain impression of marks including fingerprints and tyres;
- analysing 'blood' and 'urine' samples for their drug and alcohol content;
- analysing samples of substances from a scene of crime using chemical tests including some of the following:
  - measuring the pH of a solution using universal indicator;
  - using chromatography to separate coloured mixtures and colourless samples;
  - using chemical reactions, flame tests and other appropriate techniques to detect the presence of ions;
  - using acidified potassium dichromate solution to test for ethanol;
  - identifying carbonate ions using dilute acid;
  - testing for CO_2 with limewater;
  - testing the solubility of substances in water or organic solvents;
  - determining the density of regular and irregular solids.

5. Food Science

Food scientists use scientific techniques and knowledge to study foods and food components, either for research purposes or in a manufacturing industry. In the manufacturing area, food scientists concern themselves with analysing food product quality and safety, creating new food products and investigating new manufacturing methods. Food scientists and dieticians also help us to maintain a healthy body and a healthy lifestyle. A dietician studies an individual's diet, records food consumption and nutritionally analyses their intake. Recommendations can then be made on how to eat a healthier diet. The Environmental Health Department also employs scientists to carry out checks on food preparation premises, food hygiene and tracing the source of food poisoning outbreaks.

Your work could include one of more of the following:

- use appropriate tests to identify starch, fat, protein, reducing sugar and acidity;
- carry out tests on food to identify the level of bacteria in food;
- an understanding of aseptic techniques in practical work;
- use serial dilutions to do a bacterial count;
- use streak plates to identify the types of bacteria present;
- investigate the effect of nutrients on the growth of a food product;
- compare the vitamin C content of different fruit juices;
- carry out an analysis of a fruit drink, both qualitative and quantitative in order to detect starch, glucose, sucrose and protein molecules, and also estimate the moisture content, suspended matter and acidity;
- determine and use the iodine number to compare the degree of saturation of fats and oils in our diet.

How you will be assessed

You need to produce a portfolio of evidence which should include:

- (a) a report of an investigation carried out into working safely in science; (25 marks)

- records of practical activities in **each** of the following areas:

  (i) Sports Science

  (ii) Forensic Science

  (iii) Food Science

  Each of the above activities should be in a vocational context and include evidence that you:

  (b) carried out risk assessments;
  followed standard procedures;
  used appropriate scientific equipment and/or materials; (25 marks)

  You also need to think about whether a procedure would be useful in the workplace or in an applied context. You should include a brief description of how it might be used, or what skills you gain from the procedure which might be useful.

  (c) obtained and recorded scientific data appropriate to the task; (25 marks)

  (d) analysed scientific data appropriate to the task; (15 marks)

  (e) evaluated methods used in carrying out investigations. (10 marks)

  = 100 marks

Your teacher's assessments will be checked by the WJEC; the raw mark converted to a UMS mark and your achievement reported to you as a UMS mark out of 120.

This UMS mark will count for 67% of your qualification for GCSE in *Additional Applied Science*.

You are allowed to re-sit each assessment component an unlimited number of times before requesting certification for the qualification as a whole.

Guidance for teachers

Unit 1 develops practical skills and requires the support of theoretical ideas put forward in Unit 2. For this reason Unit 1 should be taught alongside Unit 2.

Working safely in science

Students must be made aware of the need for safe working practices both in the laboratory and in a vocational context. All practical work entails the adoption of safe procedures and risk assessments should be carried out for all such activities.

This section could make a reasoned introduction to the course and so precede the more detailed work needed to support Unit 2 and the three assessed practical activities as part of the portfolio requirements for Unit 1.

Students are expected to be aware of the common regulations concerning health and safety in the scientific laboratory and workplace:

- COSHH Regulations
- Electricity at Work Regulations (portable appliance testing)
- Management of Health and Safety at Work Regulations.

N.B. It is **not** necessary for students to study these **in depth**.

Local organisations such as St John's Ambulance or Red Cross may be able to provide information and demonstrations to help with the delivery of the First Aid section of the unit and the Fire Service with the fire prevention section. A first aid certificate at a suitable level may be credit worthy.

Sports Science

The use of standard procedures when handling scientific equipment can be used in:

- taking baseline measurements of height, weight, BMI, breathing rate, pulse rate, total lung capacity and monitoring physiological changes during, and after, exercise;
- analysing reaction time as affected by exercise;
- studying the effect of friction on different materials;
- analysing the insulating and absorbency properties of different materials;
- testing the tensile strength of different materials;
- testing the resistance to wear of different materials;
- analysing the effect of weathering and chemical corrosion of different materials;
- studying the design features of sports equipment e.g. golf clubs, tennis racquet etc.

Forensic Science

The use of standard procedures when handling scientific equipment can be used in:

- separating mixtures using filtration, evaporation, distillation and chromatography;
- preparation of standard solutions for volumetric analysis;
- carrying out titrations;
- carrying out flame tests to identify cations;
- carrying out chemical tests to identify cations and anions.
  Cl^-, CO_3^{2-}, SO_4^{2-}, NO_3^-, Ca^{2+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, K^+, Na^+, Pb^{2+}

Food Science

The use of standard procedures when handling scientific equipment can be used in:

- staining and preparing temporary slides of suitable material (e.g. yeast cells stained with methylene blue; use of Gram stain on bacteria in yoghurt or milk);
- use of aseptic techniques to culture microorganisms (e.g. yeast, bacteria in yoghurt) on agar in petri-dishes;
- use of serial dilutions and plating techniques when investigating bacterial numbers (e.g. comparing number of bacteria in samples of fresh or stale milk);
- use of serial dilutions and Rafter cell to count numbers of microorganisms such as yeast or unicellular algae in liquid cultures;
- use of antibiotic discs to discover the effectiveness of a variety of antibiotics on known cultures of non-pathogenic bacteria;
- use of bacteria (*Streptococcus thermophilus* + *Lactobacillus bulgaricus*) found in natural yoghurt to set up a culture in sterilised milk to produce yoghurt **or** culture of yeast to produce alcohol or carbon dioxide in bread dough;
- calculating the energy value from burning food e.g. pasta shapes (NOT nuts);
- use of yeast in bread making, beer and wine industries;
- role of bacteria in yoghurt and cheese making industries.

SAFETY WARNING

It would NOT be safe to culture pathogenic organisms in a normal school/college laboratory.

Incubation should be below 30°C and NOT at 37°C.

Plates should be closed with two strips of sellotape that allow air to circulate and they should NOT be opened after incubation.

All incubated cultures should be destroyed by autoclaving or burning once finished with.

UNIT 2 : SCIENCE AT WORK IN APPLIED CONTEXTS

About this unit

In this unit you will learn about the science used in three specific areas in which scientists work. This work comes in three distinct but often interrelated sections:

A. Sports Science

B. Forensic Science

C. Food Science

You will also need to consider how scientists developed theories, and raise questions and some of the issues facing both scientists and society. You will learn about:

- fitness and the importance of exercise;
- the effect of fitness on the human body;
- the design and use of materials for sports clothing and apparatus;
- how evidence is collected and analysed;
- the chemical testing of substances;
- blood typing and DNA profiling;
- food nutrients and functions;
- food additives and testing;
- food production using microorganisms;
- food preparation and safety.

