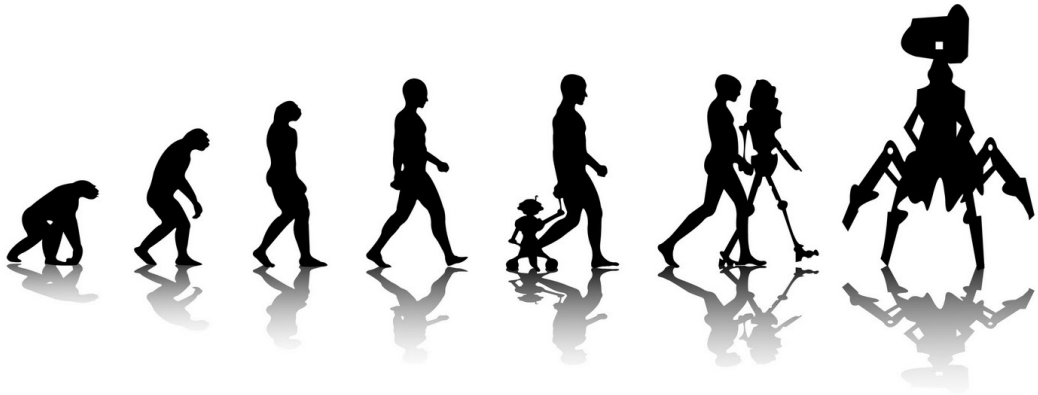
Evolve

Revision Guide



Read all the information before attempting to answer the questions.

Highlight key words. You could then turn these into flash cards.

Make a revision resource after you have done the tasks. This could be *flash cards, mind maps,* or *question and answer cards.*

Your teacher will look at your work if you take it to them.

Module: Evolve

Read through each specification and decide whether you feel confident, a little confident or not confident in your initial knowledge. You need to draw either a  next to each specification.

Specification question.	**Start of module**	**Mid way in the module**	**End of the module**
Why do we all look different?			
What does your DNA do?			
What reasons are there for us to all look different?			
The work that Watson, Crick, Wilkins and Franklin played in our discovery and knowledge of DNA.			
What is 'selective breeding'?			
What technologies exist that involve genes and DNA?			
What is the male reproductive system like?			
What is the female reproductive system like?			
How are new individuals made?			
How does the baby survive in the womb?			
How do plants breed?			
How are seeds dispersed from a plant?			
How might a species become endangered or extinct?			

Evolve key words

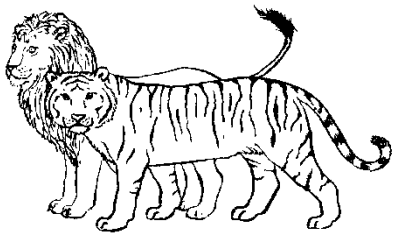
Look up these keywords and write down their definitions. Make sure you understand the meaning of each word.

Key word	Definition
Variation	
Personality	
DNA	
Genes	
Chromosomes	
Genetic variation	
Environmental variation	
Genetic technology	
Reproduction	
Scrotum	
Testes	
Ureters	
Penis	
Uterus	

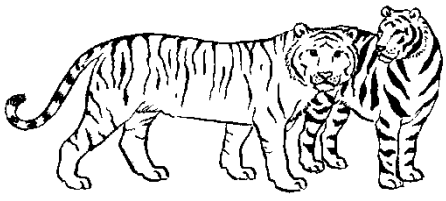
Key word	Definition
Cervix	
Fallopian tube	
Vagina	
Fertilisation	
Gestation	
Birth	
Placenta	
Dispersal	
Pollination	

Variation

A **species** is a group of organisms that can reproduce with one another to produce offspring that will also be able to reproduce. The differences between organisms are known as **variation**. There is variation between different species *and* between members of the same species.



There is variation between different species. Lions and tigers are different species. Tigers have stripes, lions do not.

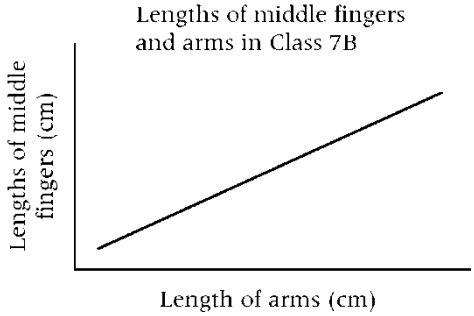


There is variation between members of the same species. All tigers have different patterns of stripes.

