# Scheme of work

## Biology - Ecology

This resource provides guidance for teaching the Ecology topic from our new GCSE Biology (8461). It has been updated from the draft version to reflect the changes made in the accredited specification. There have been no changes to the required practical. However, there have been minor changes in the specification content to sections 4.7.1.1 Communities, 4.7.2.1, Levels of organisation, 4.7.2.2 How materials are cycled, 4.7.2.3 Decomposition, 4.7.3.4 Deforestation, 4.7.3.5 Global warming, 4.7.3.6 Maintaining biodiversity, 4.7.4.1, Trophic levels, 4.7.5.1 Factors affecting food security, 4.7.5.4 Role of biotechnology. These alterations have not required changes to the scheme of work.

The scheme of work is designed to be a flexible medium term plan for teaching content and development of the skills that will be assessed.

It is provided in Word format to help you create your own teaching plan – you can edit and customise it according to your needs. This scheme of work is not exhaustive; it only suggests activities and resources you could find useful in your teaching.

### 4.6.4 Classification of living organisms

4.7.4, Trophic levels in an ecosystem, can be covered with 4.7.2, Organisation of an ecosystem, as described below.

4.6.4 Classification of living organisms - classification is a logical starting point for this section of the specification. The variety of life can be considered before going on to study how organisms interact with each other and their environment. Alternatively, it could be covered before 4.6.2.2, Evolution.

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop scientific communication skills** | **Opportunities to apply practical and enquiry skills** | **Self/peer assessment Opportunities and resources**  *Reference to past questions that indicate success* |
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| 4.6.4  4.6.4  4.6.4 | Classification  Traditionally organisms have been classified into groups depending on their structure and characteristics.  Organisms were classified into smaller and smaller groups.  Carl Linnaeus studied the similarities and differences between organisms to classify them. He developed the binomial system to name organisms by genus and species.  Today powerful microscopes are used to see internal structures. This and biochemical analysis has led to new classification systems.  Carl Woese developed the three domain system to classify organisms as:   * Archaea (primitive bacteria) * Bacteria (true bacteria) * Eukaryota (protists, fungi, plants and animals). | Classify organisms based on their similarities.  Describe classification using:   * Kingdom * Phylum * Class * Order * Family * Genus * Species.   Explain why the importance of the binomial system to name organisms.  Explain how modern technologies have affected how organisms are classified today.  Describe Carl Woese’s system of classification and classify organisms into the three mains. | 1 | Exhibition of organisms to classify, use post-it notes to explain groupings – observe and discuss choices made by other groups.  Watch BBC video clips about Linnaeus and classification (see resources).  Compare the classification of related and unrelated organisms using the Linnaeus system.  Look at the variety of names given to the same plant and discuss why the binomial system is more useful.  Watch BBC video clip about chemical analysis and its use in classifying organisms (see resources).  Sort picture cards into the three domains and give reasons.  Homework: Poster showing classification of organisms. | Exhibition of organisms to classify into groups (this could be the first lesson on evolution).  Compare classification information on related and unrelated organisms.  Pictures and names of different plants to discuss.  Card sorting activity. | Exhibition of pictures and specimens of plants and animals.  Video clips  [BBC Bitesize – Linnaeus and the first system of classification of plants](http://www.bbc.co.uk/education/clips/zwt6n39)  [BBC Bitesize – Classification](http://www.bbc.co.uk/education/guides/zbrmn39/revision/1)  [BBC Four – Botany: A Blooming System](http://www.bbc.co.uk/programmes/p011mv7c)  [BBC Bitesize – Classification techniques and the search for useful plants](http://www.bbc.co.uk/education/clips/zhb3cdm)  Cards to sort.  Range of National Stem Centre resources – search ’classification’. |

