Course Support Notes

National 5 Biology Course Support Notes

Please refer to the note of changes at the end of this document for details of changes from previous version (where applicable).

Contents

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the National 5 Biology Course.
They are intended for teachers and lecturers who are delivering the Course and its Units. They should be read in conjunction with the *Course Specification*, the *Course Assessment Specification* and the *Unit Specifications* for the Units in the Course.

General guidance on the Course

Aims

As stated in the *Course Specification,* the aims of the Course are to enable learners to:

- develop and apply knowledge and understanding of biology
- develop an understanding of biology's role in scientific issues and relevant applications of biology, including the impact these could make in society and the environment
- develop scientific inquiry and investigative skills
- develop scientific analytical thinking skills in a biology context
- develop the use of technology, equipment and materials, safely, in practical scientific activities
- develop planning skills
- develop problem solving skills in a biology context
- use and understand scientific literacy, in everyday contexts, to communicate ideas and issues and to make scientifically informed choices
- develop the knowledge and skills for more advanced learning in biology
- develop skills of independent working

Progression into this Course

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

- National 4 Biology Course

There may also be progression from National 4 Chemistry, National 4 Environmental Science, National 4 Physics and National 4 Science Courses.

Experiences and outcomes
National Courses have been designed to draw on and build on the curriculum experiences and outcomes as appropriate. Qualifications developed for the senior phase of secondary education are benchmarked against SCQF levels. SCQF level 4 and the curriculum level 4 are broadly equivalent in terms of level of demand although qualifications at SCQF level 4 will be more specific to allow for more specialist study of subjects.

Learners who have completed relevant Curriculum for Excellence experiences and outcomes will find these an appropriate basis for doing the Course.

In this Course, learners would benefit from having experience of the following:

Organisers	**Lines of development**	
Planet Earth	Biodiversity and Interdependence	SCN 01, 02, 03
Biological Systems	Body Systems	SCN 12, 13
	Inheritance	SCN 14

More detail is contained in the Biology Progression Framework. The Biology Progression framework shows the development of the key areas throughout the suite of Courses.

Skills, knowledge and understanding covered in the Course

Note: teachers and lecturers should refer to the *Course Assessment Specification* for mandatory information about the skills, knowledge and understanding to be covered in this Course.

Progression from this Course

This Course or its components may provide progression for the learner to:

- Higher Biology or Higher Human Biology
- National 5 Course in another science subject
- Skills for Work Courses (SCQF levels 5 or 6)
- National Certificate Group Awards
- National Progression Awards (SCQF levels 5 or 6)
- Employment and/or training

Hierarchies

Hierarchy is the term used to describe Courses and Units which form a structured sequence involving two or more SCQF levels.

It is important that any content in a Course and/or Unit at one particular SCQF level is not repeated if a learner progresses to the next level of the hierarchy. The skills and knowledge should be able to be applied to new content and contexts to enrich the learning experience. This is for centres to manage.

- Biology Courses from National 3 to Advanced Higher are hierarchical.
- Courses from National 3 to National 5 have Units with the same structure and titles.
- National 5 gives equal progression to both Higher Biology and Higher Human Biology. Higher Biology and Higher Human Biology give equal progression to Advanced Higher Biology.

Approaches to learning and teaching

The purpose of this section is to provide you with advice and guidance on learning and teaching. It is essential that you are familiar with the mandatory information within the National 5 Biology Course Assessment Specification.

Teaching should involve an appropriate range of approaches to develop knowledge and understanding and skills for learning, life and work. This can be integrated into a related sequence of activities, centred on an idea, theme or application of biology, based on appropriate contexts, and need not be restricted to the Unit structure. Learning should be experiential, active, challenging and enjoyable, and include appropriate practical experiments/activities and could be learner-led. The use of a variety of active learning approaches is encouraged, including peer teaching and assessment, individual and group presentations, role-playing and game-based learning, with learner-generated questions.

When developing your Biology Course there should be opportunities for learners to take responsibility for their learning. Learning and teaching should build on learners' prior knowledge, skills and experiences. The Units and the key areas identified within them may be approached in any appropriate sequence, at the centre's discretion. The distribution of time between the various Units is a matter for professional judgement and is entirely at the discretion the centre. Each Unit is likely to require an approximately equal time allocation, although this may depend on the learners' prior learning in the different key areas.

Learning and teaching, within a class, can be organised, in a flexible way, to allow a range of learners' needs to be met, including learners achieving at different levels. The hierarchical nature of the new Biology qualifications provides improved continuity between the levels. Centres can, therefore, organise learning and teaching strategies in ways appropriate for their learners.

Within a class, there may be learners capable of achieving at a higher level in some aspects of the Course. Where possible, they should be given the opportunity to do so. There may also be learners who are struggling to achieve in all aspects of the Course, and may only achieve at the lower level in some areas.

Teachers/lecturers need to consider the Course and Unit Specifications, and Course Assessment Specifications to identify the differences between Course levels. It may also be useful to refer to the Biology Progression Framework.

When delivering this Course to a group of learners, with some working towards different levels, it may be useful for teachers to identify activities covering common concepts and skills for all learners, and additional activities required for some learners. In some aspects of the Course, the difference between levels is defined in terms of a higher level of skill.

An investigatory approach is encouraged in Biology, with learners actively involved in developing their skills, knowledge and understanding by investigating a range of relevant Biology applications and issues. A holistic approach should be adopted to encourage simultaneous development of learners' conceptual understanding and skills.

Where appropriate, investigative work/experiments, in Biology, should allow learners the opportunity to select activities and/or carry out extended study. Investigative and experimental work is part of the scientific method of working and can fulfil a number of educational purposes.

All learning and teaching should offer opportunities for learners to work collaboratively. Practical activities and investigative work can offer opportunities for group work, which should be encouraged.

Group work approaches can be used within Units and across Courses, where it is helpful to simulate real-life situations, share tasks and promote team working skills. However, there must be clear evidence for each learner to show that the learner has met the required assessment standards for the Unit or Course.

Laboratory work should include the use of technology and equipment that reflects current scientific use in biology. Fieldwork provides an opportunity for practical work, using first-hand experience of an ecosystem to develop knowledge, understanding and problem solving. Appropriate risk assessment must be undertaken.

Learners would be expected to contribute their own time in addition to programmed learning time.

Effective partnership working can enhance the science experience. Where possible, locally relevant contexts should be studied, with visits where this is possible. Guest speakers from eg industry, further and higher education could be used to bring the world of biology into the classroom.

Information and Communications Technology (ICT) can make a significant contribution to practical work in National 5 Biology, in addition to the use of computers as a learning tool. Computer interfacing equipment can detect and record small changes in variables allowing experimental results to be recorded over short periods of time completing experiments in class time. Results can also be displayed in real-time helping to improve understanding. Data logging equipment and video cameras can be set up to record data and make observations over periods of time longer than a class lesson which can then be subsequently downloaded and viewed for analysis.

Learning about Scotland and Scottish culture will enrich the learners' learning experience and help them to develop the skills for learning, life and work they will need to prepare them for taking their place in a diverse, inclusive and participative Scotland and beyond. Where there are opportunities to contextualise approaches to learning and teaching to Scottish contexts, teachers and lecturers should consider this.

Assessment should be integral to and improve learning and teaching. The approach should involve learners and provide supportive feedback. Self- and peer-assessment techniques should be encouraged, wherever appropriate. Assessment information should be used to set learning targets and next steps.

As part of learning, teaching and preparation for assessment, it is recommended that learners carry out several investigations that meet the requirements of the Assignment, as stipulated in the *Course Assessment Specification*. This should help learners develop the necessary skills and prepare them for subsequent assessment.

For exemplification, a resource pack for one investigation is contained in Appendix 2. This resource pack contains background information on one topic, as well as links and suggestions of other sources of information. It exemplifies one approach to Stage 1 (research stage) of the investigation.

Learners may practice producing their report/communication, using this resource pack as their sources of information/data for Stage 1 (research stage) of the investigation. This will allow Stage 2 (communicating stage) to be carried out without learners having to access additional resources.

The *Course and Unit Support Notes* for National 4 Biology, National 4 Environmental Science and National 5 Environmental Science each contain a resource pack for a different topic. Some of these may also provide learners with suitable opportunities to practice their Assignment.

Teachers and lecturers may choose to develop other resource packs, on an ongoing basis, to provide sets of resources for learners.

Suggestions for possible contexts and learning activities, to support and enrich learning and teaching, are detailed in the table below.

The **Mandatory Course key areas** are from the *Course Assessment Specification*. **Suggested learning activities** are not mandatory. This offers examples of suggested activities, from which you could select a range. It is not expected that all will be covered. The contexts for Mandatory Course key areas are open to personalisation and choice, so centres may also devise their own learning activities.

Suggested **Exemplification of key areas** is not mandatory. It provides an outline of the level of demand and detail of the key areas.

Cell Biology		
Mandatory Course key areas	**Suggested learning activities**	**Exemplification of key areas**
1 Cell structure Cell ultrastructure and functions to include: cell wall, mitochondrion, chloroplast, cell membrane, cytoplasm, vacuole, nucleus, ribosome and plasmid using examples from typical plant, animal, fungi and bacterial cells.	Examine fresh and prepared slides of a range of plant, animal and microbial cells using appropriate stains and a light microscope/ bioviewer, eg cheek epithelium, onion epidermis, rhubarb epidermis, Elodea, yeast. Numeracy activities on cell size to investigate cell length and breadth.	Functions of structures exemplified later in this Unit. Fungal structure in terms of similarity to plant and animal cells but with a different cell wall structure. Bacterial structures only to include absence of organelles and a different cell wall structure to plant and fungal cells. Chemical composition of cell walls not required.
2 Transport across cell membranes a. The cell membrane consists of lipids and proteins and is selectively permeable. b. Passive transport is along a concentration gradient and does not require energy. c. Diffusion in cells as the movement of molecules down a concentration gradient. d. Osmosis as the movement of water molecules across a membrane in terms of water concentration.	Investigate the structure of the fluid mosaic model. Investigate diffusion and osmosis using visking tubing and/or mass/length of plant tissue, bleeding in plant cells, plant cell plasmolysis, mass changes in egg (shell removed by soaking in vinegar) in syrup/water. Research examples of osmosis for eg power generation, desalination. Differential uptake of dye in boiled and live yeast cells.	Different concentrations of substances exist between cells and their environment. Diffusion in terms of concentration gradients and importance to cells could include glucose, carbon dioxide, oxygen or amino acids.

e. Animal cells can burst or shrink and plant cells can become turgid or plasmolysed in different solutions. f. Active transport requires energy for membrane proteins to move molecules and ions against the concentration gradient.		Appropriate examples for active transport could include sodium and potassium in nerve cells, or iodine in seaweeds. These processes can be applied across relevant areas of the Course.
3 Producing new cells a. Maintenance of diploid chromosome complement by mitosis. b. Sequence of events of mitosis, including the terms chromatids, equator and spindle fibres. c. Cell production by cell culture requires aseptic techniques, an appropriate medium and the control of other factors. d. Mitosis is required for growth and repair.	Carry out numeracy activities based on cell growth graphs/curves. Select and present information using mitosis stage cards. Create model chromosomes. Observe prepared root tip cell slides/bioviewer. Practical activity/investigation/research into aseptic techniques, solid and liquid media in cell culture and use of fermenters.	Diploid cells have two matching sets of chromosomes, which are replicated during mitosis. Names of mitosis phases are not needed. Appropriate growth media include various nutrient broths and agars. Appropriate factors could include oxygen, temperature and pH.
4 DNA and the production of proteins a. Structure of DNA: double-stranded helix held by complementary base pairs. DNA carries the genetic information for making proteins. The four bases Adenine, Cytosine, Guanine and Thymine (A, C, G and T) make up the genetic code. The base sequence determines amino acid sequence in protein.	Research the relationship between chromosomes, genes, DNA and protein to illustrate that genes are located on chromosomes. Construction of 2D or 3D DNA models. Paper models of base pairing or DNA sections.	

