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Cranedale Centre
Supporting the Edexcel A Biology Syllabus 2015

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Our objective is to make our A Level field courses a richly rewarding experience for students; stimulating their ecological awareness, developing enquiring minds and inspiring students to widen their ecological experience both during and after the course.

The 2015 Edexcel A Biology specification offers many exciting new opportunities and challenges for biology students. To meet this challenge the Cranedale Centre has developed many new field studies units for students working towards a new course.

At AS/A Level, topic 4 *Biodiversity and Natural Resources* has highly relevant content covered in Cranedale field studies.

Equally at A Level, topic 5 *On the Wild Side has n*umerous aspects that we are able to cover through our fieldwork investigations.

Furthermore, we hope that by the end of the fieldtrip, students will have come across 8 of the 12 apparatus and techniques skills and are able to show progression in the mastery of the practical competencies outlined in the Common Practical Assessment Criteria (CPAC). In a full field trip, teachers have the option of also undertaking 1 of the 18 required core practicals whilst at the Centre.

Finally, a special feature of a course at the Cranedale Centre is that we are able to shape a course to your specific needs, choices and course duration. Inevitably the key decision will not be what to include, but what to leave out!

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Fieldwork Opportunities at the Cranedale Centre
Edexcel A 2015 Biology Syllabus

Overview

Our fieldwork topics are tailored to coach students through much of the content of AS/A Level Topic 4 and A Level Topic 5 examined in Papers 1, 2 and 3. Each fieldwork topic is planned with a lab-based introduction in the morning and a full day of studies in the field (with a wide range of field equipment). With the aid of iPads, student data is collated in the field, producing means, statistical calculations and graphs which allow interpretation of their results. This data can also be emailed back to school. Evening activities more often take the format of practical outdoor experiences that cover unique and exciting aspects of the syllabus.

Practical Endorsement

As part of a wider field course at the Centre, students could complete practical fieldwork fulfilling the competencies of the Common Practical Assessment Criteria (CPAC). We also can provide opportunities for students to gather data from a range of environments for the additional Level 3 Extended Research Project qualification.

Practical Skills (PS)

We endeavour to foster the practical skills necessary for students so that they are able to demonstrate their competency in all aspects of scientific enquiry; encouraging them to apply themselves and their understanding of scientific ideas to fieldwork. These skills would include, a critical appreciation of methods, application of skills, the processing and interpretation of results, evaluating their studies and considerations towards margins of error, precision and accuracy. We also aim to widen perspectives, broaden the skills and deepen the knowledge required by the A Level whilst hopefully inspiring students about Biology and future career possibilities.

Core Practical Activities

Out of the 18 'Core Practicals' each student must accomplish for A Level, Practical 10 will be able to be completed as part of a wider field course at the Centre if required.

Practical 10: Be able to carry out a study on the ecology of a habitat (for example using quadrats, transects or kick sampling where appropriate). Measuring abiotic factors appropriate to the habitat, understanding patterns in the abundance and distribution of organisms found.

Apparatus and Techniques (AT)

Depending upon time and topics chosen, courses at the Cranedale Centre will provide opportunities for students to develop many of the skills associated with apparatus and technique; required by all A-level Biology specifications. Of the skills required by Edexcel (Appendix 5c) the following 6 skills will be encountered during a field course:-

1) use appropriate apparatus to record a range of quantitative measurements (to include mass, time, volume, temperature, length and pH)

2) use appropriate instrumentation to record quantitative measurements, such as a colorimeter or photometer

5) produce a scientific drawing from observation with annotations

8) safely and ethically use organisms to measure: plant or animal responses, physiological functions

11) use sampling techniques in fieldwork

12) use ICT such as computer modelling, or data logger to collect data, or use software to process data

The following apparatus and technique skills are also likely to be encountered **in part** whilst at the Centre:

4) **use of a light microscope at** high power and **low power**, including use of a graticule

10) **safely use instruments for dissection** of an animal organ, plant organ

Mathematical Requirements (MS)

