RECOGNISING ACHIEVEMENT

# Support Material

## GCE Biology

OCR Advanced GCE in Biology: H421

Unit: F215

This Support Material booklet is designed to accompany the OCR Advanced GCE specification in Biology for teaching from September 2008.

OCR
RECOGNISING ACHIEVEMENT

# Contents

# Introduction

## Background

A new structure of assessment for A Level has been introduced, for first teaching from September 2008. Some of the changes include:

- The introduction of stretch and challenge (including the new A* grade at A2) – to ensure that every young person has the opportunity to reach their full potential
- The reduction or removal of coursework components for many qualifications – to lessen the volume of marking for teachers
- A reduction in the number of units for may qualifications – to lessen the amount of assessment for learners
- Amendments to the content of specifications – to ensure that content is up-to-date and relevant

OCR has produced an overview document, which summarises the changes to Biology. This can be found at www.ocr.org.uk, along with the new specification.

In order to help you plan effectively for the implementation of the new specification we have produced this Scheme of Work and Sample Lesson Plans for Biology. These Support Materials are designed for guidance only and play a secondary role to the Specification.

## Our Ethos

All our Support Materials were produced 'by teachers for teachers' in order to capture real life current teaching practices and they are based around OCR's revised specifications. The aim is for the support materials to inspire teachers and facilitate different ideas and teaching practices.

In some cases, where the Support Materials have been produced by a active teachers, the centre logo can be seen in the top right hand corner.

Each Scheme of work and set of sample Lesson Plans are provided in:

- PDF format – for immediate use
- Word format – so that you can use it as a foundation to build upon and amend the content to suit your teaching style and students' needs.

The Scheme of Work and sample Lesson plans provide examples of how to teach this unit and the teaching hours are suggestions only. Some or all of it may be applicable to your teaching.

The Specification is the document on which assessment is based and specifies what content and skills need to be covered in delivering the course. At all times, therefore, this Support Material booklet should be read in conjunction with the Specification. If clarification on a particular point is sought then that clarification should be found in the Specificaiton itself.

## A Guided Tour through the Scheme of Work

### = Innovative Teaching Idea

This icon is used to highlight exceptionally innovative ideas.

### = Stretch and challenge opportunity idea

This icon is added at the end of text when there is an explicit opportunity to offer Stretch and Challenge.

### = ICT Opportunity

This icon is used to illustrate when an activity could be taught using ICT facilities.

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 1* **CELLULAR CONTROL AND VARIATION** | | |
|---|---|---|---|---|
| **Topic outline** | | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
| **5.1.1 Cellular Control**<br>• State that genes code for polypeptides, including enzymes.<br>• Explain the meaning of the term *genetic code.*<br>• Describe, with the aid of diagrams, the way in which a nucleotide sequence codes for the amino acid sequence in a polypeptide. | | • A bead necklace could be used with different coloured beads or various coloured electrical wires.<br>• However, an excellent current method is to use 'Geomag' obtainable from many retailers.<br>• These come as magnetic beads and sticks. Relate this to reading a book and the need for spaces, paragraphs and chapters to make sense of the words.<br>• Use Appendix 2 in Biology 1 to show the code and how it is used.<br>• A good example here is plant germination where enzymes are switched on in the embryo and then diffuse through the endosperm to breakdown food stores.<br>• Some general reference to tertiary structure could be included and this can be illustrated again by the use of electrical wire which is easy to twist and remains in place. The model can | • Use Appendix 2 in Biology 1 (Jones, Fosbery and Taylor) to illustrate the degenerate nature of the code.<br>• Most standard genetics books but of special interest: Essential Genetics by Hartl and Jones, 2005, (ISBN 0-7637-3527-2). | |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 1* **CELLULAR CONTROL AND VARIATION** |
|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| | then be used subsequently to act as a precursor to enzyme-substrate interaction. The more able students can also be gently introduced to quaternary structure using the same approach. | | |
| **2**<br>Describe, with the aid of diagrams, how the sequence of nucleotides within a gene is used to construct a polypeptide, including the roles of messenger RNA, transfer RNA and ribosomes. | • ICT is available here for use and can help students to get to grips with this topic.<br>• The analogy of a pogo stick to illustrate translation may be useful here. | • Some good CD ROMs available to illustrate transcription and translation<br>• **Biology** Age Range: **16-18** Birchfield Interactive<br>*Also Useful for Genetic engineering* | |
| **3**<br>• State that mutations cause changes to the sequence of nucleotides in DNA molecules.<br>• Explain how mutations can have beneficial, neutral or harmful effects on the way a protein functions. | • Study cystic fibrosis to show how numerous mutations can all lead to the same phenotypic result.<br>• Some preliminary reference should be made to the fact that about 50% of enzyme-related diseases have an associated anomaly i.e. the phenomenon of 'inborn errors of metabolism'. Phenylketonuria would also be a good example of a clinical treatment involving dietary control and | | • Please stress that 99% of mutations have no effect on the phenotype of an organism. Harmful and beneficial changes are a rarity not the normal course of events but of paramount importance in the evolutionary process. Furthermore, most harmful mutations have been removed from populations over the millions of years of evolution. |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 1* **CELLULAR CONTROL AND VARIATION** | | |
|---|---|---|---|---|
| **Topic outline** | | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
| | | is indicative of the importance of screening neonates which may sustain student interest. A similar example to cystic fibrosis of course would be sickle cell anaemia where a single mutation causes a syndrome producing not only sickling of the RBCs but vascular plasticity and many other symptoms.<br>• Haemophilia or Duchenne muscular dystrophy are other examples of human mutations which could be used. | | |
| **4**<br>• State that cyclic AMP activates proteins by altering their three-dimensional structure.<br>• Explain genetic control of protein production in a prokaryote using the *lac* operon. | | • The lac operon can be a good example here as lactose alters the normal pathway initiating the synthesis of the relevant enzymes so students get to grips with the idea of repressors and promotors.<br>• See Biochemistry by Stryer to show how cyclic AMP alters protein kinases in glycogen synthesis and breakdown in the liver.<br>• It is worth stressing the importance of | • Stryer *et al*: Biochemistry (1995) WH Freeman, New York, 4th edition, 1995 ISBN 0-7167-2009-4 | |

