10. Some plants live in areas of high density of other plants. Choose **two** ways that plants may compete with others to attract pollinating insects. [2]

a) They have brightly coloured flowers.

b) They have high levels of chlorophyll in their leaves.

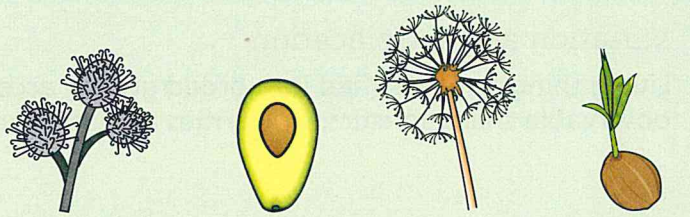
c) They produce huge numbers of light, feathery pollen grains.

d) They produce large amounts of nectar.

11. Seeds are dispersed by a variety of mechanisms. Some are shown in Figure 1.9.10b. Which type of seed is likely to be dispersed by: [2]

a) water?

b) being carried on the fur of an animal?



burdock seed | avocado stone | dandelion head | coconut

FIGURE 1.9.10b

12. A rare fruit and its seeds are analysed and are found to contain large amounts of energy compared to several other fruits. Suggest **two** reasons why containing lots of energy supports the growth of a new fruit plant. [2]

EXTEND. Questions 13–14

ee how well you can understand and explain new ideas and evidence.

13. Figure 1.9.10c shows how the populations of lynx and hares changed over time. Analyse and evaluate the data to explain why the populations rise and fall when they do. Do you think this pattern is still happening today? Explain your answer. [4]

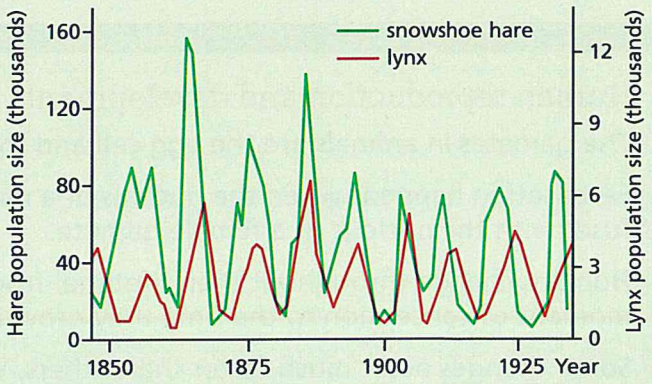


FIGURE 1.9.10c: Lynx and hare population data.

14. Using the average data in Table 1.9.10, describe the effect of sugar concentration on growth of pollen tubes. Suggest which one result the students ignored when calculating the averages. [3]

TABLE 1.9.10: The growth of pollen tubes in different sugar concentrations.

Sugar concentration (%)	5	10	15	20
Growth of pollen tubes (micrometres) – experiment 1	225	345	200	213
Growth of pollen tubes (micrometres) – experiment 2	250	350	450	207
Growth of pollen tubes (micrometres) – experiment 3	275	355	450	250
Average growth of pollen tubes	250	350	300	233

Genes
Variation *and* Human reproduction

Ideas you have met before

Variation and classification

Living things are classified into broad groups according to observable characteristics, similarities and differences.

Adaptations

Animals and plants are adapted to the conditions of the habitats in which they live.

An adaptation is a way an animal's body helps it survive in its environment – for example meerkats have dark circles around their eyes, which act like sunglasses, helping them see even when the Sun is shining very brightly.

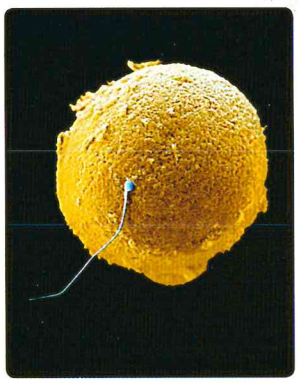
Human reproduction and development

The gametes in animals are the egg cell and the sperm cell.

Fertilisation happens when the nucleus of a male gamete fuses with the nucleus of a female gamete.

Humans change throughout their lifetime, from the moment of conception to the time they grow old.

Some changes occur much faster than others. We change fastest during the first few months of our existence.



10.0

In this chapter you will find out

Variation

- There is variation within a species and this can be measured and classified as continuous or discontinuous variation.
- Variations can be caused by the environment or by inheritance, but many are caused by a combination of both factors.
- Variation between organisms ensures that some organisms survive.
- Species that have too little variation may become extinct.

Human reproduction

- The male and female human reproductive systems are adapted for successful reproduction.
- Puberty and reproduction are controlled by hormones. Drugs can be used to support infertility and contraception.
- When an egg is fertilised it develops into a foetus. This grows in the uterus until it becomes a fully grown baby.
- Many factors affect the growth and development of a foetus, including the mother's use of alcohol, cigarettes and drugs.

Looking at variation

We are learning how to:

- Describe what is meant by variation in a species.
- Explain the difference between continuous and discontinuous variation.
- Plot graphs to show variation.

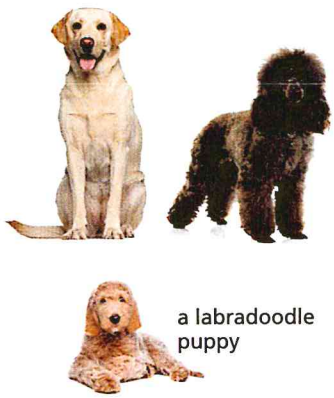
Look around you. What differences can you see between the people in your class? **Variation** in characteristics can be classified in different ways and graphs can help us to understand the different patterns of variation.

FIGURE 1.10.1a: What variation can you see among these children?

Spot the difference

A **species** is a group of living things that have more in common with each other than with other groups of living things. Organisms within a species are able to reproduce and produce fertile offspring. The scientific name for the human species is *Homo sapiens*, the dog species is called *Canis familiaris*. Within species, there are many features that vary; some of these are obvious to see, such as height, hair colour or leaf shape. Other features are not easy to see, such as blood group and differences in our genes.

1. Define 'species'.
2. List five things that differ among humans and five things that differ among dogs.



a labradoodle puppy

FIGURE 1.10.1b: A labradoodle pupp with its parents – a labrador retrieve and a standard poodle.

Types of variation

The height of a human population ranges from the shortest to the tallest individuals (called the range) – any height is possible between these values. A feature that changes gradually over a range of values is said to have **continuous variation**. Examples of such features are height and wing span.

The bell-shaped graph showing height values (Figure 1.10.1c) is called a 'normal distribution'. This is what you would expect to find in any feature with continuous variation. The most frequently occurring value is called the mode.

