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Cranedale Centre
Supporting the Edexcel B 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 B 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 3 *Classification and Biodiversity* has highly relevant content covered in Cranedale field studies.

Equally at A Level, topics 8 *Origins of Genetic Variation* and 10 *Ecosystems* have numerous 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 2 of the 16 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 B 2015 Biology Syllabus

Overview

Our fieldwork topics are tailored to coach students through much of the content of AS/A Level Topic 3 and A Level Topics 8 and 10 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 (often with a wide range of field equipment). With the aid of iPads, student data can be collated, producing means, statistical calculations and graphs which allow students to instantly interpretat their results in the field. This data can also be emailed back to school. Evening sessions 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 the 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.

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

Core Practical Activities

Out of the 16 'Core Practicals' each student must accomplish for A Level, Practicals 15 and 16 will be able to be completed as part of a wider field course at the Centre if required.

Practical 15: Investigate the effect of different sampling methods on estimates of the size of a population.
Practical 16: Investigate the effect of one abiotic factor on the distribution or morphology of one species.

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 B 2015

The following is a summary of the Edexcel B 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 hypotheses and study ecological theory. 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 factors.

Marine Conservation

RSPB Bempton Cliffs (SSSI, SPA, 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. The sustainability of North Sea fisheries yields is also examined through visiting Bridlington Harbour and viewing the landing of shellfish.

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. Marine species are collected from the intertidal zone and students are able to observe adaptations before establishing the total wet-mass of each species. 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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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.

Sustainable Woodland Ecosystems

The sustainability of natural resources is examined by the students during fieldwork that compares and contrasts two distinctive woodland ecosystems in Dalby Forest. 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. The environmental, economic and aesthetic benefits of each woodland are quantified through fieldwork that includes random sampling and sweep netting for invertebrates. Students then make informed conclusions relating to the sustainable management of woodland ecosystems, balancing the conflicts between human needs and conservation.

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 net productivity at an intensive pig farm and an extensive small-holding. The farming practices that manipulate productivity are compared, efficiencies of each system are quantified and respiratory losses of pigs are calculated. Students also use Pedigree Charts to construct genetic crosses of the pig herd, based on the pigs' phenotypes to show patterns of inheritance and deduce the dominant and recessive alleles of a monohybrid cross.

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.

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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 are able to observe anatomical adaptations of plants to gain an appreciation of each species niche. Utilising point-frame quadrats, pooters and beating trays they also 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 B 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 3 (3.1) Classification
Topic 3 (3.1 i) Know that the classification system consists of a hierarchy of domain, kingdom, phylum, class, order, family, genus, species.
Topic 3 (3.1 ii) Understand the limitations of the definition of a species as a group of organisms
Topic 3 (3.2) Natural Selection
Topic 3 (3.2 i) Understand how evolution can come about through natural selection acting on variation bringing about adaptations
Topic 3 (3.2 ii) Understand how organisms occupy niches according to physiological, behavioural and anatomical adaptations
Topic 3 (3.3) Biodiversity
Topic 3 (3.3 i) Simpson's Diversity Index
Topic 10 (10.1 i) Understand what is meant by the term ecosystem and that they range in size.
Topic 10 (10.1 iv) Know the ecological techniques used to assess abundance and distribution of organisms in a natural habitat, including types of quadrat, transects, ACFOR scales, % cover and individual counts.
Topic 10 (10.1 v) Be able to select appropriate ecological techniques according to the ecosystem and organisms to be studied.

Rocky Shore Ecology

Topic 3 (3.2 ii) Understand how organisms occupy niches according to physiological, behavioural and anatomical adaptations.
Topic 10 (10.1 iv) Know the ecological techniques used to assess abundance and distribution of organisms in a natural habitat, including types of quadrat, transects, ACFOR scales, % cover and individual counts.
Topic 10 (10.1 v) Be able to select appropriate ecological techniques according to the ecosystem and organisms to be studied
Topic 10 (10.1 vi) Be able to use statistical tests to analyse data, including t-test, correlation coefficient and Spearman's rank.
CP 16: Investigate the effect of one abiotic factor on the distribution or morphology of one species taking into account the safe and ethical use of organisms.

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Marine Conservation
Topic 10 (10.4) Human effects on ecosystems
Topic 10 (10.4 i) Understand data relating to human influences on ecosystems, including climate change and depletion of biological resources, including overfishing.
Topic 10 (10.4 ii) Understand the ethical and economic reasons (ecosystem services) for the maintenance of biodiversity.
Topic 10 (10.4 v) Understand the idea that sustainability of resources depends on effective management of the conflict between human needs and conservation, as illustrated by attempts to conserve fish stocks and reduce possible causes of climate change.

Marine Energetics
Topic 3 (3.2 ii) Understand how organisms occupy niches according to physiological, behavioural and anatomical adaptations.
Topic 3 (3.3 i) Know that biodiversity can be assessed within a habitat using Simpson's Biodiversity Index
Topic 10 (10.1 ii) Understand what is meant by trophic levels.
Topic 10 (10.1 iii) Understand the advantages and disadvantages of pyramids of numbers, biomass (dry) and energy as useful representations of ecosystem structure and how biomass and energy are transferred within them.
Topic 10 (10.2 i) Understand how energy is transferred between trophic levels using the terms 'net primary productivity' and 'gross primary productivity'.
Topic 10 (10.2 ii) Be able to calculate the efficiency of energy transfer between different trophic levels and account for the loss of energy at each level.