This unit is assessed through an external assessment. You will take one of two tiered papers covering the grades G to C and D to A* respectively. The topics will be tested by graded questions with low and medium demand on the Foundation, and with medium and high demand questions on the higher paper.

What you need to learn

A Sports Science

Physiological Changes

You need to:

1. describe the structure of the human cardiovascular system in terms of heart, ventricles, atria, veins, arteries, capillaries and double circulation system. (Names of valves not required.)

2. describe how respiration may be aerobic or anaerobic depending on the availability of oxygen, and that oxygen debt may occur in the muscles. Use of word-equations.

3. describe the physiological changes that occur during exercise including:

   - breathing,
   - heart rate,
   - temperature control,
   - water level,
   - control of blood glucose levels by insulin.

4. describe the function of the heart and lungs in providing glucose and oxygen to the muscles.

5. describe how air is breathed in and out, and the changes that take place in the composition of the air.

6. describe the antagonistic action of muscles (biceps and triceps)

7. be able to take appropriate measurements to calculate the pulse rate, breathing rate and recovery time.

8. recall the composition and functions of the blood including red blood cells, white blood cells, plasma and platelets.

Diet

In order to improve and maintain performance in sport it is essential to know the most suitable diet. Dieticians and sports nutrition experts provide advice to enable athletes to have the correct diet and energy intake in order to maximise their performance.

You need to:

1. understand that the basic energy requirements (BER) for an individual depend on the mass of the individual and that these requirements increase during exercise.

2. be able to calculate daily energy requirements and the Body Mass Index using the ratio weight/height ^{2} $\quad BMI = \frac{weight}{height^2}$

3. explain why athletes increase their intake of complex carbohydrates (bread, pasta, rice) before competing (increase glycogen stores in the muscles).

4. understand and explain why some athletes eat a diet high in protein (build muscles).

5. describe the composition of isotonic sports drinks (water, glucose and electrolytes).

6. be able to compare a normally balanced diet with that for an active athlete.

7. know the health risks of eating too much saturated fat, sugar and salt (heart disease, diabetes and high blood pressure in later life).

8. discuss the importance of controlling the overall energy intake (energy requirements of different individuals, dieting) – without severe dieting or excessive intake, and to recognise the likely results.

Sports Equipment

The clothing and materials used in sport are very important for athletes. The use of correct clothing, including footwear, is essential to optimise performance. Similarly, the design of equipment is another important part of getting the best out of participation in sport.

You need to:

1. explain why clothing needs to be lightweight, durable and comfortable:
   - be able to 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.

2. explain why friction is important in the design of sports equipment (grip on soles, aerodynamics of cycle helmet).

3. give examples of materials (wood, metal, polymer, ceramic, composite) used to make sports equipment (e.g. clubs, racquets, bicycle frames, protective equipment).

4. give the characteristic properties of metals (high tensile strength, thermal conductivity, flexibility, hardness, high density).

5. be able to determine the density of simple solids, both regular and irregular, using the formula: $\text{Density} = \frac{\text{mass}}{\text{volume}}$

6. be able to write the formula for simple elements and compounds (list of elements and compounds p.25).

7. give the characteristic properties of polymers (low density, flexibility, low thermal conductivity).

8. explain the properties of composites in terms of properties of their components.

9. be able to select appropriate materials for sports clothing, equipment and footwear, and be able to explain why the different properties are important.

Practical work can be based on the different properties of materials and their suitability:

- trainers/footwear choice and their suitability for different sports;
- testing materials e.g. used in a racing bike;
- testing materials for sports equipment: e.g. tennis racquet, golf club;
- suitability of materials for clothing – insulation, breathability (gortex type).

B Forensic Science

Forensic science has a high profile through the media, newspapers, news items and television programmes. Forensic science work is important in the collection and the analysis of evidence both by data processing or by physical means. There are a variety of methods that are used throughout the whole process. The ultimate aim is to provide accurate and reliable evidence that can be used in a Court of Law.

You need to:

1. explain the procedures undertaken at a scene of crime including restricting access, wearing of protective clothing.

2. explain the use of suitable methods to obtain, store and record evidence e.g. paint samples, fibres, fingerprints, blood, soil, and foot and tyre prints.

3. be able to compare and identify pollen grains, seeds and fibres.

4. identify the distinctive features in fingerprints that can describe a print; (loops, arches and whorl) and be able to list differences and similarities that suggest that a match is present or not.

5. be able to describe the structure of ionic compounds as consisting of ions held together by strong forces of attraction between positively charged and negatively charged ions (e.g. sodium chloride).

6. be able to write the formula for simple ionic compounds.

7. be able to describe a precipitation reaction and state the product.

8. be able to draw conclusions about the identity of substances given the results of a series of chemical tests.

9. describe the uses of paper chromatography to identify and/or separate substances present in a mixture.

10. know there are different blood groups: A, B, AB and O.

11. understand that the nucleus in nearly all cells contains DNA. Analysis by 'genetic fingerprinting' can be used to show the similarity between two DNA samples, for instance in criminal and paternity cases.

12. be able to interpret data from DNA profiling and blood grouping.

13. know that identikits or artist impressions can be used to help identify a suspect.

14. describe how databases can be used in forensic investigations and discuss the ethical issues that arise from the storage of this information.

15. be able to use and interpret data to decide if there are observable differences to indicate a link between a suspect and the scene of crime.

Practical work can be based on activities including identifying compounds by:

- making impressions of objects; finger printing, plaster casts;
- using flame tests to identify ions: sodium, potassium, calcium, and copper;
- using precipitation reactions for calcium, copper, iron (II), iron (III), lead, chloride and sulphate ions;
- using dilute acid and limewater in testing for carbonates;
- using separation techniques for coloured mixtures by paper chromatography with both water and non-aqueous solvents;
- using a microscope to compare and identify pollen grains, seeds and fibres;
- measuring the pH of a solution using universal indicator;
- measuring the mass and volume of regular and irregular solids to determine the density.

C Food Science

Human health is affected by a variety of factors, including diet and infection. Scientific knowledge of diet, the nutrients, vitamins, minerals are all important for a healthy body and may also help prevent disease. Technology may also provide the answer to some health problems. Advances in knowledge and technology, however, may also raise ethical issues for both the medical profession and for society.

You need to:

1. know that the human body requires a balanced diet in order to carry out the vital functions of life.

2. know the function of the following:
   - carbohydrates as energy providers;
   - fats for insulation and energy;
   - proteins for the repair of body tissue and for growth;
   - water;
   - fibre.

3. know about vitamins and their functions as exemplified by Vitamins C and D:
   Vitamin C – absorption of iron, maintenance of skin, lining of digestive system and immune system;
   Vitamin D – healthy teeth and bones, and absorption of calcium.

4. know the effects on the human body of vitamin deficiency:

   C bleeding gums, poor healing of cuts and wounds, weakening of blood vessels,
   D weak teeth and bones.

5. know about minerals and their functions as exemplified by Iron and Calcium
   Iron - manufacture of haemoglobin;
   Calcium - healthy teeth and bones.

6. be able to give examples of foods that are good sources of these nutrients: fats, carbohydrates, protein, vitamins C and D, and iron and calcium.

7. know that some additives are used to improve taste, to improve appearance and to increase shelf life. The nature and quantity of food additives is strictly regulated and some additives have been given an 'E' number. Discuss the disadvantages of using some additives (toxic nature of some additives; hyperactivity linked to tartrazine).