Sometimes there is a **relationship** or **correlation** between two features. A relationship is normally best shown on a line graph. The line will go steadily up or steadily down.

Variation can have **environmental** or **inherited** causes.

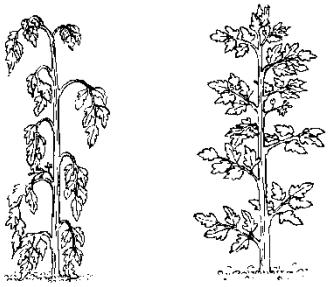
Relationship: people with longer arms have longer middle fingers.



Environmental variation

An organism's surroundings are known as its **environment**. The conditions in an environment are called **environmental factors**. Plants are affected by environmental factors like the amount of light, the amount of water, the amount of warmth and the amount of mineral salts in the soil.

The cress seedlings on the left have not had enough light.



The plant on the left has not had enough water. It has wilted.

Animals are also affected by environmental factors. Humans who get sunburnt or have scars are examples.

Inherited variation

This is caused by features being passed from **parents** to their **offspring**.

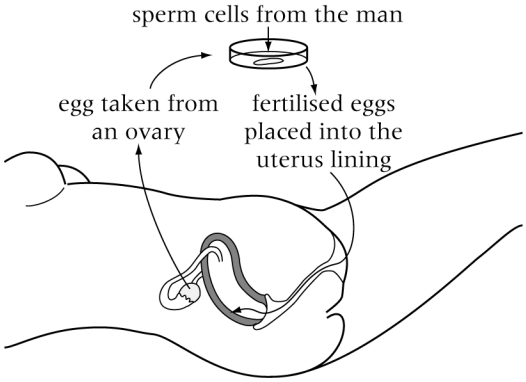
In humans, natural eye colour and natural hair colour are both examples of inherited variation.

Identical twins are formed when one sperm cell fertilises a single egg cell. This fertilised egg cell then divides and separates to form two cells. Each cell grows and divides and two individuals with exactly the same genetic information are born. The twins will have the same skin colour, the same sex and all their other inherited characteristics will be the same. The environment may have an effect on their personalities or their bodies which may cause them to be different but, genetically, the twins are identical.

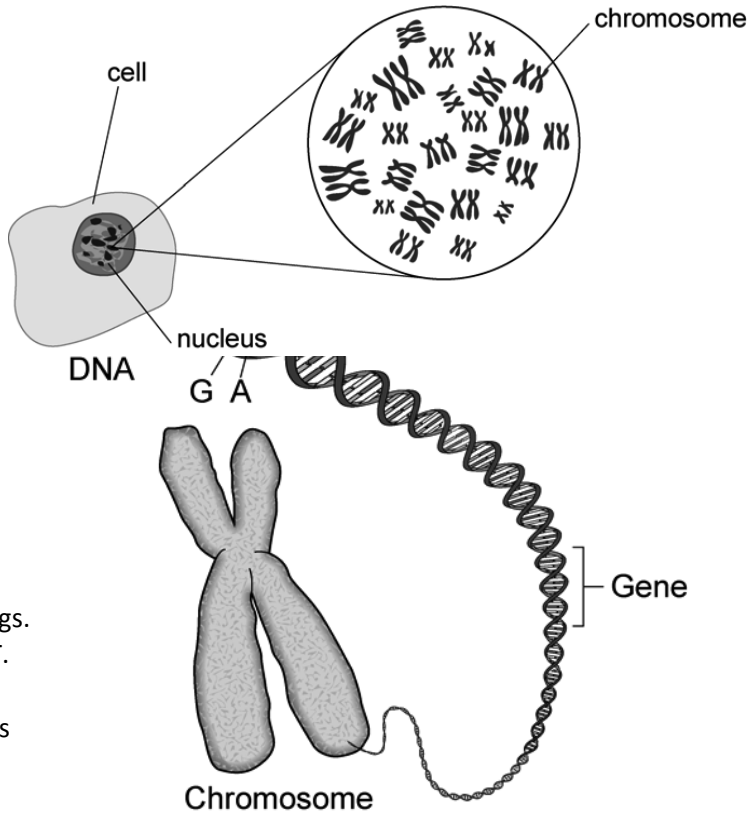
Twins that are not identical (**fraternal twins**) are formed when two sperm cells fertilise two egg cells at the same time. Each gamete contains genes with slightly different genetic information. For example, one sperm cell may contain the gene for brown eyes while another sperm cell may contain the gene for blue eyes. Therefore, when the egg cells are fertilised the individuals will be genetically different. Many of their genes, however, will be the same.

