

Use of biological resources

Pearson Edexcel · International GCSE · Biology

Using life to feed and to heal

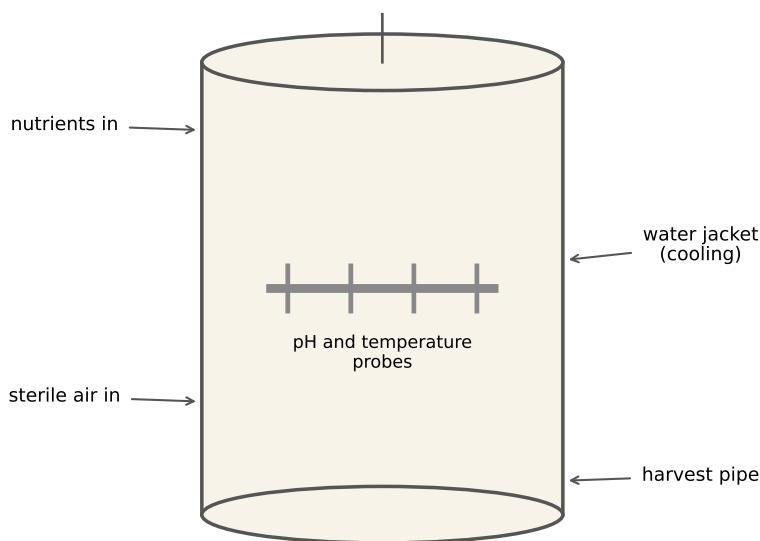
Bread rises, yoghurt thickens, insulin saves lives – all products of organisms put to work. This last section covers how humans increase yields (glasshouses, fertiliser, pest control), grow micro-organisms at scale (fermenters), and change organisms deliberately: selective breeding, genetic modification and cloning.

Edexcel International GCSE Biology 4BI1, Section 5 (statements 5.1–5.20B) completes the course. The B-suffixed statements (fish farming, micropropagation, mammal cloning) are Biology-only.

Food production

Crop plants. Glasshouses and polythene tunnels trap heat and shelter crops, letting farmers control light, temperature, CO₂ and water; raising CO₂ and temperature toward the optimum lifts the photosynthesis rate and yield. **Fertilisers** replace mineral ions (nitrate for amino acids, magnesium for chlorophyll) the soil loses with each harvest. **Pest control:** pesticides kill pests quickly and completely but risk **bioaccumulation**, harming other species and leaving residues; **biological control** (introducing a pest's predator) is self-sustaining and specific but slow and less controllable if the control species itself spreads.

Micro-organisms. Yeast ferments sugar: anaerobically it produces carbon dioxide (which raises bread) and ethanol; *Lactobacillus* converts milk sugar to lactic acid, thickening yoghurt. An **industrial fermenter** keeps micro-organisms at their optimum: **aseptic precautions** (no contamination), **nutrients**, **optimum temperature and pH**, **oxygenation** (air supply for aerobic cultures) and **agitation** (stirring spreads heat and nutrients evenly).



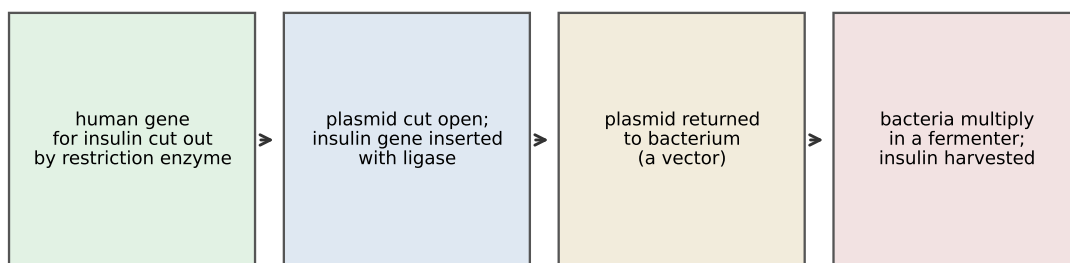
(B) Fish farming provides protein efficiently: maintain water quality, control predation (intraspecific – among the fish – and interspecific), control disease, remove waste, control feeding quality and frequency, and selectively breed fast-growing strains.

Selective breeding

Choose parents with the desired characteristics → breed them → select the best offspring → repeat over generations. It develops plants with higher yield, disease resistance or hardiness, and animals with more meat, milk or docility – but it narrows the gene pool, increasing vulnerability to disease, and takes many generations.

Genetic modification (genetic engineering)

Restriction enzymes cut DNA at specific sites; **ligase** joins pieces of DNA together. A **plasmid** (or a virus) acts as a **vector**: the human insulin gene is cut out, inserted into a opened plasmid, and the **recombinant DNA** is taken up by bacteria, which multiply in a fermenter producing **human insulin**. GM plants can resist pests or herbicides or make more food. An organism receiving genes from a different species is **transgenic**.



the product is transgenic: genetic material moved between species

Cloning (B)

Micropropagation (tissue culture): a small **explant** is grown **in vitro** on a nutrient medium with growth hormones, producing genetically identical plantlets – commercial quantities of plants with desirable characteristics, disease-free and fast. **Mammal cloning**: a **diploid nucleus from a mature cell** is inserted into an **enucleated egg cell** (its own nucleus removed); the cell divides into an embryo placed in a surrogate – Dolly the sheep. Cloned **transgenic** animals can produce human proteins in their milk.

Check yourself

1. Give two ways a glasshouse raises crop yield.
2. State one advantage and one disadvantage of biological control.
3. Why does *Lactobacillus* thicken milk?
4. List the five conditions a fermenter maintains.
5. (B) Name two methods of controlling predation in fish farming.
6. Give two drawbacks of selective breeding.
7. Name the enzyme that cuts DNA and the one that joins it.
8. What is a vector in genetic engineering?
9. Explain why bacteria with the human insulin gene make useful medicine.
10. (B) Outline the stages of cloning a mammal.

Answers: 1 Traps heat near the optimum; CO₂, light and water controlled (any two); 2 Advantage – self-sustaining, no residues; disadvantage – slow, and the control species may spread; 3 It converts lactose to lactic acid, which coagulates the milk protein; 4 aseptic conditions, nutrients, optimum temperature and pH, oxygenation, agitation; 5 (B) net cages against interspecific predators; lower stocking density against intraspecific; 6 narrows the gene pool, so disease spreads easily; takes many generations.

Answers continued: 7 Restriction enzymes cut; ligase joins; 8 a plasmid or virus carrying recombinant DNA into a cell; 9 they multiply fast in a fermenter, secreting human insulin – safe and producible at scale; 10 (B) Diploid nucleus from a mature cell → enucleated egg → divides into an embryo → implanted in a surrogate.