Some features have only a limited number of values. An individual has one type of the feature or another. This is called **discontinuous variation** – examples of this are gender, blood group (Figure 1.10.1d) and vein patterning in leaves. Measuring and recording variation can help us to understand which type of variation a feature shows.

Did you know...?

Lions and tigers can be cross-bred to produce ligers and tigons. These offspring are usually infertile (cannot breed) and so lions and tigers are classed as separate species. Although beautiful, both ligers and tigons often have serious health problems.

3. For each feature you have identified in question 2, state whether it is an example of continuous variation or discontinuous variation.
4. Explain the difference between continuous and discontinuous variation.
5. Look at the data collected in Table 1.10.1a and Table 1.10.1b on tongue rolling and arm span. Plot a graph for each of these data. Which type of variation does each feature show?

ABLE 1.10.1a

Tongue rolling	Number of students
Can roll tongue	19
Cannot roll tongue	11

ABLE 1.10.1b

Arm span (cm)	Number of people
146–150	3
151–155	16
156–160	20
161–165	24
166–170	22
171–175	15
176–180	8

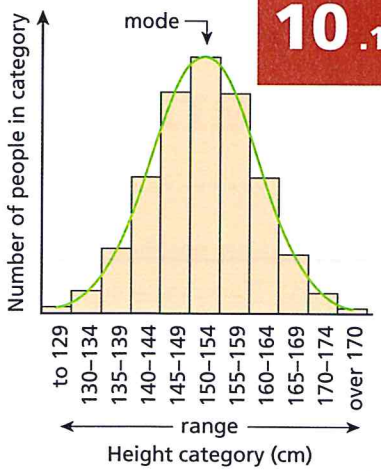


FIGURE 1.10.1c: Height shows normal distribution.

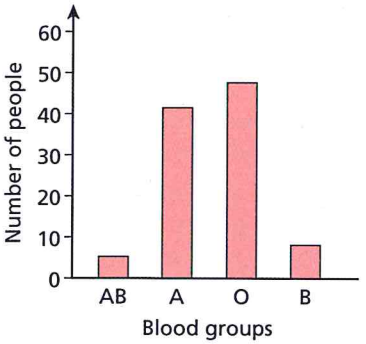


FIGURE 1.10.1d: Blood groups show discontinuous variation.

nvestigating variation

cientists can investigate variation to find out if features are nked, such as students' height and shoe size. The larger the ample size used, the more reliable the data.

scattergraph is used to show whether or not there is a elationship between two sets of data. The graph may show:

- a positive **correlation** – one quantity increases as the other does (as in Figure 1.10.1e);
- a negative correlation – one quantity increases as the other decreases;
- no correlation – there is no clear relationship.

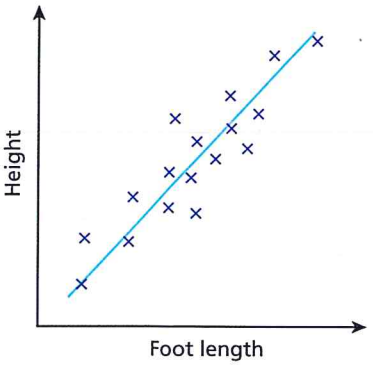


FIGURE 1.10.1e: There is a positive correlation between height and foot length in humans.

6. Describe an investigation to see if there is a link between the length of a holly leaf and the number of spikes on the leaf.
7. Explain why sample size is important.

Know this vocabulary

variation
species
continuous variation
discontinuous variation
correlation

Exploring causes of variation

We are learning how to:

- Identify whether variation is caused by inheritance or by environmental factors.
- Understand that offspring from the same parents may show variation.

There are millions of plants and animals on Earth. They are all different from one another. What causes these differences? Why are some organisms almost identical?

What causes variation?

One cause of variation in organisms is their environment. For example your diet, health and the amount of exercise you do affect your growth. Climate and food supply influence all living things. When animals fight (for example over available resources), they may lose teeth or develop scars from deep wounds. A person's country and culture can also be sources of variation – for example Buddhist monks shave their heads.

FIGURE 1.10.2a: The foal inherits the length of its legs from its parents

The other major cause of variation in organisms is the passing on of features from parents to offspring, and from their parents before them, and so on. **Inherited** variations are **genetic** and cannot be altered. For example, you may dye your hair purple, but it will always grow back in your natural colour. Sometimes there are clear traits that run in families, such as the shape of your nose or the presence of a dimple or freckles.

1. Name one characteristic that you have inherited from your parents, and one caused by the environment.
2. Name three features that a foal inherits from its parents.

Why are offspring different?

Brothers and sisters from the same parents can look very different from each other. Parents pass on genetic information to their offspring in the nucleus of their sex cells. The offspring inherit one set of information from the mother's egg cell nucleus and one set from the father's sperm cell nucleus. Every egg cell and every sperm

Did you know...?

Even twins can show huge variation. The girls in the picture are twins. Due to inheriting a mix of genes from both their mother and father, they were born with different hair colouring.

FIGURE 1.10.2b

cell contains different hereditary information from the respective parent. Each fertilised egg cell will therefore contain a different, random and unique combination of characteristics inherited from the parents. Offspring may have some similarities to their siblings, but may also look very different.

3. Why can children from the same parents be very different from each other?
4. Look carefully at Figure 1.10.2c.
   a) How are the children similar to each other?
   b) How are they different from each other?

FIGURE 1.10.2c: What variation can you see in this family?

Genetic or environmental?

Variation in characteristics is needed for the process of evolutionary change that enables a species to change gradually and survive. Sometimes this results in the development of a new species.

Scientists have debated whether certain characteristics are inherited or are caused by the environment in which people live. They now generally agree that only a small number of human features are entirely inherited and are not in any way affected by the environment. These features include:

- natural eye colour;
- natural hair colour;
- blood group;
- some inherited diseases.

Some features have a well-established genetic basis; others are mostly due to the environment. However, most features are caused by the interaction of genetic and environmental factors. For example, a person's skin may have birthmarks and moles, but during their lifetime scars may form and tattoos may be added.

FIGURE 1.10.2d: Tattoos are important in many cultures.

5. Give three other examples of inherited human features that can be affected by the environment in which a person lives.
6. Evaluate the importance of genetic and environmental variation in the survival of an organism.

Know this vocabulary

inherited

genetic

Considering the importance of variation

We are learning how to:

- Describe the importance of variation.
- Explain how variation may help a species to survive.
- Apply ideas about variation and survival to specific examples.

Differences between living things can help a species to survive. Why is variation so important to survive a changing environment?