### 4.7 Ecology

### 4.7.1 Adaptations, interdependence and competition

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| --- | --- | --- | --- | --- | --- | --- |
| 4.7.1.1 | Communities  Organisms need a supply of materials from their surroundings and other organisms to survive and reproduce.  One species depends on others for food, shelter, pollination, seed dispersal etc. This is called interdependence.  Stable communities.  Plants compete for light, space, water and mineral ions.  Animals compete for food, mates and territory. | Understand and use the terms ecosystem, community, competition, habitat, interdependence.  Describe factors that affect the survival of organisms in their habitat.  Explain how one species depends on others for survival.  Describe a stable community as one where all the species and environmental factors are in balance, so population sizes remain fairly constant. Give an example of a stable community.  Describe resources that plants and animals compete for in a given habitat. | 1 | Look at pictures of different habitats and brainstorm factors that affect the survival of organisms in a habitat.  Discuss how organisms depend on each other for survival and introduce the term ‘interdependence’.  Resource competition – hide cards with resources around room – you have to obtain 3 different resources to survive.  Investigate competition in radish or cress seedlings. | Observe organisms in their habitats and suggest inter-relationships.  Investigate the effect of planting density on height of seedlings.  Measure height and calculate means. Present and analyse the results. | [BBC Bitesize – Ecosystems Videos](http://www.bbc.co.uk/education/topics/zt63cdm/videos/1)  Competition:   * radish or cress seeds * seed trays * compost * ruler. |
| 4.7.1.3  4.7.1.2 | Biotic factors and Abiotic factors  Biotic factors are living factors that can affect a community.  Abiotic factors are non-living factors which can affect a community. | Name biotic factors in a habitat and explain how a change in a biotic factor might affect a community, eg:   * availability of food * new predators arriving * new disease organisms * one species out-competing another so the numbers are no longer sufficient to breed.   Name abiotic factors in a habitat and explain how a change in a biotic factor might affect a community, eg:   * light intensity * temperature * moisture levels * soil pH and mineral content * wind intensity and direction * carbon dioxide levels for plants * oxygen levels for aquatic animals. | 0.5 | Discuss factors that may affect the numbers or distribution of plants and animals in a habitat.  Use interactive modelling to change an environment and explore the impact of factors on the interdependence of organisms, eg poisons, disease, food shortages etc. | Model changes in an environment. |  |
| 4.7.2.1 | Distribution of organisms  Quantitative data on the distribution and abundance of organisms can be obtained by:   * random sampling with quadrats * sampling along a transect.   Required practical:  Field investigation  Measure the population size of a common species in a habitat. Use sampling techniques to investigate the effect of a factor on the distribution of this species. | Describe how to carry out random sampling of organisms using a quadrat.  Describe when and how a transect should be used.  Evaluate data gathered by using a quadrat and transect.  Calculate area, mean, median, mode and range.  Explain why sample size is important to obtain valid results.  Required practical: plan and carry out a valid method to estimate a plant population. Present and analyse the results. | 2 | Links with 4.7.1.2 and 4.7.1.3.  Look at distribution of Pleurococcus on walls, fences or trees.  Estimate percentage cover using diagrams/ photographs and plastic squares as ‘mini quadrats’.  or  Investigate patterns of grass growth under trees and see if it is linked to abiotic factor(s).  Use transect lines and quadrats to collect data.  Analyse ecological data from quadrats and transects.  Interpret various types of diagrams that illustrate the distribution of organisms in a habitat.  Required practical. | Suggest reasons for the distribution of Pleurococcus.  Evaluate method to estimate cover and modify to estimate a plant population on the school field.  Use quadrats and sensors; record and analyse results.  Use a transect to investigate the change in type and number of plant species across a changing habitat, eg a footpath.  Required practical: plan and carry out a valid method to estimate a plant population. Present and analyse the results. | [BBC Bitesize – Sampling techniques and measurement of abiotic and biotic factors](http://www.bbc.co.uk/education/guides/z7vqtfr/revision/1)  Using a quadrat can be found at: [Intel Education Resources](http://inteleducationresources.intel.co.uk/)  Abiotic factor:   * sensors * data loggers * quadrats * thermometers * clipboards.   Transect:   * string * identification charts * clipboards.   Required practical: See *Practical Handbook*  [Questions on PPT B2.4 Organisms and their environment](http://filestore.aqa.org.uk/subjects/gcsescienceassessment/B2-4-ORGANISMS-AND-THEIR-ENVIRONMENT.PPT) |
| 4.7.1.4 | Adaptations  Organisms have adaptations for survival, they may be structural, behavioural or functional.  Extremophiles can survive in very extreme environments, such as high temperature or pressure, or in high salt concentration. | Describe and explain how structural, behavioural and functional adaptations, in a range of organisms, help them to survive in their habitat.  Define the term extremophile and give general examples. | 1 | Watch video clip showing adaptations.  In pairs, observe exhibition of organisms and discuss how each is adapted for survival.  Produce a poster or media presentation to show plants, animals and microorganisms with labels to explain how their adaptations help them to survive in their habitat.  Watch BBC video clip showing adaptations of predators and prey (see resources). | Develop explanations for adaptations. | Video clip  [BBC Bitesize – Interdependence and adaptation (clip compilation)](http://www.bbc.co.uk/education/clips/z4bygk7)  Exhibition of specimens and pictures.  [BBC Bitesize – Predator prey relationships in rock pools](http://www.bbc.co.uk/education/clips/zwnpyrd)  [PPT B1.4 Interdependence and adaptation](http://filestore.aqa.org.uk/subjects/gcsescienceassessment/B1-4-INTERDEPENDENCE-AND-ADAPTATION.PPT)  [Exampro user guide PowerPoint](http://filestore.aqa.org.uk/resources/science/AQA-GCSE-SCIENCE-EXAMPRO-UG.PPTX) |

