

Sample Teaching Plan  
Unit G634: Applications of Biotechnology

**Suggested teaching time**

Plan is based on 12 weeks at 5 hours per week (4 hours contact time + 1 hour directed study).

The learning activities are suggestions only. Teachers may wish to develop alternative strategies. The plan should be read alongside the G634 Specification and, in particular, the Assessment Evidence Grid (attached for your reference).

Week number	Specification Unit Reference and Assessment Objectives	Suggested Learning Activities	Resources
1	3.15.1 The Science of genetic Engineering AO1(a)	<ul style="list-style-type: none"> <li>teacher-led discussion/recap of work done at AS level on DNA (if studied).</li> </ul> <p>Discussion/research/teacher-directed support is needed related to the scientific background required:</p> <ul style="list-style-type: none"> <li>the genetic code</li> <li>protein synthesis inside the cells</li> <li>use of restriction enzymes to produce sticky ends</li> <li>use of DNA ligase to produce recombinant DNA strands</li> <li>use of viruses and plasmids</li> <li>PCR (polymerase chain reaction) – scientific technique</li> <li>Electrophoresis.</li> </ul> <p><b>Student focus Assignment A1.</b></p>	<p>This information is widely available in a range of A level Biology text books.</p> <p>A2 Biology revision (9780435583736) has a good summary.</p> <p>Online resources.</p> <p>Guided use of Wikipedia:</p> <p><a href="http://en.wikipedia.org/wiki/DNA_ligase">http://en.wikipedia.org/wiki/DNA_ligase</a></p> <p><a href="http://en.wikipedia.org/wiki/Protein_biosynthesis">http://en.wikipedia.org/wiki/Protein_biosynthesis</a></p> <p><a href="http://en.wikipedia.org/wiki/Restriction_enzyme">http://en.wikipedia.org/wiki/Restriction_enzyme</a></p> <p><a href="http://en.wikipedia.org/wiki/Polymerase_chain_reaction">http://en.wikipedia.org/wiki/Polymerase_chain_reaction</a></p> <p><a href="http://en.wikipedia.org/wiki/Gel_electrophoresis">http://en.wikipedia.org/wiki/Gel_electrophoresis</a></p> <p><a href="http://www.biotechnologyonline.gov.au/biotechnologyonline/topitems/resources.html">http://www.biotechnologyonline.gov.au/biotechnologyonline/topitems/resources.html</a></p>

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			This web site has a range of resources that are easily accessible to the students: <a href="http://www.beep.ac.uk/content/index.php">http://www.beep.ac.uk/content/index.php</a>
<b>It is important that candidates are guided to the content of the specification 3.15.1 The Science of genetic engineering Page 60 to ensure that they cover the basic concepts for this topic area.</b>			
<b>2 – 3</b>	3.15.2 Use of Recombinant DNA technology in Medicine  AO1(b)	<p>Suggest students study the medical aspect here and present the plant /agricultural information in later assignments.</p> <p>Discussion on insulin:</p> <ul style="list-style-type: none"> <li>• understand what it is and how it works</li> <li>• discuss effectiveness of treatments</li> <li>• discuss advantages and disadvantages</li> <li>• identify the moral and ethical issues.</li> </ul> <p>This topic could support a debate (ref specification page 61).</p> <p>Students could research the legislation and control and the work of:</p> <ul style="list-style-type: none"> <li>• Gene Therapy Advisory Committee</li> <li>• Advisory Committee on Genetic Testing.</li> </ul> <p><b>Student focus Assignment A2.</b></p>	<p>Guided use of Wikipedia:</p> <p><a href="http://en.wikipedia.org/wiki/Gene_therapy">http://en.wikipedia.org/wiki/Gene_therapy</a></p> <p><a href="http://www.iptv.org/exploremore/ge/what/insulin.cfm">http://www.iptv.org/exploremore/ge/what/insulin.cfm</a></p> <p><a href="http://www.abpschools.org.uk/res/coResourceImport/modules/hormones/en-flash/geneticeng.cfm">http://www.abpschools.org.uk/res/coResourceImport/modules/hormones/en-flash/geneticeng.cfm</a> (short animation)</p> <p><a href="http://www.beep.ac.uk/content/44.0.html">http://www.beep.ac.uk/content/44.0.html</a></p> <p>Section on Health:</p> <p><a href="http://www.dh.gov.uk/ab/GTAC/Genetherapy/DH_100033">http://www.dh.gov.uk/ab/GTAC/Genetherapy/DH_100033</a></p> <p><a href="http://www.dh.gov.uk/ab/GTAC/index.htm">http://www.dh.gov.uk/ab/GTAC/index.htm</a></p>