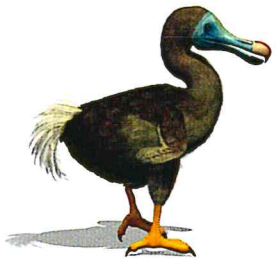


FIGURE 1.10.3a: A dodo.

The importance of variation

Variation is important for the survival of a species. If all organisms were identical and the environment changed so that none of the organisms were adapted to survive, they would die out. For example, the dodo bird lived on the island of Mauritius until 1681. Without any predators throughout its history, the dodo became a flightless bird, with no variation in flying ability. The introduction of humans and other mammals to the island led to the hunting of the dodo and, with no way of escaping predators, the dodo population decreased until it became **extinct**. If there had been variation in how well dodos could fly, there could have been an opportunity for the species to survive.

1. Explain why the dodo species died out.

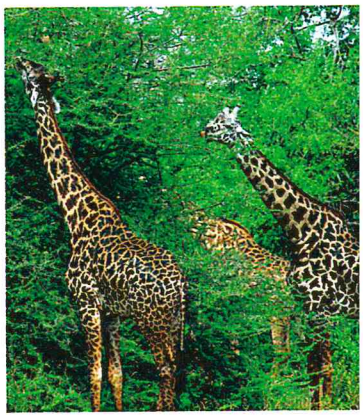


FIGURE 1.10.3b: What might happer to the shorter giraffe?

Surviving change

Variation in a population gives those organisms with more favourable features a **survival advantage**. When these organisms reproduce, the feature is passed on to offspring.

Some variation benefits a species, for example:

- Not all rabbits are killed by the viral disease myxomatosis. Some rabbits are resistant to infection and can survive an outbreak.
- Peacocks with the best display of feathers are most likely to attract a mate.

Some differences are not beneficial, for example:

- Albino (pure white) giraffes do not survive long in the wild.
- Antelopes that run slower than the herd do not survive.

FIGURE 1.10.3c: Some animals are born with no pigment. They are called albinos.

2. Look at Figures 1.10.3b and 1.10.3c. Describe the variation in the giraffes and in the squirrels and suggest any survival advantage in each case.
3. Look at the moths in Figure 1.10.3d. In unpolluted conditions, the tree bark on which these moths sit are pale with lichen. In polluted conditions, the tree bark becomes dark. Describe how variation helps these moths to survive as the amount of pollution changes.

FIGURE 1.10.3d: A dark and pale Peppered Moth (*Biston betularia*).

Superbugs

Variation is also seen in micro-organisms, such as bacteria. Some bacteria are resistant to some antibiotics. When antibiotic medicines are used, any bacteria that are resistant have the advantage and are more likely to survive and reproduce to form more resistant bacteria. As the use of antibiotics has increased, so too has the number of bacteria that are resistant to the drugs.

Antibiotic resistance is a huge problem in hospitals. There are some strains of bacteria that are resistant to many different antibiotics – these are called superbugs. One superbug is MRSA (methicillin-resistant *Staphylococcus aureus*). An infection by MRSA can be very difficult to treat.

4. Explain how variation in antibiotic resistance helps species of bacteria to survive.
5. Look at Figure 1.10.3e. Suggest why prescribing methicillin has become less effective between 1982 and 2014.

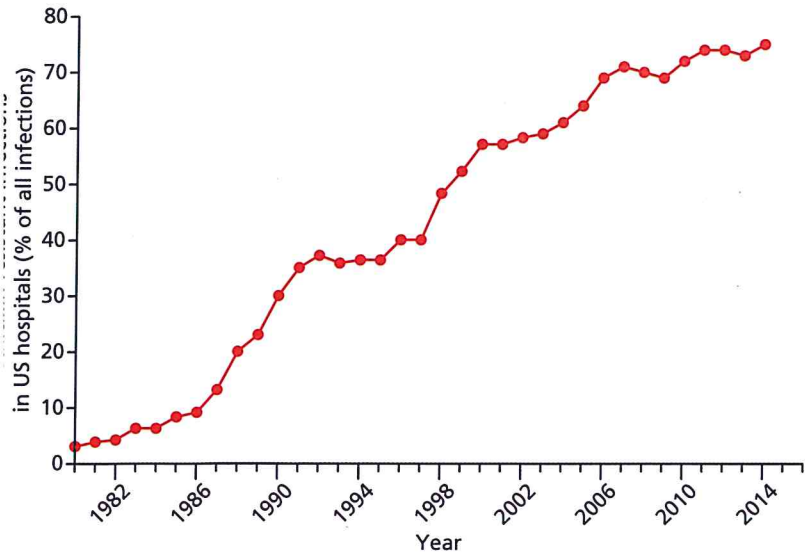


FIGURE 1.10.3e: Antibiotic resistance in bacteria.

Did you know...?

Following the discovery of the superbug MRSA, hospital doctors were required to stop wearing ties and long-sleeved shirts. It was thought that their clothing was carrying bacteria from one patient to another.

Know this vocabulary

extinct
survival advantage

Understanding the female reproductive system and fertility

We are learning how to:

- Describe the structure and function of different parts of the female reproductive system.
- Describe the process of menstruation.
- Describe causes of low fertility.

The human female fertility cycle is controlled by chemicals called hormones. The female reproductive system receives sperm and enables the fertilised egg to develop until it is ready to be born. The uterus, or womb, is where the foetus grows and develops. The uterus increases to up to 20 times its original size during pregnancy.

The functions of female organs

The human female **reproductive system** has two main purposes – to produce egg cells that may be fertilised by the male sperm, and to provide an environment for the growing foetus.

The main female organs are the **vagina**, cervix, **uterus**, **oviduct** and **ovary**. Table 1.10.4 summarises the structure and function of each of these.

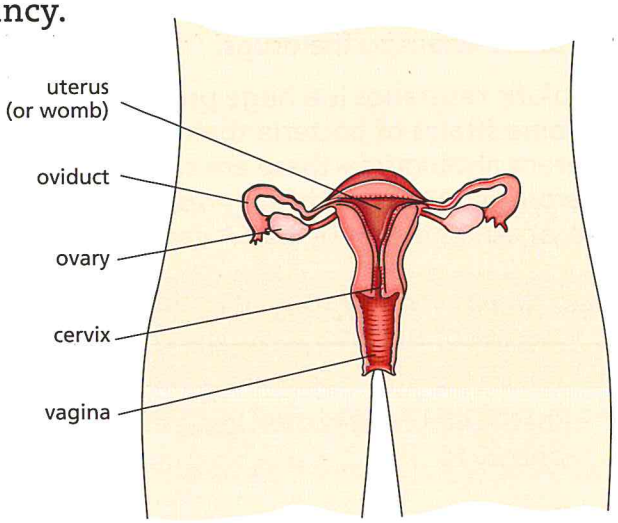


FIGURE 1.10.4a: The female reproductive systen

TABLE 1.10.4: Female reproductive organs.

