Exercise walk-through

Genetic technology applied to medicine ▪ 19.2

eXercise

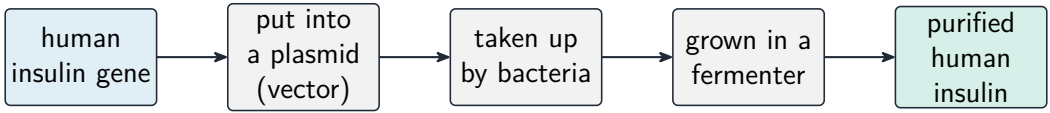
You must be able to

- explain the advantages of recombinant human proteins (insulin, factor VIII, ADA)
- outline genetic screening (BRCA, Huntington's, cystic fibrosis) and gene therapy (SCID)
- discuss social and ethical considerations

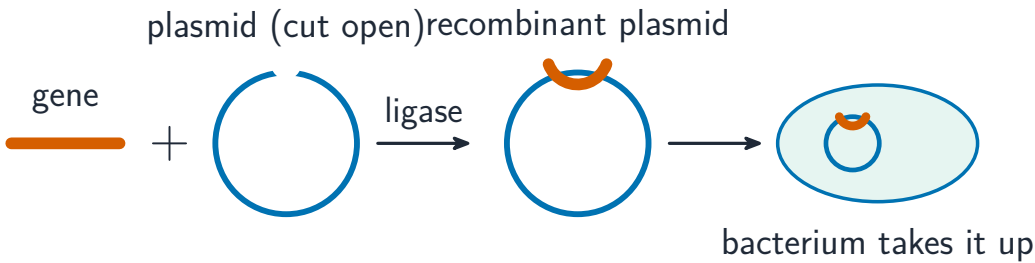
Method — Recombinant human proteins

A human gene is placed in bacteria so they make a **recombinant** human protein — an exact copy. Advantages: it is identical to the human protein, never in short supply, and avoids using animal/donor proteins (so fewer allergic reactions or infections).
Examples: **insulin 胰岛素** (diabetes), **factor VIII** (haemophilia), **adenosine deaminase** (a faulty immune system).

Method — Recombinant human proteins



Method — Recombinant human proteins



A plasmid vector carries the human gene into bacteria

Method — Genetic screening and gene therapy

Genetic screening tests DNA for disease alleles before symptoms appear — e.g. **BRCA1/BRCA2** (breast cancer risk), **Huntington's disease**, **cystic fibrosis** 囊性纤维化. **Gene therapy** puts a working gene into a patient's cells — used for **SCID** (failed immune system) and some inherited eye diseases.

Method — Ethics

Concerns: who may see your results; misuse by insurers/employers; safety and permanence of changes; who decides. These are weighed against the benefits.

Practice 2.1 ▪ 2 marks

State **two** advantages of using recombinant human insulin rather than insulin from animals.

Solution 2.1

Method: Recombinant human proteins

Worked steps

any two: identical to human insulin; never in short supply; fewer allergic reactions; no risk of animal-borne infection; no ethical objection from using animals B1 *each, max 2.*

Practice 2.2 ▪ 1 mark

Name **one** disease that can be detected by genetic screening.

Solution 2.2

Method: Genetic screening and gene therapy

Worked steps

any one: breast cancer (BRCA1/BRCA2); Huntington's disease; cystic fibrosis B1.

Exam-style 3.1 ▪ 1 mark

Gene therapy treats a genetic disease by:

A giving the patient a recombinant protein

B putting a working copy of a gene into the patient's cells

C screening the patient's DNA

D removing the faulty allele from all body cells permanently

Solution 3.1

Method: Genetic screening and gene therapy

A giving the patient a recombinant protein

B putting a working copy of a gene into the patient's cells ✓

C screening the patient's DNA

D removing the faulty allele from all body cells permanently

Worked steps

B. Gene therapy adds a working copy of the gene to the patient's cells.

Exam-style 3.2 ▪ 1 mark

Which is an advantage of making insulin from genetically engineered bacteria?

A it is slightly different from human insulin

B it is identical to human insulin and never in short supply

C it must be extracted from animal pancreases

D it cannot be purified

Solution 3.2

Method: Recombinant human proteins

A it is slightly different from human insulin

B it is identical to human insulin and never in short supply ✓

C it must be extracted from animal pancreases

D it cannot be purified

Worked steps

B. Engineered bacteria make insulin identical to human insulin, in unlimited supply.

Exam-style 3.3 ▪ 2 marks

(a) Explain **one** advantage of genetic screening for a person with a family history of Huntington's disease.
(b) Discuss **one** ethical concern raised by genetic screening.

Solution 3.3

Method: Genetic screening and gene therapy

Worked steps

(a) it lets the person know their risk before symptoms appear **M1**, so they can make informed choices about treatment, monitoring or having children **A1**.
(b) e.g. results could be misused by insurers/employers **M1**, or cause anxiety / there is no cure for Huntington's **A1**.

Exam-style 3.4 ▪ 2 marks

Explain how gene therapy could help a child with SCID.

Solution 3.4

Method: Genetic screening and gene therapy

Worked steps

a working copy of the faulty gene is inserted into the child's cells M1; the cells then make the missing protein, restoring immune function A1.