B1 1.1 DIET AND EXERCISE

- A balanced diet contains the correct amounts of:
  - Carbohydrates
  - Fats
  - Minerals
  - Water
  - Proteins
  - Vitamins
  - Fibre

The amount of energy you need varies between individuals. Eg Athletes require a lot more energy than someone who isn't active.

- Mineral ions and vitamins are needed to keep the body healthy. If the diet is unbalanced a person can become malnourished.
- Metabolic Rate refers to the chemical reactions which take place in the cells. The higher the metabolic rate, the faster the chemical reactions occur.
- Men generally have a higher metabolic rate than women.
- The proportion of muscle to fat in your body and your inherited factors can also affect your metabolic rate.
- If the energy (food) taken in is less than the energy used the person will lose mass. The more exercise you take, the more food you need.

B1 1.2 WEIGHT PROBLEMS

Exercise helps you keep the body healthy.

Being seriously underweight can lead to serious health problems such as anorexia.

Obesity can lead to type 2 diabetes, high blood pressure, heart disease and osteoarthritis.

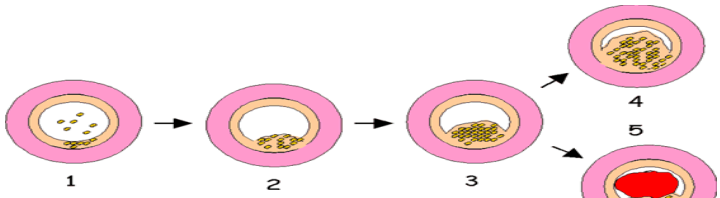
There are 3 main ways that you can lose mass.

- Reduce the amount of energy that you take in by cutting back the amount of food you eat. In particular, energy-rich foods like biscuits, crisps etc.
- You can increase the amount of energy you use by doing more exercise.
- The best way to lose weight is to do both – reduce energy intake and exercise more.

If the energy you take in equals the energy you use then your mass will stay the same. Eating too much food can lead to becoming overweight and obese as your body will store the excess as fat.
Some people are unhealthy because they have too little food (starvation). They may suffer from deficiency diseases due to lack of minerals or vitamins. An example of this would be anaemia due to a lack of iron.

B1 1.3 Inheritance, exercise and health

- Your metabolic rate can be affected by the genes you inherit from your parents.
- There are two types of cholesterol. You need 'good' cholesterol for your cell membranes and to make vital substances.
- Small numbers of the population inherit high levels of 'bad cholesterol', which can lead to heart disease.
- Foods rich in saturated fat can also increased blood cholesterol levels.
- By exercising regularly a person can increase their metabolic rate and lower high cholesterol levels.



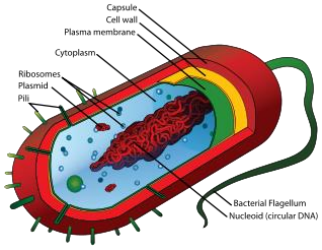
The steps in plaque formation and growth. (1) cholesterol particles infiltrate the wall of the artery at the site of the damaged inner lining of the artery; (2) a plaque develops in the artery; (3) as more cholesterol and other materials are incorporated into the plaque, the plaque grows; (4) the plaque may continue to grow, blocking blood flow through the artery or (5) the plaque may "rupture" and a blood clots may form, completely blocking blood flow through the artery.

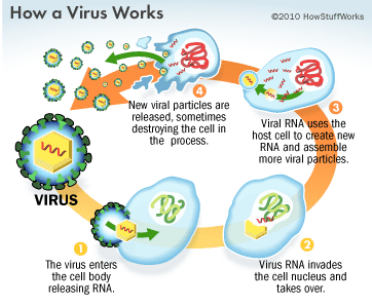
- Cholesterol is carried in your blood in two ways, as:
- - low density lipoprotein (LDL) cholesterol, which is bad and can cause heart disease.
- - high density lipoprotein (HDL) cholesterol, which is good as it can protect against heart disease by helping remove cholesterol from the walls of blood vessels.

B1 1.4 Pathogens & Disease

Pathogens are microorganisms that cause infectious diseases.

- Bacteria can reproduce rapidly inside the body. They produce toxins that make us feel ill.
- Viruses are much smaller and reproduce inside cells, damaging or destroying the cell.





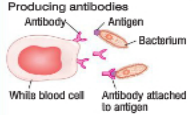
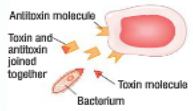
Epidemic – occurs when a wide spread of people have a disease.
Pandemic - occurs when the disease affects a whole country or goes world wide. Eg swine flu.

In the 1840s, a doctor called Semmelweis used evidence from the death rates of women to work out that they were dying because doctors were transferring something to them from dead bodies. He made all the doctors wash their hands between treating patients in chlorine water and, within a very short time, the death rate had decreased.

B1 1.5 Defence mechanisms

Pathogens can spread in a number of ways:
Droplet infection - when you cough or sneeze tiny droplets are released in the air and breathed in by other people, e.g flu
Direct contact - some diseases are spread by contact of the skin, e.g impetigo and STDs
Contaminated food / drink - Eating raw or undercooked food or drinking contaminated water. You take microorganisms straight into your stomach. E.g salmonellosis
Through a break in your skin – Pathogens can enter your body through cuts and grazes and needle punctures, eg hepatitis, HIV/Aids

The white blood cells.

Role of white blood cell	How it protects you against disease
Ingesting microorganisms 	Some white blood cells ingest (take in) pathogens, destroying them so they can't make you ill.
Producing antibodies 	Some white blood cells produce special chemicals called **antibodies**. These target particular bacteria or viruses and destroy them. You need a unique antibody for each type of pathogen. Once your white blood cells have produced antibodies once against a particular pathogen, they can be made very quickly if that pathogen gets into the body again.
Producing antitoxins 	Some white blood cells produce antitoxins. These counteract (cancel out) the toxins (poisons) released by pathogens.