8. discuss the need for accurate information to be given on food labelling and be able to interpret food labels, including sell by dates, quantities and energy values of nutrients and other components of food including salt and other food additives.

9. be able to explain the term Guideline Daily Amount (GDA) and its relevance to a controlled diet.

10. discuss the health risks of eating too much saturated fat, sugar and salt (heart disease etc.).

11. discuss the social and economic impact and the long-term harmful effects of anorexia and obesity.

12. be able to describe the use of bacteria, yeast, and other fungi in food production (bread, wine, beer, yoghurt and cheese).

13. know the optimum conditions for the growth of bacteria (warmth, moisture, food source).

14. know how food preparation areas are kept free of bacteria (personal hygiene, disinfectants, detergents, sterilisation, disposal of waste, control of pests e.g. insects mice and rats). Prevention of cross contamination.

15. be able to give examples of the ways in which the growth of bacteria is slowed down or stopped (refrigeration, freezing, heating, drying, salting, smoking, pickling).

16. know that food poisoning is caused by the growth of microorganisms, usually bacteria, and by the toxins they produce when they grow. Give examples of bacteria that cause food poisoning *(Campylobacter sp., E.coli, Salmonella sp.)* and know the common symptoms for food poisoning (stomach pains, vomiting, diarrhoea).

17. to understand the problems of contamination of food products which have led to recent recalls or health scares.

Practical work can be based on identifying and measuring quantities of different nutrients and additives:

- carrying out food tests;
- testing for moisture, iron content, vitamin C, acidity;
- determining and measuring the bacteria in food;
- using aseptic techniques, detect the presence of bacteria and use serial dilutions; to do a bacterial count;
- using streak plates to identify the types of bacteria present.

How you will be assessed

You will be assessed through an external test based on the content of the unit. You will take either the Foundation Tier Paper or the Higher Tier Paper.

Foundation Tier Paper - 45 minutes - Grades G - C

Higher Tier Paper - 45 minutes - Grades D - A*

Each question paper will consist of two sections, A and B. Section B of the Foundation Tier paper will be included in Section A of the Higher Tier paper. The mark totals for each paper will be:

Paper	Section A	Section B	Total
Foundation	36 marks	12 marks	48 marks
Higher	24 marks	24 marks	48 marks

Section A of the Foundation Tier paper will consist of questions targeted at grades G, F, E.

Section B of the Foundation Tier paper/Section A of the Higher Tier paper will consist of questions targeted at grades D, C.

Section B of the Higher Tier paper will consist of questions targeted at grades B, A, A*.

The questions will be based on information you have learned, but will also involve aspects of how knowledge and information could be applied in the workplace or vocational contexts.

Guidance for teachers

Teachers may find the following suggested activities useful when delivering this unit.

- Microscope work to compare plant and animal cells.
- Different methods of preserving milk to demonstrate food preservation.
- Effect of antiseptics and disinfectants on the growth of bacteria in agar cultures.
- Investigate health education leaflets on immunisation for children and travel abroad.

Other activities are given in the section on Unit 1 (pages 15 to 16).

Units and their symbols

You need to know how to measure and/or calculate the following quantities, using the correct units and their symbols:

Quantity	**Units/symbols**
Mass	kilogram/kg; gram/g; milligram/mg; microgram/μg
Length	kilometre/km; metre/m; centimetre/cm; millimetre/mm; micrometre/μm
Volume	cubic metre/m^3; cubic decimetre/dm^3 (litre, l); cubic centimetre/cm^3 (millilitre/ml)
Time	hour/h; minute/min; second/s
temperature	degrees Celsius/°C
chemical quantity	mole/mol
density	gram per cubic centimetre/g cm^{-3}; kilogram per cubic metre/kg m^{-3}
concentration	gram per cubic decimetre/g dm^{-3}; mole per cubic decimetre/mol dm^{-3}
force	Newton/N
Energy/work	Kilojoule/kJ; joule/J
Concentration	gram per cubic decimetre/g dm^{-3} mole per cubic decimetre/mol dm^{-3}
Tensile strength	N/m^2; n/cm^2

Chemical symbols and formulae

You need to know the chemical symbols for the following elements and be able to classify them as metals or non-metals. You also should be able to name an element given one of these symbols.

ELEMENTS			
Metals		**Non-Metals**	
Element	**Symbol**	**Element**	**Symbol**
Calcium	Ca	Hydrogen	H
Sodium	Na	Chlorine	Cl
Potassium	K	Nitrogen	N
Silver	Ag	Sulphur	S
Iron	Fe	Carbon	C
Lead	Pb	Oxygen	O
Copper	Cu		
Aluminium	Al		

You need to know the chemical formulae for the following compounds and be able to name the compound given one of these formulae.

COMPOUNDS	
Compound	**Formula**
Carbon dioxide	CO_2
Water	H_2O
Hydrochloride acid	HCl
Sulphuric acid	H_2SO_4
Sodium chloride	NaCl
Nitric acid	HNO_3
Silver nitrate	$AgNO_3$
Copper carbonate	$CuCO_3$
Sodium carbonate	Na_2CO_3
Sodium hydroxide	NaOH

4 SCHEME OF ASSESSMENT

Candidates will be assessed through two components covering the content of each of the two units. Unit 1 (67%) is available in June and will be internally assessed through portfolio work targeting the full range of grades. Unit 2 (33%) is available in January and June and will be externally assessed through one of two written papers targeting grades G - C and D - A* respectively.

Awarding, Reporting and Re-sitting

The overall grade for GCSE *Additional Applied Science* will be recorded as a single grade on the certificate, i.e. A*, A, B, C, D, E, F, or G. Results not attaining the minimum standard for the award of a grade will be reported as U (Unclassified). Individual unit results will also be reported on a uniform mark scale with the following equivalences:

		UNIT 1	UNIT 2	TOTAL
A*	90%	108 – 120	54 – 60	162 – 180
A	80%	96 – 107	48 – 53	144 – 161
B	70%	84 – 95	42 – 47	126 – 143
C	60%	72 – 83	36 – 41	108 – 125
D	50%	60 – 71	30 – 35	90 – 107
E	40%	48 – 59	24 – 29	72 – 89
F	30%	36 – 47	18 – 23	54 – 71
G	20%	24 – 35	12 – 17	36 – 53
U		0 – 23	0 – 11	0 – 35

SUMMARY

Grade	Max.	A*	A	B	C	D	E	F	G
Qualification	180	162	144	126	108	90	72	54	36

Students may re-sit each unit an unlimited number of times prior to certification. Students may, however, take the qualification more than once. Individual unit results, prior to certification of the qualification have a shelf-life limited only by the shelf-life of the specification when they are used to contribute to the qualification.

Assessment Opportunities

Unit 2 is available in January and June each year (commencing June 2008).
Unit 1 is submitted in May each year (commencing May 2008).

Assessment Objectives

Specifications must require that all candidates demonstrate the following assessment objectives in the context of the prescribed skills, knowledge and understanding.

Assessment Objective 1 (AO1): Knowledge and understanding of science and how science works

Candidates should be able to:

(a) demonstrate knowledge and understanding of the scientific facts, concepts, techniques and terminology in the specification;

(b) show understanding of how scientific evidence is collected and its relationship with scientific explanations and theories;

(c) show understanding of how scientific knowledge and ideas change over time and how these changes are validated.