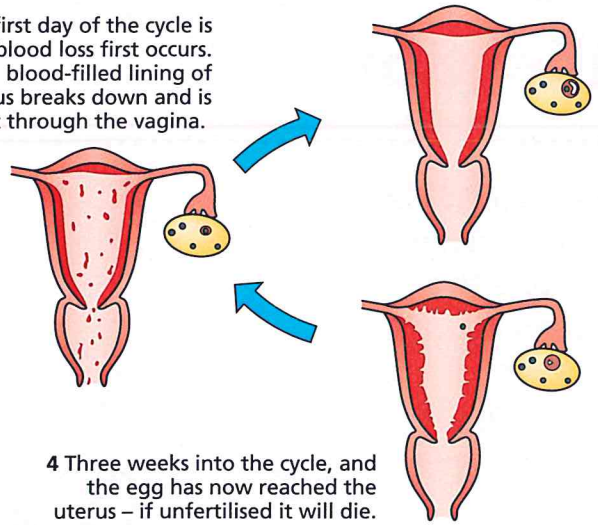
Vagina	Muscular tube, 8 to 12 cm long, that extends up to the uterus and can stretch to allow a baby to pass.
Cervix	Narrow opening from the vagina to the uterus with thick walls – can extend wide enough to allow a baby to pass.
Uterus or womb	Pear-shaped cavity with thick muscular walls, where the developing baby grows.
Oviduct (Fallopian tube)	The tube that carries the egg from the ovary to the uterus.
Ovary	Where eggs cells are made and then released into the oviduct.

1. Where are female sex cells made?
2. Why do you think the uterus has muscular walls?

Menstruation

10.4

Menstruation occurs in a cycle lasting about 28 days and is controlled by hormones.



1 The first day of the cycle is when blood loss first occurs. The thick, blood-filled lining of the uterus breaks down and is lost through the vagina.

2 After about day 5, the lining builds up again, replenishing the uterus with blood and nutrients. An egg in the ovary begins to ripen.

3 At about day 14, hormones cause the egg to mature and **ovulation** to occur, releasing the egg into the oviduct. The lining of the uterus has been building up and is now very thick, ready to receive a fertilised egg. This is the most likely time for pregnancy to occur.

4 Three weeks into the cycle, and the egg has now reached the uterus – if unfertilised it will die.

FIGURE 1.10.4b: The menstrual cycle.

3. What part do hormones play in menstruation?

Infertility

Most women below the age of 36 have little trouble in having babies. However, **infertility** affects about 3.5 million women in the UK. There are a number of causes:

- External factors – such as excessive alcohol, drugs, long-term smoking, stress and sexually transmitted diseases.
- Problems with **ovulation** – the release of eggs is controlled by hormones; a hormonal imbalance may result in eggs not being made or released.
- Endometriosis – cells from the lining of the oviduct may start to grow around the ovary and cause cysts to appear, making it difficult for the eggs to be released.
- Blockages in the oviduct – these can prevent an egg from reaching the uterus and becoming fertilised.

In men, infertility may be caused by a low number of healthy sperm or sperm that can't swim well because of disease.

Some fertility drugs work by increasing the number of eggs that a woman produces and releases each month. This increases the chance of pregnancy. Contraceptive drugs can work by stopping ovulation and so, with no egg, the pregnancy cannot occur.

4. For each of the female infertility problems, suggest a possible solution.

Did you know...?

The ovaries of new-born girls have about 600 000 immature eggs. However, an adult woman is capable of giving birth to a maximum of 35 babies.

Know this vocabulary

reproductive system
vagina
uterus
oviduct
ovary
menstruation
infertility
ovulation

Understanding the male reproductive system and fertilisation

We are learning how to:

- Describe the structure and function of different parts of the male reproductive system.
- Describe fertilisation in humans.

The human reproductive systems are controlled by chemicals called hormones. In the male, one hormone is testosterone, which controls the growth and development of the organs and sperm cells. Sperm cells take four to six weeks to mature, and live for about 36 hours once released inside the female.

The functions of male organs

The purpose of the human male reproductive system is to produce millions of male sex cells (sperm) and to transport them inside the female to fertilise an egg cell and so produce a baby.

The main parts of the male reproductive system are the **testicles**, scrotal sac, **sperm duct**, prostate gland, **semen**, **urethra** and **penis**. Table 1.10.5 summarises the structure and function of each of these.

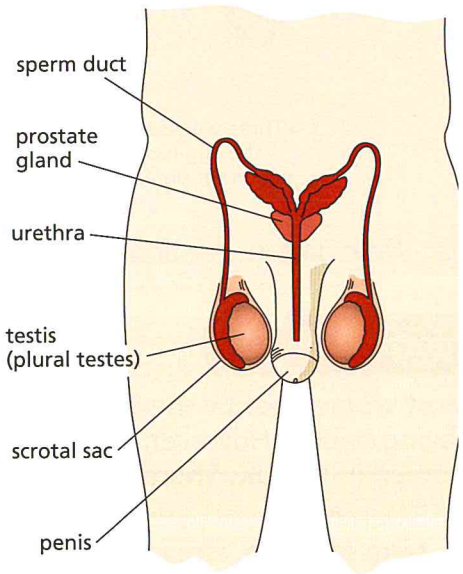


FIGURE 1.10.5a: The male reproductive system.

TABLE 1.10.5: Male reproductive organs.

Testicles	Two organs where sperm cells are made.
Scrotal sac	Protection around the testicles. This sac holds the testicles outside the body where sperm is kept at the best temperature for them to function.
Sperm duct	The tube that carries the sperm from the testicles to the prostate gland.
Prostate gland	Where semen is made.
Semen	A liquid that mixes with sperm and provides them with nutrients for their journey.
Urethra	The tube leading from the prostate gland along the penis.
Penis	The organ around the urethra. Movement of the penis releases sperm during intercourse.

Did you know...?

A human sperm is the smallest cell in the body. 5000 sperm cells would fit into one millimetre. The egg cell is the largest – about the size of a full stop.

1. List one cell and two organs in the male reproductive system.
2. Draw the journey of a sperm cell, labelling the parts of the male reproductive system that it passes through.