At least 10% of the marks assessing either AS or A-level Biology will assess mathematical skills. Depending on the time and topics chosen, a Cranedale fieldtrip offers practical experience of the following mathematical skills at AS and A-level:

A 0.1 Recognise and make use of appropriate units in calculations
A 0.3 Use of ratios and calculations of percentages
A 0.4 Estimate results
A 1.1 Use appropriate number of significant figures
A 1.10 Standard deviation & standard error
A 1.11 Calculating percentage error
A 1.2 & 1.6 Mean, median and mode
A 1.3 & MS 1.7 Constructing and interpretation of graphs, scattergraphs, bar charts, histograms
A 1.4 Understand the principles of sampling as applied to scientific data
A 1.4 Use words probability and chance
A 1.9 Selecting and using a statistical test (including Chi^2, SRCC & T-test)
A 2.2 Change the subject of an equation (including NPP = GPP – R)
A 2.3 & 2.4 Substitute numerical values into algebraic equations (including Simpsons Index)
A 4.1 Calculate the circumferences, surface areas and volumes of regular shapes

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Fieldwork Topics at the Cranedale Centre Edexcel A 2015

The following is a summary of the Edexcel A fieldwork topics that are on offer at the Cranedale Centre and gives an overall flavour of what students can expect to cover. The specific syllabus links relevant to each topic can be found in an adjoining document on our website.

Rocky Shore Ecology

The peninsula of Filey Brigg (SSSI) has tremendous opportunities for students to test two shores with contrasting wave powers. Students participate in classic fieldwork techniques (such as belt transects and random sampling with quadrats) to gather robust primary data for use in all three statistical tests required at A-level. Differences in the morphology and population of limpets and the effect of desiccation on seaweed are two of the most popular studies. Students use refractometers for seawater salinity, anemometers for wind speed and a site-specific wave height chart. Finally, students draw conclusions regarding the distribution of organisms on the rocky shore with relation to measured abiotic and biotic interactions (particularly inter/intra-specific competition).

Marine Conservation

The sustainability of North Sea fisheries yields is examined through visiting Bridlington Harbour and viewing the landing of shellfish. RSPB Bempton Cliffs (SSSI, SPA, and SAC) provides opportunity for students to view spectacular seabird assemblages from 130m high chalk cliffs. As apex predators, seabirds indicate the health of an ecosystem and students are able to conduct an EIA, evaluate evidence and data concerning climate change and the conservation of iconic species such as the gannet and puffin.

Marine Energetics

Filey Brigg (SSSI) is a biologically rich rocky shore environment which provides a dramatic and engaging ecosystem for fieldwork. Students place random quadrats within the inter-tidal zone and quantify the biomass of all organisms found whilst also being able to observe both anatomical and behavioural adaptations. The efficiency of biomass and energy transfers between trophic levels are then quantified and the students use their own primary data to construct pyramids of biomass.

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Biodiversity in Freshwater

Using a light microscope at low power, students make a scientific drawing of an olive mayfly nymph highlighting the anatomical, behavioural and physiological adaptations. Students then design and carry out fieldwork to identify the impact of crayfish on the biodiversity of freshwater ecosystems. Students will kick sample two streams, one containing crayfish and identify all freshwater species using hand-lenses and dichotomous keys. Abiotic variables including dissolved oxygen concentration, nitrate and turbidity are measured and Simpson's Biodiversity estimates for each stream are then calculated. Students then utilise their own primary data to evaluate conflicting evidence regarding the future conservation of native crayfish species.

Freshwater Energetics

The myriad freshwater life allows students to investigate the complexities of food web dynamics and to quantify the efficiency of energy transfer within an aquatic community. Students conduct kick sampling with D-nets at a local calciferous stream to capture and identify and count populations of all species using hand-lenses and dichotomous keys. Students also measure a range of abiotic variables including dissolved oxygen concentration, temperature, pH, turbidity, conductivity and nitrate and relate the findings to impacts upon different trophic levels within the food web.

