

Exercise walk-through

21.2

Biotechnology

IGCSE Biology

Why bacteria are useful

reproduce
very fast

make complex
molecules

contain
plasmids

Biotechnology uses living things (or their **enzymes**) to make useful products.



Biotechnology uses living systems for products

Why bacteria are the tool of choice

they reproduce fast

a population doubles in minutes, so a useful gene is copied millions of times cheaply

simple requirements

they grow on inexpensive nutrients in a **fermenter**

plasmids

small **rings of DNA** that are easy to remove, cut and put back – the vehicle for the new gene

few ethical**concerns**

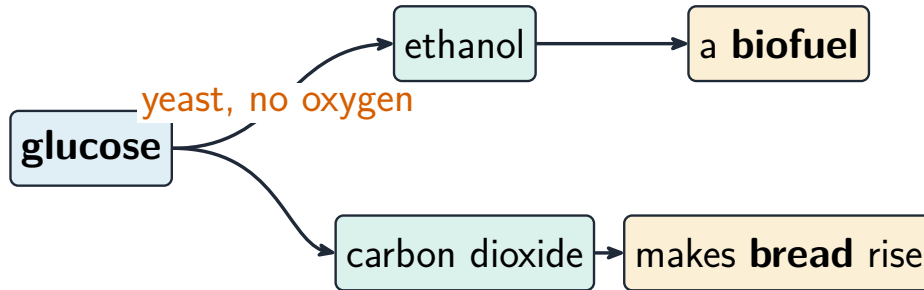
(Supplement) growing bacteria raises far fewer objections than modifying animals

they lack a nucleus

so the plasmid is directly accessible

Plasmids are the whole reason bacteria are used. They are the only easily removable, easily reinserted piece of DNA a cell offers.

Yeast: biofuels and bread



- the ethanol can be used as a **biofuel**.
- in bread-making, the carbon dioxide makes the dough rise.

Enzymes in industry

- **pectinase** – more, clearer fruit juice
- proteases & lipases – wash out stains
- **lactase** – lactose-free milk

pectinase → more fruit juice

protease + lipase → wash out stains

lactase → lactose-free milk

Three industrial enzymes

pectinase

breaks down cell walls to **release more juice** from fruit – more juice, and clearer

biological washing powder

contains protease and lipase, which digest protein and fat stains at **low** temperatures

lactase

(Supplement) breaks down **lactose** to make **lactose-free milk**, for people who cannot digest it

the shared advantage

enzymes work at low temperature and pressure, so they save energy

the shared limitation

they are proteins, so they **denature** if the process runs too hot or at the wrong pH

Each enzyme is chosen for the **one bond** it breaks. Naming the substrate and the product is what the question is actually asking.

Exercises 2.1·2.2

2.1 Name the two products yeast makes by anaerobic respiration. [2]

2.2 State the use of pectinase. [1]

Exercises 2.1·2.2

2.1 Name the two products yeast makes by anaerobic respiration. [2]

2.1

- yeast anaerobic products: **ethanol** and **carbon dioxide**
-

2.2 State the use of pectinase. [1]

2.2

- pectinase **breaks down cell walls** to release more (and clearer) fruit juice

Exercise 3.1

3.1 Biological washing powders contain enzymes that:

[1]

☐

A make stains

B digest stains at lower temperatures

C colour clothes

D kill bacteria

Exercise 3.1

3.1 Biological washing powders contain enzymes that:

[1]

☐

A make stains

B digest stains at lower temperatures

C colour clothes

D kill bacteria

3.1 B

- the enzymes **digest stains at lower temperatures**
- A, C and D are not what the enzymes do

Exercise 3.2 (a)

3.2 A fermenter is used to grow microbes.

(a) State two conditions that must be controlled in a fermenter.

[2]

Exercise 3.2 (a)

3.2 A fermenter is used to grow microbes.

(a) State two conditions that must be controlled in a fermenter.

[2]

(a)

- any **two** of: temperature / pH / oxygen / nutrient supply / waste removal

Exercise 3.2 (b)

3.2 A fermenter is used to grow microbes.

(b) Name one useful product made in a fermenter.

[1]

Exercise 3.2 (b)

3.2 A fermenter is used to grow microbes.

(b) Name one useful product made in a fermenter.

[1]

(b)

- any **one** of: insulin / penicillin / mycoprotein

Exercise 3.3 (a)

3.3 Yeast is used to make bread and to make biofuel. Industrial enzymes are used in washing powders and in producing lactose-free milk.

(a) Explain the role of yeast in making bread, and in making biofuel, naming the product that matters in each case.

[4]

Exercise 3.3 (a)

3.3 Yeast is used to make bread and to make biofuel. Industrial enzymes are used in washing powders and in producing lactose-free milk.

(a) Explain the role of yeast in making bread, and in making biofuel, naming the product that matters in each case. [4]

(a)

- bread: anaerobic respiration produces **carbon dioxide**, which makes dough rise
- biofuel: the same process produces **ethanol**, distilled and burned as fuel

Exercise 3.3 (b)

3.3 Yeast is used to make bread and to make biofuel. Industrial enzymes are used in washing powders and in producing lactose-free milk.

(b) State **two** reasons why enzymes in washing powder are useful, and explain why such a powder should not be used at very high temperature. [3]

Exercise 3.3 (b)

3.3 Yeast is used to make bread and to make biofuel. Industrial enzymes are used in washing powders and in producing lactose-free milk.

(b) State **two** reasons why enzymes in washing powder are useful, and explain why such a powder should not be used at very high temperature. [3]

(b)

- they break down stains water cannot remove: **protease** (protein) and **lipase** (fat)
- at very high temperature the enzymes are **denatured**

Exercise 3.3 (c)

3.3 Yeast is used to make bread and to make biofuel. Industrial enzymes are used in washing powders and in producing lactose-free milk.

(c) Describe how lactose-free milk is produced using an enzyme.

[2]

Exercise 3.3 (c)

3.3 Yeast is used to make bread and to make biofuel. Industrial enzymes are used in washing powders and in producing lactose-free milk.

(c) Describe how lactose-free milk is produced using an enzyme. [2]

(c)

- **lactase** is added, or milk is passed over immobilised lactase
- lactose is broken into **glucose and galactose**

Exercise 3.3 (d)

3.3 Yeast is used to make bread and to make biofuel. Industrial enzymes are used in washing powders and in producing lactose-free milk.

(d) Name **three** conditions that must be controlled inside a fermenter, and explain why each matters. [6]

Exercise 3.3 (d)

3.3 Yeast is used to make bread and to make biofuel. Industrial enzymes are used in washing powders and in producing lactose-free milk.

(d) Name **three** conditions that must be controlled inside a fermenter, and explain why each matters. [6]

(d)

- **temperature:** water jacket at the optimum; too high denatures enzymes
- **pH:** enzymes work only in a narrow range
- **oxygen:** sterile air and stirring so organisms respire and stay mixed