

Introduction

The GCSE in Applied **Science** (Double Award) is a vocational GCSE that is equivalent upon completion to two GCSE's.

It has been designed to provide a broad educational basis for further training, for further education or for moving into employment.

The course itself consists of three compulsory units that are equally weighted. Two units are assessed 'internally' after the student has produced an assignment to cover investigation and analysis of science in a vocational context, whilst the third unit is assessed externally through a written test.

All three units require knowledge and analysis of scientific organisations. However, the two internally assessed units require students to produce assignments covering an in depth investigation and analysis into scientific work places.

Unit 1

DEVELOPING SCIENTIFIC SKILLS

involves an investigation into the role of health and safety in a scientific workplace.

Unit 3

SCIENCE AT WORK

involves analysing how science is used in the workplace.

This document relates mainly to Units 1 and 3 which are internally assessed. However, by explaining the work you do, the facilities you work in and the products and services provided, you are helping the students to understand Unit 2.

This Applied Science GCSE began in September 2002 and teachers are under great pressure to invoke vocational realism to the subject through visits and speakers to allow students to appreciate how real organisations are solving scientific problems and exploiting opportunities. Students also need to appreciate how operating a commercial business can bring additional constraints and processes into the equation. Simulated exercises have a limited role, the aim is to immerse the student in the actual working environment they are studying.

This GCSE 'map' should provide EBPs and employers with an understanding of the issues and level of depth that need to be examined within scientific organisations to enable students to specifically meet the requirements of their course.

Unit I

Developing Scientific Skills. Applied Science

Developing scientific skills introduces the student to the following themes:

- 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 in the areas of:
 - Investigating living organisms
 - Chemical analysis
 - Investigating materials

WORKING SAFELY IN SCIENCE

Explanation of Term

This covers hazards such as careless behaviour, not following correct procedures, or using correct equipment and risks that arise from using chemical substances, micro-organisms and utilities such as gas and electricity. It also covers first aid procedures and fire prevention.

Factor/Evidence

Hazard warning signs, protective clothing, safety cages/doors on equipment, training manuals on safety. Gloves to handle hazardous substances. Safety instructions on notice boards. First aiders, first aid boxes, training for first aiders. Fire procedure notices, fire alarms and sprinkler systems. Different types of fire extinguishers. Talk with first aid officer on site. Rules on fighting fire and the most likely causes in the first place.

Risk Assessments, following procedures, using instruments giving precise measurements.

Data presented in tables, bars, pie charts, graphs. Simple numerical calculations. Analysis of findings, evaluation and suggested improvements.

Microscope analysis

Types of Companies

Any involved in scientific research and/or development.

Unit 1

Generic examples of questions for companies

- What training do you receive on health and safety issues?
- Who provides the training?
- Are there any standards you have to conform to?
- Do you work with any dangerous substances?
- How do you ensure you work safely with them?
- What safety equipment and clothing do you have to use?
- Who provides your first aider training?
- How many first aiders are there?
- What are the most common accidents first aiders have to deal with?
- Can we see your accident book?
What are the fire arrangements within your company?
- What are the flammable materials and substances that you work with or near?

Unit I

CARRYING OUT PRACTICAL TASKS INVOLVING THE FOLLOWING SKILLS: Following standard procedures Handling scientific equipment and materials

Explanation of Term

These are also called 'protocols' or 'standard operating procedures'. **Standard procedures** are important in science because if they are used, when the results are seen you know exactly how the observation and measurements were made no matter who did it or where it was done. **Standard procedures** may be agreed within a company, or nationally or internationally.

Factors/Evidence

Evidence of reading procedure and checking everything is understood. Evidence of health and safety checks taking place and a risk assessment. Evidence of the scientist setting out the work area and collecting together everything needed. Following instructions one step at a time, making accurate observations and measurements and using instruments giving the appropriate precision. Evaluations and repeat observations and measurements being undertaken to increase reliability.

Types of Companies

Those with forensic scientists, pharmaceutical scientists, research scientists, laboratory science technicians, engineering technicians, dental technicians.