### 4.7.2 Organisation of an ecosystem

4.7.4 Trophic levels in an ecosystem should be taught with this topic.

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| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop scientific communication skills** | **Opportunities to apply practical and enquiry skills** | **Self/peer assessment Opportunities and resources**  *Reference to past questions that indicate success* |
| 4.7.2.1 | Levels of organisation  Feeding relationships can be represented by food chains.  A food chain begins with a producer which synthesises, molecules.  Producers are eaten by consumers.  Consumers that eat other animals are predators, and those eaten are prey.  In a stable community the numbers of predators and prey rise and fall in cycles. | Explain what a food chain shows.  Explain that photosynthetic organisms are the producers of biomass for life on Earth.  Identify producers, primary, secondary and tertiary consumers in a food chain.  Interpret and explain population curves, eg hare and lynx, red and grey squirrels, and native and American crayfish. | 0.5 | Watch BBC video clip about food chains and interdependence (see resources).  Construct food chains and identify the producer and consumers.  Research producers that are not green plants.  Interpret population curves.  QSB99.2.05  QCJ9714.12 | Use a model to describe food chains.  Interpret population curves and explain predator – prey relationships. | [BBC Bitesize Activity – Food chains](http://www.bbc.co.uk/education/guides/z2m39j6/activity) |

### 4.7.4 Trophic levels in an ecosystem

This section overlaps with 4.7.2 Organisation of an ecosystem.

Producers link with 4.4.1, Photosynthesis.

Decomposition links with 4.7.2.2, How materials are cycled, and 4.7.2.3, Decomposition. The detail of decomposition should be taught with those sections.

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| --- | --- | --- | --- | --- | --- | --- |
| 4.7.4.1  4.7.4.1 | Producers, consumers and decomposers.  Organisms obtain food as producers, consumers or decomposers.  Producers are mostly plants and algae. They transfer about 1% of incident light for photosynthesis.  Consumers include herbivores, carnivores and omnivores.  Decomposers break down dead plant and animal matter. | Use and explain the terms: producer, consumer, decomposer, herbivore, carnivore and omnivore.  Consider the effect on absorption of light, of plants being green in colour and often having a shiny surface.  Describe how decomposers secrete external enzymes to digest dead plants and animals, then the small molecules diffuse into the microorganism. | 1.5 | Identify the organisms in a food chain using the terms: producer, consumer, decomposer, herbivore, carnivore and omnivore.  Discuss why plants only absorb 1% of the incident light for photosynthesis.  Demonstrate the effect of shining different colours of light on a plant.  Compare the adaptations of herbivores, carnivores and omnivores and relate these to the food they eat.  Watch time-lapse films showing a dead animal and decomposing. Discuss what causes it to happen. | Use model to represent food chains.  Observe the colour of a plant in different coloured light and suggest which colours of light are absorbed by a green plant. | Light absorption:   * projector * coloured filters. |
| 4.7.4.1  4.7.4.2  4.7.4.3 | Trophic levels and Pyramids of biomass  The stages in a food chain are called trophic levels. The producer is at level 1.  Pyramids of biomass can be constructed to represent the relative amount of biomass at each level in a food chain.  Trophic level 1 is at the bottom of a pyramid of biomass.  Only about 10% of the biomass at each trophic level is transferred to the level above. | Identify the trophic levels on food chains and pyramids of biomass.  Construct and interpret pyramids of biomass from data.  Calculate the efficiency of biomass transfer between trophic levels.  Explain what losses of biomass are due to. | 0.5 | Label the trophic levels on food chains and pyramids of biomass.  Construct scale drawings of pyramids of biomass.  Interpret scale drawings of pyramids of biomass.  Calculate the efficiency of biomass transfer between trophic levels in pyramids of biomass.  Produce a poster to explain how biomass is lost from a food chain. | Use a model to describe pyramids of biomass.  Construct and interpret scale drawings.  Calculate efficiency of biomass transfer. | [PPT B1.5 Energy and biomass in food chains](http://filestore.aqa.org.uk/subjects/gcsescienceassessment/B1-5-ENERGY-AND-BIOMASS-IN-FOOD-CHAINS.PPT) |