Nelson Thornes Ltd 2011
p.33 - *AQA Science Biology New GCSE*
ISBN: 978-1-4085-0742-1

The body has a number of defence mechanisms.
First line of defence
Skin - acts as a barrier to prevent pathogens getting into the body.
If the skin gets broken, the platelets in the blood form a clot which dries into a scab, which seals over the cut.
Breathing system – produces sticky mucus that traps pathogens. It is then moved out of the body or into the stomach where it is destroyed by stomach acid.
Second line of defence
The white blood cells – these destroy the pathogens in a number of ways. See diagram above.

B1 1.6 Using drugs to treat disease

Some medicines contain useful drugs that help to relieve the symptoms of an illness, eg cold and flu medicines, but they do not affect the pathogens causing the illness.

Alexander Fleming first discovered penicillin in 1928. He was looking for something to kill bacteria. He noticed the effect of mould on his cultures. Eventually this was developed further by Ernst Chain and Howard Florey so that it could be produced on an industrial scale.

Nelson Thornes Ltd 2011
p.35 - *AQA Science Biology New GCSE*
ISBN: 978-1-4085-0742-1

Antibiotics will kill infective bacteria in the body. They damage the bacterial cells without harming our own cells.

They cannot be used to treat viruses.

This is because viruses reproduce in the body cells, so any treatment would also damage the cells.

Antiseptics and disinfectants can be used to kill bacteria outside the body, but they are far too poisonous to use inside your body.

B1 1.7 & 1.8 Growing and investigating bacteria, Changing pathogens

- Pure cultures of non-pathogenic (safe) bacteria can be used for laboratory investigations.
- A culture of microorganisms can be used to find the effect of antibiotics on bacteria.
- Cultures need to be uncontaminated to protect everyone. If not other bacteria could grow, including pathogens.
- To culture microorganisms, they need a culture medium called agar jelly. This contains the nutrients needed for growth.
- They should be incubated at 25°C in school labs and 35°C in industry. They also need oxygen.
- To keep the culture pure you must pass metal loops through a flame, boil solutions and agar. Also prevent microorganisms getting in from the air.

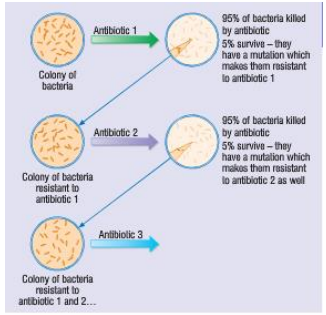
Sterilise the inoculating loop used to transfer micro-organisms to the agar by heating it until it is red hot in the flame of a Bunsen and then letting it cool. Do not put the loop down or blow on it as it cools.

Dip the sterilised loop in a suspension of the bacteria you want to grow and use it to make zigzag streaks across the surface of the agar. Replace the lid on the dish as quickly as possible to avoid contamination.

Seal the lid of the Petri dish with adhesive tape to prevent microorganisms from the air contaminating the culture – or microorganisms from the culture escaping. Do not seal all the way around the edge so oxygen can get into the dish and harmful anaerobic bacteria do not grow.

Nelson Thornes Ltd 2011
p.37 - *AQA Science Biology New GCSE*
ISBN: 978-1-4085-0742-1

Some pathogens, particularly viruses, can mutate forming a mutation. These then survive and reproduce. Some new strains can spread causing epidemics or pandemics.

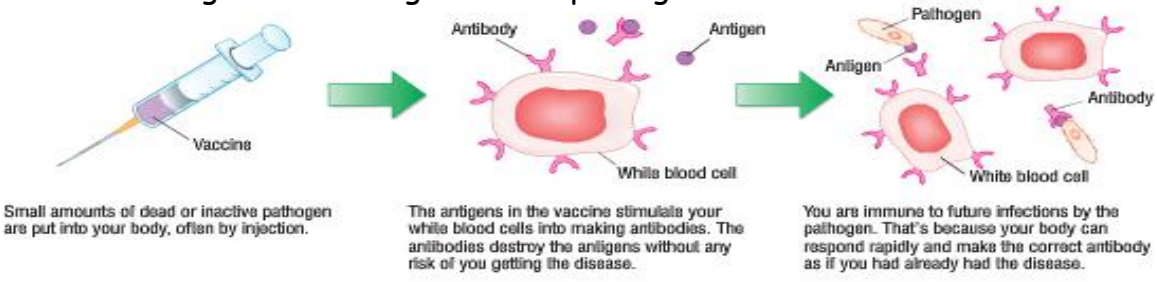


Nelson Thornes Ltd 2011
p.38 - *AQA Science Biology New GCSE*
ISBN: 978-1-4085-0742-1

Antibiotic-resistant bacteria are bacteria that have evolved through natural selection. Eg MRSA. Antibiotics should not be used too often in order to slow down the rate of resistant strains developing.

B1 1.9 Immunity & 1.10 How we deal with disease

- Dead or inactive forms of a pathogen are used to make a vaccine. Vaccines can be injected into the body.
- Vaccines can protect against bacterial and viral pathogens.
- The vaccine encourage the white blood cells to produce antibodies that destroy the pathogens.
- These make the person immune, preventing further infection because the body responds quickly by producing more antibodies.
- The antibodies recognise the antigen on the pathogen.



Most people in a population need to be vaccinated to protect society from very serious diseases.
Diseases such as measles can lead to long term damage to the body, such as deafness and occasionally death.
Some vaccines cause side effects which may be mild or serious. So there are advantages and disadvantages of immunisation.
Scientists are always trying to find new ways of treating diseases.