Generic examples of questions for companies

- What sort of standard procedures do you follow?
- Are these set within the company, nationally or internationally?
- What are the different measurement and observation instruments you use?
- How do the standard procedures used meet your commercial or industrial objectives?
- What training have you receive in following standard procedures?
- Where can things go wrong so that they result in the need to perform the experiment or measurement again?
- What qualifications do employees need to undertake standard procedures?

Unit 1

RECORDING AND ANALYSING SCIENTIFIC DATA

Explanation of Term

Standard procedures also state how to how to obtain and record observations and measurements and what to do with them. ICT should be used.

Factors/Evidence

Students need to see data presented in tables, bar charts, histograms, pie charts, graphs and other visual images. They also need to see simple numerical calculations carried out. They need to see analysis, interpretation, evaluation and suggested improvements.

Types of Companies

Companies from manufacturing and service industry (pharmaceutical, fine chemicals, medical laboratories, forensic science workshops).

Generic examples of questions for companies

- What ways do you present data you have obtained?
- What techniques are used to record data?
- What units of measurement are used?
- What accuracy is needed?
- How does ICT help measure data?
- How does ICT help store and process data?
- What statistical functions are applied to data?

Unit 1

INVESTIGATING LIVING ORGANISMS – MICROSCOPY AND MICRO-ORGANISMS

Explanation of term

This involves working safely and handling scientific equipment in order to use a microscope and study micro-organisms. Micro-organisms include the ones, which benefit society such as those used to develop yoghurt and cheese, as well as those, which have the potential to cause disease to humans, plants and animals.

Factor/evidence

Any exposure of the students to environments where materials or substances are investigated and analysed via a microscope and any environment where micro-organisms are used.

Types of Companies

Food production companies that use micro-organisms in the production of products such as yoghurt, cheese, mycoprotein, wine, sauerkraut or beer.

Generic examples of questions for companies

- Are these micro-organisms harmful or beneficial?
- Do you isolate a single type of micro-organism?
- How do you ensure there is no cross contamination?
- What techniques are used to ensure the safety of the staff from disease causing microbes?
- How do you isolate micro-organisms to avoid their escape into the environment?
- What conditions are needed to maintain microorganisms?
- On average how long do micro-organisms live?

Unit 1

CHEMICAL ANALYSIS

Explanation of Term

Analytical chemists need to be able to test for certain chemical substances in solutions. This covers detecting the presence of pollutants (e.g. in river water) banned substances (e.g. in athletes) or alcohol (e.g. those suspected of drinking and driving). Analysis is an important aspect of the work of the forensic scientist.

Factors/Evidence

Any exposure of students to chemical analysis situations. Perhaps a local industry could set a scenario that the students can investigate back at school.

Types of Companies

Forensic service attached to the police. Maybe get someone in to talk, as it can be difficult to get students into these environments.

Water companies.

Generic examples of questions for companies

- What sort of separation techniques do you use?
Evaporation, distillation or chromatography.
- Do you use qualitative or quantitative analysis?
- Can you talk through the analysis you do?
- What skills are needed by your employees to undertake measures and analysis?
- What health and safety considerations have to be taken into account in this work?

Unit 3

Science at Work

Science at work introduces the student to the following themes;

- SCIENCE IN THE WORKPLACE
- MAKING USEFUL PRODUCTS
- INSTRUMENTS AND MACHINES
- MONITORING LIVING ORGANISMS

SCIENCE IN THE WORKPLACE

Explanation of Term

This involves looking at the work environments of the people we think of specifically as scientists, but there are also people who use science in their work that we do not automatically think of as scientists. These include nurses, engineers, photographers, chefs and gardeners. Students need to identify whether the employer is a major, significant or small user of science. They need to find out why the company is located where it is. They need to identify the types of scientific activity that are carried out and the job titles and qualifications of the people who perform them, plus the skills involved. They need to find out the careers available in science and science-related areas.

The following topics need to be covered if they are relevant to your workplace.