### 4.7.2.2 How materials are cycled

The cycles link to many areas of the specification. The water cycle relates to osmosis and transpiration in plants and waste management. The carbon cycle relates to respiration, photosynthesis, decay, land use, deforestation and global warming. The decay cycle links to active transport and the use of mineral ions in plants.

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| --- | --- | --- | --- | --- | --- | --- |
| 4.7.2.2 | How materials are cycled  Materials are recycled to provide the building blocks for future organisms.  The main processes involved in recycling carbon in the carbon cycle.  The main processes in the water cycle.  The decay cycle returns carbon to the atmosphere as carbon dioxide and mineral ions to the soil. | Interpret and explain the processes in diagrams of the carbon, water and decay cycles.  Explain the importance of these cycles to living things.  Explain the carbon cycle.  Explain the water cycle.  Explain the role of microorganisms in cycling materials through an ecosystem. | 1.5 | Recap how carbon dioxide is used by plants in photosynthesis and why this is of use to animals. Discuss what happens next to eventually return carbon to the air.  Demo: Show examples of fossil fuels. Discuss how they were formed.  Discuss how to test for carbon dioxide.  Demo: Use sensors to measure carbon dioxide levels in the air.  Demo: The production of carbon dioxide when a fuel burns.  Cut-out different coloured cards for processes and organisms. Arrange them as in the carbon cycle.  Students use the idea to produce cards to make a model for the water cycle. Evaluate each other’s models. | Predict colour change of limewater.  Use a model to represent the carbon cycle.  Design and evaluate a model to represent the water cycle. | Demos:  Coal and oil.  Carbon dioxide sensor and data logger.  Fuel to burn, eg using a small Bunsen burner, inverted funnel connected to tube of limewater and pump.  [BBC Bitesize Activity – Water, nitrogen and carbon cycles](http://www.bbc.co.uk/education/guides/z72v4wx/activity)  Cards: one colour for processes, one for organisms and one for arrows. |
| 4.7.2.3 | Decomposition  Factors which affect the rate of decay of organic matter.  Required practical: investigate the effect of temperature on the rate of decay of fresh milk by measuring PH change. | Describe the factors which affect the rate of decay as:   * temperature * availability of oxygen * availability of moisture * availability of microorganisms to carry out decay * pH * build-up of toxic substances.   Interpret data showing how factors affect the rate of decay.  Calculate the rate of decay using data.  Required practical: plan and carry out a controlled investigation. Identify variables; record, present and analyse result; calculate rates of decay. | 2 | Describe how plants and animals return materials to the environment.  Bread mould practical.  Discuss what would happen if things didn’t decay when they die.  Classify items as biodegradable and non-biodegradable and agree criteria for classification.  Discuss how the rate of decay can be controlled by considering food preservation, bodies preserved in bogs, compost heaps.  Demo: Investigate the rate of decay of grass clippings. Observe results in later lesson  Interpret data about decay.  Required practical. | Classify items and present conclusions with reasons.  Apply scientific reasoning to unfamiliar situation.  Demo: Explain why each flask was set up and predict the results. Consider what controls are set up.  Interpret data and calculate rates.  Required practical: plan and carry out a controlled investigation. Identify variables; record, present and analyse result; calculate rates of decay. | [Science fair projects – Safe storage of bread](http://www.all-science-fair-projects.com/print_project_1317_108)  Exhibition of objects and pictures to classify.  Grass clippings:   * thermos flasks with thermometers/ temperature probes * disinfectant * wet and dry grass * composting agent.   Required practical: See *Practical Handbook*.  [PPT B1.6 Waste materials from plants and animals](http://filestore.aqa.org.uk/subjects/gcsescienceassessment/B1-6-WASTE-MATERIALS-FROM-PLANTS-AND-ANIMALS.PPT) |
| 4.7.2.3 | Decomposition  Compost provides gardeners and farmers with a natural fertiliser for plants and crops.  Anaerobic decay produces methane gas.  Biogas generators can produce methane which can be used as a fuel. | Explain how decay is useful to plants (links with 4.4.1.3).  Evaluate the necessity and effectiveness of recycling organic kitchen or garden wastes.  Describe how gardeners and farmers try to provide optimum conditions for rapid decay of wastes.  Explain the difference between aerobic and anaerobic decay.  Define the term biogas.  Evaluate the use of biogas generators.  Explain why the output from a biogas generator is affected by climatic conditions. | 2 | Research how kitchen and garden wastes can be recycled.  Competition – whose potato will decay the fastest? Observe results in later lesson.  Discuss where and why biogas generators are useful.  Watch BBC video showing different biogas generators (see resources).  Compare and evaluate different types of biogas generator.  Design and build a simple gas generator. Evaluate the designs and select the best to demonstrate how the methane can be burned as a fuel. | Competition: plan the best conditions for decay.  Evaluate designs. | Competition: Potatoes and equipment as described in plans.  Biogas generator: [BBC Bitesize – Biofuels](http://www.bbc.co.uk/schools/gcsebitesize/science/triple_aqa/humans_and_environment/biofuels/revision/4/)  [BBSRC – Powering the future: Biofuels](http://www.bbsrc.ac.uk/engagement/schools/keystage5/bioenergy-biofuels-discussion/)  Past exam questions on biogas generators. |

