5 Use of biological resources

Edexcel IGCSE Biology (Higher) DOUBLE AWARD - Question and answer notes

How to use these notes

For each question and answer:

- Read it carefully and make sure you **understand** it
- **Memorise** the answer
- **Practice** applying your understanding to past exam questions

You can memorise the answers by using **retrieval practice** - which is when you practise retrieving information from your memory. This can be done using flashcards or a flashcard app, by asking someone to quiz you, or by covering up the answers with a piece of paper and testing yourself. Past paper practice can also be a form of retrieval practice.

5a Food production

What is agriculture?
Agriculture - also known as farming - is growing plants, animals or other living organisms in order to produce food or other useful products.

CROP PLANTS

What is a crop?
A crop is a plant grown by humans for food or for some other use such as making textiles.

What is crop yield?

- Crop yield is the mass of a certain crop grown in a certain area over a certain period of time.
- For example, the number of kilograms of rice grown per acre in one growing season.

What are two types of building/structure that crops can be grown in to increase their yield?

- Glasshouse
- Polythene tunnel

What is a glasshouse?
A glasshouse is a glass building in which crops are grown.

What is a polythene tunnel?
A polythene tunnel is a plastic tunnel in which crops are grown.

Why do people grow crops in glasshouses and polythene tunnels?

- Glasshouses and polythene tunnels allow light through to the crops for photosynthesis, but don't allow heat to escape as easily as it would outdoors, so the plants stay warmer.
- Also, the conditions inside the glasshouse and polythene tunnel can be artificially modified - this includes using heaters to increase the temperature and artificially increasing the carbon dioxide concentration.

How does maintaining a high temperature inside a glasshouse affect crop yield?

- Maintaining a high temperature inside a glasshouse gives a high crop yield.
- This is because a higher temperature gives a higher rate of photosynthesis, due to enzyme and substrate molecules having more kinetic energy.

How does maintaining a high carbon dioxide concentration inside a glasshouse affect crop yield?

- Maintaining a high carbon dioxide concentration inside a glasshouse gives a high crop yield.
- This is because carbon dioxide is a substrate in photosynthesis, so increasing its concentration gives a faster rate of photosynthesis.

What is fertiliser?
Fertiliser is nutrient-containing material added to soil in order to increase plant growth.

What are the three main elements that fertilisers supply to plants?

- Nitrogen (N)
- Phosphorus (P)
- Potassium (P)

How do fertilisers increase crop yields?
Spreading fertilisers on a field provides the crops growing in that field with nutrients that they need to grow. This causes the plants to grow at a faster rate, leading to a higher crop yield.

What are crop pests?

- Crop pests are animals that damage crops.
- For example, some caterpillars eat certain crops.

Within agriculture, what does the term 'pest control' mean?
Pest control is anything that is done to try to prevent crop pests from destroying crops.

What are the two main types of pest control used in agriculture?

- Chemical control
- Biological control

What is chemical control?

Chemical control is spraying crops with chemicals called pesticides that kill or repel crop pests.

Note: Some types of pesticides (herbicides and fungicides) kill other types of organisms that are not animals. See below for details.

What are the main types of pesticides?

- Insecticides - kill or repel insects
- Rodenticides - kill or repel rodents
- Herbicides - kill other plants that would compete with the crops
- Fungicides - kill fungi that would damage the crops

What is biological control?

- Biological control is introducing animals that kill the crop pests.
- These animals are called ‘natural enemies’ of the pests.
- For example, introducing ladybirds that eat aphids (aphids are a crop pest)

What are the advantages of chemical control compared to biological control?

- Pesticides tend to work more quickly than biological control.
- Pesticides are often more effective at reducing pest numbers than biological control is.

What are the disadvantages of chemical control compared to biological control?

- Pesticides are often poisonous and can therefore be harmful to humans (especially the farmers who spray them), whereas the organisms introduced in biological control are not harmful to humans.
- Pesticides may harm other living things besides from the pests, whereas this is less likely with biological control.
- Pesticides have short-lasting effects, whereas biological control can be long-lasting.

MICRO-ORGANISMS

What is yeast?

Yeast is a single-celled fungus.

What process does yeast carry out that is useful for certain kinds of food production?
Yeast carries out fermentation.

What is fermentation?

- Fermentation is a biological process in which sugar is converted to ethanol and carbon dioxide.
- Yeast cells use enzymes to carry out fermentation.

What types of foods are made using fermentation by yeast?

- Bread
- Alcoholic drinks

How is bread made?
Bread is made by the following steps:

- A dough is made by mixing:
    - Flour
    - Water
    - Yeast
- The dough is left in a warm place.
- The yeast carries out fermentation, in which enzymes in the yeast cells convert sugars from the dough into ethanol and carbon dioxide.
- The carbon dioxide produced creates pockets of gas within the dough, causing the dough to rise.
- The dough is then baked to produce bread.
- During the baking process, the ethanol produced by fermentation evaporates out of the bread.

Which microorganism is used in the production of yoghurt?
A bacterium called *Lactobacillus* is used in the production of yoghurt.

How is yoghurt produced?
Yoghurt is made from milk using the following process:

- The milk is pasteurised (heated to 72°C for around 15 seconds) in order to kill any microorganisms in it.
- The milk is then cooled.

- *Lactobacillus* bacteria are then added and the milk is heated to around 40°C in a fermenter.
- The bacteria convert the sugar lactose from the milk into lactic acid.
- The acidity of the lactic acid causes the milk to thicken and turn tangy, forming yoghurt.

FISH FARMING

TRIPLE SCIENCE ONLY

If you are doing double award, you will not be tested on the contents of this box.

What is fish farming?
Fish farming is when fish are grown for food in an enclosure - for example, a cage submerged in a lake, or a tank of water on land. It is an alternative to catching wild fish.