Fraternal twins are very similar, genetically, to normal brothers and sisters with the same parents. They are all formed from the meeting of any sperm cell with any egg cell, whereas identical twins share the same sperm cell and egg cell and, therefore, contain the same genes.

Sometimes when a couple cannot have children they have gametes removed from them. The egg cells are fertilised with the sperm cells outside the body. The fertilised egg cells are then replanted back inside the mother's uterus. Lots of fertilised egg cells are placed inside the mother in case some don't grow. If many of them grow then the mother will give birth to many babies – this is known as a **multiple birth**.



Heredity is the passing of characteristics from parents to offspring through genes. Almost every cell has a nucleus. Inside the nucleus are **chromosomes.**

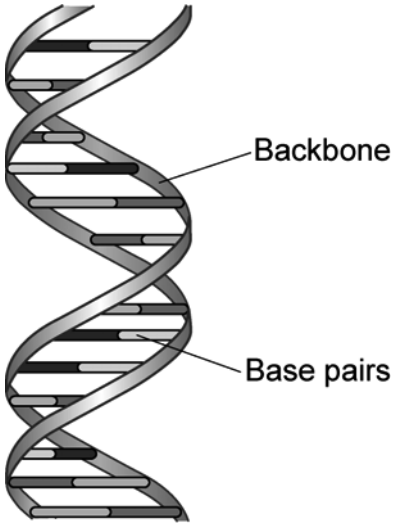


A chromosome is made up of a long molecule called **DNA**. DNA consists of atoms of carbon, hydrogen, oxygen, nitrogen, and phosphorus.
In DNA, the atoms are arranged in groups. The groups are:

- sugars
- phosphates
- bases – T, A, C, and G

You can imagine DNA as a twisted ladder. The sugars and phosphates make up the handrails. The bases are the rungs. They are always in pairs. C pairs with G, and A pairs with T.
A **gene** is a section of DNA. It is a set of instructions that affects how we grow or what we look like. Every gene has its own order of bases.

In 2013 a letter written in 1953 by Francis Crick to his 12-year-old son was sold at auction for
$5.3 million. Why was the letter so important? It was written by one of the biologists who was just about to reveal the structure of perhaps the most important molecule in living things, DNA.



"My dear Michael," the letter begins, "Jim Watson and I have probably made a most important discovery. We have built a model for the structure of des-oxy-ribose-nucleic-acid (read it carefully) called D.N.A. for short. Our structure is very beautiful." It goes on to say, "In other words we think we have found the basic copying mechanism by which life comes from life…"

Biologists knew that DNA was an important molecule, and for several years in the late 1940s and 1950s there was a great race to work out the structure of the molecule.

The molecule they described is shown here. It is a long spiral molecule called a helix. Since it has two strands in the spiral it is called a double helix.
On the outside of the molecule are two strands called the backbone, which run the length of the molecule.
Between the backbones are the base pairs, which look like the rungs of a ladder. The whole molecule looks like a twisted ladder.

Rosalind Franklin was also an expert on the technique of X-ray diffraction. She and Maurice Wilkins were to lead a team working on the structure of DNA.

In 1951 Rosalind Franklin arrived at King's College London to work with Maurice Wilkins on the structure of DNA.

Maurice Wilkins worked at King's College in London. He was an expert on the technique called X-ray diffraction. This was the experiment that gave most of the results used to work out the structure of DNA.

Franklin and Wilkins did not get on well together. They did not communicate well with each other.

Rosalind Franklin
1920–1958

Maurice Wilkins
1916–2004

In 1950 Wilkins worked out how to make threads of DNA that he could use in his X-ray technique.

Wilkins thought the structure of DNA might be a helix, and Rosalind confirmed it.

Franklin interpreted her early data but refused to use it to build a model of the DNA molecule. This frustrated Wilkins.

Rosalind Franklin had excellent experimental skills, and she produced high-quality photographs from which she could collect data to show the structure of DNA. She produced the key photograph in 1952.

Watson and Crick were fascinated with working out the structure of DNA. This was one of the key pieces of work in biology at the time.

In 1962 James Watson, Francis Crick, and Maurice Wilkins won the Nobel Prize for discovering the structure of DNA. Rosalind Franklin could not be awarded the prize as she died in 1958.

Francis Crick worked in Cambridge in the 1950s, and learnt about the theory of X-ray diffraction. In 1951 the American biologist James Watson came to Cambridge and joined Crick.