Freshwater Pollution

Chalk streams are globally rare habitats. Renowned for their pristine water quality and fragility they are becoming increasingly threatened by human activity. Pocklington Beck exhibits areas of superb biological richness as well as the impact of sewage treatment and agricultural leaching. Students assess the impact of the distribution of aquatic organisms within the stream environment to assess the consequences of pollution. Students visit and kick sample control and polluted stream sites, identifying pollution-indicator species using hand-lenses and dichotomous keys. Abiotic variables are also measured including oxygen, heavy metals, ammonium, nitrate and phosphate for eutrophication, as well as temperature, pH, turbidity and conductivity.

Agricultural Energetics

Students quantify the productivity of two contrasting agricultural-ecosystems in an effort to determine the sustainable future of farming in an increasingly crowded world. Students calculate and contrast the net productivity of indoor commercial breed pigs and outdoor rare breed pigs. The farming practices that are designed to increase productivity (increasing efficiency of energy transfer and reducing respiratory losses) are quantified and calculated. Students also use observations of the characteristics of the pig herd to interpret and predict the results of a monohybrid cross.

Sustainable Woodland Ecosystems

The environmental and economic benefits of broadleaved and coniferous woodlands are quantified through fieldwork that includes random sampling and sweep netting for invertebrates. Using the circumference and height of each tree, students quantify mass of carbon within a coniferous plantation and the broadleaved Ellers Wood (SSSI, SAC) and draw links with climate change and the carbon cycle. Students then make informed conclusions relating to the sustainable management of woodlands, balancing the conflicts between human needs and conservation.

Chalkland Succession (Summer only)

Wharram Quarry (SSSI) is a rare and species rich ecosystem where succession is managed for conservation by Yorkshire Wildlife Trust as a chalk grassland habitat. Students utilise point-frame quadrats, pooters and beating trays to investigate primary succession on a lithosere. Using their own primary data on the vegetation, microclimate, soil and invertebrates, students are challenged to solve the chronologic sequence of succession.

Sand Dune Succession (All year)

Primary succession on a psammosere is investigated by students at Bridlington South Sands, a small sand dune ecosystem on the east coast. Students are able to observe adaptations of xerophytic plants and carry out the classic belt transect using quadrats and percentage cover to investigate the changes in vegetation in relation to edaphic factors.

Wetland Succession (Spring and Autumn)

Tophill Low (SSSI) is a managed nature reserve run by Yorkshire Water. Students are able to observe management of succession whilst gathering data from five distinct seral stages (including both aquatic and terrestrial). Students are then challenged to piece together the sequence of succession of a hydrosere using their own primary data they have obtained on soil, microclimate, flora and fauna.

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Population Studies

Whilst at Cranedale, dependent upon the number of studies chosen, students are able to participate in a range of highly engaging evening fieldwork activities that explore population dynamics. These include;

Setting Traps
Setting humane traps including Longworth and camera for mammals, Heath traps for moths and pitfall traps for invertebrates equips students with a wide range of knowledge on equipment and techniques to monitor species populations. They are able to safely and ethically use organisms for study, hypothesise upon the effect of differing abiotic/biotic factors that affect species distribution and evaluate the limitations of each trapping method.

Bat Walk
Students are able to use specialist ICT equipment and software that collects and logs bats' ultrasonic calls. Using GPS to track the position of each bat sightings, calls are automatically interpreted and species identified whilst they explore different habitat areas and local roost sites.

Owl Pellet Dissection
Using light microscopes at low power students safely use instruments to dissect barn owl pellets to help illustrate the relationship between predators and prey. The anatomical, behavioural and physiological adaptations which enable barn owls to capture prey are also highlighted.

Mark-Release-Recapture
Using snail-varnish, students are able to calculate the size of a locally abundant motile species (the banded snail *Cepaea nemoralis*) estimated using the mark-release-recapture method. Following the practical, students will better appreciate the assumptions of the technique and evaluate the results with reference to these.