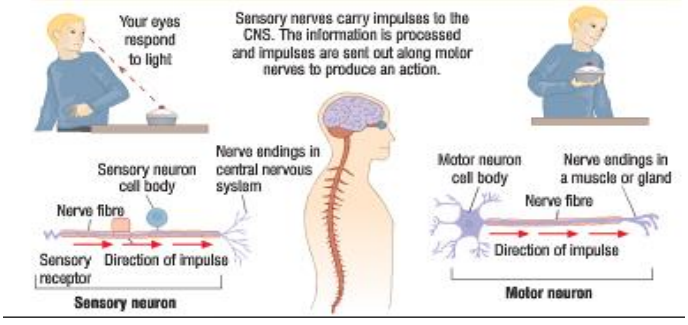
B1 2.1 Responding to change

Your nervous system has receptors that detect stimuli.

They are found in the sense organs.

The brain and spinal cord form the central nervous system (CNS)

Nerves contain neurons.
Sensory neurons carry impulses from receptors to the CNS.
Motor neurons carry impulses from the CNS to effector organs – these could be muscles or glands.
Muscles respond by contracting. Glands respond by secreting (releasing) chemicals



The rapid responses of our nervous system allows us to respond to our surroundings quickly. Your brain gets huge amounts of information from the sensory receptors and coordinates this and sends impulses out along special cells.

Receptor -> sensory neuron -> CNS -> motor neuron -> effector

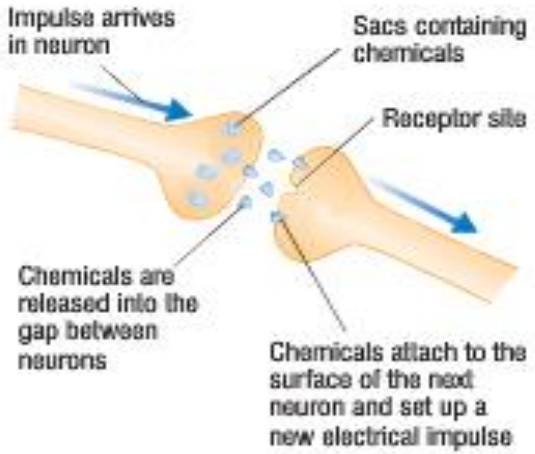
B1 2.2 Reflex actions

The main steps in a reflex action are:

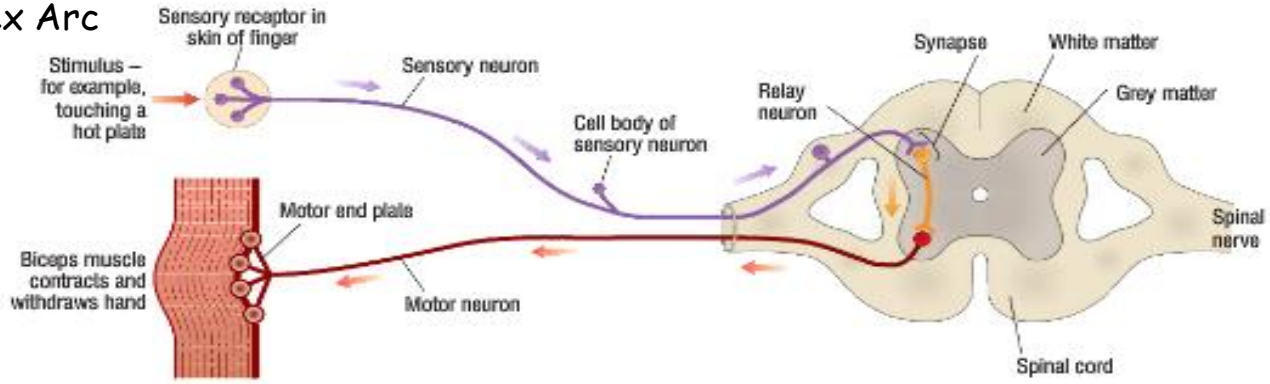
- A receptor detects a stimulus.
- A sensory neuron transmits the impulse to the CNS.
- A relay neuron passes the impulse on.
- A motor neuron is stimulated.
- The impulse passes to an effector (muscle or gland)
- Action is taken (the response).

At the junction between two neurons is the synapse. When an impulse arrives at the synapse chemicals are released that cross the gap. The impulse then continues at the next neuron.

Synapse



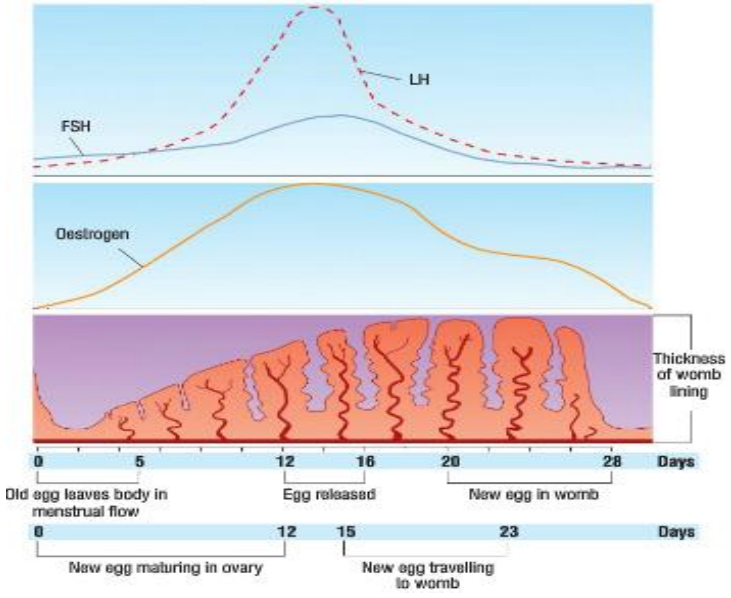
Reflex Arc



Stimulus -> receptor -> coordinator -> effector -> response

B1 2.3 Hormones and the Menstrual cycle.

Follicle stimulating hormone (FSH) is made by the pituitary gland and causes the egg to mature and oestrogen to be produced.
Oestrogen is produced by the ovaries and inhibits (stops) further production of FSH. It stimulates the production of LH and also stimulates the lining of the womb to develop to receive the fertilised egg.
Luteinising hormone (LH) is made in the pituitary gland and stimulates the mature egg to be released from the ovary (ovulation).