They knew that Wilkins and Franklin didn't work well together. They felt that they had the chance to have a second attempt to build a model of DNA.

James Watson 1928–

Francis Crick 1916–2004

Watson and Crick did not do any real experimental work on DNA. They favored building models.

Watson and Crick used data from Franklin and Wilkins and other scientists to build a successful model of DNA in February 1953. They published the model in April 1953, before Franklin and Wilkins.

Watson and Crick were shown an important X-ray photograph of Franklin's taken in 1952. This was done without her knowledge. This photograph provided vital evidence that allowed them to produce the correct model for DNA.

Franklin corrected errors in an initial model they built. She knew that the backbone was on the outside of the molecule.

Genetic engineering (GE for short) is about scientists altering the 'recipes' for making life — the genes which you find in all living things. Doing this is very clever and seems to be very useful. Back in the 1990s, many 'Greens' campaigned against genetic engineering and still do. They predicted disaster but that hasn't happened. Nobody has died from eating genetically modified (GM) food. They were also worried about the private GE companies' ownership of the recipes — genes — for making these new life forms. So is genetic engineering okay? And what about CRISPR: what is it and why so important? It's up to you to make up your own mind about GE.

'Engineering' is a fancy word for building something. So genetic engineering (often just called GE) is building something with genes. Clever scientists have learned to spot which gene does what in making a new organism. They've found out that simple organisms like bacteria or viruses often have genes which are useful because they can be snipped out and put — spliced — into plant genes. Doing this could give the plant special new abilities like resisting disease. But this can be rather like grabbing a large scorpion so it can't nip you with its claws. You know it's safe to handle since its claws can't reach you but — ***ow!*** — it's got a sting in its tail you didn't know about. There may be a 'sting in the tail' which comes from splicing strange genes into other organisms — from viruses to plants, for example. No-one can be quite certain what will happen. It is unpredictable".

Genetically modified organism, GMOs, (which are mostly plants) are mostly transgenic which means they contain genes pinched from something else like bacteria, viruses, other plants or even animals. By snipping a gene which does something useful from one organism and splicing it into another, say a crop plant, scientists can get the plant to grow bigger or faster or make more for people to eat. Or the plant could be made to be more nutritious with more protein or minerals or vitamins. Some crop plants can be made to grow in salty water or very little water — good for very dry countries. Others could be engineered to resist disease which could protect kids against nasty illnesses like polio or measles.

And there's more! Plants have been engineered which use up nitrogen fertilisers more effectively. This not only means that farmers need less expensive fertiliser but also helps slow climate change. Why? Because nitrogen fertilisers produce a lot of nitrous oxide gas which is 300 times more damaging than carbon dioxide as a greenhouse gas. Around 6 percent of warming is due to this gas.

Some plants (legumes) like peas and beans — can 'fix' the nitrogen they need directly from the air. If all plants could do that, there'd be no need for nitrogen fertilisers at all, so no nitrous oxide pollution.

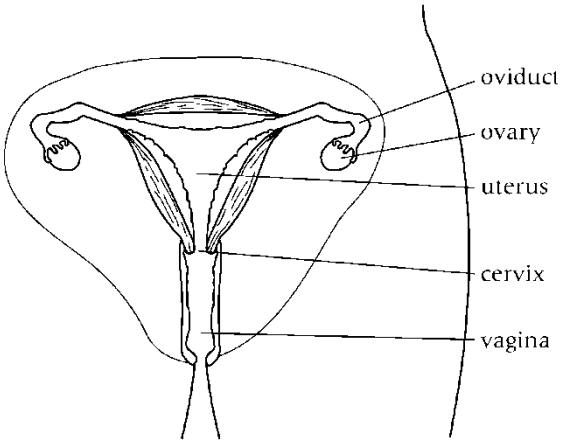
Reproduction

Reproduction produces new living things (**offspring**). In **sexual reproduction** the nucleus in a male **sex cell** joins (**fuses**) with the nucleus in a female sex cell. This is called **fertilisation** and produces a **fertilised egg cell**. When fertilisation happens outside an animal's body it is called **external fertilisation**. Animals that use this method produce a lot of eggs since some will be eaten by other animals. Humans use **internal fertilisation**.