b. Messenger RNA (mRNA) is a molecule which carries a complimentary copy of the code from the DNA, in the nucleus, to a ribosome, where the protein is assembled from amino acids.	Research biologists eg Watson and Crick, Rosalind Franklin, Maurice Wilkins, Chargaff.	Further details of transcription and translation are not required.
5 Proteins and enzymes a. The variety of protein shapes and functions arises from the sequence of amino acids. b. Functions of proteins to include structural, enzymes, hormones, antibodies and receptors. c. Enzymes function as biological catalysts and are made by all living cells. They speed up cellular reactions and are unchanged in the process. The shape of the active site of enzyme molecules is complementary to a specific substrate. d. Each enzyme works best in its optimum conditions. Enzymes and other proteins can be affected by temperature and pH. Enzymes can be denatured, resulting in a change in their shape, which will affect the rate of reaction.	Create protein models eg haemoglobin, antibodies, membrane proteins and enzymes. Use of appropriate software eg RasMol, Protein Explorer. Enzyme experiments with eg pepsin, lipase, amylase, catalase to investigate the influence of temperature and pH on activity. Effect of temperature and pH on egg white as a model for effect on other proteins. Model/sequencing activates on stages.	Levels of protein structure such as secondary/tertiary not required.

6 Genetic engineering Genetic information can be transferred from one cell to another naturally or by genetic engineering. Stages of genetic engineering to include: identify section of DNA that contains required gene from source chromosome, extract required gene, insert required gene into vector/bacterial plasmid, insert plasmid into host cell and grow transformed cells to produce a GM organism.	Research current genetic foods/issues such as golden rice, less toxic rape seed oil, bird resistance to bird flu, tomatoes with longer shelf life, blight resistant potatoes, production of medicines for human use eg insulin and growth hormone.	DNA can be transferred naturally between cells either by bacterial plasmids or viruses. Details of these processes not required. Links with Life on Earth Unit.
7 Photosynthesis a. Photosynthesis is a two-stage process. 1. Light reactions: the light energy from the sun is trapped by chlorophyll in the chloroplasts and is converted into chemical energy in the form of ATP. Water is split to produce hydrogen and oxygen. Hydrogen attaches to hydrogen acceptor molecules. Excess oxygen diffuses from the cell. 2. 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 can be converted into other substances, such as starch and cellulose. c. Limiting factors: carbon dioxide concentration, light intensity and temperature and their impact on photosynthesis and plant growth.	Oxygen production, carbon dioxide uptake or rate of photosynthesis can be investigated through the use of floating leaf discs, Elodea, Cabomba or immobilised algae. These can also be used to investigate limiting factors. Use IT simulations of photosynthesis experiments eg Multimedia Science Factors affecting starch production can be investigated through iodine testing in leaves. Analysis of limiting factors graphs.	Summary word equation for photosynthesis: Carbon dioxide + water $\xrightarrow[\text{Chlorophyll}]{\text{Light energy}}$ sugar + oxygen Carbohydrates can then be used to produce fats and proteins.

8 Respiration a. The chemical energy stored in glucose must be released by all cells through a series of enzyme-controlled reactions called respiration. b. The energy released from the breakdown of glucose is used to generate ATP from ADP and inorganic phosphate (Pi). The chemical energy stored in ATP can be released by breaking it down to ADP and inorganic phosphate. This energy can be used for cellular activities including muscle cell contraction, cell division, protein synthesis and transmission of nerve impulses. ATP can be regenerated during respiration. The breakdown of each glucose molecule via pyruvate to carbon dioxide and water in the presence of oxygen yields 38 molecules of ATP. The breakdown of each glucose molecule via the fermentation pathway yields two molecules of ATP when oxygen is not present. Breakdown of glucose to lactic acid via pyruvate in animal cells. Breakdown of glucose to alcohol/ethanol and carbon dioxide via pyruvate in plant and yeast cells. c. Respiration begins in the cytoplasm. The process of fermentation is completed in the cytoplasm. Aerobic respiration starts in the cytoplasm and is completed in the mitochondria.	Practical investigations on burning food. Practical investigations of DCPIP/Cabomba and hydrogen carbonate indicator. Use immobilised yeast and hydrogen carbonate indicator, resazurin or gas sensors and data loggers to investigate rate of respiration. Investigate respiration indirectly through breathing rates before and during exercise in humans.	Cells such as muscle, companion, sperm, neurone will have a high number of mitochondria as they require a lot of energy. Summary word equations for respiration: Glucose + oxygen $\rightarrow$ carbon dioxide + water Glucose $\rightarrow$ ethanol/alcohol + carbon dioxide Glucose $\rightarrow$ lactic acid Links with Multicellular Organisms Unit.

Multicellular Organisms		
Mandatory Course key areas	**Suggested learning activities**	**Exemplification of key areas**
1 Cells, tissues and organs Specialisation of cells, in animals and plants, leads to the formation of a variety of tissues and organs.	Examine a variety of cells from different tissues to relate their structure to function.	Multicellular organisms have more than one cell type and are made up of tissues and organs. Organs perform different functions. The cells in organs are specialised for their function. Specialisation can be applied to all named tissues in this Unit.
2 Stem cells and meristems a. Stem cells in animals can divide and have the potential to become different types of cell. Stem cells are involved in growth and repair. b. Meristems are the sites of production of non-specialised cells in plants and are the sites for mitosis in a plant. These cells have the potential to become other types of plant cell and they contribute to plant growth.	Use a variety of media to investigate the potential uses of stem cells and discuss ethical issues associated with their use. Carry out practicals on root tip/shoot tip stain.	

3 Control and Communication a. Nervous control Nervous control in animals, including structure and function of central nervous system (CNS) and the brain, to include: cerebrum, cerebellum and medulla. b. Rapid reflex action and reflex arc: sensory, relay and motor neurons. Receptors detect sensory input/stimuli. Electrical impulses carry messages along neurons. A synapse occurs between neurons. Chemicals transfer these messages across synapses. c. Hormonal control Endocrine glands release hormones into the blood stream. Hormones are chemical messengers. Target tissues have cells with receptor proteins for hormones, so only some tissues are affected by specific hormones. d. Blood glucose regulation including the role of insulin, glucagon, glycogen, pancreas and liver.	Investigate examples of where communication pathways are used eg pain receptors. Investigate examples of human reflex activities eg knee-jerk. Research the role of hormones in the body. Investigate the causes and treatment of both type 1 and type 2 diabetes with reference to trends in Scottish health statistics.	Internal communication is required for survival of a multicellular organism. Cells in multicellular organisms do not work independently. Sensory neurons pass the information to the central nervous system. The CNS processes the information from our senses which needs a response. Motor neurons enable a response to occur, which can be a rapid action from a muscle or a slower response from a gland. Diabetes as a communication pathway that has failed due to a fault in release or a failure to respond to insulin and consequences and treatment. Reference can be made to the benefits of controlling blood glucose level in relation to osmosis in cells. Detail of negative feedback is not required.

4 Reproduction a. Cells are diploid, except gametes, which are haploid. The structure of gametes and the sites of their production in plants and animals. b. The fusion of haploid gametes produces a diploid zygote at fertilisation.	Compare and contrast male and female animal and plant gametes, gonads and organs from micrographs, models, reference materials, photographs and dissection of flowers.	There may be exceptions eg polyploid organisms. This is not assessed at this level.
5 Variation and Inheritance a. Comparison of discrete and continuous variation. b. Most features of an individual phenotype are polygenic and show continuous variation. c. Genetic terms including gene, allele, phenotype, genotype, dominant, recessive, homozygous, heterozygous and P_1, F_1 and F_2.	Investigate a variety of discrete and continuous characteristics in organisms eg ear lobes, tongue-rolling and height. Research Mendel's work on peas. Research polygenic inheritance. Use Punnett squares to explain inheritance. Carry out Gene Jury activity (How my genes work) to build individual.	Combining genes from separate parents contributes to variation within a species. Single gene inheritance of characters showing discrete variation where measurements fall into distinct groups. Family trees can be used to identify the phenotype and genotype of individuals. Carrier individuals of medical traits can receive genetic counselling. Family tress and pedigree charts can be used to identify individuals.
6 The need for transport a. Plant transport systems i. Water is required for transporting materials and for photosynthesis. ii. Structures and processes involved in water movement to include root hairs, guard cells, stomata, epidermis, mesophyll cells and transpiration.	Investigate the germination of seeds to show root hairs. Transpiration experiments to show water loss. Set up stomatal models, use leaf peels and microscopes to view stomata. Stain xylem vessels using dye/celery. Examine slides showing xylem and phloem structure.	Multicellular organisms need transport systems to deal with surface area to volume ratio issue. Transpiration is the loss of water through leaves. Water is lost by evaporation through stomata, whose opening and closing is controlled by guard cells, which are found in the leaf epidermis. Mesophyll cells of the leaf require water for photosynthesis.

Water and minerals are transported through the stem in xylem. Xylem cells/vessels are lignified. iii. Sugar is transported up and down the plant in living phloem cells.		Xylem cells are lignified to withstand the pressure changes as water moves through the plant.
b. Animal transport and exchange systems i. In mammals, nutrients, oxygen and carbon dioxide are transported in the blood. ii. Pathway of oxygenated and deoxygenated blood through heart, lungs and body. Heart structure to include right and left atria and ventricles and location of valves. Blood vessels to include: aorta, vena cava, pulmonary arteries and veins, and coronary arteries. iii. Arteries have thick, muscular walls, a narrow central channel and carry blood under high pressure. Veins carry blood under low pressure; have thinner walls and a wide channel. Veins contain valves to prevent backflow of blood. Capillaries form networks at organs and tissues, and are thin walled and have a large surface area, allowing exchange of materials. iv. Red blood cells contain haemoglobin and are specialised to carry oxygen in oxyhaemoglobin.	Investigate heart structure eg dissection, models, films. Investigate structure of arteries, veins, capillaries and blood cells. Investigate lungs eg dissection, model, films. Comparisons can be made between cartilage in airways and lignin in xylem.	

v. Rings of cartilage keep main airways open. Oxygen and carbon dioxide are exchanged through the alveolar walls. Alveoli have a large surface area, a good blood supply and thin walls for more efficient diffusion of gases. Mucus traps dirt and microorganisms and cilia moves this up and away from the lungs. vi. Food is moved through the digestive system by peristalsis. Villi in the small intestine are thin walled, have a large surface area and a good blood supply to aid absorption of glucose and amino acids. The lacteals absorb the products of fat digestion.	Peristalsis model. Model gut.	
7 Effects of lifestyle choices on human transport and exchange systems	Use health promotion and reference materials to identify how healthier lifestyle choices can directly and indirectly improve the physical and mental health of an individual. Take physiological measurements. Investigate the effect of moderate exercise on these measurements. Debate whether all illnesses should be treated for free under the National Health Service in the UK.	Possible examples of lifestyle choices could be high-fat or high-salt diet, lack of exercise, use of tobacco or alcohol, or high-stress experiences. These directly and indirectly increase the chances of fatty deposits in blood vessels, blood clots, heart attacks, strokes, diabetes and stress. Lack of iron means haemoglobin cannot be made and can lead to anaemia. Possible environmental factors could be heavy metals, radiation and pollution. Heredity plays a part in the incidence of some conditions.