Assessment Objective 2 (AO2): Application of skills, knowledge and understanding

Candidates should be able to:

(a) apply concepts, develop arguments or draw conclusions related to familiar and unfamiliar situations;

(b) plan a scientific task, such as a practical procedure, testing an idea, answering a question, or solving a problem;

(c) show understanding of how decisions about science and technology are made to different situations, including contemporary situations and those raising ethical issues;

(d) evaluate the impact of scientific developments or processes on individuals, communities or the environment.

Assessment Objective 3 (AO3): Practical, enquiry and data-handling skills

Candidates should be able to:

(a) carry out practical tasks safely and skilfully

(b) evaluate the methods they use when collecting first-hand and secondary data

(c) analyse and interpret qualitative and quantitative data from different sources

(d) consider the validity and reliability of data in presenting and justifying conclusions.

The weightings for the assessment objectives over the whole qualification are:

A01	30.0%
A02	30.0%
A03	40.0%

The weightings for the assessment objectives per unit are and follows ± 5%:

	Unit 1	**Unit 2**	**Overall weighting %**
A01	10%	20%	**30%**
A02	20%	10%	**30%**
A03	37%	3%	**40%**
Overall weighting %	**67%**	**33%**	**100%**

Students will be assessed through two components covering the content of each of the two units. Unit 1 will be internally assessed through portfolio work targeting the full range of grades. Unit 2 will be externally assessed through one of two tiered written papers, targeting grades G - C (Foundation Tier) and D - A* (Higher Tier) respectively.

UNIT 1 : DEVELOPING SCIENTIFIC SKILLS IN APPLIED CONTEXTS

Internally assessed: 67%

Unit 1 requires the production of portfolio work. The portfolio should include:

- (a) a report of an investigation carried out into working safely in science; (25 marks)
- records of practical activities in each of the following areas:

  (i) Sports Science

  (ii) Forensic Science

  (iii) Food Science

  Each of the above activities should be in an applied context and include evidence that the student:

  (b) carried out risk assessments;

  followed standard procedures;

  used appropriate scientific equipment and/or materials; (25marks)

  a brief description of how the procedure/skills could be useful in a vocational context or workplace setting is required.

  (c) obtained and recorded scientific data appropriate to the task; (25 marks)

  (d) analysed scientific data appropriate to the task; (15 marks)

  (e) evaluated methods used in carrying out investigations. (10 marks)

= 100 marks

Assessment Procedure

The mark for each task within the portfolio will be based on a judgement about which of four levels of achievement - each describing the work of a typical student working at notional grades G/F, E/D, C/B, A/A* - best fits the work (see following assessment grids).

Intermediate marks between the bands recognise the extra achievement needed to progress across the boundary, when compared to the marks needed within the bands.

Candidates' work will not always fit these descriptions, e.g. within a task there may be a mixed profile of skills and understanding. Where higher level skills are shown but the candidate has not entirely met some lower level criteria, consideration should be given as to whether the higher mark band is warranted. In particular, it must be remembered that full marks are not reserved for a theoretical 'model' portfolio, but must be awarded for work which is the best one could expect from candidates working at this level.

Having established the appropriate level of achievement, a specific mark must be allocated within each band. In doing this, the following aspects should be considered:

- Has the candidate just met the criteria for a level of achievement (in which case the candidate should be awarded a mark at the bottom of that band); or met the criteria comfortably (in which case a mark should be awarded towards the top of the band)?

- Is achievement consistent or variable? For example work which shows occasional evidence of analytical skills, taking it into the C/B band rather than E/D, will be less highly rewarded within that band than work in which these skills are more consistently evident. At the same time, it is important to note that volume of evidence *per se* should not unduly influence assessment.

- Are there any particular challenges or inherent demands presented by the specific task undertaken (e.g. in terms of materials/context or approach) which should be taken into account even if differentiation is expected to be largely by outcome?

The portfolio should include:

(a) a report of an investigation carried out into working safely in science [25]

Levels of Achievement		**Marks**	**Notional grades**
S1a S1b S1c	Carry out research into working safely in science, using two sources of information. Show a basic (limited) understanding of the issues researched. One aspect of working safely is covered completely.	3-7	G, F
S2a S2b S2c	Carry out research into working safely in science, using at least four sources of information. Show a clear understanding of the issues researched. Two aspects of working safely are covered completely.	9-13	E, D
S3a S3b S3c	Carry out research into working safely in science, using at least four sources of differing types. Indicating why they were chosen. Show a detailed understanding of the issues researched. Three aspects of working safely are covered completely.	15-19	C, B
S4a S4b S4c	Carry out detailed research into working safely in science by identifying and using a wide range of sources and information, and evaluating their usefulness Show a thorough in-depth understanding of the issues researched. All aspects of working safely are covered completely and thoroughly.	21-25	A, A*

The range of marks **below** the level of the notional grade G/F should be used as appropriate for work which barely meets the grade G/F descriptors, i.e. 0-2 marks.

The portfolio should include evidence that the student:

(b)
- carried out risk assessments;
- followed standard procedures;
- used appropriate scientific equipment and/or materials. [25]

Levels of Achievement	**Marks**	**Notional grades**
P1a Carry out risk assessments given extensive guidance or treatment is very limited. P1b Follow instructions in simple standard procedures, with guidance - one step at a time using simple laboratory equipment correctly and safely.	4-7	G, F
P2a Carry out risk assessments, though some guidance is needed to cover basic safety satisfactorily. P2b Follow instructions in simple standard procedures with little guidance using simple laboratory equipment correctly and safely.	10-13	E, D
P3a Carry out risk assessments; incomplete in places. P3b Follow instructions in standard tasks without guidance, but guidance is needed for extended tasks. Appropriate laboratory equipment has been used correctly and safely.	16-19	C, B
P4a A comprehensive risk assessment is produced without needing any guidance. P4b Follow instructions in standard procedures in extended tasks, without any guidance. Equipment of appropriate precision has been used correctly and safely.	22-25	A, A*

Note: P4 cannot be awarded without a description of the use of the procedure/skills in the workplace.

The range of marks **below** the level of the notional grade G/F should be used as appropriate for work which barely meets the grade G/F descriptors, i.e. 0-3 marks.

The portfolio should include evidence that the student:

(c) obtain and record scientific data appropriate to the task. [25]

Levels of Achievement	**Marks**	**Notional grades**
O1a Make simple observations or measurements. O1b Record the observations or measurements.	4-7	G, F
O2a Make careful measurements. O2b Record them in a table and draw a graph/bar chart.	10-13	E, D
O3a Make careful and accurate measurements. O3b Record results in tables and graphs, using lines of best fit, if appropriate to the pattern of data collected.	16-19	C, B
O4a Make careful and accurate measurements in extended tasks. O4b Repeat measurements to obtain a good range of data in extended tasks.	22-25	A, A*

The range of marks **below** the level of the notional grade G/F should be used as appropriate for work which barely meets the grade G/F descriptors, i.e. 0-3 marks.

The portfolio should include evidence that the student:

(d) • analysed scientific data appropriate to the task. [15]

Levels of Achievement	**Marks**	**Notional Grades**
A1a Give a simple statement of findings.	5	G, F
A2a Give a clear conclusion consistent with the data.	7	E, D
A3a Identify and explain patterns within the data. A3b Draw conclusions which are consistent with the evidence.	9-11	C, B
A4a Manipulate data to draw detailed conclusions in extended tasks. A4b Identify and explain relationships between variables in extended tasks.	13-15	A, A*

The range of marks **below** the level of the notional grade G/F should be used as appropriate for work which barely meets the grade G/F descriptors, i.e. 0-4 marks.