### 4.7.3 Biodiversity and the effect of human interaction on ecosystems

Biodiversity could be taught with Classification, 4.6.4.1, to illustrate the wide variety of organisms and the need to classify them into groups.

There is a lot of useful information on the following websites: [Natural History Museum](http://www.nhm.ac.uk/), [Greenpeace](http://www.greenpeace.org.uk/) and [WWF](http://www.wwf.org.uk/).

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| --- | --- | --- | --- | --- | --- | --- |
| 4.7.3.1 | Biodiversity  Biodiversity is the variety of all life on Earth.  A great biodiversity ensures stability of ecosystems.  The future of the human species relies on us maintaining a good level of biodiversity.  Human activities can reduce biodiversity and we should try to stop this. | Define the term biodiversity.  Explain how great biodiversity maintains food supplies and shelter for organisms, and maintains the physical environment.  Describe examples of how a reduction in biodiversity can affect climate, food supplies for humans, useful chemical for the future etc. | 0.5 | Exhibition or video clips to show the variety of life, to include microorganisms and different plants and animals (links with 4.6.4.1 Classification) (see resources).  Discuss how some of these help humans, directly and indirectly.  Brainstorm human activities that are reducing biodiversity. | Evaluate environmental effects and ethical issues related to human activities. | [BBC Bitesize – Biodiversity](http://www.bbc.co.uk/education/guides/zs8wwmn/revision)  [Natural History Museum – Biodiversity](http://www.nhm.ac.uk/our-science/our-work/biodiversity.html) |
| 4.7.3.2  4.7.3.2  4.7.3.2 | Waste management  Rapid growth in the human population means more resources are used and more wastes are produced, which could lead to more pollution.  Pollution kills plants and animals which can reduce biodiversity.  Waste may pollute water with sewage, fertilisers or toxic chemicals.  Waste may pollute air with smoke and gases such as sulfur dioxide, which contributes to acid rain.  Waste may pollute land with toxic chemicals such as pesticides and herbicides, which may be washed from the land into water. | Describe the problems associated with an increasing human population.  Interpret graphs showing human population growth.  Describe how water can be polluted with sewage, fertiliser or toxic chemicals.  Analyse and interpret data about water pollution.  Describe examples of air pollutants and where they come from.  Describe the effects of smoke on buildings, humans and plant photosynthesis.  Describe how acid rain is formed and the effects of acid rain on living organisms.  Analyse and interpret data about air pollution.  Evaluate the use of fertiliser on plant growth and oxygen levels.  Describe what herbicides and pesticides are used for. | 2 | Discuss the effects and problems associated with an increasing population.  Interpret graphs showing human population growth globally and in different parts of the world.  Watch BBC activity videos (see resources).  Show images of sewage, industries, eutrophication and effects on water life. Brainstorm types of water pollutants and where they come from.  Show images illustrating the effects of acid rain on buildings, trees, lakes and images of smog.  Brainstorms what air may be polluted with and where the pollutants come from.  Measure the pH of rainwater samples.  Investigate the effect of sulfur dioxide on seed germination.  Discuss the Clean Air Act.  Produce poster(s) or diagrams to describe the causes and effects of sulfur dioxide and smoke pollution to complete for homework.  Show images of how land is used or damaged by man.  Discuss the sources and effects of toxic chemicals; what pesticides and herbicides are used for.  