The average length of the menstrual cycle is about 28 days. Around 14 days the matured egg is released form the ovary. If the egg is fertilised by a sperm, then pregnancy may take place. The lining of the womb provides protection and food for the developing baby. If the egg is not fertilised, the lining of the womb and the dead egg are shed form the body during menstruation.

B1 2.4 The atrificial control of fertility

The contraceptive pill may contain oestrogen and progesterone. Some pills are progesterone only and have fewer side effects.
The contraceptive pill prevents the production of FSH so no eggs mature.
If a woman cannot produce mature eggs then FSH and LH can be given. This is known as 'fertility treatment'.
The FSH causes eggs to mature and LH stimulates ovulation.

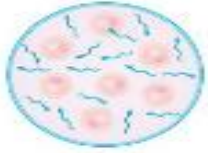
IVF (in vitro fertilisation) is when the egg and the sperm are fertilised outside of the body. They then develop into tiny embryos which are then inserted into the womb of the mother. During IVF the woman is given FSH to make multiple mature eggs. LH is then given at the end of the cycle to release the mature eggs.

Advantages	Disadvantages
Contraceptive pills have help reduce unwanted pregnancies.	Can cause side effects. Some people object to using it for ethical / religious reasons
Fertility drugs help infertile couples. IVF helps couples have a baby	IVF is expensive. Extra embryos produced may be stored or destroyed.

IVF

1 Fertility drugs are used to make lots of eggs mature at the same time for collection.

2 The eggs are collected and placed in a special solution in a Petri dish.



3 A sample of semen is collected and the sperm and eggs are mixed in the Petri dish.

4 The eggs are checked to make sure they have been fertilised and the early embryos are developing properly.

5 When the fertilised eggs have formed tiny balls of cells, 1 or 2 of the tiny embryos are placed in the womb of the mother. Then, if all goes well, at least one baby will grow and develop successfully.

B1 2.5 Controlling conditions

The body carefully controls its internal environment. Internal conditions that are controlled include:

- Water content
- Ion content
- Temperature
- Blood sugar level

Water is leaving the body all the time as we breathe out and sweat. We lose any excess water in the urine (produced by the kidneys). We also lose ions in our sweat and urine.

It is vital that the core body temperature is kept at 37°C.
We must keep our temperature constant, otherwise the enzymes in the body will not work properly.

Sugar in the blood is the energy source for cells. The level of sugar is controlled by the pancreas.

The process is called **homeostasis.**

Controlling water and ions.
Water moves in and out of your cells. How much depends on the concentration of the mineral ions (such as salt) and the amount of water in your body. If too much water moves in and out of the cells, they can be damaged or destroyed.
Your kidneys control the balance of water and mineral ions.

Controlling temperature
Your body controls temperature in several ways. It sweats to cool you down and shivers to warm you up. Your nervous system coordinates the way that your body responds to changes in temperature. Below 35°C you are at risk of dying from hypothermia. Between 40 – 42°C your enzymes and cells don't work properly. You may die from heat stroke / exhaustion

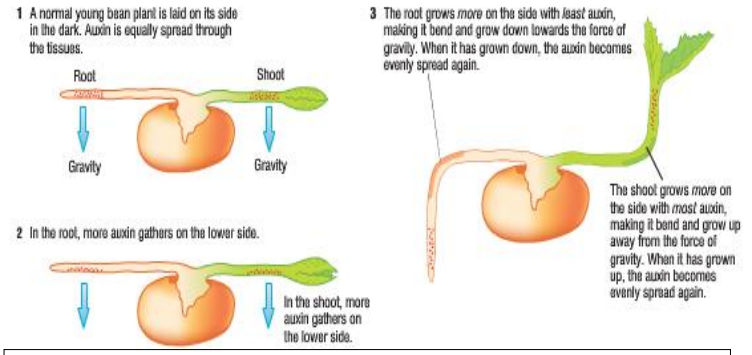
Controlling blood sugar
When you digest a meal, lots of sugar (glucose) passes into your blood. Left alone, your blood glucose levels would keep changing. Levels would be very high straight after a meal then very low again a few hours later. This would be chaos for you body.
The concentration of glucose is kept constant by hormones made by your pancreas. This means your body cells are provided with a constant supply of energy needed.

B1 2.6 Hormones and the control of plant growth

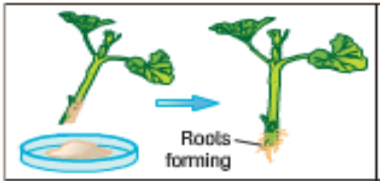
Plants need light and water for photosynthesis.
Plant responses - called **tropisms** - help make sure that any growth is towards sources of light and water.
There are two main types of tropism:
Phototropism – plant shoots grow towards light.
Gravitropism – roots grow down towards gravity.

Roots always grow towards water.

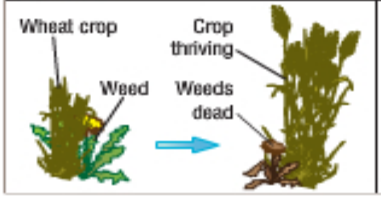
These responses are controlled by a hormone called **auxin.**



Gravitropism in shoots and roots. The uneven distribution of auxin causes unequal growth rates so the roots grow down and the shoots grow up.



Gardeners and horticulturists rely on taking cuttings to produce lots of identical plants. Plant growth hormones are used as rooting powder. A little placed on the end of a cutting stimulates the growth of new roots and helps the cutting to grow into a new plant.



You can use high doses of plant hormones as weed killers. Most weeds are broad-leaved plants which absorb a lot of hormone weed killer. This makes them go into rapid, uncontrolled growth which kills them. Narrow-leaved plants such as grasses and cereal are not affected, so the crop or lawn keeps growing well.

Plant hormones can be used to manage plants grown in the garden or home. Farmers also use them to help grow better crops.
We can use plant hormones as weed killers and as a rooting hormone on cuttings.