How your organisation uses science

Making useful products

How the company uses instruments and machines

Monitoring living organisms

Unit 3

Factor/Evidence

Job titles, qualifications and skills of the scientists employed by the organisation. Need access to laboratories and/or production lines where science graduates and technicians are employed. How laboratory work functions within the constraints of a commercial environment. How humans or other living organisms are investigated – diet sheets, performance measures.

Types of Companies

Hospital laboratories or other health sector companies. Chemical and pharmaceutical companies or organisations concerned with research and testing such as government laboratories.

Generic examples of questions for companies

- How did you get to your current position?
- How much of your scientific training do you bring to your current job?
- Why did your company locate where it is?
- How many scientific experiments does your company undertake?
- What is the main emphasis of your work?
What is your specialism?
- What is your job title?
- What are the main skills you require for your job?
- Are you a local company or do you have other divisions either nationally or internationally?

Unit 3

MAKING USEFUL PRODUCTS

Explanation of Term

This is anything to do with changing naturally occurring materials such as metals, rocks and minerals into more useful products through physical or chemical change. Also anything that shows industries making profits through maximising the amount of product produced from the starting material.

Factors/Evidence

A lot of this knowledge is gained from the classroom. Vocational links are needed to make students aware of the close connections between their laboratory work and its commercial counterpart.

Types of Companies

Any involved with changing naturally occurring materials into other ones.

Generic examples of questions for companies

- Does the company have a laboratory on site or does it contract independent research laboratories?
- What sort of reaction is used to change the metal, rock or mineral into a different product?
- What extra scientific problems does mass production present when compared to small scale experiments?
- How is it done?
- How does your company ensure it gets the maximum amount of profit from the original material?
- How do you ensure you don't waste materials or energy?
- Are there any useful bi-products from the process?
- Are scientific methods applied to quality testing?

Unit 3

INSTRUMENTS AND MACHINES

Explanation of Term

Scientists produce many machines and devices to measure, to observe, to move things and to change materials for their use and the use of the public.

Factors/Evidence

How a mechanical machine can be assembled to measure the applied force and the force produced, the work done by the machine and the efficiency of the machine.

Types of Companies

In engineering, areas include telecommunications, heating and cooling control.

In the health care sector areas include:

- A fitness centre – links with work on monitoring organisms by looking at the way in which gym equipment measures body functions and changes settings.

In the service industry areas include:

- Food preparation – controlling the temperature of an oven to provide sufficient energy with no surplus and moving contents to ensure even distribution
- Food production – stages on the production line to measure quantities, packaging and quality control.

Generic examples of questions for companies

- Have you a mechanical machine?
- How has this machine been designed to measure?
- What work does the machine do?
- How is the machine efficient?

Unit 3

MONITORING LIVING ORGANISMS

Explanation of term

Organisms include all sorts of things including human beings. Students are required to investigate the growth and/or development and/or responses of an organism under controlled conditions. Possible investigations may be to:

- Improve the yield of a plant/microorganism
- Monitor the performance of a person in a physical or mental activity
- Monitor the effects of changing the environment on the behaviour and/or growth and/or development of an organism.

Factor/Evidence

Organisms being kept in the best conditions for regrowth or alteration. Humans or athletes improving their own performance through food intake and/or monitoring their own activities. Any ethical issues that need to be addressed when carrying out investigations.

Types of Companies

- Breweries, garden centres, dairies.
- The use of case studies or scenarios is useful for schools, for example – introducing the advantages/disadvantages of computer controlled green houses in order to explore whether the optimum biological conditions for commercial growth, yield the most profit.

Generic examples of questions for companies

- What types of organisms do you work with?
- What is the purpose of monitoring the organism?
- How is the welfare of the organism considered?
- What ethical issues do you have to consider?
- What conditions do you provide and how do you control this?
- How do you monitor the organism's growth/development/responses?
- Do you draw up a monitoring schedule when you undertake an investigation?
- How do you evaluate the results of your investigations?
- Have you got an example of an evaluation?