The portfolio should include evidence that the student:

(e) • evaluated methods used in carrying out investigations. [10]

Levels of Achievement	**Marks**	**Notional Grades**
E1a Give a simple evaluation of an investigation, commenting on results **or** procedure used.	3	G, F
E2a Give a clear evaluation of an investigation, commenting on results **and** procedure used.	5	E, D
E3a Give detailed evaluations of the procedure used. E3b Show how to improve the quality of the results of an investigation.	7-8	C, B
E4a Give detailed evaluations of an extended procedure. E4b Explain, with reasons, how improve the quality of the results in an extended procedure.	9-10	A, A*

The range of marks **below** the level of the notional grade G/F should be used as appropriate for work which barely meets the grade G/F descriptors, i.e. 0-2marks.

UNIT 2 : SCIENCE AT WORK IN APPLIED CONTEXTS

Externally assessed: 33%

This unit is assessed through an external test based on the content of the unit.

Candidates will take either the Foundation Tier Paper or the Higher Tier Paper.

Foundation Tier Paper - 45 minutes - Grades G - C

Higher Tier Paper - 45 minutes - Grades D - A*

Each question paper will consist of two sections, A and B. Section B of the Foundation Tier paper will be included in Section A of the Higher Tier paper. The mark totals for each paper will be:

Paper	Section A	Section B	Total
Foundation	36 marks	12 marks	48 marks
Higher	24 marks	24 marks	48 marks

Section A of the Foundation Tier paper will consist of questions targeted at grades G, F, E.

Section B of the Foundation Tier paper/Section A of the Higher Tier paper will consist of questions targeted at grades D, C.

Section B of the Higher Tier paper will consist of questions targeted at grades B, A, A*.

Grade Descriptions

The following grade descriptions indicate the levels of attainment characteristic of the given grade for the GCSE in *Additional Applied Science.* They give a general indication of the required standard at each specified grade. The descriptions should be interpreted in relation to the content and assessment evidence requirements outlined in the specification; they are not designed to define that content. The grade awarded will depend, in practice, upon the extent to which the candidate has met the assessment evidence requirements overall. Shortcomings in some aspects of the assessment may be balanced by better performances in others.

Grade A

Candidates demonstrate a detailed knowledge and understanding of science content and how science works, encompassing the principal concepts, techniques, and facts across all areas of the specification. They use technical vocabulary and techniques with fluency, clearly demonstrating communication and numerical skills appropriate to a range of situations.

They demonstrate a good understanding of the relationships between data, evidence and scientific explanations and theories. They are aware of areas of uncertainty in scientific knowledge and explain how scientific theories can be changed by new evidence.

Candidates use and apply their knowledge and understanding in a range of tasks and situations. They use this knowledge, together with information from other sources, effectively in planning a scientific task, such as a practical procedure, testing an idea, answering a question, or solving a problem.

Candidates describe how, and why, decisions about uses of science are made in contexts familiar to them, and apply this knowledge to unfamiliar situations. They demonstrate good understanding of the benefits and risks of scientific advances, and identify ethical issues related to these.

They choose appropriate methods for collecting first-hand and secondary data, interpret and question data skilfully, and evaluate the methods they use. They carry out a range of practical tasks safely and skilfully, selecting and using equipment appropriately to make relevant and precise observations.

Candidates select a method of presenting data appropriate to the task. They draw and justify conclusions consistent with the evidence they have collected and suggest improvements to the methods used that would enable them to collect more valid and reliable evidence.

Grade C

Candidates demonstrate a good overall knowledge and understanding of science content and how science works, and of the concepts, techniques, and facts across most of the specification. They demonstrate knowledge of technical vocabulary and techniques, and use these appropriately. They demonstrate communication and numerical skills appropriate to most situations.

They demonstrate an awareness of how scientific evidence is collected and are aware that scientific knowledge and theories can be changed by new evidence.

Candidates use and apply scientific knowledge and understanding in some general situations. They use this knowledge, together with information from other sources, to help plan a scientific task, such as a practical procedure, testing an idea, answering a question, or solving a problem.

They describe how, and why, decisions about uses of science are made in some familiar contexts. They demonstrate good understanding of the benefits and risks of scientific advances, and identify ethical issues related to these.

They carry out practical tasks safely and competently, using equipment appropriately and making relevant observations, appropriate to the task. They use appropriate methods for collecting first-hand and secondary data, interpret the data appropriately, and undertake some evaluation of their methods.

Candidates present data in ways appropriate to the context. They draw conclusions consistent with the evidence they have collected and evaluate how strongly their evidence supports these conclusions.

Grade F

Candidates demonstrate a limited knowledge and understanding of science content and how science works. They use a limited range of the concepts, techniques and facts from the specification, and demonstrate basic communication and numerical skills, with some limited use of technical terms and techniques.

They show some awareness of how scientific information is collected and that science can explain many phenomena.

They use and apply their knowledge and understanding of simple principles and concepts in some specific contexts. With help they plan a scientific task, such as a practical procedure, testing an idea, answering a question, or solving a problem, using a limited range of information in an uncritical manner. They are aware that decisions have to be made about uses of science and technology and, in simple situations familiar to them, identify some of those responsible for the decisions. They describe some benefits and drawbacks of scientific developments with which they are familiar and issues related to these.

They follow simple instructions for carrying out a practical task and work safely as they do so.

Candidates identify simple patterns in data they gather from first-hand and secondary sources. They present evidence as simple tables, charts and graphs, and draw simple conclusions consistent with the evidence they have collected.

5 KEY SKILLS

Key Skills are central to successful employment and underpin future success in independent learning. This specification offers opportunities to develop and generate portfolio evidence at Levels 1 and 2 for the key skills of *Communication, Application of Number, Information Technology, Working with Others, Problem Solving, Improving own Learning and Performance.* The following tables indicate whether each unit offers clear opportunities for generating portfolio evidence (✓), opportunities for developing the key skill, and possibly for generating evidence (→), or no obvious opportunities (x). Examples of possible contexts for this are given as illustrations only; this will depend on the particular tasks set to meet the assessment evidence requirements or to prepare for the externally assessed unit.

Key skills mapping: Level 1

4 = The unit contains clear opportunities for generating key skills portfolio evidence.

) = The unit contains opportunities for developing the key skill, and possibly for generating portfolio evidence if teaching and learning is focused on that aim.

7 = There are no obvious opportunities for the development or assessment of the key skill in the unit.