B1 2.7 Using hormones

- Many women use the contraceptive pill to prevent unwanted pregnancies. It can help to plan when a woman wants to have a baby.
- Women also use hormones to help them become pregnant.
- Sometimes hormone treatment is used to help older women to have babies. This may involve using an egg donor who is given hormones to produce extra eggs.
- Taking extra hormones for a long time can lead to side effects in some women.
- Many people think that it is wrong to use hormones to control fertility.

- Plant hormones can be used by farmers and gardeners.
- Weedkillers are used to kill unwanted plants in gardens.
- When cuttings are taken form plants, hormones are used to encourage roots to grow before the cutting is planted.
- Some hormones are used to encourage fruit to ripen.
- If plant hormones are used incorrectly they can cause damage to the environment, e.g. weedkillers may harm other useful plants.

B1 3.1 Developing new medicines

- Large numbers of substances are tested to see if they might cure a disease or relieve symptoms.
- The first tests are in laboratories on cells and tissue. If the drug seems to work it is then tested on animals, healthy human volunteers (low doses are given to see if it is safe) and finally on patients.
- In some trails, with patients, placebos are used. These do not contain a drug. Half the patients are given the placebo and half take the drug. This is to check whether the drug really does have an effect on the patient.
- Sometimes, neither doctor nor patient know who is given the drug (double-blind trial).

A good medicine needs to be:

- Effective – it must prevent or cure a disease or at least make you feel better.
- Safe – the drug must not be too toxic or have unacceptable side effects.
- Stable – you must be able to use the medicine under normal conditions and store it for some time.
- Successfully taken into and removed from your body – it must reach its target and be cleared from your system once it has done its work.

Thalidomide was developed as a sleeping pill, but doctors found it could be used for morning sickness in pregnant women.
Unfortunately it had not been tested for this. Some babies were born with limb abnormalities.

The drug was banned and the rules for drug testing improved.
Thalidomide has recently been used to treat other conditions such as leprosy.

B1 3.2 How effective are medicines?

The statin revolution

High blood cholesterol levels are linked to an increased risk of cardiovascular disease.

Statins are drugs which lower the amount of 'bad' cholesterol carried in the blood.

They stop your liver producing too much cholesterol.

Trials show they have reduced the incidence of cardiovascular disease by over 40%

Patients need to keep a relatively low fat diet as well for the best effects.

Non-prescribed drugs

Some people prefer to take non-prescribed drugs.

Herbs and natural products are often used in these drugs, but they can contain potentially dangerous chemicals.

St John's Wort is a herb sometimes used to treat depression instead of anti-depressants such as Prozac.

Scientific studies carried out suggest that St John's Wort is as effective as the most common prescribed anti-depressants. It also has fewer side effects.

B1 3.3 Drugs & 3.4 Legal and illegal drugs

A drug is a substance that alters the way in which your body works.
Many drugs originally come from natural substances, often plants.
Medicinal drugs are used to control disease or help people who are suffering. Many of which are only available on prescription from a doctor.
Recreational drugs are used for pleasure and effect the brain and the nervous system.

Addiction
Some drugs change the chemical processes in your body so that you may become addicted to them. This means you become dependant on them and you need them more and more.
If you try to stop taking addictive drugs you will suffer withdrawal symptoms.

Legal & illegal drugs
Caffeine, nicotine and alcohol (over 18) are legal drugs that are used recreationally.
Cocaine, cannabis and heroin are illegal drugs that are used recreationally.
Some drugs like caffeine and cocaine speed up the activity of your brain. They make you feel more alert. These are stimulants.
Others, like alcohol and cannabis, slow down the responses of the brain. These are depressants. Heroin actually stops impulses travelling in your nervous system.

B1 3.5 Does cannabis lead to hard drugs & 3.6 Drugs in sport

- There is evidence that cannabis can cause mental illness in some people.
- Teenagers who smoke cannabis increase their risk of getting depression.
- Cannabis is an illegal drug and users are more likely to come into contact with other illegal drugs such as heroin.
- Not all cannabis users go on to hard drugs.

Figure 2 In the minds of many people – parents, teachers and politicians – cannabis is a 'gateway' drug. It opens the door to the use of other much harder drugs such as cocaine and heroin. Your health – and indeed your life itself – is at risk. How accurate is this picture?

Drugs in sport

Steroids are drugs which are used to build up muscle mass.

Other drugs may be used to increase stamina. These drugs stimulate the body to produce more red blood cells. This means they can carry more oxygen around the body.

Strong painkillers allow an athlete to train and compete with an injury. This could lead to further or permanent damage.

Using performance enhancing drugs can damage your body permanently or even lead to death.

Athletes who are found using illegal drugs are banned form competing.

B1 4.1 Adapt and survive

To survive and reproduce, organisms require materials from their surroundings and from other organisms living there.

Plants need light, carbon dioxide, water, oxygen and nutrients, such as mineral ions form the soil.

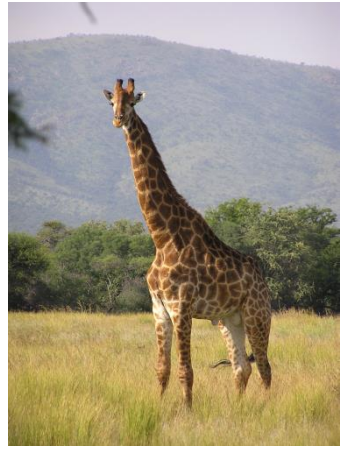
Animals need food from other organisms, water and oxygen.

Different microorganisms need different materials. Some are like plants, others are like animals. Some do not require oxygen or light to survive.

Special features of an organism are called adaptations.