Demo to investigate the effect of fertiliser on growth of duckweed and oxygen levels. Monitor results over next few lessons.  Interpret and analyse data about water, air and land pollution. | Show how fast the human population is increasing globally and in different countries using the counter on the Worldometers website.  Interpret graphs showing human population growth – look for patterns and trends, extrapolate and make predictions.  Interpret colour change of indicator.  Carry out a controlled investigation, present and analyse the results.  Consider the social, economic and environmental implications of advances in technology over the centuries.  Plan a controlled investigation; present and analyse the results.  Interpret and analyse data. | [Population – Worldometers](http://www.worldometers.info/population/)  [BBC Bitesize Activity – Water pollution and deforestation](http://www.bbc.co.uk/education/guides/zyvwxnb/activity)  [BBC Bitesize – Human impact on environment](http://www.bbc.co.uk/education/guides/zmb2pv4/revision/1)  Rain water:   * rainwater samples * indicator paper or pH probe.   Sulfur dioxide:   * Petri dishes * cotton wool * water * small pots of sodium metabisulfite solution * cress seeds * plastic bags with ties * goggles.   Demo:   * beakers containing different concentrations of fertiliser * duckweed plants * oxygen sensors * data loggers.   [PPT B3.4.1 Waste from human activity](http://filestore.aqa.org.uk/subjects/gcsescienceassessment/B3-4-1-WASTE-FROM-HUMAN-ACTIVITY.PPT)  (Also for global warming) |
| 4.7.3.3  4.7.3.4  4.7.3.3  4.7.3.4  4.7.3.3  4.7.3.4 | Land use and Deforestation  Humans reduce the amount of land available for other plants and animals by building, quarrying, farming and dumping waste.  The destruction of peat bogs to produce compost releases carbon dioxide into the atmosphere. It destroys habitats and reduces biodiversity.  Large scale deforestation occurred to:   * provide land for cattle and rice fields to provide more food * grow crops from which biofuel can be produced.   This destruction of large areas of trees has:   * increased the release of carbon dioxide by burning and microbial activity * reduced the rate at which carbon dioxide is removed from the atmosphere by photosynthesis to be ‘locked up’ in wood * led to a reduction in biodiversity. | Explain what peat is and why it is important to preserve areas of peat.  Explain why peat should not be burnt.  Define the term deforestation.  Explain why vast tropical areas have been cleared of trees.  Explain how deforestation increases the amount of carbon dioxide in the atmosphere and leads to a reduction in biodiversity. | 2 | Brainstorm how humans use land.  Observe a block of peat and some peat compost. Discuss what peat is used for and why.  Demo burning peat.  Show images of a peat bog, peat drying and peat being burnt.  Explain why the destruction of peat bogs is harmful to the environment.  Investigate the growth of plants in ‘peat free’ and peat based composts.  Describe deforestation using evidence from images or video clips of deforestation taking place – clearing, burning, rotting and destruction of habitats.  Discuss the effects deforestation has on the environment.  Observe images or video clips of land used for timber, biofuel crops, cattle and rice.  Explain why areas of tropical rain forest are being cleared.  Prepare a newspaper article for either:   * a scientific journal * tabloid newspaper * environmental news * burger chain.   Present a bias of choice to suit the article for or against deforestation. | Consider the need for cheap fuel and cheap compost for food production, against the need to conserve peat bogs as habitats and reduce carbon dioxide emissions.  Carry out a controlled investigation; decide what the dependent variable(s) will be; present and analyse the results. | Demo: Block of peat and compost.  Composts:   * ‘peat free’ compost * peat based compost * plant pots * seedlings.   [BBC Bitesize – Water pollution and deforestation](http://www.bbc.co.uk/education/guides/zyvwxnb/revision/3)  [PPT B3.4.2 Deforestation and the destruction of areas of peat](http://filestore.aqa.org.uk/subjects/gcsescienceassessment/B3-4-2-DEFORESTATION-AND-THE-DESTRUCTION-OF-AREAS-OF-PEAT.PPT) |
