

Agriculture and evaluating biotechnology

Revision notes · Fertilisers and biological control for a growing population, and the benefits and risks of genetic engineering and selective breeding.

For Edexcel GCSE Biology 1BI0 and Combined Science 1SC0. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

Agriculture and evaluating biotechnology **Spec 4.13B–4.14**

Agricultural solutions for a growing population **Spec 4.13B Triple only**

The human population is growing, so more food is needed. Two agricultural solutions are the use of fertilisers and biological control.

Fertilisers

Fertilisers add mineral ions, such as nitrates, to the soil. Plants need these to grow well, so crop yields are higher.

- Advantage: increased growth and yield, so more food is produced from the same land.
- Disadvantage: fertilisers can be washed off fields into rivers and lakes, which can harm wildlife and pollute water.
- Disadvantage: they cost money, so the farmer's costs go up.

Biological control

Biological control is the use of living organisms to control pests. For example, ladybirds can be released to eat aphids.

- Advantage: no chemical residues are left on the food, and harmful chemical pesticides are not needed.
- Advantage: the control organism usually targets only the pest, and can keep working over a long time.
- Disadvantage: it is slower than pesticides and may not completely remove the pest.
- Disadvantage: the control organism might itself become a pest, or might eat other organisms, harming the ecosystem.

Exam tip: Questions about fertilisers or biological control need both sides. Give at least one advantage and one disadvantage, each explained, not just named.

Evaluating genetic engineering and selective breeding **Spec 4.14**

'Evaluate' means weigh up benefits and risks, including practical and ethical implications, and reach a judgement. Here are the main points for agriculture and medicine.

Benefits and risks		
	Benefits	Risks and implications
Selective breeding	Higher yields and better quality food; no special equipment needed; produces useful animals and plants	Takes many generations; reduces genetic variation; inbreeding can cause health problems in animals
Genetic engineering in agriculture	Crops with new characteristics such as insect resistance or greater nutritional value; quicker than selective breeding	Unknown effects on the environment and human health; genes may spread to wild species; some people think it is wrong to alter genes
Genetic engineering in medicine	Medicines such as human insulin can be made in large amounts from GM organisms	Possible unforeseen effects; ethical concerns about changing the genes of organisms, especially animals

Practical implications include time, cost, skill and the chance that it does not work. **Ethical** implications are about what people think is right or wrong, such as animal welfare and whether humans should change the genes of living things.

Interpreting yield data (practice data)

A farmer grows a non-GM crop with a yield of 4.0 tonnes per hectare, and a GM crop with a yield of 5.0 tonnes per hectare. Calculate the percentage increase in yield with the GM crop.

1. Increase = $5.0 - 4.0 = 1.0$ tonnes per hectare
2. Percentage increase = $\text{increase} \div \text{original} \times 100$
3. $1.0 \div 4.0 \times 100 = 25\%$

Answer: 25% increase.

Maths skill: When asked to plot or read data from graphs or tables, check the axis scales and units, and use values from the data in your evaluation.

Exam tip: In a 6-mark 'evaluate' answer, give benefits and risks, include both practical and ethical points, and finish with a clear conclusion that uses them.

Quick check

1. What does 'evaluate' require you to do in a question about genetic engineering?
2. Name one practical and one ethical implication of genetic engineering.
3. Give one risk of selective breeding.

Quick check answers

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- 1 . Weigh up benefits and risks, including practical and ethical implications, and reach a judgement.
- 2 . Practical: it is costly or may not work. Ethical: some think it is wrong to alter the genes of organisms.
- 3 . It reduces genetic variation, or inbreeding causes health problems.