Key skill	Unit	Examples of opportunities for developing the key skill or for generating key skills portfolio evidence NB these are illustrative only	
N1.1 Interpret straightforward information from **two** different sources. At least one source should be a table, chart, diagram or line graph.	Unit 1	)	Considering numerical data on eg properties of materials, which can then be supported by the student's own measurements. Interpreting numerical information on quantitative and chemical analysis, presented in a simple form allowing students to extract relevant information.
	Unit 2	)	Interpreting straightforward numerical information about e.g. materials or the cost of different forms of energy, which students might be expected to consider in the context of their own investigations.
N1.2 a Carry out straightforward calculations to do with amounts and sizes.	Unit 1	)	Chemical and quantitative analysis and preparing solutions of specified concentrations. Also, accurately measuring and comparing the electrical and physical properties of different materials.
	Unit 2	)	Calculating energy usage/power and comparing energy costs. Also working with accurate measurements.
N1.2 b Carry out straightforward calculations to do with scales and proportion.	Unit 1	)	Calculating volumes in the preparation of solutions and in chemical analysis, comparing properties of different materials etc.
	Unit 2	7	
N1.2 c Carry out calculations to do with handling statistics.	Unit 1	)	Interpreting simple statistical information on materials and microorganisms etc. Deriving simple statistics from measurements they have taken.
	Unit 2	7	
N1.3 Interpret the results of your calculations and present your findings. You must use **one** chart and **one** diagram.	Unit 1	4	Presenting results from comparing materials or analysis using suitable methods/units. Labelling work correctly and describing conclusions in the context of the purpose of the activity.
	Unit 2	)	Presenting comparisons of energy usage, describing and comparing the physical properties of materials etc., using techniques such as charts, drawings, and tables. Labelling work correctly and describing conclusions in the context of the purpose of the activity.

C1.1 Take part in a **one-to-one** discussion and a **group** discussion about different straightforward subjects.	Unit 1	✓	Discussing health and safety hazards and risks in a particular area, and how these might be addressed or avoided.
	Unit 2	✓	Discussing the products of living organisms, identifying materials in everyday objects, discussing the advantages and disadvantages of different energy sources etc.
C1.2 Read and obtain information from **two** different types of documents about straightforward subjects, including at least **one** image.	Unit 1	4	Health and safety protocols, fire safety manuals, accident reporting books, notices, regulations, lab protocols/procedures.
	Unit 2	4	Textbooks, data sheets, articles and reports on e.g. gene transfer or immunisation etc. Also information leaflets etc on energy efficiency and costs.
C1.3 Write **two** different types of documents about straightforward subjects. Include at least one image in one of the documents.	Unit 1	✓	Reporting the results of a risk assessment, using text supported by diagrams, photos and drawings. Presenting the results of investigations of microorganisms, materials, chemical analysis and drawing conclusions etc.
	Unit 2	✓	Describing and explaining quantitative data e.g. on materials properties, using drawings etc.
IT 1.1 Find, explore and develop information for **two** different purposes.	Unit 1	✓	Using given sources on CD ROMS, the internet, databases etc as sources of information.
	Unit 2	4	Using a range of given sources of data, including CD ROMs, databases and the internet to find out about the physical properties of materials. Using, with guidance, the internet as a source of information on gene technology and the role of microorganisms, plate tectonics, the Solar System and Universe.
IT 1.2 Present information for **two** different purposes. Your work must include at least **one** example of text, **one** example of images and **one** example of numbers.	Unit 1	✓	Producing booklets, notices, etc on fire prevention and health and safety in the laboratory, and on first aid techniques. Also presenting the results of investigations of materials' properties and chemical analysis. Using WP, imported images and basic graphical techniques.
	Unit 2	✓	Producing reports, booklets, etc on e.g. uses for living organisms, protection from infection by harmful microorganisms, the classification of materials and chemical compounds, or the comparison of energy sources. Using WP, numerical data, imported images and basic graphical techniques.

WO1.1 Confirm what needs to be done to achieve given objectives, including your responsibilities and working arrangements.	Unit 1	✓	Tackling risk assessments or learning basic first aid as group activities, where each member of the group could be allocated a specific task, and the group's objectives are made clear. Could fulfil the group working requirement for this key skill.
	Unit 2	✓	
WO1.2 Work with others towards achieving given objectives, carrying out tasks to meet your responsibilities.	Unit 1	✓	Allocating roles in carrying out the risk assessment which would contribute to the final outcome, requiring students to work safely and effectively together. Working in pairs and/or seeking advice e.g. from a fire safety officer or first aider could fulfil the one-to-one working requirement for this key skill.
	Unit 2	✓	
WO1.3 Identify progress and suggest ways of improving work with others to help achieve given objectives.	Unit 1	✓	If group working is planned in such a way as to allow discussion of progress, identifying good ways of approaching the risk assessment, as well as problems and how they were dealt with, with a view to suggesting better ways of working together.
	Unit 2	✓	
LP1.1 Confirm understanding of your short-term targets and plan how these will be met, with the person setting them.	Unit 1	✓	Planning work in such a way as to allow opportunities for target-setting and planning, on a one-to-one basis with the student. This could relate to learning about safe working or to carrying out practical tasks e.g. where the student is required to identify risks in a particular environment or practice a technique.
	Unit 2	✓	
LP1.2 Follow your plan, using support given by others to help meet targets. Improve your performance by: ▪ studying a straightforward subject ▪ learning through a straightforward practical activity.	Unit 1	✓	If the student follows the plan agreed in LP1.1, seeking support where necessary, and uses different approaches to learning, including a practical activity such as learning basic first aid or carrying out measurements or analysis. Also acting on suggestions for improvements.
	Unit 2	✓	
LP1.3 Review your progress and achievements in meeting targets, with an appropriate person.	Unit 1	✓	Reviewing what has been learned and how the student went about it, on a one-to-one basis e.g. in tutorials, with encouragement to identify good work and bad, with suggestions for improvements.
	Unit 2	✓	
PS1.1 Confirm your understanding of the given problem with an appropriate person and identify **two** options for solving it.	Unit 1	✓	With support from an appropriate person, identifying the nature of the problem e.g. a risk assessment, and then considering ways of tackling it e.g. identifying hazards and risks and ways of preventing fires etc. Suggesting and considering the options and then choosing the best one.
	Unit 2	✓	
PS1.2 Plan and try out at least **one** option for solving the problem, using advice and support given by others.	Unit 1	✓	Investigating safe working and practical tasks both lend themselves to basic planning and the sequencing of tasks e.g. the steps in chemical analysis or in a risk assessment. Following these plans, obtaining advice from tutors, fire safety or first aid personnel etc.
	Unit 2	✓	
PS1.3 Check if the problem has been solved by following given methods and describe the results including ways to improve your approach to problem solving.	Unit 1	✓	Accurately following standard procedures and considering the reliability of results/measurements etc. Describing what went well and what didn't, and how problems were tackled. Also making suggestions for avoiding problems.
	Unit 2	✓	

Key skills mapping: Level 2

4 = the Unit contains clear opportunities for generating key skills portfolio evidence.
) = the Unit contains opportunities for developing the key skill, and possibly for generating portfolio evidence if teaching and learning is focused on that aim.
7 = there are no obvious opportunities for the development or assessment of the key skill in the unit.