Life on Earth		
Mandatory Course key areas	**Suggested learning activities**	**Exemplification of key areas**
1 Biodiversity and the distribution of life a. Biotic and abiotic factors affect biodiversity in an ecosystem. Human activities can also have an impact on biodiversity.	Investigate a range of human influences that affect national and global environments such as: pollution of air and water, habitat destruction by eg deforestation (tropical rain forest), desertification, endangered species, overfishing and lichen studies.	Various factors can increase or decrease the biodiversity of an ecosystem. pH and temperature can affect the variety of fish species.
b. Grazing and predation are biotic factors; pH and temperature are abiotic factors.	Interpret predator prey interaction graphs. Analyse Barn owl pellets from Barn Owl Trust website.	
c. Biomes are the various regions of our planet as distinguished by their climate, fauna and flora. Global distribution of biomes can be influenced by temperature and rainfall.	Research a range of biomes eg freshwater, marine, desert, forests, grassland, and tundra. Open Door website.	
d. An ecosystem consists of all the organisms living in a particular habitat and the non-living components with which the organisms interact.	Case studies/fieldwork on eg Caledonian forests, sea lochs, heather moorland, tropical rainforests, arctic tundra, coral reefs and deserts.	
e. A niche is the role that an organism plays within a community. It includes the use it makes of the resources in its ecosystem, including light, temperature and nutrient availability and its interactions with other organisms in the community including competition, parasitism and predation.	Investigate examples of niches of Scottish wildlife eg 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.	

2 Energy in ecosystems a. In transfers from one level to the next in a food chain, 90% of energy is lost as heat, movement or undigested materials. 10% is used for growth.	Investigate examples of pyramid of energy (as measured in kJ/m^2/year), pyramid of biomass (g/m^2) and pyramid of numbers.	Some losses can be accounted for through decomposition.
b. Pyramids of biomass, energy and numbers.	Investigate irregular pyramids of number eg a tree as a producer, presence of parasites.	Irregular shapes of pyramids of numbers based on different body sizes are represented as true pyramids of energy and of biomass.
c. Nitrogen in ecosystems Animal and plant proteins are produced using nitrogen from nitrates. The roles of nitrifying, denitrifying, root nodule and free-living nitrogen-fixing soil bacteria. Decomposers, such as fungi and bacteria, convert proteins and nitrogenous wastes to ammonium compounds These are converted to nitrites and then to nitrates.	Construct simple flow diagrams that illustrate the cyclical activities in the Nitrogen cycle.	Fertilisers supply nitrates to increase yield.
d. Other ecological terms including: species, population, producer, consumer, herbivore, carnivore and omnivore.		
e. Competition in ecosystems Interspecific competition is individuals of different species requiring similar resources in an ecosystem. Intraspecific competition is individuals of the same species requiring the same resources.	Investigate interspecific competition eg red and grey squirrels, brown and rainbow trout. Investigate intraspecific competition eg cress seedling seed number, trees of the same species growing close together, feeding in grasshoppers, territorial behaviour in birds eg robins, red grouse.	Competition examples can include food, light, and water.

3 Sampling techniques and measurement of abiotic and biotic factors a. Plants and animals using techniques including quadrats and pitfall traps. b. Evaluation of limitations and sources of error in the use of quadrats and pitfall traps. c. Measuring abiotic factors including light intensity, temperature, pH and soil moisture.	Techniques for biotic factors eg quadrats, transect, pitfall trap, Tullgren funnel, pooters, and tree beating/sweep net, pond netting. 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. Using data to assess the effect of abiotic factors on the distribution of organisms. Using and constructing paired-statement keys to identify organisms.	Representative sampling and adequate replication.
4 Adaptation, natural selection and the evolution of species a. A mutation is a random change to genetic material. Mutations may be neutral, confer an advantage or a disadvantage. Mutations are spontaneous and are the only source of new alleles. Environmental factors, such as radiation and some chemicals, can increase rate of mutation.	Research different types of mutation — neutral, advantageous or disadvantageous. Research mutagenic agents.	

b. Variation within a population makes it possible for a population to evolve over time in response to changing environmental conditions.	Investigate examples of adaptations such as desert mammals, plants and specific pollinators eg orchids and moths, acacia ants and acacias, bee pollinated plants and flower colour related to bee vision. Galapagos finches. Desert plants Investigate the 'Red Queen' model of ecology in which competition is the engine of evolutionary change. Research consequences of over-prescription of antibiotics. Case Study on insect resistance to 'built-in' insecticides in GM crops eg bollworm moth in cotton, European corn borer in maize.	An adaptation is an inherited characteristic that makes an organism well suited to survival in its environment/niche.
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 survive to reproduce, passing on the favourable alleles that confer the selective advantage.		
d. Speciation occurs after part of a population becomes isolated. 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 they are two species.	Research Scottish examples of isolation leading to speciation eg Arran Whitebeam, St Kilda Wren, Arctic Char. Research examples of rapid natural selection eg MRSA, insect resistance to GM crop toxins. Research the Tree of Life using OU/BBC chart to illustrate inter-connectedness of all life.	

5 Human impact on the environment a. Increasing human population requires an increased food yield. b. Fertilisers can leach into fresh water, increasing algal blooms. This leads to a reduction in oxygen levels. c. 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. d. Indicator species are species that by their presence or absence indicate environmental quality/levels of pollution. e. Biological control and GM crops may be alternatives to the use of fertilisers and pesticides.	Research GM crops, monoculture and intensive farming. Investigate the importance of minerals such as nitrates and magnesium for plant growth. Investigate bioaccumulation eg DDT. Research importance of different environmental indicator species. Survey local area for different varieties of lichen and assess local air quality. Sample freshwater invertebrates from local water courses/ponds and assess water quality. Investigate biological control eg using a virus (Myxomatosis) to kill rabbits, using ladybirds to kill aphids and scale insects, using caterpillar moth (Cactoblastis) to kill cacti (Opuntia).	There are opportunities throughout this topic for learners to investigate and debate ethical issues.

Developing skills for learning, skills for life and skills for work

Learners are expected to develop broad generic skills as an integral part of their learning experience. The *Course Specification* lists the skills for learning, skills for life and skills for work that learners should develop through this Course. These are based on SQA's *Skills Framework: Skills for Learning, Skills for Life and Skills for Work* and must be built into the Course where there are appropriate opportunities. The level of these skills will be appropriate to the level of the Course.

For this Course, it is expected that the following skills for learning, skills for life and skills for work will be significantly developed:

Numeracy
This is the ability to use numbers to solve problems by counting, doing calculations, measuring, and understanding graphs and charts. This is also the ability to understand the results. Learners will have opportunities to extract, process and interpret information presented in numerous formats including tabular and graphical. Practical work will provide opportunities to develop time and measurement skills.

2.1 Number processes
Number processes means solving problems arising in everyday life through carrying out calculations, when dealing with data and results from experiments/investigations and everyday class work, making informed decisions based on the results of these calculations and understanding these results.

2.2 Money, time and measurement
This means using and understanding time and measurement to solve problems and handle data in a variety of biology contexts, including practical and investigative.

2.3 Information handling
Information handling means being able to interpret biological data in tables, charts and other graphical displays to draw sensible conclusions throughout the Course. It involves interpreting the data and considering its reliability in making reasoned deductions and informed decisions. It also involves an awareness and understanding of the chance of events happening.

Thinking skills
This is the ability to develop the cognitive skills of remembering and identifying, understanding and applying. The Course will allow learners to develop skills of applying, analysing and evaluating. Learners can analyse and evaluate practical work and data by reviewing the process, identifying issues and forming valid conclusions. They can demonstrate understanding and application of concepts and explain and interpret information and data.

5.3 Applying
Applying is the ability to use existing information to solve biological problems in different contexts, and to plan, organise and complete a task such as an investigation.

5.4 Analysing and evaluating
Analysis is the ability to solve problems in biology and make decisions that are based on available information.
It may involve the review and evaluation of relevant information and/or prior knowledge to provide an explanation.
It may build on selecting and/or processing information, so is a higher skill.

In addition, learners will also have opportunities to develop literacy skills, working with others, creating and citizenship.

Literacy
Learners develop the literacy skills to effectively communicate key biology concepts and describe clearly biology issues in various media forms. Learners will have opportunities to communicate knowledge and understanding, with an emphasis on applications and environmental, ethical and/or social impacts. Learners will have opportunities to develop listening and reading skills when gathering and processing information.

Working with others
Learning activities provide many opportunities, in all areas of the Course, for learners to work with others. Practical activities and investigations, in particular, offer opportunities for group work, which is an important aspect of biology and should be encouraged.

Creating
Through learning in biology, learners can demonstrate their creativity. In particular, when planning and designing experiments/investigations, learners have the opportunity to be innovative in their approach. Learners also have the opportunities to make, write, say or do something new.

Citizenship
Learners will develop citizenship skills when considering the applications of biology on our lives, as well as environmental and ethical implications.

Approaches to assessment

Assessment should cover the mandatory skills, knowledge and understanding of the Course. Assessment should be integral to and improve learning and teaching. The approach should involve learners and provide supportive feedback. Self- and peer-assessment techniques should be used, whenever appropriate.

See the *Unit Support Notes* for guidance on approaches to assessment of the Units of the Course.

Added value

Courses from National 4 to Advanced Higher include assessment of added value. At National 5, Higher and Advanced Higher, the added value will be assessed in the Course assessment.

Information given in the *Course Specification* and the *Course Assessment Specification* about the assessment of added value is mandatory.

Suggested investigations

Some suggested investigations are listed below which are likely to be familiar to assessors. Centres are free to select other appropriate investigations.

Investigations
Biological detergents/use of enzymes in industry
Food production using greenhouses
Stem cell research and use
Conservation of endangered species
GM crops
DNA in forensics/paternity testing

A resource pack has been developed for one of these investigations and can be found in Appendix 2. This is not mandatory. Centres are free to develop their own investigations.

Preparation for Course assessment

Each Course has additional time which may be used at the discretion of the teacher or lecturer to enable learners to prepare for Course assessment. This time may be used near the start of the Course and at various points throughout the Course for consolidation and support. It may also be used for preparation for Unit assessment, and towards the end of the Course, for further integration, revision and preparation and/or gathering evidence for Course assessment.

During delivery of the Course, opportunities should be found:

- for identification of particular aspects of work requiring reinforcement and support
- to practise skills of scientific inquiry and investigation in preparation for the Assignment
- to practise question paper techniques

Combining assessment across Units

If an integrated approach to Course delivery is chosen then there may be opportunities for combining assessment across Units. If this approach is used, then it is necessary to be able to track evidence for individual Outcomes and Assessment Standards.