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** | *MODULE 1* **CELLULAR CONTROL AND VARIATION** |
|---|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| | the function of a kinase, its association with ATP and this could be added to an e-dictionary for each student.<br>• For the more able student, the introduction to the concept of a second messenger and signal conduction may be appropriate. | | |
| **5**<br>• Explain that the genes that control development of body plans are similar in plants, animals and fungi, with reference to homeobox sequences.<br>• Outline how apoptosis (programmed cell death) can act as a mechanism to change body plans. | • Use of the *Drosophila* developmental plan is suggested as there are two homeobox sequences which control their development via the head and anterior thorax and another to regulate the posterior thorax and abdomen.<br>• Studies of cytotoxic T cells show apoptosis.<br>• Programmed cell death also causes the development of digits on human hands as cells between fingers die. | | |
| **5.1.2 Meiosis and Variation**<br>**6**<br>• Explain the terms *allele, locus, phenotype, genotype, dominant, codominant* and *recessive*. | • A loop game might be a useful way of getting these definitions over quickly.<br>• These terms could be added to an e-dictionary.<br>• Use the Mitosis and Meiosis CD-ROM; it's great as an introduction and | • Mitosis and Meiosis CD-ROM an interactive approach V3 Uniview worldwide Ref 1060 | |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 1* **CELLULAR CONTROL AND VARIATION** | | |
|---|---|---|---|---|
| **Topic outline** | | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
| • Give an overview of meiosis in preparation for next lesson. | | as a review tool.<br>• Various lengths of different coloured electric wire to represent chromosomes and chromatids are useful for showing segregation and crossing over etc. They can be controlled by match sticks joined by Sellotape to represent the alpha and beta tubulin molecules and show changes from their function as components of spindle fibres to components of the cytoskeleton. A brief reference to anitimitotics such as colchicine in relationship to cancer would maintain interest. | | |
| **7**<br>• Describe, with the aid of diagrams, the behaviour of chromosomes during meiosis, and the associated behaviour of the nuclear envelope, cell membrane and centrioles (names of the main stages are expected but **not** the | | • Alternatively, students can use plasticine to mould each stage.<br>• This helps students to understand how one stage leads into the next. The stages can be given to pairs to make or small groups could be asked to recreate the whole process.<br>• Modelling in plasticine shows how this process can occur though little detail | • This is also shown on the Mitosis and Meiosis CD ROM mentioned earlier | |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** | *MODULE 1* **CELLULAR CONTROL AND VARIATION** |
|---|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| subdivisions of prophase).<br>• Explain the terms *linkage* and *crossing-over.* | is required. | | |
| **8**<br>• Explain how meiosis and fertilisation can lead to variation through the independent assortment of alleles.<br>• Use genetic diagrams to solve problems involving sex linkage and codominance. | • Past examination questions are always good sources of examples to use, and show best practice in setting out work so that it is clear and easy to interpret.<br>• The use of linked beads, marbles, string, tiddlywinks and electric wire can be employed to demonstrate linkage, sex linkage, assortment and codominance (incomplete dominance). | • Use old exam questions from 2804 Central Concepts module. | |
| **9**<br>• Use the chi-squared ($\chi^2$) test to test the significance of the difference between observed and expected results. (The formula for the chi-squared test will be provided). | • Get students to set their working out in columns. It creates a much clearer view and allows them to sum the final results easily on their calculator.<br>• *Drosophila* data can be employed for these tests using the 9:3:3:1 ratio against practical (or made up) results suggested by the teacher. | • Examination questions are again really useful here, as there is no substitute for practice in these types of questions.<br>• See OCR Central Concepts 2804.<br>• The Open University publish a monograph on practical ecology which identifies, by means of a flow chart, the sequence and choice of statistical tests for given | |

 = Innovative teaching idea

 = Stretch and Challenge opportunity

 = ICT opportunity

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** | *MODULE 1* **CELLULAR CONTROL AND VARIATION** |
|---|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| • Describe the interactions between loci (epistasis). (Production of genetic diagrams is **not** required).<br>• Predict phenotypic ratios in problems involving epistasis. | • It is important to stress that as long as ratios are known, the type of mechanism producing those ratios can be ascertained. | situations. | |
| **10**<br>• Describe the differences between continuous and discontinuous variation.<br>• Explain the basis of continuous and discontinuous variation by reference to the number of genes which influence the variation.<br>• Explain that both genotype and environment contribute to phenotypic variation (**No** calculations of heritability will be | • Standard discussions of height and finger length can exemplify continuous variation which can be compared to hair colour as a discrete example.<br>• Students could draw the profiles expected of continuous variation (tending towards Gaussian) and discontinuous (step-ladder progression). The step riser could be slowly reduced as gene number increases and eventually as continuous variation is achieved.<br>• A simple example is the growth of tall and dwarf plant genotypes in poor and good nutrient soils.<br>• Twin studies are especially useful | • BBC programme on The Secret lives of Twins by Sir Robert Winston may provide some good footage to support teaching here http://news.bbc.co.uk/1/hi/health/394741.stm<br>• Wellcome Institute Database<br>• Title: The secret life of twins<br>• Bibliographic details: BBC Broadcast Television, series - 3 episodes, 1999<br>• Location: 1121V, 1122V, 1123V (Moving Image and Sound Collections) | • The Hardy-Weinberg equation indicates that an allele '*A'* has a frequency of *p* in a population and its homologue '*a'* has a frequency *q*.<br>• Therefore: $p + q = 1$<br>• As there are only two alleles at one locus $p + q$ must always be equal to one.<br>• However, the genotypes *AA* and *aa* and *Aa* will only equal one in a theoretical and infinite population. Data from an experimental population will rarely if ever be equal to unity.<br>• Thus, the equation: |

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** | *MODULE 1* **CELLULAR CONTROL AND VARIATION** |
|---|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| expected).<br>• Explain why variation is essential in selection.<br>• Use the Hardy-Weinberg principle to calculate allele frequencies in populations. | here, as are studies of Japanese and Indian migrants and their susceptibility to CHD once living in the West.<br>• An elementary introduction to polymorphic variation could be included here. Reference to polymorphisms which are not necessarily harmful could be given as, for example, the presence and absence of alcohol dehydrogenase in Caucasian and Oriental populations respectively. | | $P^2 + 2pq + q^2$ only theoretically equals 1.<br>• It must always be emphasised that whenever the raw data are expressed in e.g. percentages, the equation is always considered in terms of frequencies. |
| • Explain, with examples, how environmental factors can act as stabilising or evolutionary forces of natural selection. | • Evolution of the haemoglobins (and blood groups) may be apposite with emphasis on the various environments. This example is also a way of leading into measuring numbers of mutations occurring *per* unit time and over history of a gene.<br>• Sometimes it's useful to let a student's imagination decide how an environment might change. I've used poetry to get them to describe what happens as a result of some catastrophic event.<br>• It's fun to make up organisms here and give them weird characteristics | | |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** | *MODULE 1* **CELLULAR CONTROL AND VARIATION** |
|---|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| | which might or might not be of evolutionary significance. Students can then create predators and consider what would happen to allele frequencies in the two made up populations. | | |
| **11**<br>• Explain the significance of the various concepts of the species, with reference to the biological species concept and the phylogenetic (cladistic / evolutionary) species concept. | • Give various definitions and see if students can determine which type of concept is being used.<br>• Getting students to make a mobile would be a good way to explain phylogeny and the way in which species may be inter-related. | • http://www.tolweb.org/tree/learn/concepts/whatisphylogeny.html | |
| **12**<br>• Explain how genetic drift can cause large changes in small populations. | • Drift can be shown through coin flipping experiments where small variations in a large number of flips is unsurprising but this variation in a small population has a dramatic effect. ICT can be used to model this idea too. | • Use a cut out bee with sticky pollen to show how the position of pollen is paramount for primroses.<br>• If you can get hold of the BBC series, Galapagos, this should fire students' imaginations. See their DVD collection. | |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 1* **CELLULAR CONTROL AND VARIATION** | | |
|---|---|---|---|---|
| **Topic outline** | | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
| • Explain the role of isolating mechanisms in the evolution of new species, with reference to ecological (geographic), seasonal (temporal) and reproductive mechanisms. | | • The Galapagos finches make a perfect example of geographic isolation as they all originated from the mainland. Pin-eyed and Thrum eyed primroses are great examples of reproductive isolation.Vertical and temporal zonation can easily be exemplified by various species of tropical mosquitoes living on the same treas. | | |
| **13**<br>• Compare and contrast natural selection and artificial selection.<br>• Describe how artificial selection has been used to produce the modern dairy cow and to produce bread wheat (*Triticum aestivum*). | | • This concept is probably best demonstrated in the form of a table.<br>• Documented examples of natural selection can be used to illustrate changes over very long periods of time.<br>• The initial selection of suitable animals and plants for breeding and the change in their populations over time could be shown in a series of pictures, emphasising the gradual change over time. | | • Emphasise the fact that the selection pressure, whether natural or human, is acting on the organism that already shows variation within its population. A popular misconception is that organisms undergo mutation in response to changes in their environment and that they consciously change in order to survive. |