Key skill	Unit	Examples of opportunities for developing the key skill or for generating key skills portfolio evidence NB these are illustrative only	
N2.1 Interpret information from **two** different sources, including material containing a graph.	Unit 1	)	Comparing data on e.g. properties of materials, presented in graphical form, which can then be supported by the student's own measurements. Interpreting numerical information on quantitative and chemical analysis presented in a number of ways allowing students to extract relevant information, including deriving estimates and observation.
	Unit 2	)	Interpreting numerical data about e.g. materials or the cost of different forms of energy from a range of written and graphical methods, which students might then be expected to interpret/manipulate in the context for their own investigations.
N2.2 a Carry out calculations to do with amounts and sizes.	Unit 1	)	Chemical and quantitative analysis and preparing solutions of specified concentrations. Also, measuring and comparing the electrical and physical properties of different materials. Producing sensible results and checking to ensure accuracy.
	Unit 2	)	Calculating energy usage/power and comparing energy costs. Also working with measurements.
N2.2 b Carry out calculations to do with scales and proportions.	Unit 1	)	Calculating ratios in the preparation of solutions and in chemical analysis, comparing properties of different materials etc.
	Unit 2	7	
N2.2 c Carry out calculations to do with handling statistics.	Unit 1	)	Interpreting data on materials and microorganisms etc. Deriving statistical observations of a large data set from measurements they have taken.
	Unit 2	7	
N2.2 d Carry out calculations to do with using formulae.	Unit 1	7	
	Unit 2	4	Using simple formulae for measuring power.
N2.3 Interpret the results of your calculations and present your findings. You must use at least **one** graph, **one** chart and **one** diagram.	Unit 1	4	Presenting results from comparing materials or analysis using suitable methods/units. Labelling work correctly and describing conclusions related to the purpose of the activity.
	Unit 2	)	Presenting comparisons of energy usage, describing and comparing the physical properties of materials, etc., using a range of techniques such as charts, drawings, and tables. Labelling work correctly and describing conclusions related to the purpose of the activity.

C2.1 a Contribute to a discussion about a straightforward subject.	Unit 1	✓	Discussing health and safety hazards and risks in a particular area, and how these might be addressed or avoided.
	Unit 2	✓	
C2.1 b Give a short talk about a straightforward subject, using an image.	Unit 1	✓	Presenting information on health or fire safety in a particular location, or on the results of a risk assessment in a location, or on basic first aid techniques.
	Unit 2	✓	
C2.2 Read and summarise information from **two** extended documents about a straightforward subject. One of the documents should include at least **one** image.	Unit 1	✓	Health and safety protocols, fire safety manuals, accident reporting books, notices, regulations, lab protocols/procedures. There must be evidence that information from such sources has been summarised in the student's work.
	Unit 2	✓	Textbooks, data sheets, articles and reports on e.g. organic farming, gene transfer or immunisation etc. Also information leaflets etc on energy efficiency and costs. There must be evidence that information from such sources has been summarised in the student's work.
C2.3 Write two different types of documents about straightforward subjects. One piece of writing should be an extended document and include at least one image.	Unit 1	✓	Reporting the results of a risk assessment, using text supported by diagrams, photos and drawings. Presenting the results of investigations of microorganisms, materials, chemical analysis and drawing conclusions etc.
	Unit 2	✓	Describing and explaining quantitative data e.g. on materials properties, using drawings etc.
IT 2.1 Search for and select information for **two** different purposes.	Unit 1	✓	Using CD ROMS, the internet, databases etc as sources of information.
	Unit 2	✓	Using a range of sources of data, including CD ROMs, databases and the internet to find out about the physical properties of materials. Using the internet as a source of information on farming methods, gene technology and the role of microorganisms.
IT 2.2 Explore and develop information, and derive new information, for **two** different purposes.	Unit 1	✓	
	Unit 2	✓	Developing written and graphical material for inclusion in reports, presentations etc. about e.g. the structure and use of living organisms, plant health, different forms of energy etc.
IT 2.3 Present combined information for two different purposes. Your work must include at least **one** example of text, **one** example of images and **one** example of numbers.	Unit 1	✓	Presenting booklets, notices, etc on fire prevention and health and safety in the laboratory, and on first aid techniques. Also presenting the numerical results of investigations of materials' properties and chemical analysis. Using WP, imported images and other graphical techniques.
	Unit 2	✓	Producing reports, booklets, etc on e.g. uses for living organisms, protection from infection by harmful microorganisms, the classification of materials and chemical compounds, or comparison of energy sources. Using WP, numerical data, imported images and other graphical techniques.

WO2.1 Plan straightforward work with others, identifying objectives and clarifying responsibilities, and confirm working arrangements.	Unit 1	✓	Tackling risk assessments or learning basic first aid as group activities, where each member of the group could be allocated a specific task. Could therefore fulfil the group working requirement for this key skill.
	Unit 2	7	
WO2.2 Work co-operatively with others towards achieving identified objectives, organising tasks to meet your responsibilities.	Unit 1	✓	Allocating definable roles in carrying out the risk assessment, which would contribute to the final outcome, requiring them to work co-operatively and effectively to do so? Working in pairs and/or seek advice e.g. from a fire safety officer or first aider which could fulfil the one-to-one working requirement for this key skill. Showing safe and effective group-working in carrying out practical tasks.
	Unit 2	7	
WO2.3 Exchange information on progress and agree ways of improving work with others to help achieve objectives.	Unit 1	✓	Planning the group's work to allow for progress checking, feedback and brainstorming e.g. on ways to find information or ways of correcting work so that objectives are met.
	Unit 2	7	
LP2.1 Help set short-term targets with an appropriate person and plan how these will be met.	Unit 1	✓	Planning work in such a way as to allow opportunities for target-setting and planning, on a one-to-one basis with the student. This could relate to learning about safe working or to carrying out practical tasks.
	Unit 2	7	
LP2.2 Take responsibility for some decisions about your learning, using your plan and support from others to help meet targets. Improve your performance by: ▪ studying a straightforward subject ▪ learning through a straightforward practical activity.	Unit 1	✓	If the student takes responsibility for successfully executing the plan agreed in LP2.1, and chooses different approaches to finding out what they need to know, including a practical activity such as learning basic first aid or carrying out measurements or analysis.
	Unit 2	7	
LP2.3 Review progress with an appropriate person and provide evidence of your achievements, including how you have used learning from one task to meet the demands of a new task.	Unit 1	✓	Reviewing what has been learned and how they went about it, on a one-to-one basis with the student, e.g. in tutorials.
	Unit 2	7	

PS2.1 Identify a problem and come up with **two** options for solving it.	Unit 1	4	Assessing risk and identifying hazards and risks and ways of preventing fires, considering the nature of the problem and ways of tackling it. Suggesting and then assessing different options.
	Unit 2	7	
PS2.2 Plan and try out at least one option for solving the problem, obtaining support and making changes to your plan when needed.	Unit 1	✓	Investigating safe working and practical tasks both lend themselves to basic planning and the sequencing of tasks e.g. of steps in chemical analysis or in a risk assessment. Following these plans, making any adjustments that become necessary and obtaining advice from tutors, fire safety or first aid personnel etc.
	Unit 2	7	
PS2.3 Check if the problem has been solved by applying given methods, describe results and explain your approach to problem solving.	Unit 1	4	Following standard procedures and in considering the reliability of results/measurements etc., reviewing methods and drawing conclusions as the investigation unfolds. Also reviewing work, suggesting improvements etc.
	Unit 2	7	

6 PORTFOLIO ADMINISTRATION

Supervision/Authentication

Teachers are expected to supervise and guide candidates in the production of their portfolios. This will involve:

- ensuring that candidates are aware of the regulations for the production of portfolios, e.g. the scope for planning, drafting and editing, acknowledgement of sources, presentation of work, dates for submission;
- ensuring that candidates are aware of the criteria for assessment, the levels of achievement against which work will be judged and the mark/grade scale to be used;
- advising candidates on how to approach their tasks and monitoring their progress;
- authenticating that the finally assessed portfolio is the candidate's own work and that any support given is within guidelines, or informing WJEC where any malpractice is suspected.

