Stage 5 Agricultural technology – Plant/animal production

## Exploring agricultural issues – Student workbook

Student name:

Class:

Teacher:

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## Glossary

Complete the table below with definitions as you progress through the unit. As you come across words in the text refer back to the glossary and fill in the description.

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| Term | Description |
| Biotechnology | The exploitation of biological processes for industrial and other purposes, especially the genetic manipulation of microorganisms for the production of antibiotics and hormones. |
| Selective breeding | Choosing parents with particular characteristics to breed together to produce offspring with more desirable characteristics. |
| Genetics | A branch of biology that deals with hereditary and variation of organisms. |
| DNA | Deoxyribonucleic acid, a self-replicating material which is present in nearly all living organisms as the main part of chromosomes. |
| Transgenic | An organism that contains genetic material into which DNA from an unrelated organism has been artificially introduced. |
| Ethical | Holding the moral principles held by a social group. |
| Sustainability | The avoidance of the depletion of natural resources in order to maintain an ecological balance. |
| Debate | A formal discussion in which opposing arguments are put forward. |
| Characteristics | Features or qualities belonging to a person, place or thing. |
| Career | An occupation undertaken for a significant period of a person’s life. |

## Exploring agricultural issues - Unit overview

### Summary

The unit exploring agricultural issues, provides students with the opportunity to develop an understanding of current topics faced in Australian agriculture that are considered socially or ethically debatable, or pose threats to production within enterprises. The activities can be tailored to fit plant or animal enterprises of the students choice.

Use the space below to brainstorm all the ideas that you think about in relation to the word **biotechnology.**

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### Biotechnology

Biotechnology has helped scientists bring consumers more quantity and better quality agricultural products and practices in a considerably faster way than natural breeding methods. Biotechnology is not a new field of science; it has been practised in one form or another to improve our way of life for generations. Selective breeding for desired traits and nutrition have played an important role in securing desirable and economically important characteristics in livestock and plants. Microorganisms were used to help make foods such as beverages, cheese and bread.

A common misconception is the idea that biotechnology includes only DNA and genetic engineering. The convention on biological diversity defines biotechnology as ”any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific uses”.

In the future, agricultural production will rely even more heavily on existing and emerging biotechnologies to produce enough food and fibre for the expanding world population. Genetically modified (transgenic) livestock and plants, stem cells and other emerging biotechnologies will all have important roles in producing more quantity and higher quality agricultural products.

Use your own words to create a definition for the term biotechnology.

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Thanks to new developments in science and technology, biotechnology focuses on how microbes, plants and animals can be modified and used to improve health, nutrition and agriculture. Some examples of biotechnology based developments include:

* New plants that produce higher yields
* Fruits and vegetables with improved nutritional qualities
* Crops that can grow in adverse conditions (droughts, flood, salty soils)
* Plants that do not require chemical pesticides, fungicides or herbicides

Watch the video clip from university of Guelph on [enviropig](https://www.youtube.com/watch?v=mAfCauLF-14) as an example of biotechnology in agriculture. Complete the questions that follow in the spaces provided.

Describe the problem that scientists are trying to solve by creating the enviropig?

| To try and control and reduce the environmental footprint of pig farming on the environment that comes from the amount of phosphorus that is produced in pig wastes.  The waste products produced by pig farming are spread onto pastures and crops and the excess phosphorus can leach into nearby waterways causing algal blooms. |
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How is the problem being solved through enviropig?

| Scientists have added in an e.Coli bacteria gene and mouse DNA to a normal pig embryo. These manipulations allow the Enviropig to produce an enzyme that helps it to digest more phosphorus, about fifty percent more according to research. Reducing the amount that is expelled from the body via wastes. |
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What concerns do people have about the development of enviropig? How are scientists trying to alleviate these concerns?