 = Innovative teaching idea

 = Stretch and Challenge opportunity

 = ICT opportunity

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 2* **BIOTECHNOLOGY AND GENE TECHNOLOGIES** | | |
|---|---|---|---|---|
| **Topic outline** | | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
| **5.2.1 Cloning in Plants and Animals**<br>**1**<br>• Outline the differences between reproductive and non-reproductive cloning.<br>• Describe the production of natural clones in plants using the example of vegetative propagation in elm trees. | | • Try to stick to plants that pupils have seen, such as strawberries or daffodils, when using further examples as they should find these more memorable. | | • Discuss what the possible pollinating agents for flowers could be (students should know this from GCSE and beyond so there should be little difficulty here).<br>• Vegetative propagation is useful for isolated plants to allow reproduction e.g. rare British orchids |
| **2**<br>• Describe the production of artificial clones of plants from tissue culture.<br>• Discuss the advantages and disadvantages of plant cloning in agriculture. | | • A visit to a local good quality garden centre is a good way of showing cloning in action as they may be able to give you a tour of their micro-propagation department. | • There are a number of simulations on the Internet.<br>• Simple cloning could be done through cuttings of plants in the school laboratory if time was available.<br>• Computer simulations could be used as an alternative. | |
| **3**<br>• Describe how artificial clones of animals can be | | • A debate on cloning ethics is a really good way to stimulate ideas and get students thinking about its effects. | • http://www.highwire.org.uk/teach_res/genetics/lessons/Lesson6/T_res6/TNclone.pdf gives information on Dolly's life history | • Giving students particular personalities or points of view to represent helps them to break out of |

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** | *MODULE 2* **BIOTECHNOLOGY AND GENE TECHNOLOGIES** |
|---|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| produced.<br>• Discuss the advantages and disadvantages of cloning animals. | Give them preparation time though and a specific point of view for each person to follow (maybe even develop personalities). | | their initial stereotypes and usually makes for a better debate. It does involve more input from you initially but is very often worth it! |
| **5.2.2 Biotechnology**<br>**4**<br>• State that biotechnology is the industrial use of living organisms (or parts of living organisms) to produce food, drugs or other products.<br>• Explain why microorganisms are often used in biotechnological processes.<br>• Describe, with the aid of diagrams, and explain the standard growth curve of a microorganism in a closed culture. | • Decide on certain topics you want students to cover for industrial uses and get each person or group to investigate the development of this resource on the internet.<br>• (You may wish to consider the OCR monograph on Microbiology and Biotechnology, which has a plethora of relevant examples).<br>• Use counters or beads to show how binary fission quickly produces a large population of microorganisms. This will then be easy to extrapolate to show how the intermediate metabolites that can be produced when relating to the sigmoidal growth curve, which the students could draw themselves. The harvesting of the secondary products could then be shown using an aspirator with a tap at | • http://www.microbiologyprocedure.com, generally useful on microorganisms growth etc. | • Sometimes it's a good idea to give students set websites to look at (such as the websites given in the resources section) before you start, otherwise the students can get in a real muddle with technical language they do not understand and do not need. |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 2* **BIOTECHNOLOGY AND GENE TECHNOLOGIES** | | |
|---|---|---|---|---|
| **Topic outline** | | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
| | | the bottom. Purification can be exemplified using a centrifuge and chromatography column. This clarifies the original problem of explaining the importance of microorganisms in biotechnology. By selecting various coloured beads, different microorganism examples can be chosen. | | |
| **5**<br>• Describe how enzymes can be immobilised.<br>• Explain why immobilised enzymes are used in large-scale production.<br>• Compare and contrast the processes of continuous culture and batch culture. | | • Plasticine with beads immobilised would exemplify the affinity system or, better still, magnetic beads embedded in the plasticine, which could then bind to the ligand whether it be an antibody, antigen or enzyme.<br>• Explaining the process of flushing out a system will help them to realise that enzymes would be lost if they were not "tethered" by being immobilised. Link these ideas to the cost of production of enzymes and hopefully this will help students to see that immobilisation is a cost effective way of working. | • http://www.rpi.edu/dept/chem-eng/Biotech-Environ/IMMOB/immappl.html for applications of use<br>• http://www.rpi.edu/dept/chem-eng/Biotech-Environ/Contin/working.html for continuous culture | |

 = Innovative teaching idea

 = Stretch and Challenge opportunity

 = ICT opportunity

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 2* **BIOTECHNOLOGY AND GENE TECHNOLOGIES** |
|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| **6**<br>• Describe the differences between primary and secondary metabolites.<br>• Explain the importance of manipulating the growing conditions in a fermentation vessel in order to maximise the yield of product required.<br>• Explain the importance of asepsis in the manipulation of micro-organisms. | • Use of therapeutic agents would engender enthusiasm e.g. alkaloids such as morphine (still not synthesisable in the laboratory), taxol from Taxus spp, flavonoids as anti-inflammatory modulators, isoprenoids as antimicrobial, antineoplastic and anti-inflammatory agents etc.<br>• Getting students to try aseptic technique is the best way to get them to appreciate the need for it. Plating up some bacteria is a great practical and can be used to show how antibiotics are developed through the use of impregnated discs to clear areas on agar. | • Any phytochemistry textbook, Website, Science Direct, Medline, Pharmaceutical journal, pharmacognosy site and so on. | |
| **5.2.3 Genomes and Gene Technologies**<br>**7**<br>• Outline the steps involved in sequencing the genome of an organism. | • This can be a complicated process for students to understand. Getting hold of a sequencing gel would help them to see what happens. Contact your local genetics lab for details.<br>• Genetics companies will provide good information on restriction enzymes in their catalogues showing the cutting sites available. | • http://www.sanger.ac.uk is a useful site as it tells students all about sequencing of many organisms including humans.<br>• http://genome.wellcome.ac.uk/doc_WTD021037.html is the Wellcome instututes review of genome sequencing and gives a clear insight into the process.<br>• http://www.ornl.gov/sci/techresources/Human_Genome/faq/seqfacts.shtml | |

 = Innovative teaching idea

 = Stretch and Challenge opportunity

 = ICT opportunity

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 2* **BIOTECHNOLOGY AND GENE TECHNOLOGIES** | | |
|---|---|---|---|---|
| **Topic outline** | | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
| | | • If students can use an electrophoresis kit, then they will begin to comprehend the electrophoretic mobility of different sized pieces of DNA through a gel, which may help them to understand the concept of sequencing although these techniques are significantly different. | | |
| **8**<br>• Outline how gene sequencing allows genome-wide comparisons between individuals and between species. | | • Get hold of a sequencing gel if possible. Local genetics laboratories at Universities might help here. By seeing a gel with markers for each base, students can then see how comparisons can be made.<br>• The Wellcome Trust has a good database which can be used from the website above. | • http://www.wellcome.ac.uk | • Sequencing shows the difference in cystic fibrosis proteins produced from the 174+ mutations in the gene which all give the same phenotypic effect. |
| **9**<br>• Define the term *recombinant DNA.*<br>• Explain that genetic engineering involves the | | • The Foundation paper 2801 June 2007 had a good long answer on the use of genetic engineering for insulin and might make a useful resource for students to grasp the terminology | • Foundation Paper 2801 June 2007<br>• Papers from the 'Application of Genetics' and 'Microbiology and Biotechnology' banks would also be helpful | • Use a specific example throughout, like insulin, although make students aware that some proteins can now be found from their DNA rather than extracting mRNA from cells. |