Transfer for evidence
Evidence for the achievement of Outcome 1 and Assessment Standards 2.2, 2.3 and 2.4 for one Unit can be used as evidence of the achievement of Outcome 1 and Assessment Standards 2.2, 2.3 and 2.4 in the other Units of this Course.

Exemplification of standards

Assessment Standards can be achieved via a number of pieces of evidence covering work done on different occasions.

Assessors should record evidence of achievement of Outcomes and Assessment Standards. The recording evidence table on the next page shows how the evidence has been recorded, with comments, where appropriate. Tables like this are not mandatory.

Candidate 1's report provides evidence for Assessment Standards 1.1, 1.3, 1.4 and 1.5 in a single report. Candidate 2's report provides evidence for Assessment Standard 1.6.

The assessor's recording evidence table provides an alternative example. It shows when each Assessment Standard was overtaken. It also includes a record of the evidence to demonstrate success for Assessment Standard 1.2.

Assessment Standard	Evidence required	Evidence produced
1.1 Planning an experiment/practical investigation	Aim of experiment	The aim is stated in the candidate's report.
	Dependent/independent variable	These variables are stated in the candidate's report.
	Variables to be kept constant	Several appropriate variables are stated.
	Measurements/ observations to be made	Measurements to be made are stated.
	Resources	Resources are stated and shown in the labelled diagram.
	Method including safety	The method is described.
1.2 Following procedures safely	Procedures have been followed safely and correctly	The assessor used a checklist to record that they had seen the candidate carry out the procedure.
1.3 Making and recording observations/measurements accurately	Observations/measurements taken are correct	Observations/ measurements are presented and these are correct. The assessor recorded that they had seen these.
1.4 Presenting results in an appropriate format	Results have been presented in an appropriate format	Results are presented in an appropriate format, ie table and line graph. Units are used appropriately.
1.5 Drawing valid conclusions	What the experiment shows, with reference to the aim	A correct conclusion is stated.
1.6 Evaluating experimental procedures	The suggestion given will improve the experiment	An appropriate improvement is suggested.

Candidate 1

The effect of temperature change on hydrogen peroxide

Aim - The aim of the experiment was to investigate the effect of temperature change on hydrogen peroxide by measuring the volume of oxygen produced.

Conclusion - In conclusion as the temperature increased the volume of oxygen increased.

✓1.5

The effect of Temperature on enzyme activity.

Aim - The aim of this experiment was to investigate the effect of the catalyst amylase in the breakdown of starch solution at different temperat

1.1 ✓aim adequate

Method - Controlled Variables:
- ratio of amalase to starch solution
- volume of starch solution
- volume of amylase solution
- concentration of solutions

1.1 ✓ Variables to be controlled are identified

Dependant Variable:
- the rate of the breakdown of starch 1.1 ✓

Independant Variable:
- temperature 1.1 ✓

Equipment: starch solution, amylase solution, dropper pipette, hot water bath, test tubes, dimple tray

Safety: wear an apron, be careful with the hot water bath 1.1 ✓ Safety issues considered.

Method

Collect equipment. Pre-incubate solutions at the appropriate temperatures to ensure that all the reactants are at the correct temperature throughout the experiment. Prepare four dimple trays with iodine solution for the tests for starch. After 15 mins in the water baths remove test tube at each temperature and add 2cm³ of amylase and 2cm³ of starch. At each temperature immediately test for starch. Start the timer and put the solutions in the bath. Every minute remove a sample of ~~each~~ solution and test it for starch by adding a drop to the iodine solution in the dimple tray. Continue this process until the starch has gone. Repeat this at each temperature. Repeat experiment for ensure reliability. Take an average 1.1 ✓ Good description of method.

Results

	Tests for starch at different temps				
	0°C	20°C	40°C	60°C	80°C
Time (mins)					
0	✓	✓	✓	✓	✓
1	✓	✓	✓	✓	✓
2	✓	✓	✓	✓	✓
3	✓	✓	–	✓	✓
4	–	✓	X	✓	✓
5	–	–	X	✓	✓
6	✓	–	X	✓	✓
7	✓	–	X	✓	✓
8	✓	–	X	✓	✓

key
✓ - positi
X - negativ
– - small quantity of starch present

✓1.3 & 1.4

Candidate 2

Excepeiment to investigate the production of starch from

aim - to investigate if glucose is built up by the enzyme potato phosphorylase to make starch.

Method -

independent varibles - the presence of glucose and phosphorylase

dependent varible - the rate of the build up of starch

varibles :

- the same temperature (40°C)
- the same volume of Glucose in test tubes A + B (2c
- the same volume of Potato phosphorylase in test tubes B + C ($2cm^3$).
- the time intervals between testing.
- same volume of iodine
- same pH . - add pH Buffer

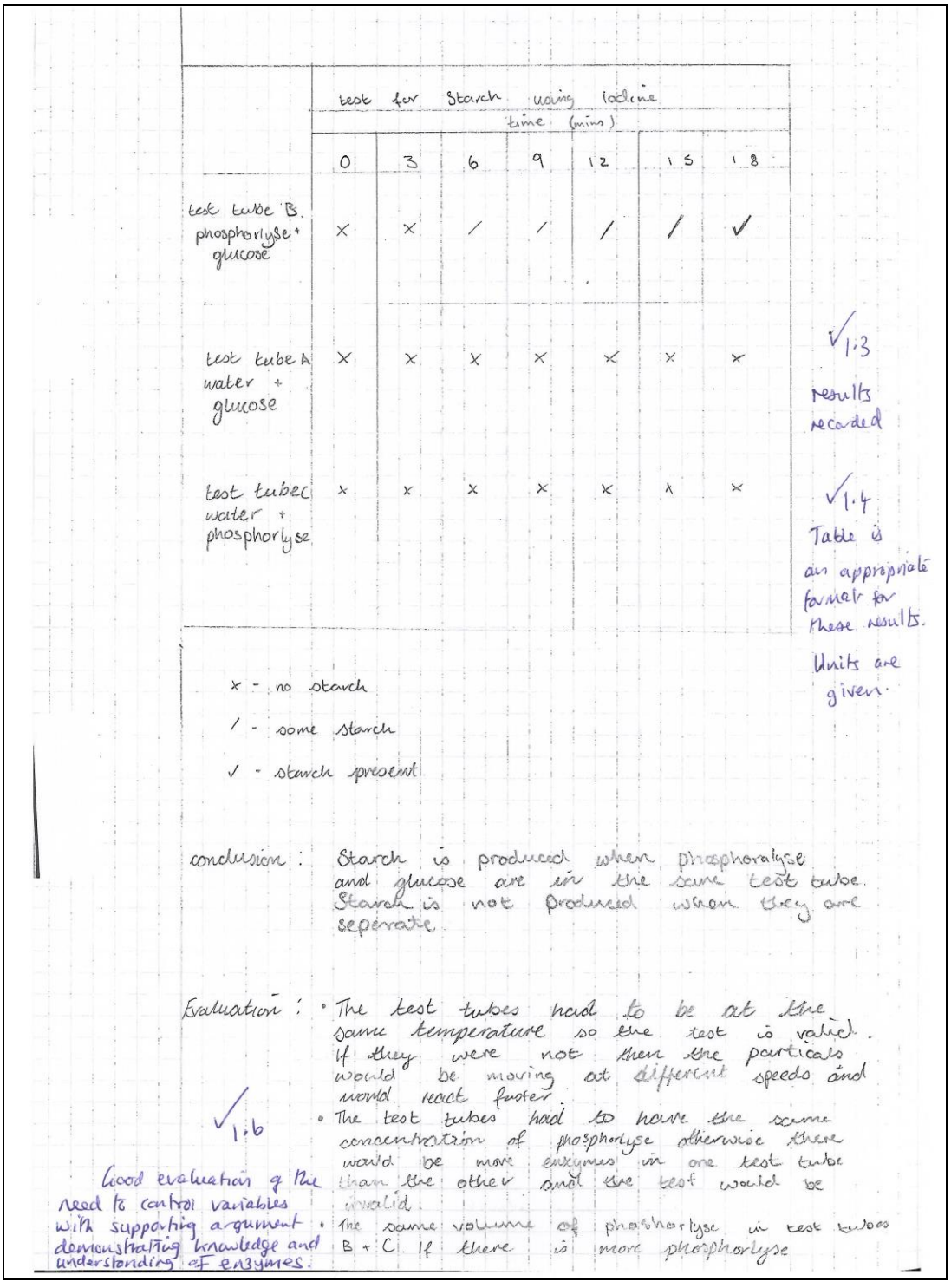
Apperatus :

- 3 test tubes
- $2cm^3$ of glucose in test tubes A + B
- $2cm^3$ of Potato phosphorylase in test tubes B + C
- $2cm^3$ of water in test tubes A + C
- pippette
- water bath at 40°C.
- iodine
- dimple tray.
- $2cm^3$ of pH Buffer in each test tube.

Method :

- centrafuse the Potato phosphorylase to get rid of all the starch.
- collect goggles, aprons and the apperatus
- in test tube A add $2cm^3$ water and $2cm^3$ of glucose also add pH Buffer
- immediately take a sample of mixture and add to iodine in dimple trays.
- put test A in the 40° water bath
- take a sample and test for iodine every 3 mins until starch present.
- repeat the first steps for test tube B, but adding phosphorylase instead of water. In test tube C add water and phosphorylase.
- record results
- repeat experiment
- get the average of the results and record in table.

Candidate 2 (contd)



	test for Starch using Iodine — time (mins)						
	0	3	6	9	12	15	18
test tube B phosphorlyse + glucose	×	×	/	/	/	/	✓
test tube A water + glucose	×	×	×	×	×	×	×
test tube C water + phosphorlyse	×	×	×	×	×	×	×

✓1.3 results recorded

✓1.4 Table is an appropriate format for these results. Units are given.

× - no starch

/ - some starch

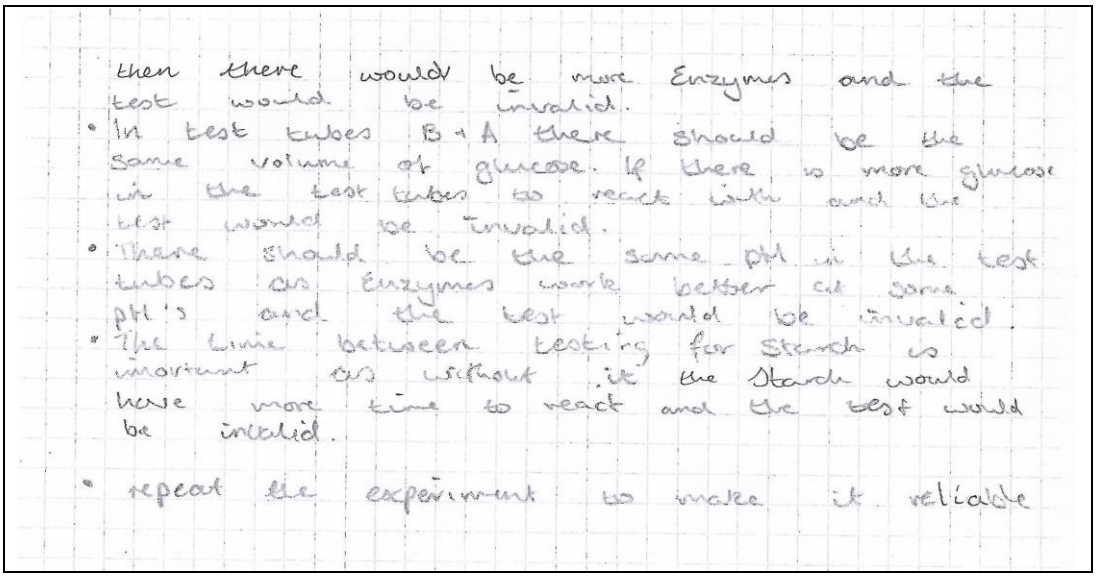
✓ - starch present

conclusion : Starch is produced when phosphorlyse and glucose are in the same test tube. Starch is not produced when they are seperate

Evaluation :
- The test tubes had to be at the same temperature so the test is valid. If they were not then the particals would be moving at different speeds and would react faster
- The test tubes had to have the same concentration of phosphorlyse otherwise there would be more enzymes in one test tube than the other and the test would be invalid
- The same volume of phosphorlyse in test tubes B + C. If there is more phosphorlyse

✓1.6 Good evaluation of the need to control variables with supporting argument demonstrating knowledge and understanding of enzymes

Candidate 2 (contd)



then there would be more Enzymes and the test would be invalid.

