Topic 5: Use of biological resources

Edexcel International GCSE Biology 4BI1 · Section 5 · statements 5.1–5.20B · sheets 5.1–5.2

Organisms put to work

Your turn

Bread rises, yoghurt thickens, and diabetics inject human insulin.

A. Which organism makes bread rise, and with which gas?
B. What does Lactobacillus make that thickens milk?
C. Where does human insulin for medicine come from today?

Raising crop yields

Glasshouses and polythene tunnels

Trap heat and shelter crops; control light, temperature, CO_2 and water.

Raising CO_2 and temperature towards the optimum raises photosynthesis and yield.

Fertilisers

Replace mineral ions each harvest removes.

Nitrate for amino acids; magnesium for chlorophyll.

Pesticides or biological control?

	Pesticides	**Biological control**
advantage	kill pests quickly and completely	self-sustaining, specific, no residues
disadvantage	**bioaccumulation**, harm other species, residues	slow; the control species may itself spread

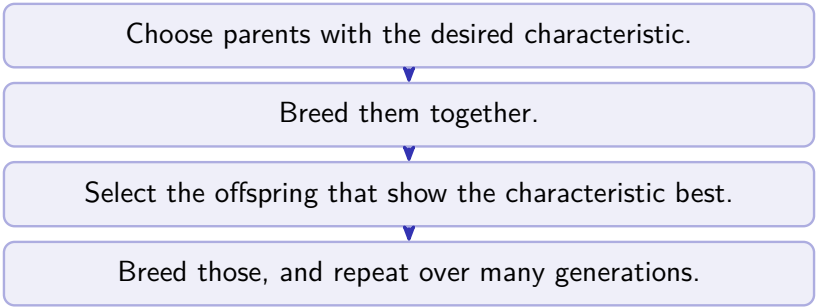
The industrial fermenter

Condition	Why
aseptic precautions	no contaminating microbes compete or spoil the product
nutrients	food for growth
optimum temperature and pH	enzymes work fastest; a cooling jacket removes heat
oxygenation	sterile air for aerobic cultures
agitation	stirring spreads heat and nutrients evenly

(B) Fish farming

Control	How
water quality	keep oxygen high; remove waste
predation	nets against other species; lower stocking density within one species
disease	treat and isolate; avoid overcrowding
feeding	control food quality and frequency
breeding	selectively breed fast-growing strains

Selective breeding



Drawbacks: a narrower gene pool makes disease spread more easily; it takes many generations.

Making human insulin in bacteria

A **restriction enzyme** cuts the insulin gene out of human DNA.

The same enzyme opens a **plasmid**; **ligase** joins the gene into it.

The recombinant plasmid (the vector) is taken up by a bacterium.

The transgenic bacteria multiply in a fermenter and secrete human insulin.

GM crops and transgenic organisms

Your turn

A crop plant is given a gene from a bacterium that makes a protein toxic to caterpillars.

A. Why is the crop called transgenic?

B. Which enzymes and vector would you use?

C. Give one benefit and one concern about growing it.

(B) Micropropagation and cloning mammals

Micropropagation

A small **explant** grows **in vitro** on a nutrient medium with growth hormones.

Many identical, disease-free plantlets, fast and in commercial quantities.

Cloning a mammal

Diploid nucleus from a mature cell $\rightarrow$ enucleated egg $\rightarrow$ embryo $\rightarrow$ surrogate.

Dolly the sheep; cloned **transgenic** animals can make human proteins in milk.

Check yourself

Your turn

Answer without notes, then check.

A. Give one advantage and one disadvantage of biological control.

B. List the five conditions a fermenter maintains.

C. Name the enzyme that cuts DNA and the one that joins it.

D. What is a vector in genetic engineering?

E. (B) Outline the stages of cloning a mammal.