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** | *MODULE 2* **BIOTECHNOLOGY AND GENE TECHNOLOGIES** |
|---|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| extraction of genes from one organism, or the manufacture of genes, in order to place them in another organism (often of a different species) such that the receiving organism expresses the gene product.<br>• Describe how sections of DNA containing a desired gene can be extracted from a donor using restriction enzymes. | needed. This could be placed into a loop game to help them grasp each enzyme and processes function. | | |
| **10**<br>• Outline how DNA fragments can be separated by size using gel electrophoresis.<br>• Describe how DNA probes can be used to identify fragments containing specific sequences.<br>• Outline how the polymerase chain reaction (PCR) can be used to make multiple | • A practical activity here would be really useful as students learn best when they can see things for themselves.<br>• The use of coiled wire is useful here to show the underlying theory. Get students to show up the bands on their gel and then explain that probes can be labelled and would anneal to the bands where there is a match.<br>• PCR can be explained by a cut and stick experiment with fragments being made and used as later templates. | • SAPS do some good electrophoresis kits that allow students to see what is happening during the process. These mini gels can be made and run within an hour lesson. | |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** | *MODULE 2* **BIOTECHNOLOGY AND GENE TECHNOLOGIES** |
|---|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| copies of DNA fragments. | Alternatively, model using ICT. | | |
| **11**<br>• Explain how isolated DNA fragments can be placed in plasmids, with reference to the role of ligase.<br>• State other vectors into which fragments of DNA may be incorporated.<br>   | • PowerPoint is a good way to demonstrate this technique as once set up you can move forward and backwards through slides easily. | • Other methods to show the site of a desired gene would be to use a section of coloured string within a long piece and cut this in various places using scissors. | |
| **12**<br>• Explain how plasmids may be taken up by bacterial cells in order to produce a transgenic microorganism that can express a desired gene product.<br>• Describe the advantage to microorganisms of the | • Resistance factors are plasmids carrying genes for antibiotic resistance. These are utilised in genetic engineering.<br>• Where there are two antibiotic genes, researchers can identify the organisms with the plasmid using one antibiotic for positive selection | | • Plasmids can contain genes to metabolise unusual sugars, hence are vital and can be passed horizontally between micro-organisms by conjugation. |

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 2* **BIOTECHNOLOGY AND GENE TECHNOLOGIES** |
|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| capacity to take up plasmid DNA from the environment.<br>• Outline how genetic markers in plasmids can be used to identify the bacteria that have taken up a recombinant plasmid. | and go through negative selection by inserting the gene to disrupt a second antibiotic (more useful process in research than the details given in most books). | | |
| **13**<br>• Outline the process involved in the genetic engineering of bacteria to produce human insulin. | • Foundation paper 2801 June 2007 had a long answer question relating to this topic, which could be a good assessment task for students. It would assess initial understanding and could be done as a timed or open book activity. | • Foundation paper 2801 June 2007<br>• Also Microbiology and Biotechnology legacy option papers could be used where available | • As stated previously, it may be more use to use this example throughout to show the stages in a process. Giving a process a name often makes it more memorable, although this method does rely on mRNA isolation. |
| **14**<br>• Outline the process involved in the genetic engineering of 'Golden Rice™'.<br>• Outline how animals can be genetically engineered to allow xenotransplantation.<br>• Explain the term *gene* | • A good research activity for ICT topics and a presentation opportunity.<br>• SCID is a great disease to use for gene therapy, as it is not one that students have generally heard of before. It can highlight the difference between somatic cell gene therapy and germ line cell gene therapy too. | • http://www.goldenrice.org is a really useful site in showing how the rice was produced and the reasons behind its development<br>• www.scid.net | • Stress that presentations must be in student friendly language otherwise it is not always clear if a group has actually understood the concepts covered. |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 2* **BIOTECHNOLOGY AND GENE TECHNOLOGIES** | | |
|---|---|---|---|---|
| **Topic outline** | | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
| *therapy.*<br>• Explain the differences between somatic cell gene therapy and germ line cell gene therapy. | | | | |
| **15**<br>• Discuss the ethical concerns raised by the genetic manipulation of animals (including humans), plants and microorganisms. | | • A suitable opportunity for a debate, if that is something to help to get your students talking. An alternative idea is to get in touch with the genetics ethics council who debate what projects are going to be sanctioned each year. | | |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** | *MODULE 3* **ECOSYSTEMS AND SUSTAINABILITY** |
|---|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| **5.3.1 Ecosystems**<br>**1**<br>• Define the terms *ecosystem, biotic factor, abiotic factor, producer, consumer, decomposer* and *trophic level* (giving named examples where relevant).<br>• State that ecosystems are dynamic systems.<br>• Describe how energy is transferred through ecosystems.<br>• Outline how energy transfers between trophic levels can be measured.<br>• Discuss the efficiency of energy transfers between trophic levels. | • Bring in a loop game to review all these ecological terms. Many have been met before, so should be revision rather than new learning for many, so this is a quick way to get through all the definitions in this module.<br>• Terms could be placed in an e-dictionary.<br>• The construction of trophic levels could be achieved by using organisms from toy shops. Bacteria and fungi could be represented by counters/tiddlywinks identified with a felt tip pen etc.<br>• The text, Biological Science, gives a good description of energy transfers and efficiency. However, a simple bomb calorimeter can be obtained from the Internet.<br>• Energy transfer can be shown using coloured balls, some representing heat lost. | • Green, Stout and Taylor, 1997, Biological Science 1 and 2 (3rd Edition) Cambridge University Press. ISBN 0-5215-6178-7<br>• Dowdeswell, W.H., wrote some excellent texts on theoretical and practical ecology, which are traditional but not outdated. e.g.' Introduction to Animal Ecology' and 'Animal Ecology'.<br>• A basic text is 'Introductory Ecology' (2002) by Cotgreave and Forseth ISBN 0-6320-4227-3 | |

 = Innovative teaching idea

 = Stretch and Challenge opportunity

 = ICT opportunity

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 3* **ECOSYSTEMS AND SUSTAINABILITY** |
|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| **2**<br>• Describe one example of primary succession resulting in a climax community.<br>• Describe how the distribution and abundance of organisms can be measured, using line transects, belt transects, quadrats and point quadrats. | • Sand dunes are something that many students can relate to and make a good basis for succession. Alternatives are bare ground to woodland or water areas to woodland.<br>• Primary succession is also easily observed (especially over time) using an initially bare tree stump. Also, it can provide an excellent example of a microecosystem and associated microclimate.<br>• Environmental Science gives good examples of succession and general features of all succession methods.<br>• Practical activity is vital here – get students outside whenever possible. | • Environmental Science, Earth as a Living Planet, 2007, Botkin and Keller (6th Ed) Wiley & Sons<br>• There is also a good example at http://www.offwell.free-online.co.uk/successn/primary.htm | • Any outdoor activity needs a risk assessment these days, but getting students out onto a field and carrying out a belt transect from the fence to the centre will highlight the techniques used in sampling. |
| **3**<br>• Explain how human activities can manipulate the flow of energy through ecosystems. | • Get students to observe how human activity affects landscapes and consider *why* management techniques such as grazing or burning are carried out. Also, look at | • Environmental Science, listed above, is great for giving specific examples, although these are generally based around the USA. | • Explain how human activities can interfere with natural succession. |