| People have concerns about genetic engineering of animals and the safety for human consumption.  Scientists and government groups are put through rigorous trials before any genetically modified products are available to the consumer.  Centre for food safety spokesperson has concerns that these genetically engineered animals are not required, changes to the process of pig farming are more appropriate. |
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Research other examples of biotechnology in agriculture and create an infographic or other suitable visual stimulus to present your research.

| * Insect resistant corn and cotton. * Vitamin enriched rice called sunrice. * Round-up ready soybeans. * Genetically modified salmon from aqua advantage. |
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## Ethical concerns

**While biotechnology has been a useful tool in improving quantity and quality for some agricultural products, it also initiates worldwide ethical debates. Many questions have arisen in the media, by social groups, in classrooms and at home.**

### What is ethics?

**Ethics can be defined as the standards, values or ideals that people use in order to make a judgement about whether something is right or wrong. In any society, there are ethical norms that determine what is acceptable and who is responsible for what. Different cultures, religions, socio-economic demographics and countries can have different ethics to each other.**

**Biotechnology has always been surrounded by ethical debates and issues. Issues about sustainability, environmental safety, human health and distribution or profits from these technologies being the most commonly debated.**

**Despite the promise of biotechnology in agriculture improving quality and quantity of products, there are still safety issues to be considered. One such issue being food safety. Can the presence of new DNA in an animal or plant make it unsafe for humans to eat? Another issue comes with the possibility of creating uncontrollable pests in the environment if pesticide or herbicide immune plants are created.**

**There are several Australian government agencies involved in regulating the release of biotechnology derived products and foods in the market. However, the processes used to make these decisions can often be called into question and whether the regulations keep up with advancements in science and technology in this space?**

**Watch the video clip from Greenpeace Australia pacific on** [genetic engineering in agriculture](https://www.youtube.com/watch?v=zcTNmCUMZ7c) **to see the ethical issues from the point of view of an environmental rights group.**

### Biotechnology in agriculture PMI

In the table below complete a plus, minus, interesting (PMI) analysis of the use of biotechnology in agriculture.

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| --- | --- | --- | --- |
| Plus | Minus | Interesting | |
|  |  |  |

Read the articles about genetically modified sheep and answer the questions that follow.

[Meet the world’s first glow in the dark sheep](https://www.news.com.au/technology/science/glow-in-the-dark-sheep/news-story/5be6ed7dfb32c2f3911e4c80a0ca6d8d)

[Someone in France accidentally ate a fluorescent lamb with jellyfish DNA](https://www.theverge.com/2015/6/23/8830069/lamb-fluorescent-jellyfish-dna-sold-france-inra)

Explain the advantages and disadvantages that could come from these experimental genetic engineering projects on livestock. Consider the short- and long-term consequences in your answer.

| Advantages:   * Improved medicines for humans. * Faster growing crops. * Less impact on the environment from farming practices. * Better quality nutrition for third world countries.   Disadvantages:   * Super plants and animals that have negative impacts on the environment. * Allergic reactions to foods by humans. |
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Do you think that genetic engineering of animals is a good direction for agriculture to be moving in? Why or why not?

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## Designing new agricultural products

All of these biotechnology in agriculture examples have been developed in response to a need in society. Bt cotton addresses the concerns about using too many chemicals in the environment, genetically modified milk is looking at improving human nutrition. Think about a need in society or the environment and develop an idea for an improved agricultural product, food or fibre, that could be created using biotechnology.

Address each of the following criteria in your design:

* Outline the intended benefits of producing this product
* What is the original product that is being enhanced and how is it being changed? For example, what characteristics are you taking from another organism, or removing from the original?
* What secondary organism will be used to enhance the first one, if any?

Draw a promotional campaign to sell the product to the community and alleviate any ethical concerns that may surround the product.

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## Careers in biotechnology

Research one career in agricultural biotechnology and create a ‘careers in focus’ poster that informs school students about what is involved in the career and the pathways to getting into the field.

Include the following information about the career, using the format of your choice:

* Name of career.
* Qualifications/tertiary education if required.
* Approximate income or salary.
* General duties performed.
* Possible employers or companies they work for.
* Pictures that represent the career or the work that is done.