Transfer of the male sex cell

Humans carry out internal fertilisation. In sexual intercourse, the penis is inserted inside the vagina, and its movement stimulates the release of sperm from the testicles. In this way, sperm are guaranteed to be placed directly inside the female. Both a plant's anthers and the testicles produce millions of male sex cells to maximise the likelihood of successful fertilisation. However, plants produce pollen only when the stigmas are likely to be ready for fertilisation.

3. Which parts make the male sex cells in plants and in humans?

Fertilisation

The general name for the sex cells (egg and sperm) is **gametes**. One egg matures each month in the ovary and is released into the oviduct – this process is ovulation. The lining of the oviduct contains specialised cells with tiny hairs that beat, causing the egg to move down to the uterus. For up to 24 hours the egg may be fertilised by a sperm cell. Only one sperm penetrates the egg cell, losing its tail as it does so. **Fertilisation** is when the nucleus of the sperm fuses with the nucleus of the egg, combining the genetic material of both. The fertilised egg is the start of a new life. Once the egg is fertilised, the menstrual cycle stops to allow the foetus to develop.

4. Why does the egg need to move from the ovary to the uterus?
5. Why do you think the egg cell is so much bigger than the sperm cell?
6. Explain the difference between ovulation and fertilisation.

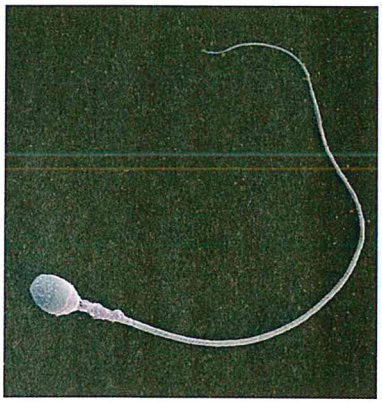


FIGURE 1.10.5b: The human male sex cell is adapted to carry out its job. How is it different from a pollen cell?

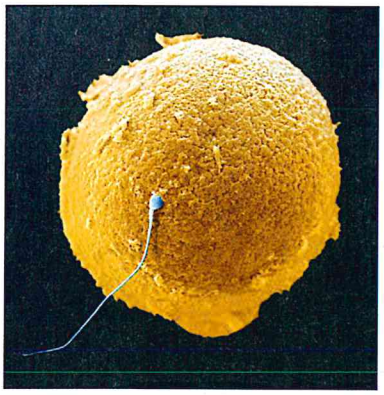


FIGURE 1.10.5c: Fertilisation occurs when one sperm cell penetrates the egg cell and their nuclei fuse.

Know this vocabulary

testicle
sperm duct
semen
urethra
penis
gamete
fertilisation

Learning how a foetus develops

We are learning how to:

- Describe the role of the mother in supporting and protecting the developing foetus.
- Describe the stages in the development of a foetus.

A human foetus takes 38 weeks to grow from one fertilised cell into a complete baby ready to be born. Dogs take just two months, whereas elephants take up to two years. This period of development is called **gestation**. The mother provides the developing foetus with all the nutrients and oxygen it needs, as well as removing all waste products.

Cell division

When an egg cell has been fertilised, it divides into two cells. These cells further divide to make four cells, which divide again to make eight cells. This cell division continues until there are several thousand cells. This is the process of growth, where cells divide to make new cells and the overall size of the organism increases. Within the first two to three weeks the cells are all the same – they are called stem cells, and have the ability to become any specialised cell in the body.

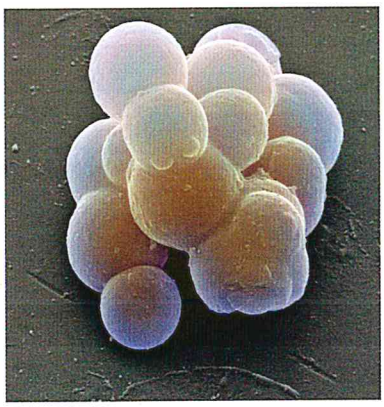


FIGURE 1.10.6a: Stem cells.

1. What is 'growth'?
2. What is special about stem cells?

Development of the foetus

Once the ball of stem cells reaches a certain size, the cells begin to differentiate and become specialised cells. Some cells will develop into the organs and tissues of the developing baby. At this stage when the cells begin to differentiate, the ball of cells is called an **embryo**. Once it reaches about 8 weeks old, when most of the main organs are formed, including the heart which is now beating, it is called a **foetus**.

Figure 1.10.6b shows the different stages of development of a human foetus. Ultrasound is used to make images of the foetus at different stages to monitor its development and identify any problems. The size of the foetus can be measured using these images.

3. When is the fastest period of growth of the developing foetus? Explain your answer.

Did you know...?

The taste buds of a foetus develop at 14 weeks; it can hear at 24 weeks and track objects with its eyes at 31 weeks. At 28 weeks, a foetus is likely to survive if born.

weeks of gestation	8	12	16	20	24	28	32	36	40
size (length) of foetus	40 mm	100 mm	140 mm	190 mm	230 mm	270 mm	300 mm	340 mm	380 mm

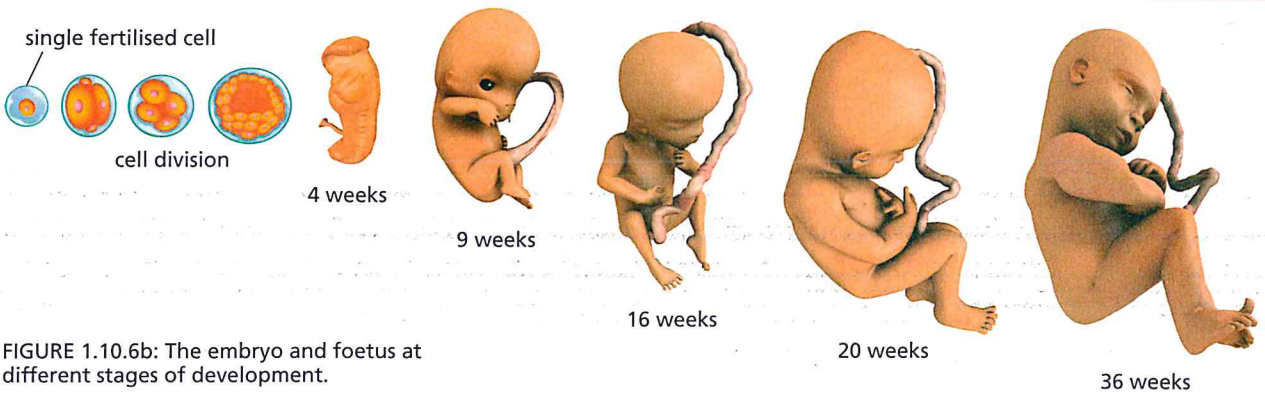


FIGURE 1.10.6b: The embryo and foetus at different stages of development.