What is predation?
Predation is when an animal is eaten by another animal.

What is intraspecific predation?
Intraspecific predation is when an animal is eaten by another animal of the same species.

What is interspecific predation?
Interspecific predation is when an animal is eaten by an animal of a different species.

In fish farming, how is water quality maintained?
If the fish are being grown in a tank, the temperature, pH and oxygen levels of the water are monitored and adjusted if needed.

In fish farming, how is intraspecific competition prevented?
The fish are separated by size to prevent larger fish from eating smaller, younger fish.

In fish farming, how is interspecific competition prevented?
Growing the fish in a tank or a cage protects them from predators of other species.

Why is disease control important in fish farming?
Having large numbers of fish in an enclosure together makes it more likely that diseases will spread.

In fish farming, how is disease controlled?
Pesticides or biological control are used to control pests that cause disease in fish.

In fish farming, why is it important to remove waste, and how is this done?

- Over time, waste such as fish faeces and uneaten food will build up.
- As this waste builds up, it can lead to the growth of bacteria that could harm the fish.
- The water is filtered to remove waste.

In fish farming, how is feeding controlled?

- Fish are given food containing the nutrients they need.
- The frequency of feeding is controlled so that the fish are not over- or under-fed.

How is selective breeding used in fish farming?

- Selective breeding is used to produce fish with desired characteristics - e.g. larger fish.
- In each generation, the fish with the desired characteristics are selected and bred with each other.
- Over many generations, this leads to the desired characteristics becoming more common in the population.

5b Selective breeding

How can selective breeding be used to develop plants or animals with desired characteristics?

- From the existing plants/animals, choose the ones that have the most desirable characteristics and breed them with each other.
- From the offspring produced, choose the ones with the most desirable characteristics and breed them with each other.
- Repeat this process over many generations.

5c Genetic modification (genetic engineering)

What is genetic modification?
Genetic modification is the process of changing an organism's genome - usually by inserting genes from another organism.

What is a transgenic organism?
A transgenic organism is an organism that has had DNA from another species inserted into it through genetic engineering.

What are examples of how genetic modification has been used?

- Genetic modification has been used to insert the human insulin gene into bacteria so that the bacteria produce human insulin, which can then be extracted and used to treat diabetes.
- Genetic modification has been used to produce crops with desirable characteristics, such as resistance to pests, leading to higher crop yields.

What are the two main types of enzymes used in genetic engineering?

- Restriction enzymes
- Ligase enzymes

What do restriction enzymes do?
Cut DNA at specific sites.

What do ligase enzymes do?
Join pieces of DNA together.

In genetic engineering, what does the term 'vector' mean?
A vector, in genetic engineering, is something that is used to get DNA from one organism into another organism.

In genetic engineering, what are the two main types of things used as vectors?

- Plasmids (small loops of DNA from bacteria)
- Viruses

What is recombinant DNA?
Recombinant DNA is a DNA molecule made up of DNA from two or more different species joined together.

How have genetically modified bacteria that produce human insulin been made?

- First, human DNA is extracted from human cells.
- Restriction enzymes are then used to cut out the gene that codes for insulin from that human DNA.
- Restriction enzymes are also used to cut open a bacterial plasmid (which will act as a vector).
- The cut out human insulin gene and the cut open bacterial plasmid are mixed together and ligase enzymes are added.
- The ligase enzymes join the human insulin gene to the plasmid.
- The plasmid is now an example of recombinant DNA.
- The recombinant plasmid is inserted into bacterial cells.
- The bacteria can now be grown in a fermenter. As they grow and divide, they will produce human insulin, which can be extracted and used to treat people with diabetes.

5d Cloning [Triple only]

TRIPLE SCIENCE ONLY

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What is cloning?

- Cloning is the process of creating an organism that is genetically identical to an existing organism.
- Cloning occurs naturally in some species.
- Cloning can also be done artificially by scientists.

What is one method of artificially cloning plants?
Micropropagation (also known as tissue culture)

How is micropropagation carried out?

- A plant with desirable characteristics is selected to be cloned.
- Small pieces of tissue are cut from the plant. These small pieces of tissue are called explants.
- The explants are sterilised to kill any microorganisms that are on them.
- The explants are placed into Petri dishes containing nutrients and growth hormones.
- The explants grow into small plants.
- These small plants are then planted in soil.
- Each one grows into a clone of the original plant.

What is a diploid nucleus?
A diploid nucleus is a nucleus containing two full sets of chromosomes.

What is a haploid nucleus?
A haploid nucleus is a nucleus containing one full set of chromosomes.

Describe the process by which an animal can be cloned from an adult cell.

- An adult cell is taken from the animal that is to be cloned.
- This adult cell has a diploid nucleus.
- This diploid nucleus is taken from the adult cell. The rest of the adult cell is discarded.
- An egg cell is taken from another individual of the same species.
- The nucleus of this egg cell is removed and discarded. The egg cell is now called an enucleated egg cell.
- The diploid nucleus is inserted into the enucleated egg cell.

- The cell produced by this fusion begins to divide and develops into an embryo.
- This embryo is implanted into the uterus of a female of the same species, where it develops until it is born.
- The animal that is born is a clone of the animal that the adult cell was taken from.

Who was the first mammal to be cloned from an adult cell?
Dolly the sheep

How can cloned transgenic animals be used to produce a human protein?

- Genetic engineering can be used to create a transgenic animal that produces a human protein.
- For example, a cow can be genetically engineered to produce human proteins in its milk.
- The proteins can then be extracted from the milk and purified and used (for example to treat human diseases).
- This transgenic animal can be cloned to produce more genetically identical animals that also produce the human protein.