

## CHAPTER 20

# BIOTECHNOLOGY AND GENETIC ENGINEERING

The stuff you need to know in this chapter:

### 20.1 BIOTECHNOLOGY AND GENETIC ENGINEERING

#### *Core*

- State that bacteria are useful in biotechnology and genetic engineering due to their rapid reproduction rate and their ability to make complex molecules

#### *Extended*

- Discuss why bacteria are useful in biotechnology and genetic engineering, limited to:
  - lack of ethical concerns over their manipulation and growth
  - genetic code shared with all other organisms
  - presence of plasmids

### 20.2 BIOTECHNOLOGY

#### *Core*

- Describe the role of anaerobic respiration in yeast during production of ethanol for biofuels
- Describe the role of anaerobic respiration in yeast during bread-making
- Investigate and describe the use of pectinase in fruit juice production
- Investigate and describe the use of biological washing powders that contain enzymes

#### *Extended*

- Investigate and explain the use of lactase to produce lactose-free milk
- Describe the role of the fungus *Penicillium* in the production of the antibiotic penicillin
- Explain how fermenters are used in the production of penicillin

### 20.3 GENETIC ENGINEERING

#### *Core*

- Define genetic engineering as changing the genetic material of an organism by removing, changing or inserting individual genes
- State examples of genetic engineering:
  - the insertion of human genes into bacteria to produce human insulin
  - the insertion of genes into crop plants to confer resistance to herbicides
  - the insertion of genes into crop plants to confer resistance to insect pests
  - the insertion of genes into crop plants to provide additional vitamins



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## *Extended*

- Outline genetic engineering using bacterial production of a human protein as an example, limited to:
  - isolation of the DNA making up a human gene using restriction enzymes, forming sticky ends
  - cutting of bacterial plasmid DNA with the same restriction enzymes, forming complementary sticky ends
  - insertion of human DNA into bacterial plasmid DNA using DNA ligase to form a recombinant plasmid
  - insertion of plasmid into bacteria (specific detail is **not** required)
  - replication of bacteria containing recombinant plasmids which make human protein as they express the gene
- Discuss the advantages and disadvantages of genetically modifying crops, such as soya, maize and rice



## BIOTECHNOLOGY AND GENETIC ENGINEERING

1. Outline what is meant by the term "biotechnology"

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2. Complete the sentence below giving reasons why microorganisms are used in biotechnology. Use some of the words below:

*useful      reproduce      chemical      useful      sense      dance*

Micro-organisms can \_\_\_\_\_ very rapidly, so we can make many of them very \_\_\_\_\_. In addition, they can make many different substances, and some of these are very \_\_\_\_\_ to us.