Extremophiles are organisms that live in very extreme environments and can survive conditions that would kill most other organisms. The extreme conditions can include:

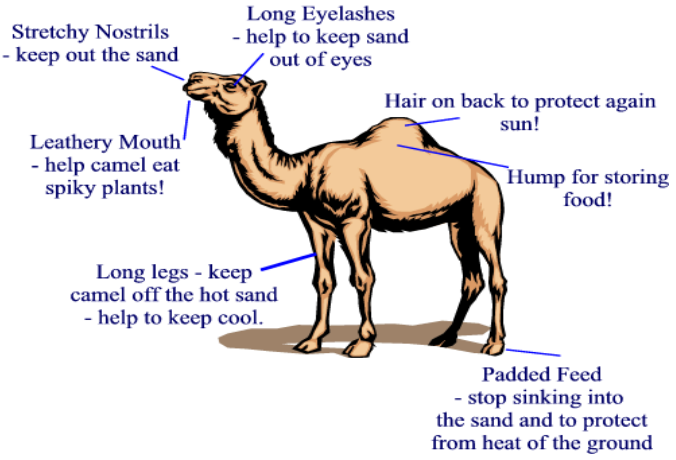
- high temperatures
- high concentrations of salt in water
- high pressures.

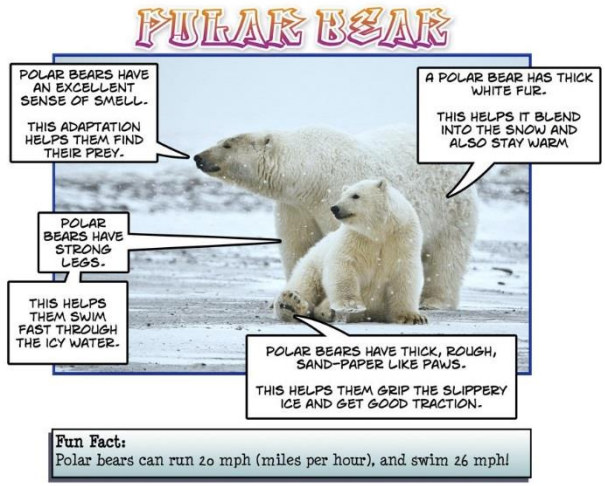


Herbivores (plant eating animals) have teeth for grinding up plants.
Carnivores (meat eating animals) have teeth adapted for tearing flesh and crushing bone.

B1 4.2 Adaptation in animals

- If animals were not adapted to survive in the areas they live in, they would die.
- Animals in the Arctic(e.g Artic fox) are white in the winter and brown in the summer. This means that they are camouflaged so they are not easily seen.
- Bigger animals have a smaller surface areas compared to their volume. This means that they can conserve energy more easily, but it is also difficult to cool down.



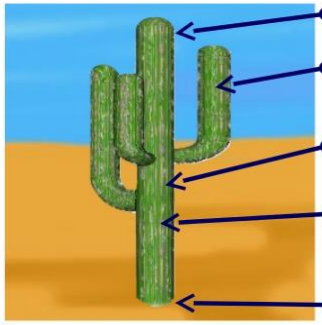


- Animals in cold climates have a thick fur and fat under the skin (blubber) to keep them warm.
- In hot dry conditions (desert) animals are adapted to conserve water and to stop them getting too hot. Animals in the desert may hunt or feed at night so that they remain cool during the day.

B1 4.3 Adaptation in plants

How is a cactus adapted?

How is a cactus adapted to life in a very hot, dry climate?



- Thick, waxy surface to reduce water loss.
- Leaves are narrow spines that reduce water loss and protect from predators.
- Stores water in fleshy stem.
- Plant surface area is small compared to volume to reduce water loss.
- Some have shallow, spreading roots for surface water, others have deep roots.

- Plants need light, water, space and nutrients to survive.
- Plants need to collect and conserve water. They can lose water as water vapour through holes in the leaves called stomata.
- Water can be collected if the plant has an extensive root system.

- Water can be conserved if the plant has very small or waxy leaves. A plant might have a swollen stem to store water.
- In dry conditions, e.g deserts, plants (such as cactus) have become very well adapted to conserve water. Others (such as the mesquite tree) have adapted to collect water using extensive root systems.

Unusual plant adaptations

Plants can live in acid or waterlogged soils where there is little nitrate. Some plants have evolved a rather cunning adaptation to obtain the nutrients they need.

Pitcher plants have a large hollow filled with fluid that traps insects or other small organisms that may fall in.

Hairs on the slippery inside of the plant are angled down to ensure that the victim cannot escape!

The plant **digests** its victims to absorb the nitrates it needs!

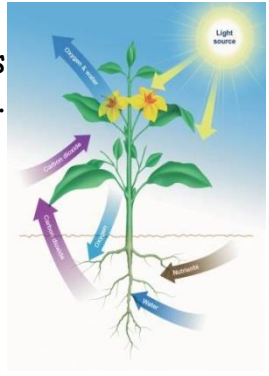
B1 4.4 & 4.5 Competition

Competition in Animals

Animals are in competition with each other for water, food, mates and territory.
Their territory needs to be large enough to find water, food and have space for breeding.
Predators compete with their prey as they want to eat them. Prey compete with each other to avoid being hunted.
Predators and prey may be camouflaged so they are less easy to see.
Some animals e.g caterpillars, may be poisonous and have warning colours so they do not get eaten.

Competition in plants

All plants compete for water, nutrients and light.



Plants which grow deep roots can reach underground water better than those with shallow roots.

Some plants spread their seeds over wide areas so they don't compete with themselves.
Some of these plants use animals to spread their fruit and seeds.
Some plants use the wind or mini explosions to spread their seeds.

B1 4.6 How do you survive?

Some animals and plants have very unusual adaptations which make them successful competitors. Female fig wasps have specially shaped heads for getting into fig tree flowers and ovipositors that allow them to place eggs deep inside the flower. Some male fig wasps spend their lives inside the flowers waiting for a female.

Ovipositor is the egg-laying organ of most female insects, consisting of a pair of specialized appendages at the end of the abdomen

The star-nosed mole lives underground and is almost blind, but is very sensitive to touch and smell.