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<b>It is important that candidates are guided to the content of the specification to ensure that they understand the concepts needed for the assignment. It is important that candidates are guided to the content of the specification Page 61 3.15.2 Use of Recombinant DNA Technology in Medicine to ensure they understand the wider picture and the concepts needed for the assignment.</b>			
4 – 7	3.15.3 Production of genetically modified Food plants  AO2(a)  AO2(c)  AO2(b)	<p>Main focus is on the completion of the assignment.</p> <p>In order to make students aware of the knowledge needed for the production of GM plants students could research and present individual topics:</p> <ul style="list-style-type: none"> <li>• introduction to techniques used in GM plants : gene guns/marker genes (ref Page 61)</li> <li>• the use of tissue culture or micropropagation</li> <li>• examples of successful genetically modified food plants one herbicide resistant/one insect pest resistant.</li> </ul> <p>Before assignment work students need to discuss problems that need to be overcome by use of recombinant DNA processes.</p> <p>Student assignment work to support the research requirements for describing how successful recombinant DNA technology is in solving food related problems.</p> <p>Time needs to be spent discussing concerns about the use of genetically modified organisms, to include:</p> <ul style="list-style-type: none"> <li>• pollution</li> <li>• overuse of herbicides</li> <li>• toxicity</li> <li>• uncontrolled spread of GMO plants</li> <li>• cost of seed to high for developing countries.</li> </ul> <p>These topics are a good focus for a debate.</p>	<p><a href="http://www.beeb.ac.uk/content/327.0.html">http://www.beeb.ac.uk/content/327.0.html</a></p> <p>Good section on GM crops.</p> <p>Take care that the students for this section don't just explain how GM plants/foods are produced but they:</p> <ul style="list-style-type: none"> <li>• describe how successful the technology is in solving particular problems associated with food production</li> <li>• at least two examples need to be discussed for higher mark bands.</li> </ul>

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		<p>Check students are aware of the legislative processes involved with GM foods.</p> <p>Calculation work can be introduced here for AO2(b) based on research topics if preferred.</p> <p><b>Student focus Assignment B1.</b></p>	
<p><b>It is important that candidates are guided to the content of the specification 3.15.3 The Science of genetically modified Food Plants Page 61- 62 to ensure that they cover the basic concepts for this topic area. Check throughout the practical work that candidates are doing sufficient calculations to cover AO2(b) – if assessing it through the practical investigation.</b></p>			
8 – 11	<p>3.15.4 Enzyme Technology</p> <p>AO3(a), (b), (c) &amp; (d)</p> <p>AO2(b)</p>	<p>Students will need to be made aware of how enzymes work.</p> <p>Individual or teacher-directed research needs to cover:</p> <ul style="list-style-type: none"> <li>• how enzymes work (lock &amp; key)</li> <li>• information on batch and continuous production</li> <li>• the techniques used in enzyme immobilisation.</li> </ul> <p>The practical work should be linked to a vocational context. It is advised that there is an awareness of:</p> <ul style="list-style-type: none"> <li>• medical uses</li> <li>• agricultural uses.</li> </ul> <p>Students then need to focus on the requirements of the practical investigation. They will need to know how to:</p> <ul style="list-style-type: none"> <li>• produce an immobilised enzyme</li> <li>• assemble a simple bioreactor.</li> </ul>	<p>Chenn, P. <i>Microorganisms and Biotechnology</i> (1997) John Murray, London. ISBN 0719575095</p> <p>O'Toole, G. &amp; S. <i>Understanding Biology for Advanced Level</i> (1999) Nelson Thornes, Gloucestershire. ISBN 0003222764</p> <p><a href="http://en.wikipedia.org/wiki/Immobilized_enzyme">http://en.wikipedia.org/wiki/Immobilized_enzyme</a></p> <p>NCBE booklet "In a jam and out of juice". ISBN: 0 7049 1373 9</p>

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		<p>For the assignment the candidates need to understand the requirements to:</p> <ul style="list-style-type: none"> <li>plan an investigation which will be able to monitor the effect of increased temperature on one chosen enzyme</li> <li>carry out a full risk assessment - consistent with COSHH guidelines - independent and detailed work for MB3.</li> </ul> <p>During the experiment candidates need to:</p> <ul style="list-style-type: none"> <li>carry out measurements</li> <li>use a range of techniques.</li> </ul> <p>Check for the higher marks:</p> <ul style="list-style-type: none"> <li>measurements are repeated where appropriate</li> <li>they have explained the use of the different techniques</li> <li>work is to an appropriate degree of accuracy.</li> </ul> <p>The candidates need to ensure:</p> <ul style="list-style-type: none"> <li>relevant observations and measurements are made and recorded on the effect of temperature on the reactions studied</li> <li>data are suitably displayed and processed.</li> </ul>	<p>Available free from NCBE's website:  <a href="http://www.ncbe.reading.ac.uk/NCBE/PROTOCOLS/juice.html">http://www.ncbe.reading.ac.uk/NCBE/PROTOCOLS/juice.html</a>  or  from NCBE, Science and Technology Centre, Earley Gate, University of Reading, Whiteknights, READING, RG6 6BZ.</p> <p>Tel: 0118 987 3743  Fax: 0118 975 0140.</p> <p><a href="http://www.saps.org.uk/">http://www.saps.org.uk/</a></p>

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		<p>Check for the higher marks:</p> <ul style="list-style-type: none"> <li>• there is evidence of independent work</li> <li>• work is detailed and recorded to the appropriate precision</li> <li>• the results are displayed accurately in a range of ways</li> <li>• processing is accurate and detailed</li> <li>• sufficient data are collected to show trends.</li> </ul> <p>The candidates need to check:</p> <ul style="list-style-type: none"> <li>• results are interpreted with information on how enzymes work and information on enzyme immobilisation</li> <li>• work has been evaluated.</li> </ul> <p>Check for higher marks:</p> <ul style="list-style-type: none"> <li>• results are interpreted and supported by secondary sources</li> <li>• information on the advantages of using bioreactors and enzyme immobilisation</li> <li>• conclusions need to be related to the use of bioreactors and enzyme immobilisation</li> <li>• work is supported with examples in either medicine or industry</li> <li>• evidence of the significance of the outcomes of the experimental work</li> <li>• evaluations are detailed and at a high level.</li> </ul>	

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12	Portfolio collation	Students to revisit work as necessary. Collation and organisation of portfolio work.	