3. Use the headings below as a guide, give more information as to why we use micro-organisms in biotechnology

*Ethics:*

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*DNA is universal:*

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*Plasmids:*

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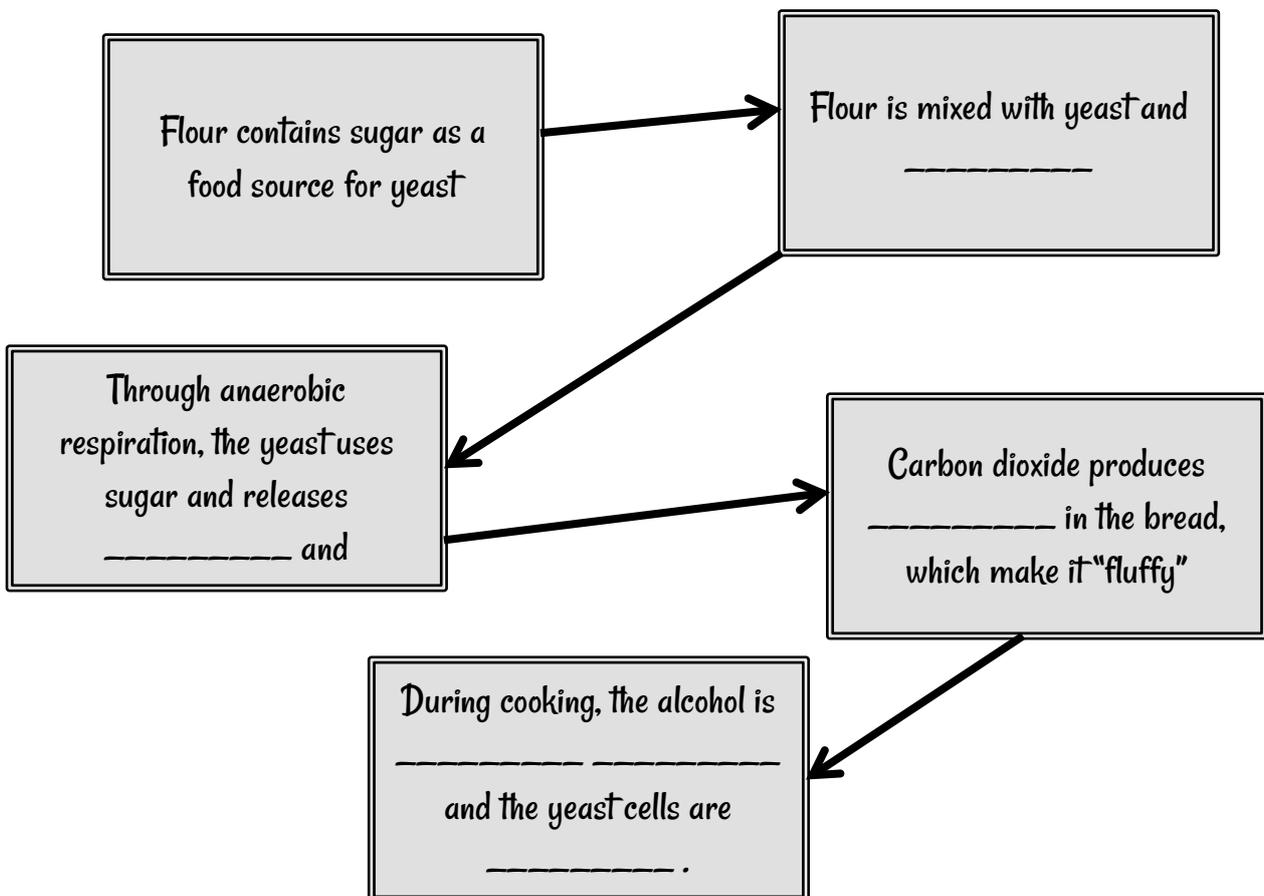
## BIOTECHNOLOGY

1. Write a word equation for anaerobic respiration in yeast

2. Using bullet points, outline the stages involved in producing biofuel from crops.

3. Carbon dioxide is a greenhouse gas, and causes global warming. Burning ethanol as a biofuel releases carbon dioxide, but it is considered more environmentally friendly than burning regular petrol/gasoline. Explain why this is.

4. Complete the flow diagram to explain how yeast is useful in bread-making.



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5. Pectin is material found in plants which helps keep their cells stuck together.

a) State the enzyme that can be used to break down pectin. (Hint: if you guess the name of it, you'd probably be correct)

b) Explain how the use of this enzyme can be commercially useful

6.

a) State the name given to washing powders that contain enzymes

b) Name 3 enzymes that might found in washing powders and they products they break down on laundry

Enzyme	Substrate

Washing powders have now been developed using enzymes from bacteria that live in hot springs.

c) Explain why this is useful.



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7. Lactose is a sugar found in milk

a) State why consuming milk with lactose in is a problem for some people

b) Write a word equation for the breakdown of lactose using an enzyme. Include the name of the enzyme in your equation.

c) The breakdown of lactose is often done with immobilized enzymes. Explain why this is useful.

c) Give one other reason, apart from catering for lactose intolerance, for breaking down lactose using enzymes.

8.

a) State the type of microorganism that produces antibiotics

b) State the purpose of antibiotics

c) State the name of the fungus that produces penicillin

(Question 8 continues on the next page.)



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d) Draw an *annotated* diagram to show a fermenter producing penicillin

e) Describe how the fermenter works (use bullet points if you want to)

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## GENETIC ENGINEERING

1. Define "genetic engineering".

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2. List 4 uses of genetic engineering

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3. Outline the stages involved in producing human proteins through genetic engineering. Use the subheadings to guide your answer.

*Isolation:*

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*Cutting plasmid:*

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*Insertion of human DNA:*

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*Insertion of plasmid:*

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*Replication of bacteria:*

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4. Using human insulin production as an example, draw a diagram summarizing the production of human proteins using biotechnology

*Remember that insulin is involved in blood-glucose level control. People with type 1 diabetes have problems with their insulin levels and injecting insulin into their body is a way of treating it.*