Some possible career pathways that could be explored include, but are not limited to:

* Animal technician
* Genomics technician
* Laboratory assistant
* Patent examiner
* Clinical researcher
* Biotechnologist plant breeder
* Agricultural engineer
* Microbiologist
* Soil and plant scientist

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## Agricultural issues or problems

Research an agricultural problem for an industry you are studying or will be studying at school. Create a newspaper report outlining the issue to raise awareness of it amongst the community.

Include the following in your report:

* Description of the problem.
* Who or what is affected most by this problem?
* The overall cost to Australian agriculture (this doesn’t have to be a financial cost, it could be loss of jobs, loss of land, loss of life).
* Pictures to generate interest.
* Newspaper article format and features, including a title, credit line and captions for pictures used.

This article needs to show features of persuasive text to get the readers feeling an intended emotion, for example, angry that the situation has occurred, sad for the people or animals involved or inspired to help.

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Most newspapers have an online presence for one or more social media platforms. Identify one social media platform and create a shorter, provocative piece that gets the reader interested in clicking the link to read the full article. Ensure the social media’s format and features are used when creating this work, including character limits, styles and pictures.

Examples of social media platforms that could be used include, but are not limited to:

* Facebook
* Instagram
* Twitter

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After researching this agricultural issue for the newspaper article, brainstorm a list of possible solutions to fix or reduce the problem for the most affected group.

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For one of these solutions, explain how it would address the issue and how this could fix or reduce the problem for the identified group most affected. Include diagrams or pictures where possible to assist in explaining your solution.

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## Marking rubric

The following marking rubric is to be used as a guide only. Individual teacher judgement and knowledge of specific students’ needs is required.

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| Glossary and biotechnology definition | Grade |
| Students communicate their understanding of the terminology by providing a clear and concise definition of the term. | A |
| Students communicate a general understanding of the terminology by providing a definition of the term. | B |
| Students communicate some understanding of the terminology by providing a basic definition of the term. | C |
| Students communicate little understanding of the terminology by providing only a limited definition of the term. | D |
| Little or no attempt to complete the glossary. | E |

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| Ethical concerns | Grade |
| Students undertake extensive research with a comprehensive analysis of their findings on a range of ethical issues relevant to biotechnology. | A |
| Students undertake research with an analysis of their findings on a range of ethical issues relevant to biotechnology. | B |
| Students undertake basic research with some analysis of their findings on a range of ethical issues relevant to biotechnology. | C |
| Students undertake limited research with incomplete analysis of their findings on a narrow scope of ethical issues relevant to biotechnology. | D |
| Little or no attempt to carry out research or analyse the findings. | E |

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| Designing a new product | Grade |
| Students undertake extensive research to design a high quality final design and promotional campaign that accurately meets the design brief. | A |
| Students undertake research to design a quality design and promotional campaign that meets the design brief. | B |
| Students undertake basic research to produce a design and promotional campaign that somewhat meets the design brief. | C |
| Students produce a limited final design without regard for the design brief. | D |
| Little or no attempt made to produce a final design or promotional campaign. | E |

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| Careers | Grade |
| Students undertake extensive research with a comprehensive analysis of their findings. | A |
| Students undertake research with an analysis of their findings. | B |
| Students undertake basic research with some analysis of their findings. | C |
| Students undertake limited research with incomplete analysis of their findings. | D |
| Little or no attempt to carry out research or analyse the findings. | E |

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| Agricultural problems | Grade |
| Students undertake extensive research and follow style formats for the text. Solution extensively addresses the challenge, demonstrating significance to the impacted group. | A |
| Students undertake research and follow style formats for the text. Solution addresses the challenge, demonstrating significance to the impacted group. | B |
| Students undertake basic research and follow some style formats for the text. Solution basically addresses the challenge. | C |
| Students undertake limited research and follow some style formats for the text. | D |
| Little or no attempt to carry out research or follow style formats for the text. | E |