SCQF level 5
Unit Specification

Biology: Life on Earth

SCQF: level 5 (6 SCQF credit points)

Unit code: J4AC 75

Unit outline

The general aim of this Unit is to develop skills of scientific inquiry, investigation and analytical thinking, along with knowledge and understanding of life on Earth. Learners will apply these skills when considering the applications of life on Earth on our lives, as well as the implications on society/the environment. This can be done by using a variety of approaches, including investigation and problem solving.

The Unit covers the key areas of ecosystems; distribution of organisms; photosynthesis; energy in ecosystems; food production; and evolution of species. Learners will research issues, apply scientific skills and communicate information related to their findings, which will develop skills of scientific literacy.

Learners who complete this Unit will be able to:

1 Apply skills of scientific inquiry and draw on knowledge and understanding of the key areas of this Unit to carry out an experiment/practical investigation
2 Draw on knowledge and understanding of the key areas of this Unit and apply scientific skills

This Unit is a free-standing Unit. The *Unit Support Notes* in the Appendix provide advice and guidance on delivery, assessment approaches and development of skills for learning, skills for life and skills for work. Exemplification of the standards in this Unit is given in *Unit Assessment Support*.

Recommended entry

Entry to this Unit is at the discretion of the centre. However, learners would normally be expected to have attained the skills, knowledge and understanding required by one or more of the following or equivalent qualifications and/or experience:

- National 4 Biology Course or relevant component Units

Equality and inclusion

This Unit Specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence. For further information, please refer to the Appendix: *Unit Support Notes.*

Standards

Outcomes and Assessment Standards

Outcome 1

The learner will:

1 Apply skills of scientific inquiry and draw on knowledge and understanding of the key areas of this Unit to carry out an experiment/practical investigation by:

1.1 Planning an experiment/practical investigation
1.2 Following procedures safely
1.3 Making and recording observations/measurements correctly
1.4 Presenting results in an appropriate format
1.5 Drawing valid conclusions
1.6 Evaluating experimental procedures

Outcome 2

The learner will:

2 Draw on knowledge and understanding of the key areas of this Unit and apply scientific skills by:

2.1 Making accurate statements
2.2 Solving problems

Evidence Requirements for the Unit

Assessors should use their professional judgement, subject knowledge and experience, and understanding of their learners, to determine the most appropriate ways to generate evidence and the conditions and contexts in which they are used.

The key areas covered in this Unit are ecosystems; distribution of organisms; photosynthesis; energy in ecosystems; food production; and evolution of species.

The following table describes the evidence for the Assessment Standards. Exemplification of assessment is provided in *Unit Assessment Support*.

Assessment Standard	Evidence required
Planning an experiment/practical investigation	The plan must include: ♦ an aim ♦ a dependent and independent variable ♦ key variables to be kept constant ♦ measurements/observations to be made ♦ the resources ♦ the method, including safety considerations
Following procedures safely	The learner must be seen to follow procedures safely.
Making and recording observations/measurements correctly	The raw data must be collated in a relevant format, for example a table.
Presenting results in an appropriate format	One format from: bar graph or line graph.
Drawing a valid conclusion	This must include reference to the aim and be supported by the results.
Evaluating experimental procedures	Provide one evaluative statement about the procedures used. **or** Suggest an improvement for the experiment. Appropriate justification must also be provided, whichever option is chosen.
Making accurate statements and solving problems	Achieve at least 50% of the total marks available in a holistic assessment. A holistic assessment must include: ♦ an appropriate number of opportunities to make accurate statements for each key area of the Unit ♦ at least one opportunity to demonstrate each of the following problem-solving skills: — make generalisations/predictions — select information — process information, including calculations, as appropriate — analyse information

Assessment Standard thresholds

Outcome 1

Learners are not required to show full mastery of the Assessment Standards to achieve Outcome 1. Instead, five out of the six Assessment Standards for Outcome 1 must be met to achieve a pass. Learners must be given the opportunity to meet all Assessment Standards.

Outcome 2

Learners are assessed using a holistic assessment that assesses Assessment Standards 2.1 and 2.2. To gain a pass for Outcome 2, learners must achieve 50% or more of the total marks available in the assessment.

Transfer of evidence

Evidence for the achievement of Outcome 1 for this Unit can be used as evidence for the achievement of Outcome 1 in the SCQF level 5 Units: Biology: Multicellular Organisms (J4AA 75) and Cell Biology (J4A9 75).

Evidence for the achievement of Outcome 2 for this Unit is **not** transferable between the SCQF level 5 Units: Biology: Multicellular Organisms (J4AA 75) and Cell Biology (J4A9 75).

Re-assessment

SQA's guidance on re-assessment is that there should only be one or, in exceptional circumstances, two re-assessment opportunities. Re-assessment must be carried out under the same conditions as the original assessment.

Outcome 1

Learners can re-draft their original Outcome 1 report or carry out a new experiment/practical investigation.

