

GCSE Subject Criteria for Additional Science

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The criteria

Introduction

GCSE subject criteria set out the knowledge, understanding, skills and assessment objectives common to all GCSE specifications in a given subject.

They provide the framework within which the awarding organisation creates the detail of the specification.

Aims and learning outcomes

1. GCSE specifications in Additional Science should encourage learners to develop their knowledge about the living, material and physical worlds and provide insight into, and experience of, how science works. They should enable learners to engage with science and to make informed decisions about further study in science and related subjects and about career choices.
2. GCSE specifications in Additional Science must enable learners to:
 - develop their knowledge and understanding of the material, physical and living worlds;
 - develop their understanding of the effects of science on society;
 - develop an understanding of the importance of scale in science;
 - develop and apply their knowledge and understanding of the nature of science and of the scientific process;
 - develop their understanding of the relationships between hypotheses, evidence, theories and explanations;
 - develop their awareness of risk and the ability to assess potential risk in the context of potential benefits;
 - develop and apply their observational, practical, modelling, enquiry and problem-solving skills and understanding in laboratory, field and other learning environments;
 - develop their ability to evaluate claims based on science through critical analysis of the methodology, evidence and conclusions both qualitatively and quantitatively;

- develop their skills in communication, mathematics and the use of technology in scientific contexts.
3. The content of GCSE specifications in Additional Science must reflect the learning outcomes.

Subject content

4. GCSE specifications in Additional Science must require learners to demonstrate knowledge and understanding of:
- science as an evidence-based discipline;
 - the collaborative nature of science as a subject discipline, the way new scientific knowledge is validated and the limitations of science;
 - the importance of working accurately and safely;
 - hazard identification and the nature of risk;
 - risk factors and risk assessment in the context of potential benefit;
 - the importance of scale in terms of time, size and space in science;
 - the uses of modelling, including mathematical modelling to explain aspects of science;
 - the chemical properties of elements and compounds in terms of structure and bonding, including metallic, ionic and covalent bonds and forces between molecules;
 - the chemical properties of elements related to their atomic structure and their position in the periodic table;
 - how conditions and quantities can be used to control the rate of chemical reactions;
 - chemical analysis using detection and separation techniques;
 - the quantitative interpretation of chemical formulae and equations, including percentage yield
 - the energy changes that take place during chemical reactions;
 - the relationship between work and energy, and changes in gravitational potential energy and kinetic energy;

- electrical circuits, including the relationships between power, current and voltage and resistance, current and voltage;
 - Newton's laws of motion and their theoretical and practical uses calculating changes in the velocity and acceleration of bodies acted on by forces, including momentum;
 - radioactivity, sources of background radiation;
 - effects of ionising radiations;
 - radioactive decay, half-life, fission and fusion;
 - the structure of cells, including plant, animal and microbial cells;
 - mitosis and meiosis;
 - fieldwork techniques to explore the relationships between communities of organisms and their environments;
 - the structure and function of DNA and its role in protein synthesis;
 - structure and functions of proteins including enzyme action;
 - how chemical reactions essential for life take place inside and outside cells;
 - photosynthesis and respiration;
 - the different patterns of growth and development in plants and animals;
 - the need for, and development and functions of specialised organ systems;
 - how organisms have changed through time.
5. GCSE specifications in Additional Science must require learners to develop the ability to:
- develop hypotheses and plan practical ways to test them including risk assessment; manage risks when carrying out practical work; collect, process, analyse and interpret primary and secondary data including the use of appropriate technology to draw evidence-

based conclusions; review methodology to assess fitness for purpose, and review hypotheses in light of outcomes;

- use scientific theories, models and evidence to develop hypotheses, arguments and explanations; develop and use models to explain systems, processes and abstract ideas;
- communicate scientific information using scientific, technical and mathematical language¹, conventions and symbols.

Assessment objectives

6. All specifications in Additional Science must require learners to demonstrate their ability to:

Assessment objectives		Weighting
AO1	Recall, select and communicate their knowledge and understanding of science.	30–40%
AO2	Apply skills, knowledge and understanding of science in practical and other contexts.	30–40%
AO3	Analyse and evaluate evidence, make reasoned judgements and draw conclusions based on evidence.	25–35%

Scheme of assessment

7. GCSE specifications in Additional Science must allocate a weighting of 75 per cent to external assessment and a weighting of 25 per cent to controlled assessment in the overall scheme of assessment.
8. Question papers in Additional Science must be targeted at either foundation or higher tier.

¹ See Appendix A.

Grade descriptions

9. Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by learners awarded particular grades. The descriptions must be interpreted in relation to the content in the specification; they are not designed to define that content.
10. The grade awarded will depend in practice upon the extent to which the learner has met the assessment objectives overall. Shortcomings in some aspects of learners' performance in the assessment may be balanced by better performances in others.