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** | *MODULE 3* **ECOSYSTEMS AND SUSTAINABILITY** |
|---|---|---|---|

| Topic outline | Suggested Teaching And Homework Activities | Suggested resources | Points to note |
|---|---|---|---|
| | soil compaction exemplified by examining flower beds etc., over which trampling has occurred.<br>• This could be achieved as a joint homework exercise and subsequent class discussion. | | |
| **4**<br>• Describe the role of decomposers in the decomposition of organic material.<br>• Describe how microorganisms recycle nitrogen within ecosystems (only *Nitrosomonas, Nitrobacter* and *Rhizobium* need to be identified by name). | • An A3 sheet with cut-out statements (or diagrams if you are artistic) is a good way to revise what students know and can place and then supplement with new information. This can be stuck down and kept in their folders.<br>• There is some very useful information in the Microbiology and Biotechnology OCR monograph. | • There are some useful web addresses included. However, a very useful supplement to all this work is Biology by Martin, Solomon and Berg (2007). This book simply and clearly explains the majority of the concepts discussed in this SOW.<br>• http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/N/NitrogenCycle.html<br>• http://www.visionlearning.com/library/module_viewer.php?mid=98<br>• http://en.wikipedia.org/wiki/Decomposer<br>• http://www.qrg.northwestern.edu/projects/marssim/simhtml/info/whats-a-decomposer.html | |
| **5.3.2 Populations and Sustainability**<br>**5**<br>• Explain the significance of limiting factors in determining the final size | • Use organisms which will be memorable to students. It helps them visualise the topic in the examination room. | • One practical example would be to grow seeds from the same packet in clinal amounts of water (light) but other environmental conditions being kept constant.<br>• A more advanced experiment would be to compare dwarf | • Standard text-book examples include the arctic fox and snowshoe hare but you could easily be more adventurous! |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 3* **ECOSYSTEMS AND SUSTAINABILITY** | | |
|---|---|---|---|---|
| **Topic outline** | | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
| of a population.<br>• Explain the meaning of the term *carrying capacity.*<br>• Describe predator-prey relationships and their possible effects on the population sizes of both the predator and the prey. | | • Include some reference to change in carrying capacity as intensive farming is carried out.<br>• Making a pretend population of a weird organism can free students from the normal limits of worrying that they may look silly if they are wrong.<br>• It must be emphasised that the theory should then be transposed into actual and well-defined populations to ensure that students understand the actual concepts and identify well-chosen examples. | and tall peas, using the same approach. | • Remember to stimulate students to think of plant-limiting factors as well as animal ones! |
| **6**<br>• Explain, with examples, the terms *interspecific* and *intraspecific* competition. | | • The effects of competition on the distribution and population size can be mapped using graphing tools in Excel if students insert relevant numbers and plot them. | • http://www.blackwellpublishing.com/townsend/Chapters/EOEC06.pdf . | |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** | *MODULE 3* **ECOSYSTEMS AND SUSTAINABILITY** |
|---|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| **7**<br>• Distinguish between the terms *conservation* and *preservation.*<br>• Explain how the management of an ecosystem can provide resources in a sustainable way, with reference to timber production in a temperate country. | • Transfer terms to a student's personal e-dictionary.<br>• Pictures are vital in trying to explain timber management to students as many have never seen coppicing, pollarding or management with standards etc.<br>• These make an enlightening introductory PowerPoint presentation and stimulate students' ideas. | • A good reference book on ecological phenomena in general is 'Ecology: Individuals, Populations and Communities', Begon, Harper and Townsend. | • Many FSC centres do good field courses which cover timber management and can be tailored to any syllabus as required. Contact www.field-studies-council.org for more information on courses. |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 4* **RESPONDING TO THE ENVIRONMENT** |
|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| **8**<br>• Explain that conservation is a dynamic process involving management and reclamation.<br>• Discuss the economic, social and ethical reasons for conservation of biological resources.<br>• Outline, with examples, the effects of human activities on the animal and plant populations in the Galapagos Islands. | • Consider the effect of logging in the Amazon basin (the local inhabitants are financially dependent on logging). They are unable to see the ecological effects as they are too close to the situation. Similar examples can be used from Borneo, where the forests are being removed so that palm oil plants can be grown, again to stimulate a weak economy. | • http://news.mongabay.com/2006/0425-oil_palm.html. This looks at both logging and palm oil as processes which are rapidly reducing rainforest areas.<br>• The BBC series Galapagos may be a really useful resource (DVD). | • This can be linked into other lessons if time is short, but if this is done, it is worthwhile highlighting the fact to students as ethical values are discussed. |
| **5.4.1 Plant Responses**<br>**1**<br>• Explain why plants need to respond to their environment in terms of the need to avoid predation and abiotic | • There are some good page spreads in A2 level Biology pg 348 – 366 which would make good PowerPoint slides or handouts if possible.<br>• Could relate stress to biotechnology approaches. There are some | • Bradfield, Dodds, Dodds and Taylor, 2002, A2 Level Biology, Longman ISBN 0582 42945-5<br>• Biology by Solomon, Berg, Martin and Villee | |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 4* **RESPONDING TO THE ENVIRONMENT** |
|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| stress.<br><br>• Define the term *tropism.*<br>• Explain how plant responses to environmental changes are co-ordinated by hormones, with reference to responding to changes in light direction. | interesting Web articles on gene mobilisation and stress which interrelate with the genetic component. | | |
| **2**<br>• Evaluate the experimental evidence for the role of auxins in the control of apical dominance and gibberellin in the control of stem elongation. | • Link this lesson to the previous PowerPoint or handouts. Telling the story of the research often gets the point across really well.<br>• For homework, ask the students to subject a plant to unilateral light and observe the changes that occur compared to control. This type of experiment can be performed in a relatively short period of time.<br>• Alternatively, get students gardening to look what happens to plants when apical shoots are removed. | • See A2 Level biology<br>• http://www.plant-hormones.info a useful site (University of Bristol) | |