Outcome 2

Learners must have a full re-assessment opportunity, ie a holistic assessment. To achieve Outcome 2, learners must achieve 50% of the total marks available in the re-assessment.

Development of skills for learning, skills for life and skills for work

It is expected that learners will develop broad, generic skills through this Unit. The skills that learners will be expected to improve on and develop through the Unit are based on SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work* and drawn from the main skills areas listed below. These must be built into the Unit where there are appropriate opportunities.

2 Numeracy

2.1 Number processes
2.2 Money, time and measurement
2.3 Information handling

5 Thinking skills

5.3 Applying
5.4 Analysing and evaluating

Amplification of these is given in SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work.* The level of these skills should be at the same SCQF level of the Unit and be consistent with the SCQF level descriptor. Further information on building in skills for learning, skills for life and skills for work is given in the Appendix: *Unit Support Notes.*

Appendix: Unit Support Notes

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing this Unit. They are intended for teachers and lecturers who are delivering this Unit. They should be read in conjunction with:

- *Unit Assessment Support*

Developing skills, knowledge and understanding

Teachers and lecturers are free to select the skills, knowledge, understanding and contexts that are most appropriate for delivery in their centres.

Approaches to learning and teaching

Biology: life on Earth		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
1 Ecosystems a Definitions of ecological terms: species, biodiversity, population, producer, consumer, herbivore, carnivore, omnivore, predator, prey, food chain, food web		
b An ecosystem consists of all the organisms (the community) living in a particular habitat and the non-living components with which the organisms interact.		♦ Research a variety of ecosystems and the organisms found in them.
Interactions of organisms in food webs	Effects of removal of organism(s) from a food web	
c A niche is the role that an organism plays within a community. It relates to the resources it requires in its ecosystem, such as light and nutrient availability and its interactions with other organisms in the community. It involves competition and predation and the conditions it can tolerate, such as temperature.		♦ Investigate niches of Scottish wildlife, for example wildcat, red squirrel, red grouse, Scottish crossbill, brown trout, and bracken. ♦ Analyse data related to distribution of barnacles on rocky shores, native woodland and red deer numbers, distribution of ptarmigan.

Biology: life on Earth		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
1 Ecosystems (continued) d Competition in ecosystems occurs when resources are in short supply. Interspecific competition occurs among individuals of different species for one or a few of the resources they require. Intraspecific competition occurs among individuals of the same species and is for all resources required. Intraspecific competition is therefore more intense than interspecific competition. **2 Distribution of organisms** a Competition for resources, disease, food availability, grazing and predation are biotic factors. Light intensity, moisture, pH and temperature are abiotic factors. b Measuring abiotic factors, such as light intensity, soil moisture, pH and temperature. Possible sources of error and how to minimise them.		♦ Investigate interspecific competition in animals, for example red and grey squirrels, brown and rainbow trout. ♦ Investigate interspecific competition in plants, for example a variety of different seeds grown together. ♦ Investigate intraspecific competition, for example cress seedling density, trees of the same species growing close together. ♦ Interpret predator prey interaction graphs. ♦ Use of techniques for abiotic factors: temperature using thermometer or temperature probes, light using light meters, moisture using moisture meters, pH using pH meters or chemical test. ♦ Use of probes linked to appropriate data-logging software.

Biology: life on Earth		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
2 Distribution of organisms (continued) c Sampling of plants and animals using quadrats and pitfall traps. Evaluation of limitations and sources of error in their use.	The need for representative sampling and adequate replication	♦ Investigate the abundance of plants and/or invertebrates in an area. ♦ Investigate the distribution of a species in an ecosystem using a line transect.
d Using and constructing paired-statement keys to identify organisms		
e The effect of biotic and abiotic factors on biodiversity and the distribution of organisms	Factors that can cause an increase or a decrease in biodiversity	♦ Investigate the effect of light and/or moisture on the abundance of plants in an area. ♦ Investigate a range of human influences that affect environments, such as pollution of air and water, habitat destruction by, for example, deforestation (tropical rain forest), desertification, overfishing. ♦ Research human activities that cause species to become endangered.
f Indicator species are species that by their presence or absence indicate environmental quality and/or levels of pollution.		♦ Investigate the effect of air pollution on lichens. ♦ Investigate the effect of organic pollution on freshwater organisms.

Biology: life on Earth		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
3 Photosynthesis a Photosynthesis is a two-stage process: i Light reactions: the light energy from the sun is trapped by chlorophyll in the chloroplasts and is converted into chemical energy, which is used to generate ATP. Water is split to produce hydrogen and oxygen. Oxygen diffuses from the cell. ii Carbon fixation: a series of enzyme-controlled reactions, which use hydrogen and ATP (produced by the light reactions) with carbon dioxide to produce sugar. b The chemical energy in sugar is available for respiration or the sugar can be converted into other substances, such as starch (storage) and cellulose (structural). c Limiting factors: carbon dioxide concentration, light intensity and temperature and their impact on photosynthesis and plant growth Analysis of limiting factors graphs	Word summary of the process of photosynthesis: carbon dioxide + water $\xrightarrow{\text{light energy}}$ sugar + oxygen	♦ Factors affecting starch production can be investigated through iodine testing in leaves. ♦ Investigate limiting factors through experiments with *Elodea*, immobilised algae or the use of IT simulations.