Natural Selection in Cepaea nemoralis
Students explore the allele's effects on shell phenotype in this species which wears its genes on its banded back. The Hardy-Weinberg principle is used to calculate the frequency of alleles and genotypes. Woodland and grassland habitats are sampled to investigate whether selection is at work.

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Syllabus Links covered by the Cranedale Centre Edexcel A 2015

The following document provides the syllabus links which the Cranedale Centre will cover for each fieldwork topic.

Syllabus Links Common to Most Fieldwork Days
Topic 4 (4.1 i) Understanding the terms 'biodiversity' and 'endemism'
Topic 4 (4.1 ii) Simpsons Biodiversity Index
Topic 4 (4.2) Understand the concept of niche and discuss examples of adaptation of organisms to their environment (behavioural, physiological, anatomical).
Topic 5 (5.1) Understand the concepts of ecosystems, communities, populations and habitats.
Topic 5 (5.2) Understand that the numbers and distribution of organisms in a habitat are controlled by biotic and abiotic factors.
Topic 5 (5.3) Understand how the concept of niche accounts for the distribution and abundance of organisms in a habitat.
Topic 4 and 5 (A.1.5) Understand the principles of sampling as applied to scientific data

Rocky Shore Ecology
Topic 4 (4.5 i) Understanding classification as a means of organising the variety of life.
Topic 4 (4.5 ii) Understand the process and importance of critical evaluation of new data by the scientific community, which leads to new taxonomic groupings (including the three domains of life based on molecular phylogeny).
Topic 5 (5.2) Understand that the numbers and distribution of organisms in a habitat are controlled by biotic and abiotic factors.

Marine Energetics
Topic 4 (4.1 i) Understand the terms: 'biodiversity' and 'endemism'
Topic 4 (4.1 ii) Know that biodiversity can be measured within a habitat using species richness using Simpson's Biodiversity Index
Topic 5 (5.10 i) Know how to calculate net primary productivity
Topic 5 (5.10 ii) Understand the relationship between gross primary productivity, net primary productivity and plant respiration.
Topic 5 (5.11) Know how to calculate the efficiency of energy transfers between trophic levels.

Freshwater Energetics
Topic 4 (4.1 i) Understand the terms: 'biodiversity' and 'endemism'
Topic 4 (4.1 ii) Know that biodiversity can be measured within a habitat using species richness using Simpson's Biodiversity Index
Topic 5 (5.10 i) Know how to calculate net primary productivity
Topic 5 (5.10 ii) Understand the relationship between gross primary productivity, net primary productivity and plant respiration.
Topic 5 (5.11) Know how to calculate the efficiency of energy transfers between trophic levels.

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Biodiversity in Freshwater

Topic 4 (4.1 i) Understanding the terms 'biodiversity' and 'endemism'
Topic 4 (4.1 ii) Simpsons Biodiversity Index
Topic 5 (5.1) Understand the concepts of ecosystems, communities, populations and habitats.
Topic 5 (5.2) Understand that the numbers and distribution of organisms in a habitat are controlled by biotic and abiotic factors.
Topic 5 (5.3) Understand how the concept of niche accounts for the distribution and abundance of organisms in a habitat.

Freshwater Pollution

Topic 4 (4.1 i) Understand the terms: 'biodiversity' and 'endemism'
Topic 4 (4.1 ii) Know that biodiversity can be measured within a habitat using species richness using Simpson's Biodiversity Index
Topic 4 (4.2) Understand the concept of niche and discuss examples of adaptations
Topic 4 (4.10) Understand the importance of water and inorganic ions (nitrate, calcium and magnesium ions) to plants.
Topic 5 (CP 10) Kick sampling, quadrats, measuring abiotic factors of a habitat

Agricultural Energetics

Topic 2 (2.13 i) Know the meaning of the terms: gene, allele, genotype, phenotype, recessive, dominant, incomplete dominance, homozygote and heterozygote.
Topic 2 (2.13 ii) Understand patterns of inheritance, including the interpretation of genetic pedigree diagrams, in the context of monohybrid inheritance.
Topic 5 (5.10 i) Know how to calculate net primary productivity
Topic 5 (5.10 ii) Understand the relationship between gross primary productivity, net primary productivity and plant respiration.
Topic 5 (5.11) Know how to calculate the efficiency of energy transfers between trophic levels.
Topic 5 (5.16) Understand the effect of temperature on the rate of enzyme activity and its impact on plants, animals and microorganisms.