 = Innovative teaching idea

 = Stretch and Challenge opportunity

 = ICT opportunity

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 4* **RESPONDING TO THE ENVIRONMENT** | | |
|---|---|---|---|---|
| **Topic outline** | | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
| **3**<br>• Outline the role of hormones in leaf loss in deciduous plants.<br>• Describe how plant hormones are used commercially. | | • Examples are in most biology textbooks<br>• Biology by Solomon, Berg, Martin and Villee (2001) has a very good and simple account of plant hormones.<br>• Contact East Malling Research centre for more up to date uses. They are very good and keen to be involved with schools as are many universities with extant botany departments.<br>• This topic can be related to the tissue culture of plants. Students can be asked to investigate rooting powders from local garden centres and write an account of the composition and effects for homework. | • East Malling Research Centre, East Malling, Kent | |
| **5.4.2 Animal Responses**<br>**6**<br>• Discuss why animals need to respond to their | | • A great set of pages for students to use and written to be student friendly. This tutorial goes on to | • http://www.biology-online.org/8/1_nervous_system.htm<br>• Biology by Solomon, Berg, Martin and Villee | • The tutorial assessment grading might be useful for you to look at to see how students think they have |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 4* **RESPONDING TO THE ENVIRONMENT** |
|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| environment.<br>• Outline the organisation of the nervous system in terms of central and peripheral systems in humans.<br>• Outline the organisation of the nervous system in terms of central and peripheral systems in humans.<br>• Describe, with the aid of diagrams, the gross structure of the human brain, and outline the functions of the cerebrum, cerebellum, medulla oblongata and hypothalamus. | discuss the functions of each part of the brain so could be set as an out-of-classroom research project which is then presented in poster or presentation format by students to allow assessment of understanding. | • Useful Web addresses:<br>• http://en.wikipedia.org/wiki/Autonomic_nervous_system<br>• http://images.google.co.uk/images?hl=en&q=autonomic%20system&oe=UTF-8&um=1&ie=UTF-8&sa=N&tab=wi | assimilated the information given on the Web pages. |
| **7**<br>• Describe the role of the brain and nervous system in the co-ordination of muscular movement.<br>• Describe how co-ordinated movement requires the | • Role play is useful here again showing how controlled movements require contraction of both abductor and adductor muscles to prevent rapid jerky movements. | • A reasonable animation of neuromuscular activity.<br>• http://www.mhhe.com/biosci/esp/2002_general/Esp/folder_structure/su/m4/s10/sum4s10_7.htm<br>• http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookMUSSKEL.html#Types%20of%20Skeletal%20Systems | • This partly relates to the old Transport module (2803/01) so applets which teachers may have developed there for the vagus and accelerator nerve will still be relevant to use in general terms. |

 = Innovative teaching idea

 = Stretch and Challenge opportunity

 = ICT opportunity

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** | *MODULE 4* **RESPONDING TO THE ENVIRONMENT** |
|---|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| action of skeletal muscles about joints, with reference to the movement of the elbow joint. | | • http://images.google.co.uk/images?hl=en&q=skeletal%20movement&oe=UTF-8&um=1&ie=UTF-8&sa=N&tab=wi | |
| **8**<br>• Explain, with the aid of diagrams and photographs, the sliding filament model of muscular contraction.<br>• Outline the role of ATP in muscular contraction, and how the supply of ATP is maintained in muscles.<br>• Outline the structural and functional differences between voluntary, involuntary and cardiac muscle. | • Various animations of sliding filament theory are available on the internet. As an alternative if your school has the software, ask the students to write their own applet showing the sliding filament theory.<br>• A basic model to initially demonstrate the theory can be constructed with two long elastic bands and some pieces of wood.<br>• Useful to set this out in a table to allow easy comparison by students. For weaker students, give some boxes filled in so they have only to find the contrasting statements. | • http://3dotstudio.com/zz.html<br>• Both the below are very good simulations of the slilding filament muscle contraction:<br>• http://www.sci.sdsu.edu/movies/actin_myosin_gif.html<br>• Good amination of pairs of muscle contracting: http://biology.clc.uc.edu/courses/bio105/muscles.htm)<br>• An excellent animation on structure and function of muscle: http://entochem.tamu.edu/MuscleStrucContractswf/index.html | |

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 4* **RESPONDING TO THE ENVIRONMENT** |
|---|---|---|

| **Topic outline** | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
|---|---|---|---|
| **9**<br>• Compare and contrast the action of synapses and neuromuscular junctions.<br>• State that responses to environmental stimuli in mammals are co-ordinated by nervous and endocrine systems.<br>• Explain how, in mammals, the 'fight or flight' response to environmental stimuli is co-ordinated by the nervous and endocrine systems. | • Useful to set this out in a table to allow easy comparison by students. For weaker students give some boxes filled in so they have only to find the contrasting statements.<br>• Role play can be used to get students to show the effect of hormones and stress on the control of heart rate.<br>• This can either be achieved by student members of the group being given roles of hormones etc., or alternatively this can be achieved by using cards manipulated by various team members each with defined activities on them.<br>• The activity can be demonstrated by a ball, a piece of string and a length of wood. | • A good animation of synapse activity.<br>• www.tvdsb.on.ca/westmin/science/sbioac/homeo/synapse.htm | |
| **5.4.3 Animal Behaviour**<br>**10**<br>• Explain the advantages to organisms of innate behaviour. | • This can be demonstrated using choice chambers and woodlice which go to damp or dark places. | • Choice chambers with damp or dry area created by anhydrous chemicals (e.g. calcium carbonate, sodium sulphate, silica gel) can be used. | |

 = Innovative teaching idea

 = Stretch and Challenge opportunity

 = ICT opportunity

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 4* **RESPONDING TO THE ENVIRONMENT** | | |
|---|---|---|---|---|
| **Topic outline** | | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
| • Describe escape reflexes, taxes and kineses as examples of genetically-determined innate behaviours. | | • Results can be discussed as a class.<br>• Could be set in context with statistical analysis such as chi - squared analysis. | | |
| **11**<br>• Explain the meaning of the term *learned behaviour.*<br>• Describe habituation, imprinting, classical and operant conditioning, latent and insight learning as examples of learned behaviours.<br>• Describe, using one example, the advantages of social behaviour in primates.<br>• Discuss how the links between a range of human behaviours and the dopamine receptor DRD4 | | • This could be as simple as explaining the learning needed to override reflexes when carrying something which is perhaps expensive or hot (which would cause a burn or scald).<br>• Riding a bicycle is an example of a learned behaviour which most of us can do at some point in our lives. Consider the stages involved in this process.<br>• Grooming in any primate is a good example of social behaviour. Alternatives are the social hierarchy in wolves or wild dogs. | • Some excellent animation on synapses at: http://www.learner.org/channel/courses/biology/units/neuro/images.html<br>• An excellent introduction which is simple to understand is: An Introduction to Animal Behaviour by Aubrey Manning. | |

 = Innovative teaching idea

 = Stretch and Challenge opportunity

 = ICT opportunity

# A2 Unit F215 Control, Genomes and Environment: OCR Advanced GCE in Biology H421

| **SUGGESTED TEACHING TIME** | 15 HOURS | **TOPIC** *MODULE 4* **RESPONDING TO THE ENVIRONMENT** | | |
|---|---|---|---|---|
| **Topic outline** | | **Suggested Teaching And Homework Activities** | **Suggested resources** | **Points to note** |
| may contribute to the understanding of human behaviour. | | | | |

# Other forms of support

In order to help you implement the new Biology specification effectively, OCR offers a comprehensive package of support. This includes:

## OCR Training

### Get Started… towards successful delivery of the new specifications

These full-day events will run from Spring 2008 and will look at the new specifications in more depth, with emphasis on first delivery.

### Get Ahead… raising standards through examination feedback

These full-day events will run from spring 2009 and will look at the new specifications in more depth, with emphasis on first delivery.

Visit www.ocr.org.uk for more details.

## Interchange

OCR Interchange has been developed to help you carry out day to day administration functions online, quickly and easily. The site allows you to register and enter candidates online. In addition, you can gain immediate and free access to candidate information at your convenience. Sign up at https://interchange.ocr.org.uk

## Published Resources

OCR offers centres a wealth of quality published support with a fantastic choice of 'Official Publisher Partner' and 'Approved Publications' resources, all endorsed by OCT for use with OCR specifications.

### Publisher partners

OCR works in close collaboration with three Publisher Partners; Hodder, Heinemann and Oxford University Press (OUP) to ensure centres have access to:

- Better published support, available when you need it, tailored to OCR specifications
- Quality resources produced in consultation with OCR subject teams, which are linked to OCR's teachers support materials
- More resources for specifications with lower candidate entries

- Materials that are subject to a thorough quality assurance process to achieve endorsement

The publisher partnerships are non exclusive with the GCE Sciences being the only exception. Heinemann is the exclusive publisher partner for OCR GCE Sciences.