Biology: life on Earth		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
4 Energy in ecosystems a In transfers from one level to the next in a food chain, the majority of the energy is lost as heat, movement or undigested materials. Only a very small quantity is used for growth and is therefore available at the next level in a food chain.		
b Definitions and comparisons of pyramids of numbers and energy	Irregular shapes of pyramids of numbers based on different body sizes can be represented as true pyramids of energy.	♦ Investigate examples of pyramid of energy (as measured in kJ/m^2/year) and pyramid of numbers. ♦ Investigate irregular pyramids of number, for example a tree as a producer, presence of parasites.

Biology: life on Earth		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
5 Food production a Increasing human population requires an increased food yield. This can involve the use of fertilisers and pesticides. Fertilisers provide chemicals, such as nitrates, which increase crop yield. Plants and animals that reduce crop yield can be killed by pesticides. b Nitrates dissolved in soil water are absorbed into plants. Nitrates are used to produce amino acids, which are synthesised into plant proteins. Animals consume plants or other animals to obtain amino acids for protein synthesis. Fertilisers can be added to soil to increase the nitrate content of the soil. c Fertilisers can leach into fresh water, adding extra, unwanted nitrates. This will increase algal populations, which can cause algal blooms. Algal blooms reduce light levels, killing aquatic plants. These dead plants, as well as dead algae, become food for bacteria, which increase greatly in number. The bacteria use up large quantities of oxygen, reducing the oxygen availability for other organisms. Genetically modified (GM) crops can be used to reduce the use of fertilisers.	Details of the full nitrogen cycle are not required.	♦ Investigate the effect of fertilisers on plant growth. ♦ Investigate the effect of fertiliser concentration on algal growth.

Biology: life on Earth (continued)		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
5 Food production (continued) d Pesticides sprayed onto crops can accumulate in the bodies of organisms over time. As they are passed along food chains, toxicity increases and can reach lethal levels. The use of biological control and genetically modified (GM) crops as alternatives to the use of pesticides.	The build-up of toxic substances in living organisms is known as bioaccumulation.	♦ Research GM crops that can reduce fertiliser use. ♦ Research bioaccumulation through former use of DDT, lead (from leaded petrol) and mercury. ♦ Research biological control, such as using a virus (for example calicivirus) to kill rabbits; using ladybirds to kill aphids and scale insects; using caterpillar moth (*Cactoblastis*) to kill cacti (*Opuntia*). ♦ Investigate GM rice plants, which take up nitrogen more efficiently. ♦ Research Bt toxin in tomatoes as an alternative to pesticides.

Biology: life on Earth		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
6 Evolution of species a A mutation is a random change to genetic material. Mutations may be neutral, confer an advantage or confer a disadvantage to survival. Mutations are spontaneous and are the only source of new alleles. Environmental factors, such as radiation and some chemicals, can increase the rate of mutation.		♦ Research different types of mutation — neutral, advantageous or disadvantageous. ♦ Research mutagenic agents.
b New alleles produced by mutation can result in plants and animals becoming better adapted to their environment. Variation within a population makes it possible for a population to evolve over time in response to changing environmental conditions.	An adaptation is an inherited characteristic that makes an organism well suited to survival in its environment or niche.	♦ Investigate examples of adaptations, such as desert mammals and plants and Galapagos finches.
c Species produce more offspring than the environment can sustain. Natural selection or survival of the fittest occurs when there are selection pressures. The best adapted individuals in a population survive to reproduce, passing on the favourable alleles that confer the selective advantage. These alleles increase in frequency within the population.		♦ Research consequences of over-prescription of antibiotics.

Biology: life on Earth		
Key areas	**Depth of knowledge required**	**Suggested learning activities**
6 Evolution of species (continued) d Speciation occurs after part of a population becomes isolated by an isolation barrier, which can be geographical, ecological or behavioural. Different mutations occur in each sub-population. Natural selection selects for different mutations in each group, due to different selection pressures. Each sub-population evolves until they become so genetically different that they are two different species.	Examples of each type of barrier, for example ecological: pH, salinity or different habitats	♦ Research Scottish examples of isolation leading to speciation, for example Arran whitebeam, St Kilda wren, Arctic char. ♦ Research examples of rapid natural selection, for example MRSA, insect resistance to GM crop toxins.

Administrative information

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Superclass: RH

History of changes to National Unit Specification

Version	Description of change	Authorised by	Date