Venus fly traps are insect eating plants. They have a sweet, sticky nectar that the insects are attracted to. Sensitive hairs pick up movement and trigger the plant to snap shut.

B1 4.7 & 4.8 Measuring environmental change & Impact of change

Animals and plants are affected by their environment. If the environment changes, the organisms may not be able to live there anymore.

Non-living factors which might change include : temperature, rainfall, light and oxygen levels.

Living factors which might change include: arrival of a new predator or disease, or the introduction of new plants which provide new food or habitats

The impact of change

- Changes in the environment affect the distribution of living organisms.
- It is sometimes difficult to determine what is affecting the organism.
- Birds may fly North if the climate gets warmer. Other birds may then have new competitors.
- The large fall in the bee population may have been caused by several factors. These include the use of chemical sprays by farmers, a viral disease or possibly changes in flowering plants due to climate change.

Pollution indicators and monitoring

- Lichens indicate the level of air pollution, particularly sulfur dioxide. The more species of lichen growing, the cleaner the air. They are an example of an indicator species, which indicate changes in environmental pollution levels.
- Freshwater invertebrates indicate the level of water pollution in the same way, in particular the concentration of dissolved oxygen in the water. The wider the range of these invertebrates, the cleaner the water in the streams, river or pond. Some freshwater invertebrates will only live in polluted water.
- Equipment such as rain gauges, thermometers, pH and oxygen sensors and data loggers can be used to monitor non-living changes in the environment.

B1 5.1 Pyramids of biomass

- Biomass is the mass of living material in plants and animals.
- A pyramid of biomass represents the mass of the organisms at each stage in a food chain. It may be more accurate than a pyramid of numbers. For example, one bush may have many insects feeding on it but the mass of the bush is far greater than the mass of the insects.
- Green plants transfer solar (light) energy to chemical energy which is then passed through the food chain.

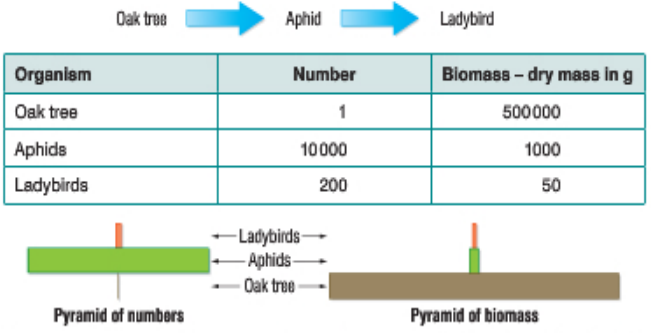
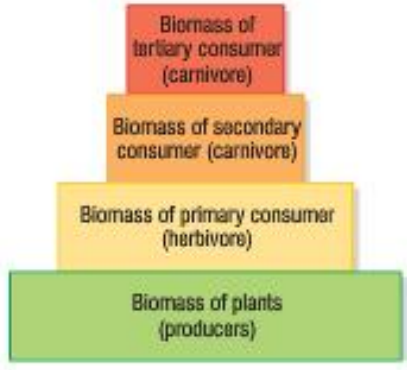


Figure 2 Using a pyramid of biomass shows us the amount of biological material involved at each level of this food chain much more effectively than a pyramid of numbers



Any food chain can be turned into a pyramid of biomass like this

B1 Energy transfers

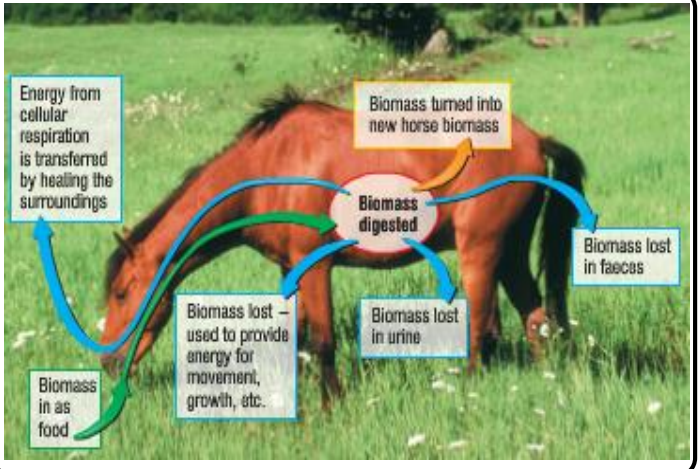
There is energy wastage between each stage of a food chain. This means that not all of the energy taken in by an organism results in the growth of that organism.

Not all of the food can be digested, so energy is stored in faeces or as urea in urine (waste materials).

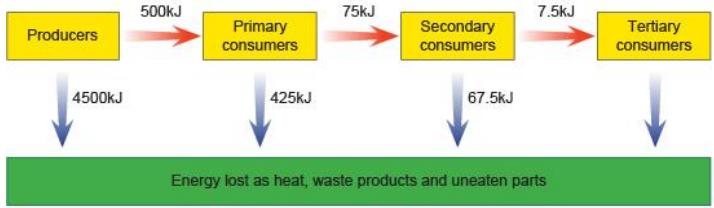
Some of the biomass (food) is used for respiration, which releases energy for living processes. This includes movement, so the more something moves the more energy it uses and less is available for growth.

In animals that need to keep a constant temperature, energy from the previous stage of the food chain is used up simply to keep the animal at its normal body temperature.

Much of the energy released in respiration is eventually transferred to the surroundings.



Energy is never 'lost', it is transferred. Not all the energy is transferred to the next stage is converted into growth.



B1 5.3 Decay process

The decay process

All organisms take up nutrients. If they didn't eventually release them, the nutrients would run out.