Heinemann has produced the following resource for OCR GCE Biology for first teaching in September 2008

**OCR AS Biology, Kennedy, P. & Sochacki, F.** (2008) ISBN 9780435691806

**AS Biology Student Book and Exam Café CD-ROM**. (2008) ISBN: 9780435691806

Sochacki, F. & Duncan, R. & Wakefield-Warren, J. **AS Biology Exam Café CD-ROM**. (included with Student Book)

Wakefield-Warren, J. & Sochacki, F. & Winterbottom, M. **AS Biology Teacher File and CD-ROM**. (2008) ISBN: 9780435691776

Fosbery, R. & Stevens, I. **Revise AS Biology for OCR**. (2008) ISBN: 9780435583705

Hocking, S. Kennedy, P, Sochacki, F. & Winterbottom, M. **A2 Biology Student Book and Exam Café CD-ROM** (2008) ISBN: 978-0-43561-90-5

## Endorsement

OCR endorses a range of publisher materials to provide quality support for centres delivering its qualifications. You can be confident that materials branded with OCR's "Official Publishing Partner" or "Approved publication" logos have undergone a thorough quality assurance process to achieve endorsement. All responsibility for the content of the publisher's materials rests with the publisher.

These endorsements do not mean that the materials are the only suitable resources available or necessary to achieve an OCR qualification. Any resources lists which are produced by OCR shall include a range of appropriate texts.

# GCE Lesson Plan
# A Level GCE Biology H421
# F215 A2 Unit: Control, Genomes and Environment

## Module 4: Responding to the Environment – Lesson 2

OCR recognises that the teaching of this qualification will vary greatly from school to school and from teacher to teacher. With that in mind, this lesson plan is offered as a possible approach but will be subject to modifications by the individual teacher.

Lesson length is assumed to be **one hour**.

*There are two ways to approach this lesson. One is to produce a handout of the various experiments completed on coleoptiles showing the advances which were made over time by researchers. This can then indicate the development of a scientific theory and show how different research groups work together. It would create a didactic lesson which would be teacher-led although it should produce clear outcomes and notes for the students.*

*The alternative approach is to grow some small seedlings such as beans or peas and allow the students to experiment with them using clinometers to demonstrate the effect of unidirectional light on shoots (and perhaps extend the investigation to include gravity). Older seedlings could be used to show the effect of apical dominance and, although it would require the topic to be revisited the following week, to observe how the seedlings have progressed; it may provide the students with a more memorable experience.*

### Learning Objectives for the lesson

| | |
|---|---|
| Objective 1 | Evaluate the evidence for the role of auxins and gibberellins in plant tropisms. |
| Objective 2 | Include the control of apical dominance and stem elongation. Evaluate the methods used by plants to control these two processes. |

### Insert Recap of previous experience and prior knowledge

- Recap on the PowerPoint information used last lesson. This could be achieved by quickly reviewing the slides showing how a plant responds to the environment.

### Content

| Time | Content |
|---|---|
| 5 minutes | Recap on last lesson via the PowerPoint or whatever means was used. |
| 5-45 minutes | Give students various seedlings if this is your chosen option for teaching this lesson. Using permanent marker, get them to mark on the stems 1cm spaces which will allow them to see how and where elongation occurs as the plant grows. Set up seedlings in various environmental conditions, such as in dark places, boxes |

| | |
|---|---|
| | with one side cut out to give unidirectional light or full illumination.<br>Ask students to repeat the process with larger seedlings to take a similar approach and use some plants with the seedling tips intact and some where the tips have been removed. |
| 45-55 minutes | Ask students to postulate what they believe will happen to each plant experiment which has been set up. Ask for reasons why they think this will happen relating their ideas to the distribution of hormones if they can (from GCSE level). |

## Consolidation

| **Time** | **Content** |
|---|---|
| 5 minutes | Sum up what has happened and remember to come back to these experiments the following week to review what has occurred. |
| | |
| **Following week** | Discuss the results and then relate the data to the distribution of auxins in a plant. Discuss how this distribution is capable of causing elongation and apical dominance in plants. |

OCR
RECOGNISING ACHIEVEMENT

# GCE Lesson Plan
# A Level GCE Biology H421
# F215 A2 Unit: Control, Genomes and Environment

## Module 3: Ecosystems and Sustainability – Lesson 3

OCR recognises that the teaching of this qualification will vary greatly from school to school and from teacher to teacher. With that in mind, this lesson plan is offered as a possible approach but will be subject to modifications by the individual teacher.

Lesson length is assumed to be **one hour**.

## Learning Objectives for the lesson

| | |
|---|---|
| Objective 1 | To explain how human activities can manipulate the flow of energy through managed ecosystems. |
| Objective 2 | To explain how human activities can interfere with natural succession. |

## Insert Recap of previous experience and prior knowledge

- Review succession. This could be achieved either by using pictures and getting students to describe what is happening at various levels of succession or by allowing them to draw and annotate a successional ecosystem themselves either on the board, wallpaper or computer-aided simulation e.g. PowerPoint which could then be placed around the laboratory as a revision aid.

## Content

| Time | Content |
|---|---|
| 0-10 minutes | Begin with succession review from last lesson to establish the normal course of events in an ecosystem.<br>Pond animation:<br>http://library.thinkquest.org/04oct/00228/succession.htm (Bog animation)<br>http://www.wiley.com/college/strahler/0471480533/animations/ch23_animations/animation1.html |
| 10-15 minutes | Use pictures to show how ecosystems can be changed and maintained in a certain condition. Examples include heathland where heather is burnt to rejuvenate the plants, common ground where grazing deflects succession and prevents shrubs from growing, marshland where reeds are cut and beds are dredged to maintain the habitat. |
| 15-40 minutes | Distribute various areas to each group and get them to create a short presentation on *why* humans carry out these tasks and manage ecosystems and the energy flow. Have access to the Internet available as well as books and library resources |

| | |
|---|---|
| | to help students determine what advantages this management system provides. |
| 40-55 minutes | Allow each group to go through what they have found out. Give the other students time to question them about advantages and disadvantages of the management system as well as the habitats special place in our country's ecology. Consider what we would lose if these habitats were destroyed. |
| 55-60 minutes | Explain the consolidation exercise is to write up two of these managed ecosystems so that they have a full and informative set of notes for revision. This could be done by each group providing a hand out of their information for the rest of the class or each student choosing two management systems which they can relate to and writing them up. This can be completed for homework as well as being part of the consolidation process. |

## Consolidation

| **Time** | **Content** |
|---|---|
| 5 minutes | See above for consolidation in this lesson. |

# GCE Lesson Plan
# A Level GCE Biology H421
# F215 A2 Unit: Control, Genomes and Environment

## Module 2: Biotechnology and Gene Technologies – Lesson 7

OCR recognises that the teaching of this qualification will vary greatly from school to school and from teacher to teacher. With that in mind, this lesson plan is offered as a possible approach but will be subject to modifications by the individual teacher.

Lesson length is assumed to be **one hour**.

### Learning Objectives for the lesson

| | |
|---|---|
| Objective 1 | Outline the steps involved in sequencing the genome of an organism. |
| Objective 2 | Ensure students can effectively place the sequencing stages in order and relate the technological words to their function. |

### Insert Recap of previous experience and prior knowledge

- Discuss the Human Genome project. Why was it carried out and what is its function? See the initial 10 minutes of the lesson.

