# Scheme of work

## Combined Science: Trilogy

## Biology - Ecology

This resource provides guidance for teaching the Ecology topic from our new GCSE in Combined Science; Trilogy (Biology) 8464. It has been updated from the draft version to reflect the changes made in the accredited specification.

There has been a small change to the wording of the required practical in section 4.7.2.1. In additions some minor changes have been made to the specification in sections 4.7.1.1 Communities, 4.7.2.1 Levels of organisation, 4.7.2.2 How materials are cycled, 4.7.3.4 Deforestation and 4.7.3.5 Global warming and 4.7.3.6 Maintaining biodiversity. 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

4.6.4 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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| 4.6.44.6.44.6.4 | ClassificationTraditionally 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 | CommunitiesOrganisms 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.
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| 4.7.1.34.7.1.2 | Biotic factors and Abiotic factorsBiotic 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 organismsQuantitative data on the distribution and abundance of organisms can be obtained by:* random sampling with quadrats
* sampling along a transect.

Required practical: Field investigationsMeasure 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’. orInvestigate 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 | AdaptationsOrganisms 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

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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 organisationFeeding 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.QSB99.2.05QCJ9714.12 | 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) |

### 4.7.2.2 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 cycledMaterials 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. |

### 4.7.3 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 | BiodiversityBiodiversity 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) |
| 4.7.3.24.7.3.24.7.3.2 | Waste managementRapid 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) |
| 4.7.3.3.4.7.3.44.7.3.3.4.7.3.44.7.3.3.4.7.3.4 | Land use and DeforestationHumans 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 warmingLevels 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.
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| 4.7.3.6 | Maintaining biodiversityProgrammes 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. |  |  |