Sustainable Woodland Ecosystems

Topic 4 (4.1 i) Understand the terms 'biodiversity' and 'endemism'
Topic 4 (4.11) Understand how the uses of plant fibres and starch may contribute to sustainability
Topic 5 (5.12) Understand the different types of evidence for climate change and its causes, recognising correlations and causal relationships.
Topic 5 (5.13) Understand the causes of anthropogenic climate change – including the role of greenhouse gases CO2 and CH4
Topic 5 (5.14) Understand that data can be extrapolated to make predictions and that these are used in models of future climate change, limitations of models.
Topic 5 (5.15) Understand the effects of climate change on plants and animals
Topic 5 (5.15) Understand the effect of temperature on the rate of enzyme activity and its impact on plants, animals and microorganisms
Topic 5 (5.21) Understand the carbon cycle
Topic 5 (5.22) Understand how reforestation and the use of sustainable resources including biofuels are examples of effective management of the conflict between human needs and conservation.

Chalkland Succession
Topic 4 (4.1 i) Understanding the terms 'biodiversity' and 'endemism'
Topic 4 (4.1 ii) Simpsons Biodiversity Index
Topic 5 (5.1) Understand the concepts of ecosystems, communities, populations and habitats.
Topic 5 (5.2) Understand that the numbers and distribution of organisms in a habitat are controlled by biotic and abiotic factors.
Topic 5 (5.3) Understand how the concept of niche accounts for the distribution and abundance of organisms in a habitat.
Topic 5 (5.4) Understand the concept of succession to a climax community.

Sand Dune Succession
Topic 4 (4.1 i) Understanding the terms 'biodiversity' and 'endemism'
Topic 4 (4.1 ii) Simpsons Biodiversity Index
Topic 5 (5.1) Understand the concepts of ecosystems, communities, populations and habitats.
Topic 5 (5.2) Understand that the numbers and distribution of organisms in a habitat are controlled by biotic and abiotic factors.
Topic 5 (5.3) Understand how the concept of niche accounts for the distribution and abundance of organisms in a habitat.
Topic 5 (5.4) Understand the concept of succession to a climax community.

Wetland Succession
Topic 4 (4.1 i) Understanding the terms 'biodiversity' and 'endemism'
Topic 4 (4.1 ii) Simpsons Biodiversity Index
Topic 5 (5.1) Understand the concepts of ecosystems, communities, populations and habitats.
Topic 5 (5.2) Understand that the numbers and distribution of organisms in a habitat are controlled by biotic and abiotic factors.
Topic 5 (5.3) Understand how the concept of niche accounts for the distribution and abundance of organisms in a habitat.
Topic 5 (5.4) Understand the concept of succession to a climax community.

Population Studies
Topic 2 (2.13 i) Know the meaning of the terms: gene, allele, genotype, phenotype, recessive, dominant, incomplete dominance, homozygote and heterozygote.
Topic 4 (4.3) Understand how natural selection can lead to adaptation and evolution.
Topic 4 (4.4 i) Understand how the Hardy-Weinberg equation can be used to see whether a change in allele frequency is occurring in a population over time.
Topic 4 (4.4 ii) Understand that reproductive isolation can lead to accumulation of different genetic information in populations potentially leading to the formation of new species.
Topic 5 (5.17) Understand how evolution (a change in allele frequency) can come about through gene mutation and natural selection.