| 4.7.3.5 | Global warming  Levels of carbon dioxide and methane in the atmosphere are increasing and contribute to ‘global warming’.  Consequences of global warming include:   * loss of habitat when low lying areas flood * changes in the distribution of species where temperature of rainfall changes * changes in migration patterns. | Explain the terms greenhouse effect and global warming.  Explain with the aid of a diagram how levels of carbon dioxide and methane contribute to global warming.  Describe the possible effects of global warming. | 1 | Research the causes and effects of global warming.  Produce a poster to explain the greenhouse effect including sources of carbon dioxide and methane.  Describe the possible effects of global warming.  Show a computer simulation of the greenhouse effect.  Measure the temperature inside and outside a greenhouse over 24 hours.  Demonstrate how a black object absorbs and re-radiates heat using sensors or hold near the skin. | Draw a model to explain the greenhouse effect.  Use results to explain the greenhouse effect using the words or phrases ‘absorb’ and ‘re-radiate’. | Video clip  [BBC Bitesize – Carbon dioxide in the atmosphere](http://www.bbc.co.uk/education/clips/zwnncdm)  [BBC Bitesize – Greenhouse effect](http://www.bbc.co.uk/schools/gcsebitesize/geography/climate_change/greenhouse_effect_video.shtml)  Greenhouse:   * temperature sensors * data loggers.   Demo:   * black object * infrared lamp * temperature sensors. |
| 4.7.3.6 | Maintaining biodiversity  Programmes have been put in place to reduce the negative effects on ecosystems and biodiversity. | Describe programmes introduced to maintain biodiversity:   * breeding programmes for endangered species * protection and regeneration of rare habitats, eg coral reefs, mangroves, heathland * reintroduction of field margins and hedgerows in agricultural areas * reduction of deforestation and carbon dioxide emissions by some governments * recycling resources rather than dumping waste in landfill.   Explain and evaluate conflicting pressures on maintaining biodiversity. | 1 | Recap what biodiversity is and how all the topics covered in 4.7.3 might affect biodiversity.  Research the list of programmes that could help to maintain biodiversity.  Brainstorm what individuals, businesses and governments could do to slow down the reduction in biodiversity.  Discuss why it is difficult to make changes that will maintain biodiversity. |  |  |
| 4.7.2.4 | Impact of environmental change  Environmental changes affect the distribution of species in an ecosystem. | Describe how environmental changes, such as water availability, temperature and atmospheric gases may be seasonal, geographic or caused by human interaction.  Explain the possible impact of each environmental change on the distribution of species in an ecosystem. | 1 | Discuss in groups variation in water availability, temperature and atmospheric gases due to:   * the seasons * geographic position * human interaction.   Consider how they could affect the distribution of organisms in an ecosystem.  Produce a presentation to the class in a suitable format. It should include references to some named organisms. |  |  |