Freshwater Energetics
Topic 3 (3.2 ii) Understand how organisms occupy niches according to physiological, behavioural and anatomical adaptations.
Topic 3 (3.3 i) Know that biodiversity can be assessed within a habitat using Simpson's Biodiversity Index
Topic 10 (10.1 ii) Understand what is meant by trophic levels.
Topic 10 (10.1 iii) Understand the advantages and disadvantages of pyramids of numbers, biomass (dry) and energy as useful representations of ecosystem structure and how biomass and energy are transferred within them.
Topic 10 (10.2 i) Understand how energy is transferred between trophic levels using the terms 'net primary productivity' and 'gross primary productivity'.
Topic 10 (10.2 ii) Be able to calculate the efficiency of energy transfer between different trophic levels and account for the loss of energy at each level.

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Sustainable Woodland Ecosystems
Topic 10 (10.4) Human effects on ecosystems
Topic 10 (10.4 i) Understand data relating to human influences on ecosystems, including climate change and depletion of biological resources, including overfishing.
Topic 10 (10.4 ii) Understand the ethical and economic reasons (ecosystem services) for the maintenance of biodiversity.
Topic 10 (10.4 v) Understand the idea that sustainability of resources depends on effective management of the conflict between human needs and conservation, as illustrated by attempts to conserve fish stocks and reduce possible causes of climate change.

Agricultural Energetics
Topic 8 Origins of Genetic Variation
Topic 8 (8.1 i) Understand that mutations are the source of new variations and that the processes of random assortment and crossing over during meiosis give rise to new combinations of alleles in gametes.
Topic 8 (8.2 ii) Understand how random fertilisation during sexual reproduction brings about genetic variation.
Topic 8 (8.2 i) Understand the terms, genotype and phenotype, homozygote and heterozygote, dominance, recessive, codominance and multiple alleles.
Topic 8 (8.2 ii) Be able to construct genetic crosses and pedigree diagrams
Topic 10 (10.1 ii) Understand what is meant by trophic levels.
Topic 10 (10.1 iii) Understand the advantages and disadvantages of pyramids of numbers, biomass (dry) and energy as useful representations of ecosystem structure and how biomass and energy are transferred within them.
Topic 10 (10.2 i) Understand how energy is transferred between trophic levels using the terms 'net primary productivity' and 'gross primary productivity'.
Topic 10 (10.2 ii) Be able to calculate the efficiency of energy transfer between different trophic levels and account for the loss of energy at each level.

Chalkland Succession
Topic 3 (3.2 ii) Understand how organisms occupy niches according to physiological, behavioural and anatomical adaptations.
Topic 10 (10.3 i) Understand how ecosystems can develop overtime, including use of the terms colonisation and successions and types of climax communities.
Topic 10 (10.1 iv) Know the ecological techniques used to assess abundance and distribution of organisms in a natural habitat, including types of quadrat, transects, ACFOR scales, % cover and individual counts.
Topic 10 (10.1 v) Be able to select appropriate ecological techniques according to the ecosystem and organisms to be studied.

Sand Dune Succession
Topic 3 (3.2 ii) Understand how organisms occupy niches according to physiological, behavioural and anatomical adaptations.
Topic 10 (10.3 i) Understand how ecosystems can develop overtime, including use of the terms colonisation and successions and types of climax communities.
Topic 10 (10.1 iv) Know the ecological techniques used to assess abundance and distribution of organisms in a natural habitat, including types of quadrat, transects, ACFOR scales, % cover and individual counts.
Topic 10 (10.1 v) Be able to select appropriate ecological techniques according to the ecosystem and organisms to be studied

Wetland Succession
Topic 3 (3.2 ii) Understand how organisms occupy niches according to physiological, behavioural and anatomical adaptations.
Topic 10 (10.3 i) Understand how ecosystems can develop overtime, including use of the terms colonisation and successions and types of climax communities.
Topic 10 (10.1 iv) Know the ecological techniques used to assess abundance and distribution of organisms in a natural habitat, including types of quadrat, transects, ACFOR scales, % cover and individual counts.
Topic 10 (10.1 v) Be able to select appropriate ecological techniques according to the ecosystem and organisms to be studied.

Population Studies
Topic 8 (8.2 i) Understand the terms, genotype and phenotype, homozygote and heterozygote, dominance, recessive, codominance and multiple alleles.
Topic 8 (8.3 i) Understand that selection pressures acting on the gene pool change allele frequencies in the population, including; stabilising selection, disruptive selection.
Topic 8 (8.3 ii) Understand that sometimes changes in allele frequencies can be the result of chance and not selection, e.g. genetic drift.
Topic 8 (8.3 iii) Understand that allele frequencies can be influenced by: population bottlenecks and the founder effect.
Topic 8 (8.3 iv) Understand how the Chi-squared test can be used in genetic studies and how the Hardy-Weinberg equation can be used to monitor changes in the allele frequencies in a population