- In test tubes B + A there should be the same volume of glucose. If there is more glucose in the test tubes to react with and the test would be invalid.
- There should be the same pH in the test tubes as Enzymes work better at some pH's and the test would be invalid.
- The time between testing for Starch is important as without it the Starch would have more time to react and the test would be invalid.
- repeat the experiment to make it reliable

Experimental Investigation

Assessment Standards	Evidence required	Evidence Given
1.1 Planning an experiment/practical investigation	an aim	11/1/13 ✓
	a dependent and independent variable	11/1/13 ✓
	key variables to be kept constant	11/1/13 ✓
	measurements/observations to be made	11/1/13 ✓
	resources required	11/1/13 ✓
	method, including health and safety considerations	11/1/13 ✓
1.2 Following procedures safely	The candidate should be seen to follow procedures correctly, including health and safety considerations.	PPE used 11/1/13 ✓
		Safe practice 11/1/13 ✓
1.3 Making and recording observations/measurements accurately	Measurements taken should be appropriate. Measurements should be repeated and averages calculated, where appropriate.	✓ 11/1/13
1.4 Presenting results in an appropriate format	Results have been presented in an appropriate format. Using one format from: a table, line graph, chart, key, diagram, flow chart or summary or other appropriate format.	✓ 11/1/13
	Units used appropriately.	✓ 11/1/13
1.5 Drawing valid conclusions	Conclusion draws from what the experiment/practical investigation shows, with reference to the aim.	✓ 3/12/12
1.6 Evaluating experimental procedures	Evaluation should be supported by justification/reasoning and possible improvement(s) for the experiment/practical investigation. • effectiveness of procedure • control of variables • limitations of equipment • possible sources of error • possible improvements	22/1/13 ✓

Candidates 3 and 4

The reports from candidates 3 and 4 show how research into the same application of biology produced individual evidence for Assessment Standard 2.2.

Assessment Standard	Evidence required	Evidence produced
2.2 Describing an application	The application is related to a key area of the Course	The Assessor identified the associated key area of the Course — proteins and enzymes.
	Application stated	The candidates have given relevant and different applications — use in fruit juice production and use in the textile industry.
	Appropriate biology knowledge used to describe application	Each candidate has used appropriate National 5 Biology knowledge to describe the application. Although the reports are longer than the suggested word count, the candidates have provided detailed reports, which go beyond the minimum requirements for the Assessment Standard. Although one report references sources, this is not required for the Assessment Standard. However, these may help the assessor ensure that this is the candidate's own work.

Candidate 3 (contd)

Production of Fruit Juice

Enzymes are used in the production of fruit juice. To make the fruit juice, most of the juice has to be taken out of the fruit, but before this can be done the cells of the fruits have to be broken down. The cell walls are made up of cellulose fibres which use pectins and hemicelluloses to hold it together and keep it very strong. Because of the high temperatures that are needed to break down the fruit tissue, the colour and flavour of the juice will be affected. To prevent this from happening, the fruit is instead squashed, and enzyme preparations that hav cellulases, hemicellulases and pectinases in them are combined. This reaction causes the majority of the liquid to be released because the cell walls have been broken down.

Electronic Resources:

1. http://www.absorblearning.com/chemistry/demo/units/LR1507.html#Otherproductsmade byusingenzymes ; 20th January 2013

2. Useful Enzymes; http://www.h2g2.com/approved entry/A3328355 ; 20th January 2013

Candidate 4 (contd)

Enzymes in the textile industry

Enzymes have been used lots in human history to produce things such as: cheese, beer, wine, bread, yogurt, fruit juice and washing detergent etc.
We rely on enzymes and could not survive without them. Since around 30 years ago, enzymes were brought in for use in the textile industry.
Enzymes are very useful in the textile industry because they can do things with fabric without damaging the fabric, which chemicals cannot. Enzymes are also eco-friendly, especially when the alternative to them is strong chemicals. A range of enzymes can be used in the textile industry including: amylase, cellulase, pectinase, protease. These enzymes help the textile industry in the processes of desizing, denim finishing, bleach clean-up, bio-polishing and de-pilling.
An example of one of these treatments...
Bio-polishing is when an enzyme is used to 'treat' a fabric and give it a smoother and glossier appearance, making the fabric a brighter colour and feel softer. It does this by removing any tiny strands of fibre that protrude from the surface of the yarn.
All in all, enzymes are essential to the textile industry and allow fabrics of a better quality and appearance to be made.

Candidates 5 and 6

The reports from candidates 5 and 6 show how research into the effect of the same biological issue produces individual evidence for Assessment Standard 2.3.

Assessment Standard	Evidence required	Evidence produced
2.3 Describing a biological issue in terms of its effect on the environment/ society	The issue is related to a key area of the Course	The assessor identified the associated key area of the Course — biodiversity and the distribution of life.
	A biological issue is stated	The biological issue is identified – ash dieback
	Appropriate biology knowledge is used to describe its effect	Each candidate has used appropriate National 5 Biology knowledge to describe the issue and its effect. Although the reports are longer than the suggested word count, each candidate has provided a detailed report, which goes beyond the minimum requirements for the Assessment Standard. Although both reports reference sources, these are not required for the Assessment Standard. However, they could help the assessor ensure that they are the candidate's own work.

Candidate 5

One biological issue in terms of the effect of a new disease on the environment is Ash dieback is a disease of ash trees caused by a fungus called *Chalara fraxinea* .The disease causes leaf loss and crown dieback in affected trees, and it can lead to tree death. Researcher believes this fungus was originality from Asia. It has already caused the destruction of 100,000 trees a sit continues to ravage the countryside. Die back fungus was first reported as an unknown new disease in Poland in 1992. It has caused widespread damage to ash populations in Europe, including estimated losses of between 60 and 90 % of Denmark's ash trees. Ash Dieback fungus is also a threat to wildlife because almost 80 million of the ash tree provides shelter and food to the wild range of birds and insects. This will have a negative impact on the ecosystem.

2·3

Bibliography

http://www.forestry.gov.uk/chalara
http://www.telegraph.co.uk/earth/countryside/9638401/Fight-to-save-a-third-of-Britains-trees-from-killer-fungus.html
http://www.forestry.gov.uk/forestry/INFD-8W9EUV
http://www.kew.org/news/chalara-dieback-of-ash.htm
http://www.surreyheath.gov.uk/planning/treepreservationorders/ashtrees.htm
http://www.lic.wisc.edu/shapingdane/facilitation/all_resources/impacts/analysis_environmental.htm
http://www.bbc.co.uk/safety/default.aspxpage1219.shtml
http://www.un-documents.net/ocf-06.htm

Candidate 6

Ash dieback fungal disease (Chalara Fraxinea) is a fungal disease that causes ash trees to loose their leaves and therefore die out. The fungus has caused widespread damage to ash tree populations in continental Europe since it was first reported as an unknown new disease in Poland in 1992. Experts say that 19 out of every 20 trees may die because of the disease. 90% of Denmark's ash trees have been already been infected and died. Over 100,000 ash trees have been destroyed to stop the spread of the fungus. Ash trees make up around 30% of the UK's wooded landscape and for them to disappear could have a negative impact on the natural environment. The loss of these trees could pose a threat to the UK plants and animals that depend on trees for survival such as mammals, birds and snails. They would also remove a crucial producer from the UK deciduous ecosystem.

2.3

http://www.telegraph.co.uk/earth/countryside/9638401/Fight-to-save-a-third-of-Britains-trees-from-killer-fungus.html
http://www.bbc.co.uk/safety/default.aspxpage1219.shtml

Equality and inclusion

The following should be taken into consideration:

Situation	Reasonable adjustment
Carrying out practical activities	Use could be made of practical helpers for learners with: ♦ physical disabilities, especially manual dexterity, when carrying out practical activities ♦ visual impairment who have difficulty distinguishing colour changes or other visual information
Reading, writing and presenting text, symbolic representation, tables, graphs and diagrams	Use could be made of ICT, enlarged text, alternative paper and/or print colour and/or practical helpers for learners with visual impairment, specific learning difficulties and physical disabilities
Process information using calculations	Use could be made of practical helpers for learners with specific cognitive difficulties (eg dyscalculia)
Draw a valid conclusion, giving explanations and making generalisation/predictions	Use could be made of practical helpers for learners with specific cognitive difficulties or autism

As far as possible, reasonable adjustments should be made for the Question Paper and/or Assignment, where necessary. All adjustments currently available for the Question Paper would be available for Component 1. Learners will have a choice of Assignment topic for Component 2, for which reasonable adjustments can be made. This includes the use of 'practical helpers', readers, scribes, adapted equipment or assistive technologies.

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in these *Course Support Notes* is designed to sit alongside these duties but is specific to the delivery and assessment of the Course.

It is important that centres are aware of and understand SQA's assessment arrangements for disabled learners, and those with additional support needs, when making requests for adjustments to published assessment arrangements. Centres will find more guidance on this in the series of publications on Assessment Arrangements on SQA's website: www.sqa.org.uk/sqa//14977.html.

Appendix 1: Reference documents

The following reference documents will provide useful information and background.

- Assessment Arrangements (for disabled learners and/or those with additional support needs) — various publications are available on SQA's website at: www.sqa.org.uk/sqa//14977.html.
- *Building the Curriculum 3: A framework for Learning and Teaching*
- *Building the Curriculum 4: Skills for learning, skills for life and skills for work*
- *Building the Curriculum 5: A framework for assessment*
- Course Specifications
- Design Principles for National Courses
- *Guide to Assessment* (June 2008)
- Overview of Qualification Reports
- Principles and practice papers for Sciences curriculum area
- Science: A Portrait of current practice in Scottish schools (Nov 2008)
- *SCQF Handbook: User Guide* (published 2009) and SCQF level descriptors (to be reviewed during 2011 to 2012): www.sqa.org.uk/sqa/4595.html
- *SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work*
- *Skills for Learning, Skills for Life and Skills for Work: Using the Curriculum Tool*

Appendix 2: Resource packs

National 5 Biology: Assignment

Resource pack: The decline of honey bees

Learners will investigate a topical issue in biology, using knowledge and skills drawn from National 5 Cell Biology, Multicellular Organisms and/or Life on Earth key areas. This should take the form of a report.