Supporting structures

During pregnancy, other cells from the original ball of cells will become structures that connect with the mother – the **placenta**, amnion, **amniotic fluid** and **umbilical cord**. These structures are shown in Figure 1.10.6c.

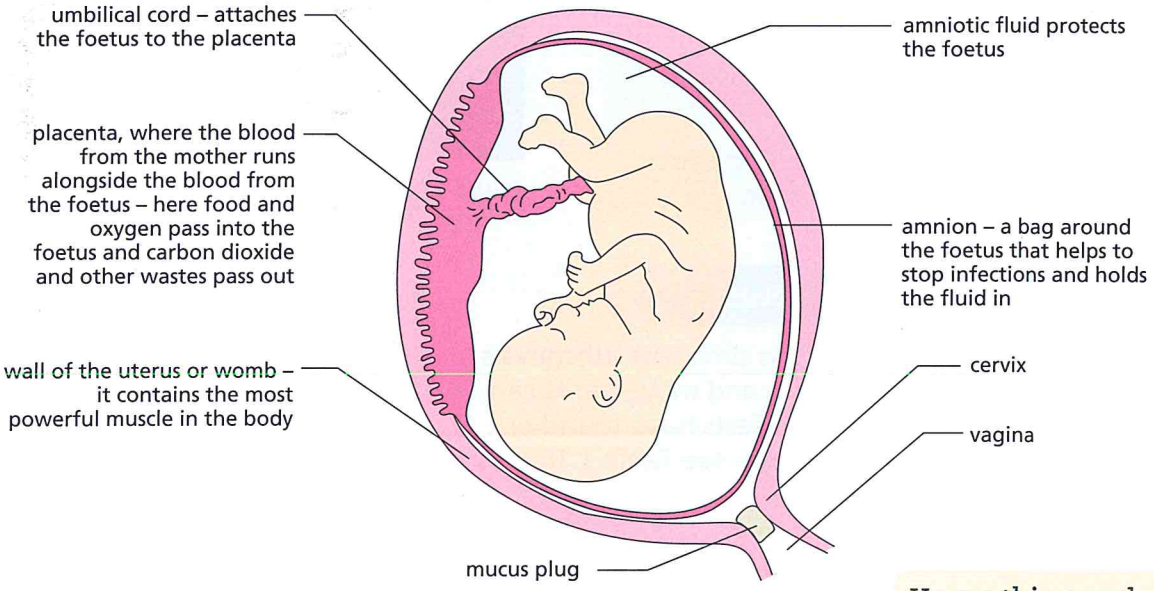


FIGURE 1.10.6c: The developing foetus in the uterus.

4. Why does a foetus need the placenta?
5. Why is it important for the baby to be surrounded by fluid?
6. Summarise the different ways in which a pregnant uterus is different from a normal uterus.

Know this vocabulary

gestation
embryo
foetus
placenta
amniotic fluid
umbilical cord

Understanding factors affecting a developing foetus

We are learning how to:

- Describe the effects of different factors on a developing foetus.
- Evaluate the strength of data.
- Analyse advice given to pregnant women.

A foetus cannot take in its own food or oxygen and relies on the mother to supply it with essential chemicals and nutrients. The placenta allows substances to pass from mother to baby.

The role of the placenta

The placenta allows oxygen, glucose, digested proteins and fats, vitamins and minerals to enter the foetus – it also removes carbon dioxide and waste products, such as urea. Harmful substances can also cross the placenta including alcohol, nicotine, carbon monoxide, cocaine, insecticides, lead and mercury.

1. How might the harmful substances come to be at the placenta?
2. What would happen to a foetus without the placenta? Explain your answer.

FIGURE 1.10.7a: An ultrasound scan of a foetus enables its development to be checked.

Effects of substances on the foetus

Scientific studies have established how different substances affect a developing foetus. Foetal size and movements can be tracked and the heartbeat measured. Tests have found out how some substances affect the foetus – see Table 1.10.7.

TABLE 1.10.7: Substances that affect a developing foetus.

Alcohol	Higher rate of stillbirth (baby dead at birth), lower birth weight, lower IQ; baby slower to move and think; more likely to be dependent on alcohol in adulthood.
Smoking – nicotine and carbon monoxide	Much higher risk of stillbirth, **premature** birth and low birth weight resulting in poor development; greater likelihood of developing asthma.
Drugs – marijuana, cocaine	Higher rate of stillbirth, premature birth, low birth weight, learning difficulties; likely addiction to the drug.
Nutrition – folic acid	Good for the development of the brain and spinal cord; supplements should be taken as soon as pregnancy is recognised.

Pregnancy and baby

Search...

Getting pregnant | Pregnancy | Labour and birth | Your newborn | Babies and toddlers

Advice

1. Eat healthily. Eat more calories but get these from nutritious foods such as fruit and vegetables.
2. Limit alcohol intake and consider avoiding alcohol completely.
3. Do not smoke and try to avoid smoky places.
4. Take folic acid supplements.

FIGURE 1.10.7b: Some advice to pregnant women.

3. What are the common factors that badly affect the development of a foetus?

4. Look at Figure 1.10.7b. Explain why this advice is given to pregnant women. What advice can you give to pregnant mothers to help them have a healthy baby?

Validity and reliability in research

Researchers need to ensure that their investigations produce **valid** and **reliable** evidence. 'Valid' means that the evidence collected answers the question being investigated. It must take account of all possible variables. The evidence should also be reliable. This can be done through repeat readings or, in the case of a survey, using a large **sample size**.

5. Comment on the validity and reliability of the following studies:

a) The first research on the effects of alcohol was conducted on 127 babies born to alcoholic mothers in France in 1968. The babies were found to have lower birth weights and lower intelligence.

b) In a study on the effect of smoking, the ultrasound scans of 65 mothers who smoked were compared with the scans of 36 mothers who were non-smokers.

Did you know...?

A woman may not realise she is pregnant until about 8 weeks after conception (when the sperm and egg meet). The embryo's brain starts to develop after just 2 to 3 weeks and is highly affected by chemicals coming through the placenta.

FIGURE 1.10.7c: A premature birth is a possible consequence of smoking during pregnancy.

Know this vocabulary

premature
valid
reliable
sample size

Communicating ideas about smoking in pregnancy

We are learning how to:

- Critique claims linked with the effects of smoking in pregnancy.
- Identify potential bias in sources of information.
- Give a reasoned opinion.

Nowadays, most people accept that smoking in pregnancy is harmful to the unborn baby. However, this is a fairly recent development. Why did it take so long for such an important message to be accepted?