### 4.7.5 Food production

GM crops links to Genetic engineering, 4.6.2.4

| **Spec ref.** | **Summary of the specification content** | **Learning outcomes**  *What most candidates should be able to do* | **Suggested timing (hours)** | **Opportunities to develop scientific communication skills** | **Opportunities to apply practical and enquiry skills** | **Self/peer assessment Opportunities and resources**  *Reference to past questions that indicate success* |
| --- | --- | --- | --- | --- | --- | --- |
| 4.7.5.1  4.7.5.1 | Factors affecting food security  These include:   * the increasing human population * changing diets in developed countries means scarce food resources are transported around the world * new pests and pathogens affect farming * environmental changes affect food production * cost of agricultural inputs * conflicts in some parts of the world over the availability of water or food.   New ways must be found to feed all people without endangering the ecological balance of the planet. | Explain how factors affect food production and food security locally and globally.  Interpret population and food production statistics to evaluate food security. | 1 | Give each group one factor that affects food production and security to discuss.  Consider whether anything can be done to address each problem.  Present their findings to the class.  List each factor with possible solutions.  Research the work of Oxfam and other charities.  Produce an advert in suitable format to encourage people to donate to famine relief.  Consider the pros and cons of eating foods that have travelled a long way. |  |  |
| 4.7.5.2 | Farming techniques  The efficiency of food production can be improved by restricting energy transfer from food animals.  Battery chickens and calves raised in pens are examples of ‘factory farming’.  Fish grown in cages can be fed high protein food and have restricted movement.  There are moral and ethical objections to some ‘factory farming’ techniques. | Explain how restricting the movement of animals and controlling the temperature of their surroundings improves efficiency of food production.  Define the term factory farming and give examples of animals farmed in this way.  Evaluate modern farming techniques. | 1 | Discuss the food and energy requirements of animals raised outdoors and those raised by ‘factory farming’. Suggest reasons for the difference.  Consider the rate of meat production, flavour and health considerations of the animals.  Role play:  a conversation between a battery hen and a free range hen  or  a farmer and an animal rights supporter.  Carry out a survey to find out what sort of eggs people buy and why. | Model – role play.  Design a questionnaire, carry out a survey, present and analyse the results. Consider whether the survey would produce valid results. |  |
| 4.7.5.3 | Sustainable fisheries  Fish stocks are declining and need to be maintained at levels where breeding continues or some species may disappear.  Net size and fishing quotas play important roles in conservation of fish stocks. | Explain why some fish stocks are declining and why this is a problem.  Describe ways that fish stocks can be conserved.  Give an example of sustainable food production. | 0.5 | Competition – who can catch the most fish?  Discuss the problems of catching both large and small fish and relate to the fishing industry. How can we maintain fish stocks?  Research fishing quotas for different types of fish and display the information.  Research what has happened to bluefin tuna and what we could do to increase fish stocks. | Model fishing nets.  Present and analyse data. | Fishing:  Different sized nets and different sized fish or objects to represent fish, troughs or buckets of water. |
| 4.7.5.4 | Role of biotechnology  Modern biotechnology techniques enable large quantities of microorganisms to be cultured in industrially controlled vats for food or medical purposes.  The fungus Fusarium is useful for producing mycoprotein, a protein-rich food suitable for vegetarians. The fungus is grown on glucose syrup, in aerobic conditions, and the biomass is harvested and purified.  GM crops could provide more food or food with improved nutritional value, eg Golden rice. | Describe how microorganisms can be grown in large vats to produce useful products.  Explain how the conditions in the vat are monitored and controlled for optimal growth.  Describe how the fungus Fusarium can be grown to produce mycoprotein that can be eaten.  Evaluate the use of mycoprotein as a food.  Describe the process of genetic engineering to produce better crops.  Describe what Golden rice is and how it was produced.  Interpret information about genetic engineering techniques.  Make informed judgements about the economic, social and ethical issues concerning genetic engineering. | 1 | Label a diagram of an industrially controlled vat for microbial growth. Explain all the sensors and control features.  Do a taste comparison of a mycoprotein based food and its ‘real’ counterpart.  Compare values for protein, fat and fibre found in beef and mycoprotein. Produce a marketing strategy to sell more mycoprotein.  Research how foods such as Quorn are produced and describe in a flow diagram.  Explain the advantages and disadvantages of using mycoprotein as a food and produce a poster.  See the activities for 4.6.2.4.  Research Golden rice – what it is, how and why it was produced?  Discuss the advantages and disadvantages of Golden rice.  If not already done in 4.6.2.4, draw a diagram to explain how a plant can be genetically modified to have a desired characteristic, eg Golden rice. | Model an industrially controlled vat.  Design a valid comparison, record and present the outcomes and analyse them.  Use a model to describe a process.  Evaluate the use of mycoprotein.  Evaluate the production and use of Golden rice. |  |