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## Teacher Guide: Unit 15 Applications of Biotechnology

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### GUIDANCE FOR TEACHERS

- Guidance on delivery – Page 195-197 – or reference to this from the specifications
- Resources - Page 202 – or reference to this from the specifications.

### Guidance on Assessment

- Assessment guidance – Page 197-201 – or reference to this from the specifications
- Assessment Evidence grid Unit 15 – attached.

### Assignment Work

- The assignment briefs included with this unit are expected to give ideas on how to cover the required assessment criteria
- It is important that the time spent on the topic area links to the mark awarded
- It is hoped that centres will use these ideas as a starting tool
- Outline guidance from the specification included with this unit gives help to support the requirements of the assignment. It is hoped that this should be used to help to support the standard required.

### Suggested Time Allocation

- Based on 50-60 hours spent on this unit
- Includes work on assignment + teaching and learning time
- Some time should also be reserved for feedback and return of work after/before moderation.

Assessment Objective to be Covered	Mark Awarded	Possible Time Allocation
AO1	10	12 hours
AO2	14	16 hours
AO3	26	30 hours

## Teacher Resource Material

- Assessment Recording Sheet – suggestion of a possible method to collate marks from assignments
- Assignment No 15.1: Genetically Modified Food
- Assignment No 15.2: Enzyme Technology.

<b>Unit 15: Applications of biotechnology</b>				
<b>What you need to do:</b>				
<p><b>You need to produce</b> evidence of your investigation into the use of biotechnology to solve agricultural, medical and industrial problems [50 marks]. This evidence needs to include:</p> <p><b>AO1:</b> the production of a public information booklet to include information on the science of genetic engineering and the use of recombinant DNA technology in medicine <b>or</b> agriculture [10];</p> <p><b>AO2:</b> an evaluation of the effectiveness of techniques, benefits and impact on society of the production of genetically modified food plants, including evidence of associated financial calculations, consideration of the moral and ethical issues and the impact of legislation associated with the production of genetically modified food plants [14];</p> <p><b>AO3:</b> a practical investigation into enzyme technology, to include construction of a simple bioreactor and the effect of temperature on enzyme activity [26].</p>				
<b>How you will be assessed:</b>				
<b>Assessment Objective</b>	<b>Mark Band 1</b>	<b>Mark Band 2</b>	<b>Mark Band 3</b>	<b>Mark Awarded</b>
<b>AO1</b>	You will produce a clearly presented booklet about the science of genetic engineering; <b>[0 1 2]</b>	you will produce a researched, detailed booklet about the science of genetic engineering with relevant information selected that is clearly and logically presented; <b>[3]</b>	you will produce a booklet about the science of genetic engineering, based on thorough research, with evidence that relevant information has been selected from a variety of sources, that is clearly and logically presented. <b>[4 5]</b>	<b>/10</b>
	You will produce a clearly presented booklet about the use of recombinant DNA technology in medicine <b>or</b> agriculture; <b>[0 1 2]</b>	you will produce a researched, detailed booklet about the use of recombinant DNA technology in medicine <b>or</b> agriculture with relevant information selected that is clearly and logically presented; <b>[3]</b>	you will produce a booklet about the use of recombinant DNA technology in medicine <b>or</b> agriculture, based on thorough research, with evidence that relevant information has been selected from a variety of sources, that is clearly and logically presented. <b>[4 5]</b>	
<b>AO2</b>	You will describe how successful recombinant DNA technology is in solving problems associated with food production by crop plants and come to a simple conclusion on the overall benefits of the technology; <b>[0 1 2]</b>	you will describe how successful recombinant DNA technology is in solving problems associated with food production by crop plants and come to a conclusion based on clear evidence; some evidence of evaluation of at least <b>two</b> specific examples of the technology is needed; <b>[3]</b>	you will produce a comprehensive evaluation of the success of specific examples of the production of genetically modified plants; there will be clearly referenced evidence for your case and a summary of your main findings. <b>[4 5]</b>	<b>/14</b>
	You will present some financial, statistical evidence involving basic calculations; <b>[0 1]</b>	you will present detailed financial, statistical analysis including calculations; <b>[2]</b>	you will present financial evidence with appropriate complex calculations. <b>[3]</b>	
	You will carry out a simple analysis of the moral and ethical case for <b>one</b> aspect of using recombinant DNA technology in the production of GM plants and explain <b>one</b> of the controls placed on scientists working in this field, using some relevant evidence; <b>[0 1 2]</b>	you will summarise some of the moral, ethical and environmental issues concerning the use of recombinant DNA technology in the production of GM plants; you will need to explain <b>two</b> types of controls placed on scientists that work in this field; <b>[3 4]</b>	you will explain fluently what you consider to be the main moral, ethical and environmental issues concerning the use of recombinant DNA technology in the production of GM plants; you will need to evaluate <b>two</b> types of controls placed on scientists that work in this field for how effective they are. <b>[5 6]</b>	

<b>Unit 15: Applications of biotechnology (continued)</b>				
<b>Assessment Objective</b>	<b>Mark Band 1</b>	<b>Mark Band 2</b>	<b>Mark Band 3</b>	<b>Mark Awarded</b>
<b>AO3</b>	You will plan your practical work with help, including risk assessments; you will construct a simple reactor and be able to produce and use an immobilised enzyme; <b>[0 1 2]</b>	you will produce a clear plan with limited help which includes risk assessments consistent with COSHH guidelines; <b>[3]</b>	you will produce a clear plan of action of your own, including detailed risk assessments consistent with COSHH guidelines, using secondary sources. <b>[4 5]</b>	
	You will carry out measurements from the reactor, with help; you will use a range of techniques and equipment; <b>[0 1 2]</b>	you will carry out measurements from the constructed bioreactor using an immobilised enzyme system; you will use a range of techniques and equipment and have repeated measurements, working with an appropriate degree of accuracy; <b>[3]</b>	you will carry out measurements from the constructed bioreactor, using an immobilised enzyme system, on factors affecting your bioreactor; you will explain the use of a range of techniques and equipment and will have repeated measurements when appropriate; you will work with an appropriate degree of accuracy. <b>[4 5]</b>	
	You will make and record relevant observations and measurements on the effect of temperature on the constructed bioreactor, with help; you will display the data obtained using tables and simple graphs, with help; <b>[0 1 2 3]</b>	you will make and record relevant observations and measurements on both the bioreactor and the immobilised enzymes, using precision in your measurements; you will display the scientific data accurately in a range of ways including some simple calculations on rates of reaction; <b>[4 5 6 7]</b>	you will make and record a detailed set of relevant observations with limited help, using the appropriate precision in your measurements; you will display the scientific data accurately in a range of ways, and process them in a manner chosen to best illustrate the trends in data; you will collect sufficient data to complete simple statistics on the results. <b>[8 9]</b>	
	You will give some interpretation of the results and relate these to how enzymes work and enzyme immobilisation; <b>[0 1 2]</b>	you will interpret the results and draw basic conclusions relating your results to how enzymes work, the advantages of using bioreactors and enzyme immobilisation; <b>[3 4 5]</b>	you will interpret the results in detail using secondary sources to support your findings; you will draw conclusions relating your results to the use of bioreactors and enzyme immobilisation, specifying named examples in either medicine or industry; you will discuss the significance of your findings in terms of how enzymes work and the advantage of enzyme technology to industry. <b>[6 7]</b>	
<b>Total mark awarded:</b>				<b>/26</b>
<b>Total mark awarded:</b>				<b>/50</b>