FIGURE 1.10.8a: Some pregnant women continue to smoke, despite the compelling evidence that it is harmful to their unborn baby.

Considering bias

Until the 1950s, cigarettes were not known to cause health issues. Even when evidence showed links with lung cancer of the smoker, it took much longer for the message about harm to an unborn baby to be accepted.

When evidence, or the conclusion from evidence, is swayed towards a certain outcome, we say it is biased. **Bias** may result from a mistake in an experimental procedure or can be caused on purpose, for example by someone who wants you to believe something.

1. Look at Figure 1.10.8b. Describe the message that is given to women by the advert.
2. Explain why there may be bias in the information in an advert.

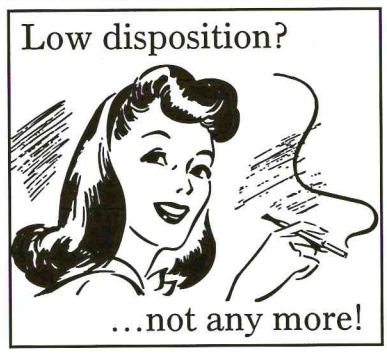


FIGURE 1.10.8b: Many 1950s adverts encouraged women to smoke and some even told them it was normal to feel nervous whilst pregnant and a cigarette could calm their nerves.

Critiquing a claim about smoking in pregnancy

A **claim** is a statement that says something is true. There must be facts or data that support a claim; these are the **evidence**. As more evidence was collected about the effects of smoking on the smoker, those around them and an unborn baby, more people's **opinions** started to change.

The more specific we can be in making a claim, the better. For example, 'smoking in pregnancy is harmful' is not as specific as 'smoking in pregnancy increases the risk of miscarriage'. The more specific the claim, the easier it is to demonstrate specific evidence to support the claim.

TABLE 1.10.8: Would this evidence convince you that smoking in pregnancy is harmful?

Claim	Evidence
Smoking in pregnancy increases the risk of premature birth.	Large-scale studies have shown that babies of smokers are approximately 15–200 g lighter at birth.
Smoking in pregnancy causes increased risk of the baby having cleft lip and palate.	Studies of 2000 babies showed that babies of mothers who smoked during pregnancy were 1.6 times more likely to be born with cleft lip and palate.
Smoking in pregnancy increases the risk of asthma in the baby.	Studies of 700 children showed that children of mothers who smoked more than 10 cigarettes per day in pregnancy were 2.5 times more likely to suffer from asthma.

3. Write a specific claim stating that there is a link between smoking in pregnancy and babies being born smaller than babies of non-smokers.

4. Suggest what evidence you would want to see to back up the claim in question 3.

Justify an opinion

We must be able to **justify** any opinion by explaining the ideas we have developed from the evidence. This is called **reasoning**. For example, we could have the opinion that the UK school day should be longer. We could use evidence such as the length of school day in various countries and a comparison of how their students do in tests. We could justify our opinion by explaining that the evidence shows that in China, for example, they have a longer school day and outperform the UK in some tests. Good justification would choose one or two other pieces of evidence to support the opinion. Finally, we should acknowledge other opinions and be prepared to defend our own opinion if someone disagrees with it.

It has been suggested that smoking in pregnancy should be banned. But some people feel that pregnant women should have free choice about whether they smoke or not.

5. In as much detail as possible:

a) give your opinion on whether pregnant women should be banned from smoking;

b) present the evidence that supports your opinion;

c) explain the reasoning for your opinion;

d) identify the opposite opinion to your own, and suggest how you would defend your opinion if someone disagreed with you.

10.8

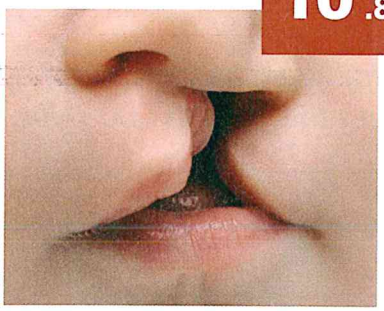


FIGURE 1.10.8c: A baby with cleft lip and palate.

Did you know...?

In 2015, a law came into force banning smoking in vehicles carrying anyone under the age of 18. Studies have shown that smoke can stay in the air for up to 2.5 hours after a cigarette is put out. This exposure to second-hand smoke is called passive smoking.

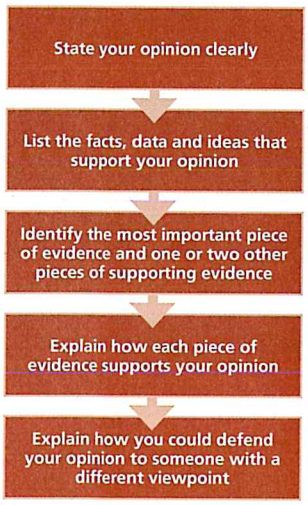


FIGURE 1.10.8d: The stages in justifying an opinion.

Know this vocabulary

bias **opinion**
claim **justify**
evidence **reasoning**

Checking your progress

To make good progress in understanding science you need to focus on these ideas and skills.

- Identify some features of different organisms of the same species.
- Explain the difference between continuous and discontinuous variation.
- Use data to explain whether variation is continuous or discontinuous and to investigate correlations between varying features.
- Identify examples of variation caused by inheritance and of variation caused by the environment in which the organism lives.
- Explain how a mix of genes from our parents means that siblings are different.
- Discuss the relationship between inherited features and the environment and describe how many features are caused by a combination, with examples.
- Recognise that variation within a species can help that species to survive.
- Use examples to describe how variation within a species can be an advantage if the environment changes.
- Make predictions about changes within a species to changes to external conditions.
- Name the main parts of the male human reproductive system.
- Describe the structures and functions of the main parts of the male human reproductive system; describe how fertility problems may arise.
- Explain how the male reproductive structures are designed for fertilisation; describe methods to combat infertility.

☐ Name the main parts of the female human reproductive system.	☐ Describe the structures and functions of the main parts of the female human reproductive system; describe how fertility problems may arise.	☐ Explain how the female reproductive structures are designed for fertilisation; describe methods to combat infertility.
☐ Recall the stages in development as a change from a single fertilised egg to an embryo and foetus.	☐ Compare the growth of the foetus at different stages. Describe the role of the mother in protecting the developing foetus.	☐ Describe the functions of different supporting structures of the mother.
☐ Identify substances passed on from a mother that will either help or harm her developing foetus.	☐ Describe how substances pass to and from a developing foetus and describe the effects of different factors on a developing foetus.	☐ Apply knowledge of effects of substances on advice given to pregnant women, considering validity of evidence.
☐ Identify bias in a claim and link it to claims about smoking in pregnancy.	☐ Explain what it means to critique a claim, and give examples of evidence to support a claim about the effects of smoking in pregnancy.	☐ Justify an opinion about smoking in pregnancy using evidence to support the opinion and to defend against an alternative opinion.