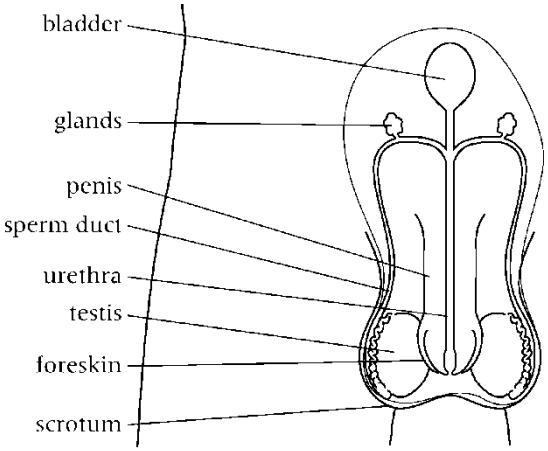
The fertilised egg cell grows into an **embryo** and the embryo eventually becomes a new living thing. Sexual reproduction needs two **parents**. The offspring from sexual reproduction are different from the parents; they are new **varieties**.

The human reproductive systems

Humans have **reproductive organs** so that they can reproduce. The ovaries and testes produce sex cells.



Female – ovaries are where the female sex cells (**egg cells**) are produced.



Male – testes are where the male sex cells (**sperm cells**) are produced.

Puberty and adolescence

The reproductive organs get bigger and start to make sex cells at **puberty**. This is a time when major physical changes occur in our bodies. These changes are caused by **sex hormones**.

Changes in boys

- voice deepens ('breaks')
- shoulders get wider
- hair grows under arms, on face and on chest
- pubic hair grows
- testes and penis get bigger
- testes start to make sperm cells
- body smell increases

Changes in girls

- underarm hair grows
- breasts develop
- ovaries start to release egg cells
- hips get wider
- pubic hair grows
- body smell increases

Adolescence is the time when puberty is occurring and emotional changes happen.
It starts between the ages of 10–15 and ends at about 18. The changes start sooner in girls. After puberty, men produce sperm cells for the rest of their lives. Women stop releasing egg cells at the age of 45–55. This is called the **menopause**.

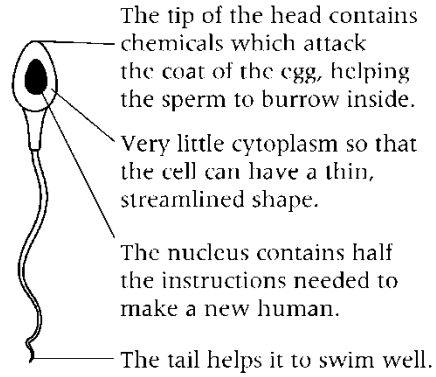
The menstrual cycle

The **menstrual cycle** starts with **menstruation** (the loss of the uterus lining and some blood through the vagina). It takes 28–32 days for each cycle. About 14 days after menstruation starts, an egg cell is released from an ovary. This is called **ovulation**. If the egg cell is not fertilised, the uterus lining starts to break down and the cycle starts again.

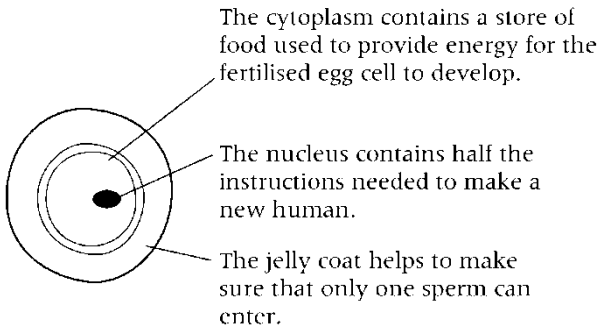
Sex

The sperm cells enter the **vagina** during **sexual intercourse**. **Semen** (sperm cells mixed with special liquids from the **glands**) is forced out of the penis and into the top of the vagina. This is called **ejaculation**. The semen is moved into the top of the uterus and the sperm cells can swim down the oviducts.

Egg cells and sperm cells are **adapted** to their **functions**.



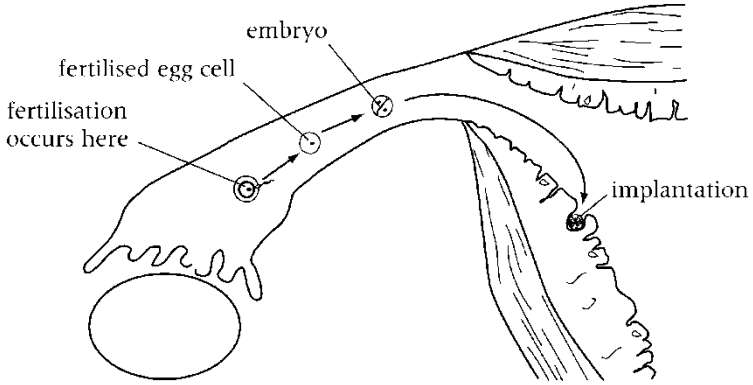
A sperm cell is much smaller than an egg cell.