### Content

| **Time** | **Content** |
|---|---|
| 0-10 minutes | Discussion of the Human Genome project and its function. It is useful to have this short introductory discussion in order to allow students to express their views on sequencing and the use of genome projects. It will often taint their opinions when it comes to discussing ethics, so an initial discussion can be interesting especially if students then radically change their views in the light of the specification teaching. (Stimulus questions below). |
| 10-15 minutes | Show the class a slide of how genomic sequencing is carried out detailing the basic processes involved. These are cutting the genome with various restriction enzymes, sequencing the sections using an electrophoresis gel sequencer and then finding out how the pieces fit together. The sequencing process doesn't have a sensible analogy, but the practical task below can show how overlapping sequences can be placed in the correct order once sequenced. |
| 15-30 minutes | You will need short paragraphs of text, probably enlarged in size. There should be 5 copies of each paragraph and enough so that every student will initially have their own sheet of text. Scissors are required for the whole class. |

| | |
|---|---|
| | Separate the class into groups of about 5 students. Give each group 5 copies of the same paragraph of text. Instruct students to cut their text into sections and separate words after certain letters (e.g. one individual may cut after every 'a' whilst another may cut after every 't'). Once the text is cut, each student should pass their cut text to one person in another group so that the group has 5 copies of the same paragraph, but all cut up.<br>Using the 5 copies, it should be possible to work out the correct order of the text by comparing the fragments the group has been given. This is similar to the process of genome sequencing. |
| 30-45 minutes | PowerPoint slides would be helpful here to show a sequencing gel unless you can copy one so that groups of students can see the gel relatively easily.<br>Explain the process of sequencing the DNA using different length fragments of DNA. Synthesis of each section stops when a radioactive or fluorescent base is randomly joined to the end of a fragment.<br>Fragments differ by one base and are separated on an electrophoresis gel. The bases can then be read off up the gel identified by their electrophoretic mobilities and the sequence identified.<br>Remember to explain that initially this was done 'by hand' but recent technological advances needed for the Human Genome project have meant that it has been mechanised. |
| 45-55 minutes | Discuss the problems associated with clarifying the sequence of the words. What if the same text appeared twice in the paragraph, how would you know which section came first? This is a similar problem to restriction length polymorphisms where a repeating code occurs numerous times in the genome and can cloud clear sequencing. |

## Consolidation

| **Time** | **Content** |
|---|---|
| 55-60 minutes | What is sequencing?<br>How is it carried out?<br>Ask students to write their own critique of 'what' and 'how' as a way to access their understanding of the process. Get them to research for next lesson the advances, which have been made as a result of sequencing and be prepared to discuss whether these are significant to them.<br>Ask them to consider the issue of patent law. Some companies who have sequenced important genes have tried to patent the sequence so that they can recoup to the money spent by them on the research needed to complete the sequencing. Is this ethical? Who owns the genome sequence of an organism? Should it be public property?<br>This lesson lends itself to staff finishing with more questions for the students than have been answered. It is a real opportunity for students to go away and think about what is being carried out in science and whether researchers are doing the right thing. Use it as a springboard to inspire them! |

Useful resource, which might help in this lesson:

http://www.ornl.gov/sci/techresources/Human_Genome/graphics/DNASeq.Process.pdf

This shows the process of sequencing a genome.

**Possible stimulus Material for the Human Genome Project discussion.**

What do you understand by the Human Genome project?
What good things has it done?
Are there any negative aspects to the project which should be stopped?
Who runs it?
Who owns the information?
Why was it started?
Does anyone control what can be done with the information which is produced? (In the UK there is a genetics ethics committee which regulates any work carried out and decides whether certain research topics can be undertaken to try to avoid “eugenic type” action by researchers).

# GCE Lesson Plan
# A Level GCE Biology H421
# F215 A2 Unit: Control, Genomes and Environment

## Module 1: Meiosis and Variation – Lesson 10

OCR recognises that the teaching of this qualification will vary greatly from school to school and from teacher to teacher. With that in mind, this lesson plan is offered as a possible approach but will be subject to modifications by the individual teacher.

Lesson length is assumed to be **one hour**.

## Learning Objectives for the lesson

| | |
|---|---|
| Objective 1 | Describe the differences between continuous and discontinuous variation. |
| Objective 2 | Explain the basis of continuous and discontinuous variation by reference to the number of genes which influence the variation. |
| Objective 3 | Explain why both the genotype and environment contribute to phenotypic variation. |
| Objective 4 | Explain why variation is essential in selection. |
| Objective 5 | Explain, with examples, how environmental factors can act as stabilising or evolutionary forces of natural selection. |

## Insert Recap of previous experience and prior knowledge

- Continuous and discontinuous variation have been studied previously at GCSE and AS level. Ask students to brainstorm what features of an organism do vary and then use this information to introduce continuous and discontinuous variation and compile a list of two columns of features. Some reference to the term phenotype is useful at this stage emphasising that it can be used to describe any gene products from the biochemical level to the whole organism level.

## Content

| Time | Content |
|---|---|
| 0-5 minutes | Brainstorming session and compilation of a list of features which vary. Students may not instantly recall discontinuous and continuous variation. Use the group session to elicit this information from them. Use the stair model to indicate how the number of genes influences the riser height and therefore the cline from discontinuous to continuous variation initially with few genes and then with a large number of genes as for example height and mass. There is an excellent photograph of the height distribution of students at the University of Connecticut in Hartl and Jones ("*Essential Genetics*"). |
| 5-10 minutes | Use this information to get them to consider from what they know about genetics in this module and how discontinuous variation is controlled. Most students should be able to identify with the one allele one phenotypic variable concept. Emphasise the important differences between multiallelic and polygenic inheritance. |
| 10-20 minutes | To explain continuous variation, prepare 5 cards per student with the letters T or S on them. These represent tall and short alleles (make sure nobody is sensitive to height issues before you begin this demonstration). Give 5 cards to each student and tell them that they represent genes controlling their height. Let them try to work out who would be the tallest in the class and who would be the shortest by arranging themselves in height order according to the genes they have inherited. This should show that these is an interaction between genes and where there are two individuals with the same gene combinations, it is possible to use this information to stimulate a discussion on the various effects of different genes and begin to see that if these people grew up in different environments, then they may also achieve different overall heights. |
| 20-40 minutes | Use a clip from "*The Secret Lives of Twins*" to show how twins developed in separate environments are not identical. Discuss how the environment affects their development. This can be supplemented with news articles regarding the incidence of CHD in Japan compared to those who emigrated to the west. A further example would be the higher incidence of melanoma in Australians who have not emigrated to cooler climates.<br>VP = VG + VE can be introduced to show how genes and the environment link together to give the final phenotype. |
| 40-55 minutes | Give other examples of variation in a population and use these to show how organisms are able to survive changing environments. Peppered moth pictures and other standard example which students will recognise, but what about examples like disease-resistant genes in wheat or potatoes which allowed farmers to survive the potato famine? These could then link with the genetic engineering sections later in the unit. Clinical variation such as inborn errors linked to mutations referred to in the syllabus will maintain student interest. The variation, certainly at the monofactoral level, can then be calculated by Hardy Weinberg. Examples could include phenyketouria, alkaptouria and the slightly more difficult haemohilia or colour blindness, both being X-linked. |

## Consolidation

| Time | Content |
|---|---|
| 5 minutes | Review variation as both a genetic and environmental phenomenon using a PowerPoint presentation of different organisms. Ask students to deduce whether the environment or the genetic make up of an individual has had more effect on its overall phenotype. |