Criteria

- The aim of the investigation
- The relevance of chosen topic
- Investigate/research the topic
- The application of the topic
- Presentation of data/results
- An evaluation of the impact on society/the environment
- A conclusion
- Describe the biological knowledge and understanding related to the topic investigated/researched
- Communicate the findings of the investigation

The sections in the pack provide background information on:

1. Honey bees
2. Bees and pollination
3. Insecticides
4. Effect of insecticides on bees
5. Colony collapse disorder

Background information

1. Honey bees

Honey bees are insects, which live in colonies wherever there is sufficient food for the bees. Honey bees live as far north as Greenland and as far south as South Africa. In the wild, they create elaborate nests, called hives, containing up to 20 000 individuals during the summer months. Hives controlled by beekeepers may have over 80 000 bees.

2. Bees and pollination

Honey bees feed on pollen and nectar, which they collect from plants. Flowers, therefore, provide bees with all the food they need. Honey bees use the nectar to produce honey. The commercial production of honey from bees is an application of biology.

Honey bees bring pollen back to the hive which has either been collected intentionally by the bees or as pollen grains that have stuck to their bodies when they have been gathering nectar.

Bees pollinate most of the world's flowering plants. Much of our food comes either directly from seed-producing plants or from the animals that feed on them. As a result, we are dependent on insects, like the honey bee, to pollinate the plants which are the start of food chains.

3. Insecticides

The use of insecticides is an **application** of biology. Pesticides are substances used to kill organisms regarded as pests by humans.

We use a variety of pesticides, including insecticides. Insecticides are chemicals used by humans, to prevent the plants we want to grow from being attacked by other organisms. Without these, we would not be able to grow as much food as we do and the price of food would be higher.

Insecticides can be classified in several different ways, including:

a. How they are absorbed by insects

- **Systemic insecticides** are absorbed into the treated plants and travel throughout the plants. Insects take them in when they feed on the sap in the phloem.
- **Contact insecticides** are sprayed onto the surface of the plants where they remain. They become effective when insects come into direct contact with them.

b. Origin

- Natural insecticides, such as nicotine, are made by plants as defence against insects. Nicotine-based insecticides are still being widely used in the US and Canada, though they are banned in the EU.
- Synthetic insecticides are man-made organic chemicals and they comprise the largest proportion of pesticides available for use today.

c. Mode of action

This is how the insecticide kills or inactivates a pest. This is important in predicting whether an insecticide will be toxic to other species, such as fish, birds and mammals.

Some common insecticides are:

- DDT

This is the best known example of a type of insecticide which interferes with insect nervous systems. The insects cannot control their movements, go into spasm and die. DDT has been banned in the UK because it is toxic to other living things. It does not break down easily and so persists in the environment and accumulates in food chains.

- Malathion

Malathion belongs to a group of insecticides which also affects insect nervous systems. It prevents the nerve cells from communicating with each other.

♦ Pyrethroids

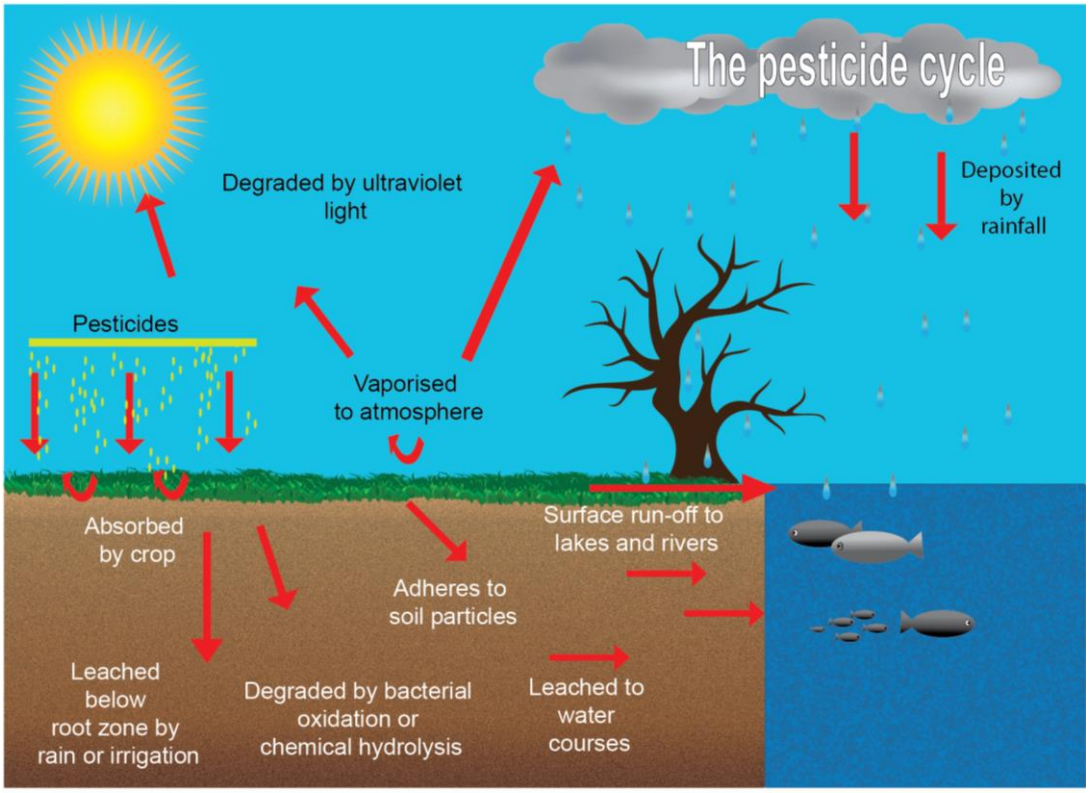
Pyrethroids are synthetic compounds which are considered to be among the safest insecticides, since they break down when exposed to light. They affect the nervous system in insects.

♦ Neonicotinoids

This insecticide group has recently been developed. They are artificial versions of nicotine compounds. They induce tremors, rapid wing movements, disorientation, paralysis and death. Producers of these insecticides believe they do not affect the human nervous system and that they are not toxic to mammals. On this basis, they are seen to have a big safety advantage.

Maize is an important grain crop, with 332 million metric tonnes grown annually in the United States. This is one quarter of all the harvested crops in the country. All of it is sprayed with neonicotinoids.

The diagram below represents the pesticide cycle. This shows how pesticides, such as insecticides, which are sprayed onto plants, can have wider environmental effects.



4. Effect of insecticides on bees

Some insecticides kill or harm other creatures, in addition to those they are intended to kill. For example, birds may be poisoned when they eat food that was recently sprayed with insecticides or when they mistake insecticide granules on the ground for food and eat it. Sprayed insecticides may drift from the area to which it is applied and into wildlife areas, especially when it is sprayed from the air.

While bees are collecting pollen and nectar, if there is a substance on or in the flowers, then that will also be taken back to the hive. This is the case with insecticides, which build up, as the bees pass nectar and pollen to each other within the colony.

Use of insecticides

a. Pros

- Some producers of insecticides claim that their products do not cause harm to honey bees. One such claim can be found in the publication *Honey bee Health* at
  www.bayercropscience.co.uk/assets/stewardship-fe/Honey beecare.pdf

- A video giving a farmer's views can be found at:
  http://www.bayercropscience.us/our-commitment/bee-health

- Another manufacturer which produces a neonicotinoid insecticide claims that it is not toxic to wildlife
  http://www2.dupont.com/Prod_Agriculture/en-ca/content/crop-protection/assail.html

b. Cons

- Organic farming advocates the minimum use of chemicals, as they may harm the environment and the organisms that live in it. In the following link, at the end of the presentation are many articles and research papers which provide further information.
  http://www.soilassociation.org/wildlife/bees/beeresearch

- Science and the environment. This article summarises recent research on bees, carried out by the University of Stirling.
  http://www.bbc.co.uk/news/science-environment-17535769

- Bee Strawbridge. What are neonicotinoid pesticides and how are they killing bees?
  http://beestrawbridge.blogspot.co.uk/2012/04/what-are-neonicotinoid-pesticides-and.html

5. Colony collapse disorder

In October 2006, some beekeepers in the USA began reporting significant losses, which amounted to of 30–90% of their hives by the end of the winter. This scale of losses was unusually high and has since become known as **colony collapse disorder (CCD)**. Beekeepers have since reported similar phenomena in many European countries.

The main symptom of CCD is few or no adult honey bees in the hive, although strangely, no dead honey bees are found. There is a live queen and often there is still honey in the hive, along with immature bees.

However, the cause of CCD has not been identified by researchers. Suggestions include insecticides, malnutrition, pathogens, parasites and beekeeping practices such as the use of antibiotics, or long-distance transportation of beehives. Recent information suggests a combination of factors is most likely. The USA Department of Agriculture is carrying out research into possible CCD causes, as well as studying honey bee diseases and parasites and how best to control them.

A survey of honey bee colony losses in the United States was carried out in 2008–09. The most commonly reported suspected causes of colony loss are shown in the table below, along with the percentage of bees lost from the colonies.

Reported cause of colony loss	Beekeepers reporting drop (%)	Bees lost (%)
Bees are weak in autumn	12·4	51·8
CCD	6·5	34·5
Hive management	8·3	39·6
Mites	16·7	24·5
*Nosema ceranae**	8·3	39·6
Pesticides	4·1	40·7
Queens	22·8	27·1
Starvation	41·5	26·9
Weather	17·9	39·0

**Nosema ceranae* is a unicellular fungus, which is a parasite of bees.

Effect on humans

The loss of honey bee colonies affects the quantity of honey produced for commercial sale. This in turn affects the economy of many countries.

Additional websites which can provide useful information
http://www.ecifm.rdg.ac.uk/pesticides.htm

US Department of Agriculture
http://www.ars.usda.gov/News/docs.htm?docid=15572

IBRA (International Bee Research Association)
http://www.ibra.org.uk

National 5 Biology: Assignment

Resource pack: Genetically modified crops

Learners will investigate a topical issue in biology, using knowledge and skills drawn from National 5 Cell Biology, Multicellular Organisms and/or Life on Earth key areas. This should take the form of a report

Criteria

- The aim of the investigation
- The relevance of chosen topic
- Investigate/research the topic
- The application of the topic
- Presentation of data/results
- An evaluation of the impact on society/the environment
- A conclusion
- Describe the biological knowledge and understanding related to the topic investigated/researched
- Communicate the findings of the investigation.

The sections in the pack provide background information on:

1. Selective breeding
2. Genetic engineering
3. Arguments for and against genetically modified (GM) crops
4. What the papers say
5. Experimental evidence

Background information

1. Selective breeding

The traditional method of breeding plants and animals is to select organisms with the most favourable characteristics, such as drought tolerance or disease resistance. These individuals are bred together to produce the next generation. Selective breeding has proved to be very successful over many years. However, its effect is limited, due to the long time between generations, particularly in large animals. In addition, undesirable genes may be inherited along with the desirable genes selected by the breeder.

2. Genetic engineering

The use of genetic engineering is an *application* of biology. Genetic engineering (or genetic modification) uses modern biotechnology to change the genetic make-up of an organism. An animal or plant that has had its genes altered in this way is known as a **genetically modified (GM) organism**.

Genetic engineering allows scientists to add or alter a gene in an organism, which will only have an effect on the characteristic being targeted. The first organisms that scientists were able to genetically engineer were bacteria. In 1973, two American scientists created the first **transgenic organism** by adding a gene for antibiotic resistance to *Escherichia coli*, a bacterium.