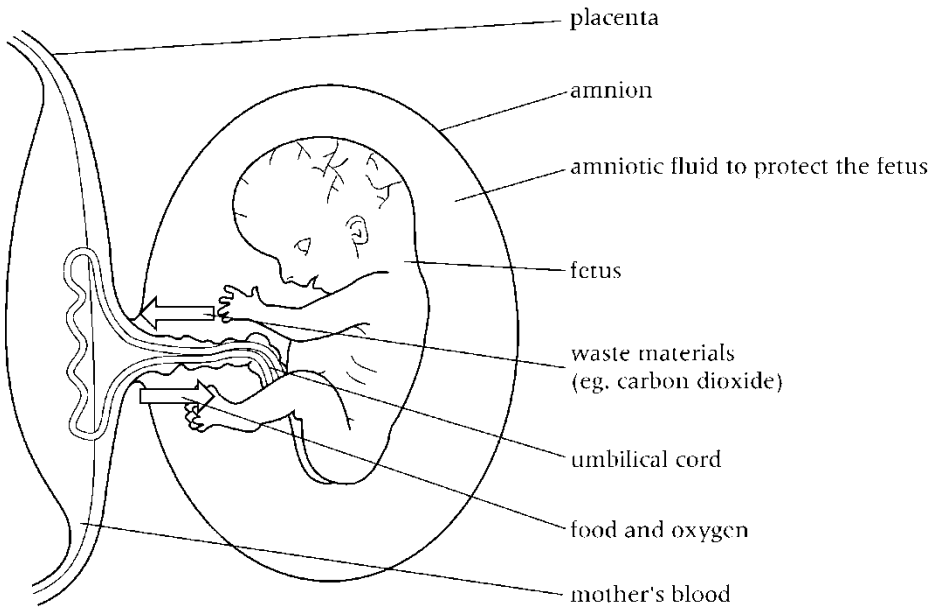
The egg cell is about the size of a full stop.

Pregnancy

If the egg cell meets a sperm cell in an oviduct fertilisation can occur. The fertilised egg cell divides to form a ball of cells (an **embryo**). The embryo travels to the uterus where it sinks into the soft lining (**implantation**). The woman is now **pregnant**. Once it has developed all its organs (after about 10 weeks) it is called a **fetus**. It takes about 40 weeks (9 months) for a fertilised egg cell to grow into a baby ready to be born. This time is called the **gestation period**.



The fertilised egg cells of many animals grow and develop outside their parents. This is called **external development**. Humans use **internal development** and produce less offspring than animals using external development since the growing embryos are protected inside the mother.



While inside the uterus, the fetus is supplied with oxygen and food by the **placenta**. The placenta also gets rid of waste (especially carbon dioxide) from the fetus. The **cord** (or **umbilical cord**) connects the fetus to the placenta.

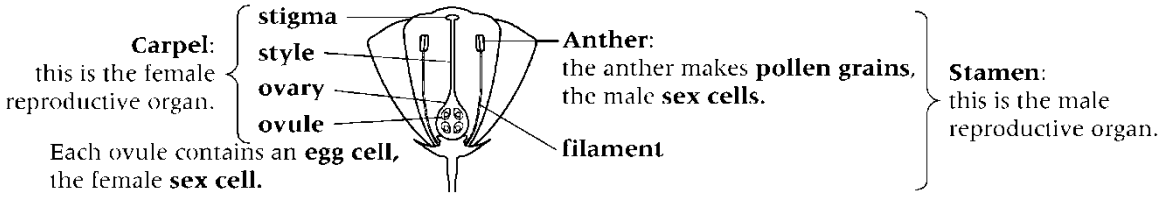
If a mother smokes, drinks too much alcohol or takes drugs while pregnant she might damage the baby. The baby might be **premature**.