Work on portfolios may take place outside the centre as well as in normal curriculum time. Tasks may be organised in groups, especially in the early stages, providing that each candidate is enabled to work to his or her level of ability and that each individual's work is clearly identifiable.

Teachers may comment on work in progress and return it for re-drafting but comments must be framed in such a way as to enable the candidate to take the initiative in developing the work further.

Internal deadlines may be set for the submission of work. It should be made clear to candidates that once the final portfolio has been submitted for assessment no further work may take place. Regulations for subsequent resubmission following the grading of a unit will be provided.

The cover sheet for the portfolio requires candidates to sign that the work is their own, and for the teacher to countersign that to the best of their knowledge this is the case. This must be completed for all portfolios, not only those submitted for moderation.

Presentation of Portfolios

The following procedures must be followed.

- All standard operating procedures (and/or worksheets) must be provided in a separate 'Background Information Folder' and sent with the moderation sample.
- The portfolio sample sheet and the portfolio cover sheet (Appendix B) must be completed.
- Any sources, copied material, quotations, etc., must be acknowledged and references provided, where appropriate (this may be in the form of an appendix to the cover sheet).

- Work submitted for moderation must have pages which are easily accessible, e.g. contained in an envelope folder or held together by treasury tags, and **not** placed in a series of plastic wallets **or** a bulky ring binder.

- All pieces of work must be clearly marked with specification title, the unit, centre name and number, candidate name and number. Every page should carry some form of identification, e.g. candidate name.

Internal Standardisation

Where more than one teacher is involved in teaching and assessing the subject, centres are required to ensure that internal standardisation has taken place. This may take a number of forms: marking of common folders using exemplar material provided by WJEC or the centre's own archive material; cross-marking elements of portfolios as they are produced; re-assessment of a sample of folders from each group at the end of the course.

While on-going discussion of task-setting and assessment criteria is important to establish a consistent approach within the centre, it is recommended that one teacher takes responsibility for checking the reliability of the centre's rank order. Evidence of internal moderation will be welcomed by the moderator. The finally agreed mark(s) must be clearly indicated.

External Moderation

In view of the weighting of the internally assessed unit being individually certificated and worth 67% of the single award GCSE, centres may submit marked work for consultative moderation at any time during the course. A written report will usually be provided. This is strongly recommended especially in the early stages of running the course.

Dates will be published for the submission of unit marks to WJEC and of samples of work to the moderator (both dates are likely to be in mid May). Internal deadlines will need to allow for the completion of any internal standardisation. Samples will be selected according to a formula provided by WJEC.

A tolerance of 6% will be applied in the re-assessment process (i.e. 6 marks for Unit 1). If marks fall outside this tolerance and a need is identified to bring marking into line with external standards, the centre's rank order will be preserved, unless this is significantly questioned, in which case WJEC reserves the right to call in all the work of a centre for re-assesssment.

Report

A report on each unit will be provided under the following headings:

- Administration: the presentation of material and the provision of information for the Moderator;

- Task-setting: the quality and appropriateness of the tasks set;

- Assessment: the application of criteria and marking standards.

APPENDIX A

Spiritual, Moral, Ethical, Social and Cultural Issues Sign-posting

Opportunities for the development of students' awareness of spiritual, moral, social and cultural issues are identified in the table below.

Key:

Sp	Spiritual	**M**	Moral	**E**	Ethical	**So**	Social
C	Cultural	**Cz**	Citizenship	**EI**	European Initiatives	**En**	Environment

	Sp	M	E	So	C	Cz	EI	En
Unit 1								
• Working safely in science.				✓		✓	✓	
• Working with living organisms, the use of banned substances and radioactivity.	✓	✓	✓				✓	
• Unwanted materials and their safe disposal.				✓			✓	✓
• Fire regulations and 'standard operating procedures'.							✓	
• Recording accurate results, not copying others, and working collaboratively in experiments and sharing results.		✓	✓	✓				
Unit 2								
• The scientific production of goods meeting needs of society.				✓				
• Working with living organisms.	✓	✓	✓				✓	
• The use of fossil fuels, nuclear fuels, recycling and energy saving.				✓		✓	✓	✓
• Recognition of the genetic engineering debate.		✓	✓	✓			✓	✓
• Immunisation and the killing of some bacteria. (So and En). Copyright and use of materials. (EI)				✓			✓	✓
• The ethical use and recognition/citation of source information.			✓	✓				

APPENDIX B

WELSH JOINT EDUCATION COMMITTEE **CYD-BWYLLGOR ADDYSG CYMRU**
General Certificate of Secondary Education **Tystysgrif Gyffredinol Addysg Uwchradd**

ADDITIONAL APPLIED SCIENCE

APS

PORTFOLIO SAMPLE SHEET

Total number of candidates entered for this component:

Portfolio **Unit 1**

Name of Centre	Centre Number

Candidate's Examination No.	**Candidate's Name (Surname first)** IN RANK ORDER BLOCK CAPITALS	Teaching Group	Centre Mark	Moderator's Mark	Difference	For office use only

Subject Teacher	**Date**	**Moderator**

WELSH JOINT EDUCATION COMMITTEE **CYD-BWYLLGOR ADDYSG CYMRU**
General Certificate of Secondary Education **Tystysgrif Gyffredinol Addysg Uwchradd**

ADDITIONAL APPLIED SCIENCE

Unit 1 portfolio

Centre Name: _____Centre Number: _____

Candidate's Name: _____Candidate's Number: _____

The portfolio should include:				**Mark**	**Max. Mark**
• (a) A report of an investigation carried out into working safely in science. Assessor's comment (if required)					**25**
• Records of practical activities in each of the following areas: (i) Sports science (ii) Forensic Science (iii) Food science Each of the above activities should include:	**Sports Science** **(i)**	**Forensic Science** **(ii)**	**Food Science** **(iii)**	**Best (highest) Mark**	**Max. Mark**
(b) Evidence that student carried out risk assessments; followed standard procedures; used appropriate scientific equipment and/or materials. Assessor's comment (if required) - overleaf	**/25**	**/25**	**/25**		**25**
(c) Evidence that the student obtained and recorded scientific data appropriate to the task. Assessor's comment (if required) - overleaf	**/25**	**/25**	**/25**		**25**
(d) Evidence that the student analysed scientific data appropriate to the task. Assessor's comment (if required) - overleaf	**/15**	**/15**	**/15**		**15**
(e) Evaluated methods used in carrying out investigations. Assessor's comment (if required) - overleaf	**/10**	**/10**	**/10**		**10**
***TOTAL best fit mark for skills (b), (c), (d) and (e)**					**75**

***Circle or highlight the best mark for each skill and transfer these to the best mark column.**

TOTAL MARK FOR PORTFOLIO (a) + overall best fit mark		**100**

General comments/justification (if needed)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Declaration by candidate

The attached portfolio, with the exceptions noted, is my own unaided work.

Signature: _____Date: _____

Declaration by teacher

I certify that the candidate has been properly supervised during the presentation of the coursework. I also certify that, to the best of my knowledge, the portfolio is the candidate's unaided work, with the exceptions noted.

Signature: _____Date: _____