Oilseed rape as an example
In the 1990s, the chemical company Monsanto was able to genetically modify the oilseed rape plant, to make it resistant to a herbicide known as ‘Roundup’. This herbicide usually kills all vegetation that it comes into contact with. By making the rape plant resistant to the herbicide, the farmer is able to spray a field of oilseed rape with Roundup without harming the crop plant. This will keep the crop completely free of weeds, minimising competition and so increasing the yield. This genetically modified crop is now widely used in much of the American continent. However, it is still banned in the EU.

3. Arguments for and against genetically modified (GM) crops

The genetic modification of organisms is a controversial topic. Members of the public, organisations, industry and governments hold different views on the subject.

a. Pros

- Companies such as Monsanto, which are responsible for GM crops, argue that:

  'The first large acreage plantings of GM crop took place in 1996. Since then, many GM crops, with herbicide tolerance, insect tolerance and virus resistance, have been given clearance for planting and consumption. These include varieties of corn, sugar beets, squash and papaya. All of these crops have been assessed for food and feed safety in producing countries. Many other countries have approved the import of food or food ingredients that contain GM products. Hundreds of millions of meals containing food from GM crops have been consumed. There has not been a single substantiated instance of illness or harm associated with GM crops.'
  http://www.monsanto.com/newsviews/Pages/food-safety.aspx

- 'Biotechnology helps to secure the food supply'. This essay can be viewed at the following link:
  www.research.bayer.com/en/22-essay.pdfx?forced=true

- Other companies involved in the production of GM crops share these views. One company argues that:

  'With this technology, we see more vigorous wheat with increased growth, larger seed heads and larger seed. If we can achieve significant yield increases in the field, this will have a major impact on food production on a global scale. Increasing wheat yields, under the water-limited environments that Australian growers face, is a significant achievement. The rapid increase in the world's population is continuing and is predicted to reach 9 billion by 2050. This will put pressure on existing food systems to produce more. So, increasing yield of crops, like wheat, is a crucial step forwards. With a total global production of over 650 million tonnes of wheat per annum, wheat is one of the most important food crops needed to support the global population.'

  The full article can be viewed at:
  http://www.bayercropscience.com.au/cs/mediagallery/default.asp?articleid=594

b. Cons

- Friends of the Earth: Link to article on GM Crops and Food:
  www.foe.co.uk/resource/briefings/gm_crops_food.pdf

- Greenpeace: http://www.greenpeace.org.uk/gm/whats-the-problem

  'Food is central to life. How we grow it affects the land, water and wildlife around us, as well as farm animals, our health and rural communities. It's hard to resist cheap food or 'buy one get one free' offers but the

environmental cost of the culture of intensive farming, over-production and over-consumption is enormous.

Genetic engineering enables scientists to create plants, animals and micro-organisms by manipulating genes in a way that does not occur naturally, often by taking DNA from one species and inserting it into another, completely unrelated one. Jellyfish genes have been inserted into pigs, firefly genes have been bred into tobacco plants, and bacterial genes are present in crops such as soya, maize and cotton.

These genetically modified organisms (GMOs) can spread through nature and interbreed with naturally-occurring organisms, replicating themselves and spreading through the environment in an unpredictable and uncontrollable way. Their release into the environment is a form of genetic pollution and a major threat because, once they're out there in the wild, they cannot be recalled.

But because of the commercial interests of wealthy governments and biotech companies such as Monsanto and Bayer Cropscience, the public is being denied the right to know about genetically modified (GM) ingredients in the food chain and risks losing the right to avoid them.'

4. What the papers say

- The following article was published in *The Guardian* newspaper on 9 March 2012 :
  Public concern over GM food has lessened, survey shows
  http://www.guardian.co.uk/environment/2012/mar/09/gm-food-public-concern

- This article was published in The Guardian newspaper on 19 October 2011:
  GM crops promote superweeds, food insecurity and pesticides, say NGOs
  http://www.guardian.co.uk/environment/2011/oct/19/gm-crops-insecurity-superweeds-pesticides

- This article was published in *The Sun* newspaper on 26 January 2011.
  World can't afford to ban GM crops
  http://www.thesun.co.uk/sol/homepage/features/3371621/Peter-Seabrook-The-world-cant-afford-to-ban-GM-crops.html#ixzz23XS3ppaG

- The following article was published in *The Independent* newspaper on 14 August 2012:
  British scientists awarded £6.4m GM crop grant
  http://www.independent.co.uk/news/science/british-scientists-awarded-64m-gm-crop-grant-7945138.html

- This article was published in *The Guardian*, Wednesday 30 May 2012:
  The GM Debate is Growing Up
  http://www.guardian.co.uk/commentisfree/2012/may/30/gm-debate-grown-up

5. Experimental evidence

Over the last few years, many scientific studies have been carried out to try to test the safety of genetically modified food crops.

These studies have considered aspects such as:

- whether or not the food produced has a negative effect on human health
- the risk posed by pollen from GM crops contaminating conventional crop species
- the effect of using GM crops on the local biodiversity

An investigation was carried out to determine whether the introduction of GM crops has affected the biodiversity of plant and animal species found within the growing crop. The investigation involved about 75 farmers throughout England, Scotland and Wales.
season.

The crops chosen for this study were sugar beet, oilseed rape and maize. The GM variety of sugar beet was genetically modified to be resistant to the herbicide Roundup. The GM varieties of maize and oilseed rape were genetically modified to be resistant to a herbicide called Liberty.

By using these GM crops, the farmers were able to alter their spraying regime, with the intention of using less chemical to control weeds during the growing

Spraying conventional crops
The normal practice with conventional crops is to spray against weeds before the crop emerges, so that the crop plants do not get damaged by the herbicide. This is effective at controlling the first flush of weed growth. However, it can mean that more weeds germinate later on, once the effect of the herbicide has worn off. If farmers try to spray later, they may need to use an expensive selective herbicide, which only kills certain plant species, ie weeds.

Spraying GM crops
With crops genetically modified to resist the effect of the herbicide, it is possible to spray once the crop has germinated. This allows the weeds to reach a larger size before they are killed but a more complete kill of the weeds is possible. One treatment with a broad-spectrum herbicide is usually sufficient to control the weeds for the whole growing season.

Argument against GM crops
Opponents of GM crops argue that spraying crops with herbicide later in the growing season and killing all weed plants will reduce the biodiversity in the crop. It will both reduce the plant species that can survive in the crop and remove food and shelter plants that animal species rely on.

Argument for GM crops
Supporters of GM crops argue that there is great environmental benefit from growing GM crops. It can reduce the overall herbicide use. In addition, because the weeds in the crop are able to grow to a larger size before they are killed, they

might provide food and shelter for animal species for longer during the crop growing season.

Method
The 75 farmers were chosen to represent a number of different management strategies. These ranged from the most to the least intensive farming and covered a range of different soil types (from heavy clay soils through loams to light sands).

On each farm the farmer identified a suitable field that was surrounded by hedge-rows or woodland. The size of the fields varied between different farms, but was representative of the field sizes normally used for this type of crop growing.

Each farmer was told to divide their field in half and plant one half with a conventional variety of the crop and the other half with the GM equivalent. Farmers were not told how to manage their crops. They were expected to take advice on the best strategy for herbicide application from their local agronomist (crop specialist).

During the growing season, scientists monitored the crops, taking 12 equally placed samples from each crop. At each sample site, the plant and animal abundance was sampled along a transect from the crop edge to a point 32 m towards the centre of the crop. Samples were taken at 2 m, 4 m, 16 m, 24 m and 32 m into the crop.

The number of weed seedlings at each sample site was determined, using a quadrat, and these weeds were identified to the species level. Soil invertebrates were sampled using pitfall traps and insects living on the weeds were sampled using a pooter. Pollinating insects (bees and butterflies) were counted along four 100 metre transects, on three occasions, in maize and oilseed rape crops and on four occasions in sugar beet crops.

Results
The results for the total number of ground beetles, rove beetles, springtails, spiders, bees and butterflies found at all the trial sites growing winter oilseed rape are recorded in the table below.

Organism	Number in conventional crop	Number in genetically modified crop
Ground beetles	497	520
Rove beetles	147	157
Springtails	620	769
Spiders	187	177
Bees and butterflies	18	14

Source of results:
http://rspb.royalsocietypublishing.org/content/suppl/2009/02/12/272.1562.463.DC1/PB050463supp.pdf

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Pesticide cycle image

Administrative information

Published: June 2013 (version 1.1)

History of changes to Course Support Notes

Course details	Version	Description of change	Authorised by	Date
	1.1	Exemplar materials and resource pack added.	Qualifications Development Manager	June 2013

Unit Support Notes

Unit Support Notes — Cell Biology (National 5)

Please refer to the note of changes at the end of this document for details of changes from previous version (where applicable).

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the Cell Biology (National 5) Unit. They are intended for teachers and lecturers who are delivering this Unit. They should be read in conjunction with:

- the Unit Specification
- the Course Specification
- the Course Assessment Specification
- the Course Support Notes
- appropriate assessment support materials

General guidance on the Unit

Aims

The general aim of this Unit is to develop skills of scientific inquiry, investigation and analytical thinking, along with knowledge and understanding of cell biology. Learners will apply these skills when considering the applications of cell biology 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:

- Cell structure
- Transport across cell membranes
- Producing new cells
- DNA and the production of proteins
- Proteins and enzymes
- Genetic engineering
- Photosynthesis and respiration

Learners will research issues, apply scientific skills and communicate information related to their findings, which will develop skills of scientific literacy.

Progression into this Unit

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 the following or equivalent qualifications and/or experience:

- National 4 Biology Course

There may also be progression from National 4 Chemistry, National 4 Environmental Science, National 4 Physics and National 4 Science Courses.

Skills, knowledge and understanding covered in this Unit

Information about skills, knowledge and understanding is given in the National 5 Biology *Course Support Notes*.

If this Unit is being delivered on a free-standing basis, teachers and lecturers are free to select the skills, knowledge, understanding and contexts which are most appropriate for delivery in their centres.

Progression from this Unit

This Unit may provide progression to:

- other qualifications in Biology or related areas
- further study, employment and/or training

Approaches to learning and teaching

Approaches to learning and teaching and suggested learning activities are covered in the *Course Support Notes*.

Developing skills for learning, skills for life and skills for work

Information about developing skills for learning, skills for life and skills for work in this Unit, is given in the relevant *Course Support Notes*.

Approaches to assessment and gathering evidence

The purpose of this section is to give advice on approaches to assessment for the Unit. There will be other documents produced for centres to provide exemplification of assessments and guidance on how to write them.

Approaches to the assessment of a Unit when it forms part of a Course may differ from approaches to assessing the same Unit when it is not being delivered as part of a Course. If an integrated approach to Course delivery is chosen, then there may be opportunities for combining assessment across Units.

Assessments must be valid, reliable and fit for purpose for the subject and level, and should fit in with learning and teaching approaches.

Unit assessment should support learning and teaching and, where possible, enable personalisation and choice for learners in assessment methods and processes. Teachers and lecturers should select the assessment methods they believe are most appropriate, taking into account the needs of their learners and the requirements of the Unit.

There is no mandatory order for delivery of the Outcomes. These should be overtaken throughout the Unit and are an integral part of learning and teaching.