Birth

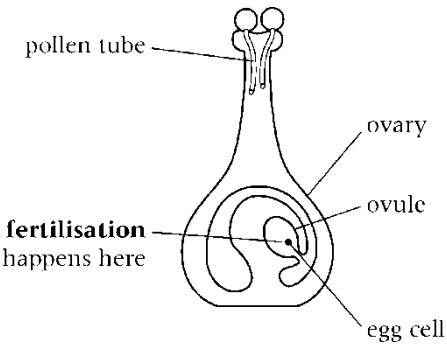
When the baby is ready to be born, the uterus starts **contractions** and the woman goes into **labour**. The muscles of the cervix relax. The baby is pushed out head first through the cervix and the vagina. After birth, the baby starts to breathe and the cord is cut. The scar left behind is the **navel**. After this the placenta is pushed out of the uterus. This is the **afterbirth**. The baby is fed on milk, often from the mother's breasts which contain **mammary glands** that produce milk. The milk contains **antibodies** which help destroy microbes that might cause a disease in the baby.

Sex cells are produced by the **reproductive organs**. In plants, these are contained inside **flowers**. Sex cells are used for **sexual reproduction** which needs two **parents**. The offspring from sexual reproduction are different from the parents; they are new **varieties**.

PLANTS



The **pollen grains** need to be carried to the **stigma** of another flower. They can be carried by insects or the wind. The carrying of pollen from an anther to a stigma is called **pollination**.



Once on the stigma, a pollen grain grows a **pollen tube** which enters the **ovule** containing an **egg cell**. The nucleus from the pollen grain then joins with the nucleus inside the egg cell. This is called **fertilisation**.

For each statement, say if it is true or false. For each false statement, write out a correct version.

1 The colour of your eyes is a characteristic that is inherited.
2 You inherit characteristics from your mother only.
3 Your brothers or sisters inherit exactly the same characteristics as you.
4 All animals inherit some characteristics from their parents.
5 Plants are not able to inherit characteristics.
6 Not all characteristics are inherited.
7 The environment has no effect on your characteristics.
8 Genes carry genetic information and are found inside every cell.
9 There are half as many genes in gametes as there are in normal body cells.
10 Fertilisation is when a sperm cell fuses with an egg cell.
11 A fertilised egg cell only contains half the genetic information of a normal body cell.
12 Identical twins form from a single egg cell and a single sperm cell.

Here is a list of human variations. Fill in the table to show which are caused by inherited factors, environmental factors or both.

being sunburnt **natural eye colour** **weight**
natural hair colour **speaking French** **your accent**

Caused only by inherited factors	Caused only by environmental factors	Caused by both inherited and environmental factors

Fill in the missing words in the sentences, using words from the box.

You may need to use some words more than once.

Inside every cell in our bodies there is _____ _____.

The information is carried on _____ that tell the cells in our body how to make us. Many_____ are controlled by genes. Eye colour, hair colour and height are just a few examples.

Some characteristics are not controlled by genes but by the _____ .

For example, a _____ is not something you are born with but some people may choose to have one. If a person has chickenpox and scratches their spots they may get _____. You are not born with these characteristics; they are things that you get during life.

Plants may have all the correct genes that allow them to grow but if the _____ is too cold or there is not enough _____ then they will become weak or die. The temperature and the amount of water are environmental factors.

There are some characteristics that can be controlled by genes *and* the _____ .

An example of this is _____ . If children have very tall parents then it is likely they will grow up to be _____ too. Their parents will have _____ that have made them tall. These genes may be passed onto their children so they may be tall as well. However, if the child grows up in an environment where there is not enough food, so they do not get enough of the essential _____ , then the child's growth will be stunted. This is where the environment has had an effect.

characteristics	**environment**	**genes**	**genetic information**	**height**
nutrients	**scars**	**tall**	**tattoo**	**temperature**	**water**

2 In the passage, circle words or phrases which are characteristics controlled by genes.

3 In the passage, underline words or phrases which are environmental factors.

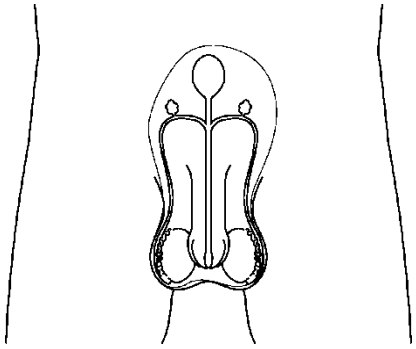
Watson and Crick	Franklin and Wilkins	
		How the teams contributed to an understanding of the structure of
		How the individual teams were held back from understanding the structure of DNA

Here are the names of four things. Which ones use sexual reproduction?

brick	**human**	**chair**	**elephant**

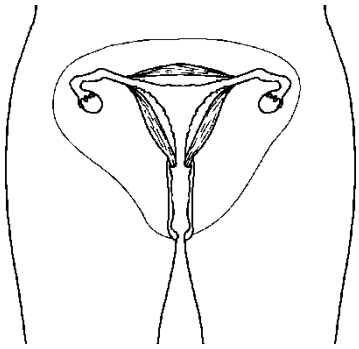
[2 marks]