Grade	Description
A	<p>Learners recall, select and communicate precise knowledge and detailed understanding of science and its applications, and of the effects and risks of scientific developments and its applications on society, industry, the economy and the environment. They demonstrate a clear understanding of why and how scientific applications, technologies and techniques change over time and the need for regulation and monitoring. They use terminology and conventions appropriately and consistently.</p> <p>They apply appropriate skills, including communication, mathematical and technological skills, knowledge and understanding effectively to a wide range of practical contexts and to explain applications of science. They apply a comprehensive understanding of practical methods, processes and protocols to plan and justify a range of appropriate methods to solve practical problems. They apply appropriate skills, including mathematical, technical and observational skills, knowledge and understanding in a wide range of practical contexts. They follow procedures and protocols consistently, evaluating and managing risk and working accurately and safely.</p> <p>Learners analyse and interpret critically a broad range of quantitative and qualitative information. They reflect on the limitations of the methods, procedures and protocols they have used and the data they have collected and evaluate information systematically to develop reports and findings. They make reasoned judgements consistent with the evidence to develop substantiated conclusions.</p>

<p>C</p>	<p>Learners recall, select and communicate secure knowledge and understanding of science. They demonstrate understanding of the nature of science, its laws, its applications and the influences of society on science and science on society. They understand how scientific advances may have ethical implications, benefits and risks. They use scientific and technical knowledge, terminology and conventions appropriately, showing understanding of scale in terms of time, size and space.</p> <p>They apply appropriate skills, including communication, mathematical and technological skills, knowledge and understanding in a range of practical and other contexts. They recognise, understand and use straightforward links between hypotheses, evidence, theories and explanations. They use models to explain phenomena, events and processes. Using appropriate methods, sources of information and data, they apply their skills to answer scientific questions, solve problems and test hypotheses.</p> <p>Learners analyse, interpret and evaluate a range of quantitative and qualitative data and information. They understand the limitations of evidence and develop arguments with supporting explanations. They draw conclusions consistent with the available evidence.</p>
<p>F</p>	<p>Learners recall, select and communicate their limited knowledge and understanding of science. They have a limited understanding that scientific advances may have ethical implications, benefits and risks. They recognise simple interrelationships between science and society. They use limited scientific and technical knowledge, terminology and conventions, showing some understanding of scale in terms of time, size and space.</p> <p>They apply skills, including limited communication, mathematical and technological skills, knowledge and understanding in practical and some other contexts. They show limited understanding of the nature of science and its applications. They can explain straightforward models of phenomena, events and processes. Using a limited range of skills and techniques, they answer scientific questions, solve straightforward problems and test ideas.</p> <p>Learners interpret and evaluate some qualitative and quantitative data and information from a limited range of sources. They can draw elementary conclusions having collected limited evidence.</p>

Appendix A: Mathematics requirements

These criteria contain as one of the learning outcomes the requirement for specifications to provide learners with the opportunity to develop their skills in communication, mathematics and the use of technology in scientific contexts. In order to deliver the mathematical element of this outcome, specifications and assessment materials must contain opportunities for learners to demonstrate scientific knowledge using appropriate mathematical skills.

The following represent the areas of mathematics that have been identified as arising naturally from the science content in the subject criteria.

While this is not a checklist for each question paper or assessment, awarding organisations must ensure that their assessment materials properly reflect these mathematical requirements, assessing the full range of mathematical skills over a reasonable period of time.

Learners are permitted to use calculators in all assessments.

Learners are expected to use units appropriately. However, not all questions need to reward the appropriate use of units.

Learners should be able to:

- Understand number size and scale and the quantitative relationship between units.
- Understand when and how to use estimation.
- Carry out calculations involving +, -, \times , \div , either singly or in combination, decimals, fractions, percentages and positive whole number powers.
- Provide answers to calculations to an appropriate number of significant figures.
- Understand and use the symbols =, <, >, \sim .
- Understand and use direct proportion and simple ratios.
- Calculate arithmetic means.
- Understand and use common measures and simple compound measures such as speed.

- Plot and draw graphs (line graphs, bar charts, pie charts, scatter graphs, histograms) selecting appropriate scales for the axes.
- Substitute numerical values into simple formulae and equations using appropriate units.
- Translate information between graphical and numeric form.
- Extract and interpret information from charts, graphs and tables.
- Understand the idea of probability.
- Calculate area, perimeters and volumes of simple shapes.

In addition, higher tier learners should be able to:

- Interpret, order and calculate with numbers written in standard form.
- Carry out calculations involving negative powers (only -1 for rate).
- Change the subject of an equation.
- Understand and use inverse proportion.
- Understand and use percentiles and deciles.

Awarding organisations may add to this list to enable them to draw upon other areas of mathematics in their assessments without significantly impacting on the level of demand of the specification.

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