The table below gives guidance and advice on possible approaches to assessment and gathering evidence:

Strategies for gathering evidence
There may be opportunities in the day-to-day delivery of the Units in a Course to observe learners providing evidence, which satisfies completely, or partially, a Unit or Units. This is naturally occurring evidence and can be recorded as evidence for an Outcome or parts of an Outcome. In some cases, additional evidence may also be required to supplement and confirm the naturally occurring evidence. Approaches to assessment might cover the whole Unit or be combined across Outcomes. A holistic approach can enrich the assessment process for the learner by bringing together different Outcomes and/or Assessment Standards.

If a holistic approach is used, then it is necessary to be able to track individual Assessment Standard evidence.

Strategies for gathering evidence and ensuring that the learners' work is their own could include:

- personal interviews during which the teacher or lecturer can ask additional questions about completed work
- an oral presentation on their work
- writing reports in supervised conditions
- checklists to record the authenticity
- supplementary sources of evidence, such as witness testimony, film or audio clips

Evidence can be gathered from classwork, experiments, investigations and/or research carried out in this Unit. It can be obtained using one or more of the strategies outlined above or by alternative methods, which could include a test of knowledge, understanding and skills.

Equality and inclusion

The *Course Support Notes* provide full information on equality and inclusion for this Unit.

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in these Unit Support Notes is designed to sit alongside these duties but is specific to the delivery and assessment of the Unit.

Alternative approaches to Unit assessment to take account of the specific needs of learners can be used. However, the centre must be satisfied that the integrity of the assessment is maintained and that the alternative approaches to assessment will, in fact, generate the necessary evidence of achievement.

Appendix 1: Reference documents

The following reference documents will provide useful information and background.

- Assessment Arrangements (for disabled learners and/or those with additional support needs) — various publications on SQA's website: http://www.sqa.org.uk/sqa/14976.html
- *Building the Curriculum 3: A framework for Learning and Teaching*
- *Building the Curriculum 4: Skills for learning, skills for life and skills for work*
- *Building the Curriculum 5: A framework for assessment*
- Course Specifications
- Design Principles for National Courses
- *Guide to Assessment* (June 2008)
- Overview of Qualification Reports
- *Principles and practice papers for Sciences curriculum area*
- *Research Report 4 — Less is More: Good Practice in Reducing Assessment Time*
- *Coursework Authenticity — a Guide for Teachers and Lecturers*
- Science: A Portrait of current practice in Scottish schools (Nov 2008)
- *SCQF Handbook: User Guide (published 2009)* and SCQF level descriptors (to be reviewed during 2011 to 2012): www.sqa.org.uk/sqa/4595.html
- *SQA Skills Framework: Skills for Learning, Skills for Life and Skills for Work*
- *Skills for Learning, Skills for Life and Skills for Work: Using the Curriculum Tool*
- SQA Guidelines on e-assessment for Schools
- SQA Guidelines on Online Assessment for Further Education
- SQA e-assessment web page: www.sqa.org.uk/sqa/5606.html

Administrative information

Published: June 2013 (version 1.1)

Superclass: RH

History of changes to Unit Support Notes

Unit details	Version	Description of change	Authorised by	Date
	1.1	Exemplar materials and resource pack added.	Qualifications Development Manager	June 2013

Unit Support Notes

Unit Support Notes — Biology: Multicellular Organisms (National 5)

Please refer to the note of changes at the end of this document for details of changes from previous version (where applicable).

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the Biology: Multicellular Organisms (National 5) Unit. They are intended for teachers and lecturers who are delivering this Unit. They should be read in conjunction with:

- the Unit Specification
- the Course Specification
- the Course Assessment Specification
- the Course Support Notes
- appropriate assessment support materials

General guidance on the Unit

Aims

The general aim of this Unit is to develop skills of scientific inquiry, investigation and analytical thinking, along with knowledge and understanding of multicellular organisms.

Learners will apply these skills when considering the applications of multicellular organisms 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:

- Cells, tissues and organs
- Stem cells and meristems
- Control and communication
- Reproduction, variation and inheritance
- The need for transport
- Effects of life-style choices on animal transport and exchange systems

Learners will research issues, apply scientific skills and communicate information related to their findings, which will develop skills of scientific literacy.

Progression into this Unit

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 the following or equivalent qualifications and/or experience:

- National 4 Biology Course

There may also be progression from National 4 Chemistry, National 4 Environmental Science, National 4 Physics and National 4 Science Courses.

Skills, knowledge and understanding covered in this Unit

Information about skills, knowledge and understanding is given in the National 5 Biology *Course Support Notes*.

If this Unit is being delivered on a free-standing basis, teachers and lecturers should cover the mandatory skills and key areas in ways which are most appropriate for delivery in their centres.

Progression from this Unit

This Unit may provide progression to:

- other qualifications in Biology or related areas
- further study, employment and/or training

Approaches to learning and teaching

Approaches to learning and teaching and suggested learning activities are covered in the *Course Support Notes*.

Developing skills for learning, skills for life and skills for work

Information about developing skills for learning, skills for life and skills for work in this Unit, is given in the relevant *Course Support Notes*.

Approaches toassessment and gathering evidence

The purpose of this section is to give advice on approaches to assessment for the Unit. There will be other documents produced for centres to provide exemplification of assessments and guidance on how to write them.

Approaches to the assessment of a Unit when it forms part of a Course may differ from approaches to assessing the same Unit when it is not being delivered as part of a Course. If an integrated approach to Course delivery is chosen, then there may be opportunities for combining assessment across Units.

Assessments must be valid, reliable and fit for purpose for the subject and level, and should fit in with learning and teaching approaches.

Unit assessment should support learning and teaching and, where possible, enable personalisation and choice for learners in assessment methods and processes. Teachers and lecturers should select the assessment methods they believe are most appropriate, taking into account the needs of their learners and the requirements of the Unit.

There is no mandatory order for delivery of the Outcomes. These should be overtaken throughout the Unit and are an integral part of learning and teaching.

The table below gives guidance and advice on possible approaches to assessment and gathering evidence:

Strategies for gathering evidence
There may be opportunities in the day-to-day delivery of the Units in a Course to observe learners providing evidence, which satisfies completely, or partially, a Unit or Units. This is naturally occurring evidence and can be recorded as evidence for an Outcome or parts of an Outcome. In some cases, additional evidence may also be required to supplement and confirm the naturally occurring evidence. Approaches to assessment might cover the whole Unit or be combined across Outcomes. A holistic approach can enrich the assessment process for the learner by bringing together different Outcomes and/or Assessment Standards.

If a holistic approach is used, then it is necessary to be able to track individual Assessment Standard evidence.

Strategies for gathering evidence and ensuring that the learners' work is their own could include:

- personal interviews during which the teacher or lecturer can ask additional questions about completed work
- an oral presentation on their work
- writing reports in supervised conditions
- checklists to record the authenticity
- supplementary sources of evidence, such as witness testimony, film or audio clips

Evidence can be gathered from classwork, experiments, investigations and/or research carried out in this Unit. It can be obtained using one or more of the strategies outlined above or by alternative methods, which could include a test of knowledge, understanding and skills.

Equality and inclusion

The *Course Support Notes* provide full information on equality and inclusion for this Unit.

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in these *Unit Support Notes* is designed to sit alongside these duties but is specific to the delivery and assessment of the Unit.

Alternative approaches to Unit assessment to take account of the specific needs of learners can be used. However, the centre must be satisfied that the integrity of the assessment is maintained and that the alternative approaches to assessment will, in fact, generate the necessary evidence of achievement.

Appendix 1: Reference documents

The following reference documents will provide useful information and background.

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Administrative information

Published: June 2013 (version 1.1)

Superclass: RH

History of changes to Unit Support Notes

Unit details	Version	Description of change	Authorised by	Date
	1.1	Exemplar materials and resource pack added.	Qualifications Development Manager	June 2013

Unit Support Notes

Unit Support Notes — Biology: Life on Earth (National 5)

Please refer to the note of changes at the end of this document for details of changes from previous version (where applicable).

Introduction

These support notes are not mandatory. They provide advice and guidance on approaches to delivering and assessing the Biology: Life on Earth (National 5) Unit. They are intended for teachers and lecturers who are delivering this Unit. They should be read in conjunction with:

- the *Unit Specification*
- the *Course Specification*
- the *Course Assessment Specification*
- the *Course Support Notes*
- appropriate assessment support materials

General guidance on the Unit

Aims

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:

- Biodiversity and the distribution of life
- Energy in ecosystems
- Sampling techniques and measurement of abiotic and biotic factors
- Adaptation, natural selection and the evolution of species
- Human impact on the environment

Learners will research issues, apply scientific skills and communicate information related to their findings, which will develop skills of scientific literacy.

Progression into this Unit

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 the following or equivalent qualifications and/or experience:

- National 4 Biology Course

There may also be progression from National 4 Chemistry, National 4 Environmental Science, National 4 Physics, and National 4 Science Courses.

Skills, knowledge and understanding covered in this Unit

Information about skills, knowledge and understanding is given in the National 5 Biology *Course Support Notes*.

If this Unit is being delivered on a free-standing basis, teachers and lecturers should cover the mandatory skills and key areas in ways which are most appropriate for delivery in their centres.

Progression from this Unit

This Unit may provide progression to:

- other qualifications in Biology or related areas
- further study, employment and/or training

Approaches to learning and teaching

Approaches to learning and teaching and suggested learning activities are covered in the *Course Support Notes*.

Developing skills for learning, skills for life and skills for work

Information about developing skills for learning, skills for life and skills for work in this Unit, is given in the relevant *Course Support Notes*.

Approaches to assessment and gathering evidence

The purpose of this section is to give advice on approaches to assessment for the Unit. There will be other documents produced for centres to provide exemplification of assessments and guidance on how to write them.

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Unit assessment should support learning and teaching and, where possible, enable personalisation and choice for learners in assessment methods and processes. Teachers and lecturers should select the assessment methods they believe are most appropriate, taking into account the needs of their learners and the requirements of the Unit.

There is no mandatory order for delivery of the Outcomes. These should be overtaken throughout the Unit and are an integral part of learning and teaching.

The table below gives guidance and advice on possible approaches to assessment and gathering evidence:

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- writing reports in supervised conditions
- checklists to record the authenticity
- supplementary sources of evidence, such as witness testimony, film or audio clips

Evidence can be gathered from classwork, experiments, investigations and/or research carried out in this Unit. It can be obtained using one or more of the strategies outlined above or by alternative methods, which could include a test of knowledge, understanding and skills.

Equality and inclusion

The *Course Support Notes* provide full information on equality and Inclusion for this Unit.

It is recognised that centres have their own duties under equality and other legislation and policy initiatives. The guidance given in these *Unit Support Notes* is designed to sit alongside these duties but is specific to the delivery and assessment of the Unit.

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Appendix 1: Reference documents

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- *Principles and practice papers for curriculum areas*
- *Research Report 4 — Less is More: Good Practice in Reducing Assessment Time*
- *Coursework Authenticity — a Guide for Teachers and Lecturers*
- Science: A Portrait of current practice in Scottish schools (Nov 2008)
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Administrative information

Published: June 2013 (version 1.1)

Superclass: RH

History of changes to Unit Support Notes

Unit details	Version	Description of change	Authorised by	Date
	1.1	Exemplar materials and resource pack added.	Qualifications Development Manager	June 2013