2 On the diagram, label the following parts: **penis** **testes** **scrotum** **sperm duct**



[2 marks]

3 On the diagram, label the following parts: **uterus** **ovary** **vagina** **cervix**



[2 marks]

4 Complete the table to show the names of the male and female sex cells and where they are made.

	Name of sex cell	**Where it is made**
Male		
Female		

[2 marks]

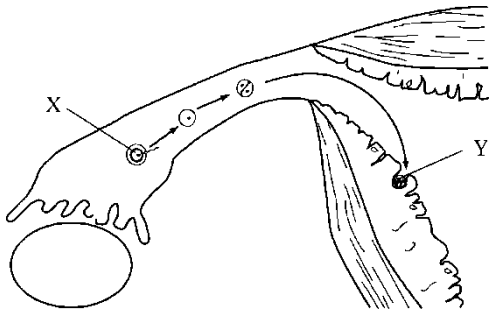
5 Look at the drawing. Name two ways in which the cell is adapted to its function.

i _____

ii _____

[2 marks]

6 **a** Look at the diagram. What processes are happening at points 'X' and 'Y'?



X is _____

Y is _____

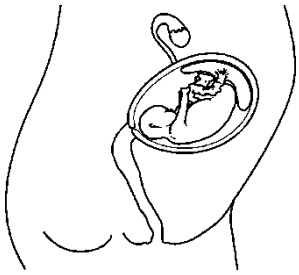
[2 marks]

b After process 'X' has happened, what is formed?

_____

[1 mark]

7 The diagram shows a fetus inside the mother.



a What is the name of the organ system in the drawing? _____

b What is the fetus surrounded by? _____

c Why is the fetus surrounded by this? _____

d Name one substance that passes from fetus to mother. _____

[4 marks]

8 Complete these sentences about the menstrual cycle:

a The menstrual cycle starts with _____ .

b About 14 days after the menstrual cycle starts, _____ occurs.

[1 mark]

9 **a** Describe two changes that happen in girls between the ages of 10 and 15.

i _____

ii _____

[1 mark]

b What is the name given to the time when physical changes occur?

_____

[1 mark]

10 **a** Which part of a baby is born first? _____

b What is the 'afterbirth'? _____

[2 marks]

11 The cells lining the fallopian tubes have very small hairs on them. What are these 'hairs' called and what job do they do?

_____

[1 mark]

12 Frogs use external fertilisation. Humans use internal fertilisation.

a Explain why female frogs produce hundreds of eggs at a time but a human female produces only one.

_____

_____

[1 mark]

b When an embryo grows it gets bigger. What is the main way in which this happens?

_____

Complete the sentences using some of these words:

pollination **fertilisation** **seed dispersal** **germination**

a An insect carrying pollen from an anther to a stigma is an example of _____.

b A male sex cell joining with a female sex cell is called _____.

[1 mark]

10 Number the following sentences in the order that they happen.

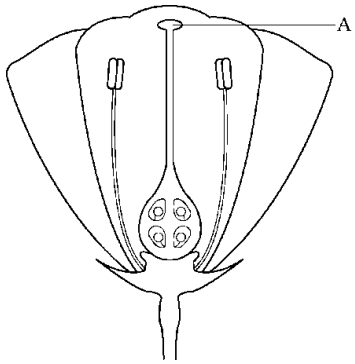
_____ Male sex cell joins with female sex cell.

_____ Pollen tube grows down the style.

_____ Pollen lands on the stigma.

_____ Part of the flower swells to form a fruit.

On the diagram the part labelled with the letter 'A' is the:



A style. **B** ovary.

C stigma. **D** anther.

2 Pollination is:

A the carrying of pollen from an anther to a stigma.

B when two sex cells join together.

C when an insect eats pollen.

D when harmful substances enter the air.

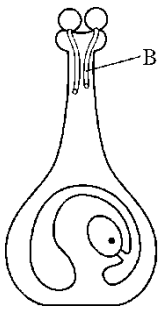
3 Fertilisation is:

A the carrying of pollen from an anther to a stigma.

B when two sex cells join together.

C when an insect eats pollen.

D when a seed starts to grow.



4 In the diagram, the part labelled 'B' is:

A an ovary. **B** an anther.

C a xylem tube. **D** a pollen tube.