Questions

KNOW. Questions 1–6

See how well you have understood the ideas in the chapter.

1. An example of continuous variation is: [1]

a) height; **b)** tongue rolling; **c)** blood type; **d)** attachment of ear lobes.

2. State the two causes of variation. [2]

3. Explain why variation within a species is important. [4]

4. Which of the following will not pass from a mother to her developing foetus across the placenta? [1]

a) Carbon dioxide **b)** Carbon monoxide **c)** Alcohol **d)** Glucose

5. Male sperm cells are made in the: [1]

a) penis; **b)** testicles; **c)** sperm duct; **d)** urethra.

6. Outline what happens in the menstruation cycle. [4]

APPLY. Questions 7–12

See how well you can apply the ideas in this chapter to new situations.

7. Which of these features of butterflies is an example of discontinuous variation? [1]

a) Area of wings **b)** Length of body **c)** Length of legs **d)** Presence of spots

8. Suggest a variation of a feature that would be disadvantageous to a tiger. [1]

9. A rose seller plans to develop roses that grow in heavy, wet soil. Explain to the rose seller how this will affect variation in his roses and why it may not be a good idea. [2]

10. A woman is trying to get pregnant. Tell her the most likely time during her menstrual cycle to become pregnant. [1]

a) Day 1 **b)** Day 5 **c)** Day 14 **d)** Day 21

11. A student midwife is explaining about the development of a foetus to some pregnant women. She has the diagram, right, and wants to show them where the baby grows. Which label should she choose? [1]

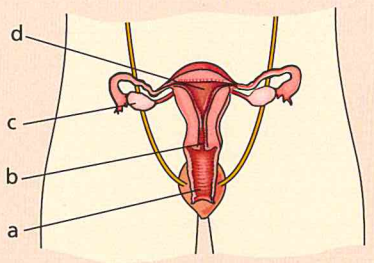


FIGURE 1.10.10a

12. Two women are having treatment with drugs, one to increase fertility and the other to provide contraception. Explain how the drug each of them takes affects ovulation. [2]

EXTEND. Questions 13–15

See how well you can understand and explain new ideas and evidence.

13. Marvin is investigating shoe size among men. He measured the feet of 118 men. Figure 1.10.10b shows his results. [4]

a) What is the sample size?

b) What is the range?

c) What type of variation is shown in the graph?

d) What is the mode value of shoe size?

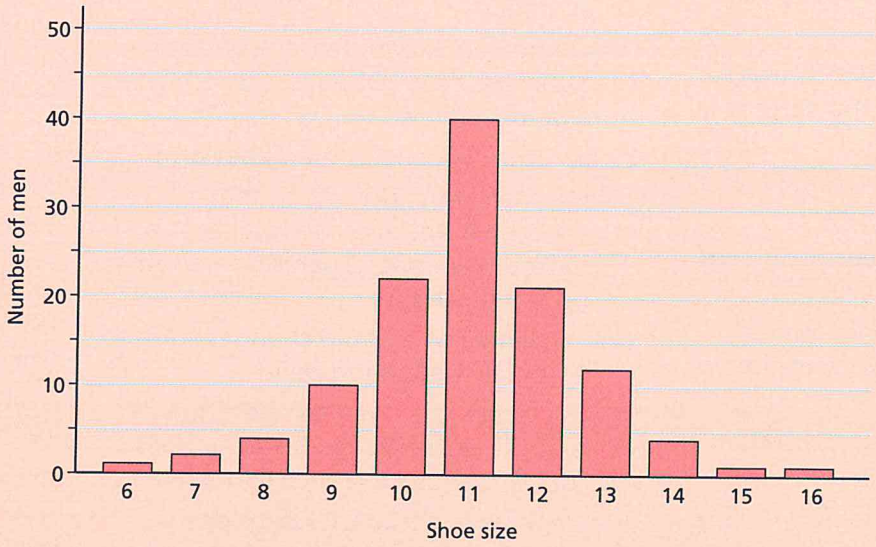


FIGURE 1.10.10b: Graph showing the results of an investigation into men's shoe size.

14. Scientists have carried out a survey to find out the effect of a diet pill on developing babies. Suggest one way that they can help to make evidence reliable. [1]

15. Sketch a graph to show how the weights of foetuses from smoking mothers compare to those from non-smoking mothers over time. Give reasons for the differences. [4]

Glossary

absorption taking in, for example energy transferred by sound

accelerate speed up

acceleration how quickly speed increases or decreases

acid substance that has a pH lower than 7

air resistance frictional resistance when something moves through the air

alkali a soluble substance with a pH higher than 7

alloy mixture of two or more metals

ammeter used to measure the current flowing in a circuit

amniotic fluid liquid that surrounds and protects a foetus in the uterus

ampere unit of measurement of current, symbol A

amplitude maximum distance moved in a vibration, measured from the middle position

angle of incidence between the normal and incident ray

angle of reflection between the normal and reflected ray

antacid substance that neutralises stomach acid

antagonistic muscles pair two muscles that act in unison to create movement

anther pollen-producing part of the stamen of a flower

anticline an upfold in the Earth's crust

arthritis painful disease of the joints

attract pull towards; a magnet will attract any magnetic material that is close enough

auditory range the range of sound frequencies from the lowest to the highest that an animal or human can hear

average speed the overall distance travelled divided by the overall journey time

axis of rotation the centre line around which something rotates

bacteria (singular: bacterium) simple unicellular (single-celled) organisms, some of which can cause illness

balance when different elements of a system (physical, chemical, biological or ecological) are in equilibrium

base a substance that neutralises an acid; a base that dissolves in water is called an alkali

bias When an experimenter affects the outcome, or when a journalist favours a point of view

bicep upper muscle in the upper arm

bioaccumulation increase in the concentration of a chemical as it is passed from one organism to another up a food chain

boil when all of a liquid changes state to a gas, at the boiling point

boiling point the fixed temperature at which a pure liquid substance boils (or a gaseous substance condenses)

bone marrow tissue found inside some bones where new blood cells are made

brittle easily cracked or broken by hitting or bending

calcium hard mineral found in bone

carpel female part of a flower, made up of stigma, style and ovary

cartilage smooth tissue found at the end of bones, which reduces friction between them

cell 'building block' that all living things are made from

cell membrane layer around a cell that controls substances entering and leaving the cell

cell wall tough outer layer of plant cells, made of cellulose