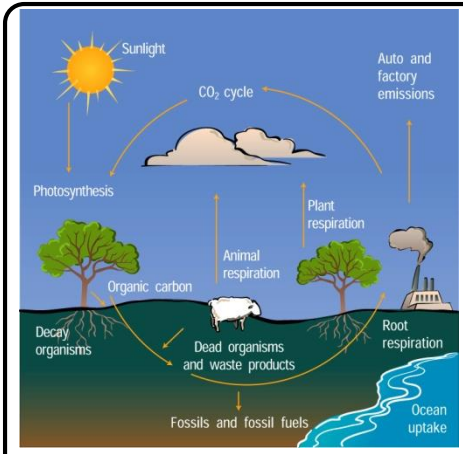
- Decomposers are a group of microorganisms that include bacteria and fungi. They feed on waste droppings and dead organisms.
- Detritus feeders (such as maggots and some type of worms) may start the process of decay by eating dead animals or plants and produce waste materials. Decay organisms then break down the waste.
- Decay organisms are microorganisms (bacteria and fungi). They are called decomposers.
- All materials from the waste and dead organisms are recycled, returning nutrients to the soil.

Conditions for decay

The speed at which things decay on the conditions. Decay is faster if it is warm, moist. Most decomposers respire and so decay takes place more rapidly when there is plenty of oxygen.

In sewage treatment plants we use microorganisms to break down the bodily waste that we produce. This makes it safe to release into rivers or the sea.
Decomposers are used in compost heaps to break down garden waste and vegetable peelings. This makes a useful substance called compost that can be use as a fertiliser.

B1 5.4 the carbon cycle.



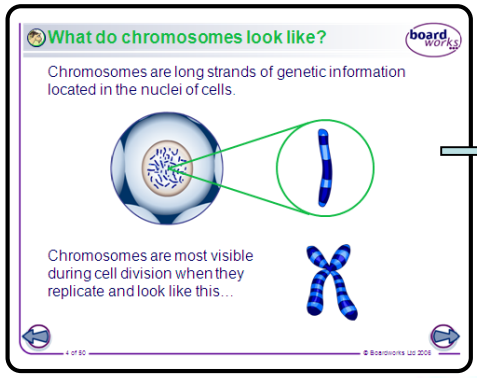
- The recycling of carbon involves both photosynthesis and respiration.
- Photosynthesis removes CO_2 from the atmosphere.
- Green plants as well as animals respire. This returns CO_2 to the atmosphere.
- Combustion of fossil fuels releases CO_2 into the atmosphere.
- Animals eat green plants and build the carbon into their bodies. When organisms die (or produce waste) microorganisms release CO_2 back into the atmosphere through respiration.
- A stable community recycles all of the nutrients it takes up.

5.5 Recycling organic waste

Waste vegetables and peelings from the kitchen, or grass cuttings and clippings from trees in the garden, contain organic waste.
Organic waste can be composted in several ways.
The most efficient methods of composting allow the waste to be mixed with oxygen and moisture. They allow energy to escape by heating the surroundings.
Gardeners may add worms and layers of garden soil to composters to speed up the process.
Councils also collect garden waste and use shredders and large bins to compost the material.

B1 6.1 Inheritance

The nucleus of a cell contains chromosomes.



Chromosomes carry the genes.

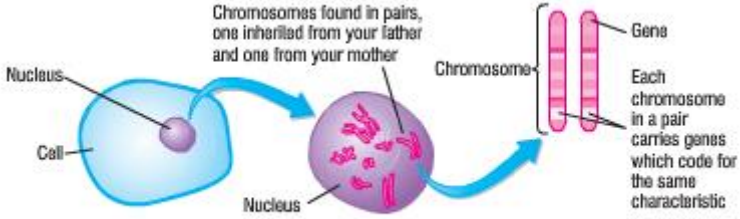


Figure 3 The nucleus of your cell contains the chromosomes that carry the genes which control the characteristics of your whole body

Humans have 26 pairs of chromosomes. In the nuclei of the gametes (sex cells) there is only a single set of chromosomes. Make and female gametes contain one set of genes.

Genetic information is passed from the parents to offspring during reproduction. Offspring then contain 2 sets of genes, inherited from both parents.
Different genes control the development of different characteristics of the offspring.
In most body cells the chromosomes are in pairs. One set form the female gamete and one from the male gamete.

B1 6.2 Types of reproduction

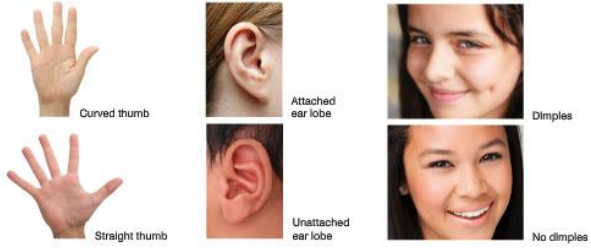
Asexual reproduction does not involve the fusion of gametes (sex cells). All of the genetic information comes form one parent. All of the offspring are genetically identical to the parent, so there is little variety.

Identical copies produced by asexual reproduction are called clones.

Sexual reproduction involves the fusion of sex cells (gametes).
There is a mixing of genetic information, so the offspring show variation.
In animals, the sex cells are eggs and sperm.
Offspring produced by sexual reproduction are similar to both parents, but cannot be identical.
That is because they have a combination of two sets of genes.
Random mixing of genes leads to variation in the offspring. This is important in survival. Some characteristics may give offspring a better chance of surviving difficult conditions

Variation

Different genes control genes control the development of different characteristics. Hair colour and eye colour are controlled by several pairs of genes. Some are controlled by 1 single pair such as earlobes, dimples etc.



B1 6.3 Genetic and environmental differences

Nature – genetic variety

The genes you inherit determine a lot about you. The basic characteristics of every species are determined by the genes they inherit.
Certain human characteristics are clearly inherited. Features such as eye colour, the shape of your nose and earlobes, your sex and dimples are a result of genetic information inherited from your parents.

Nurture – environmental variety

Some differences between you and other people are due to the environment they live in. For example, if a have a scar from an accident or operation or you may change the colour of your hair. These are environmental variation not genetic.

Genes play a major part in deciding how an organism will look. However the conditions in which it develops play an important part too. Genetically identical plants that are grown under different conditions would not look identical.

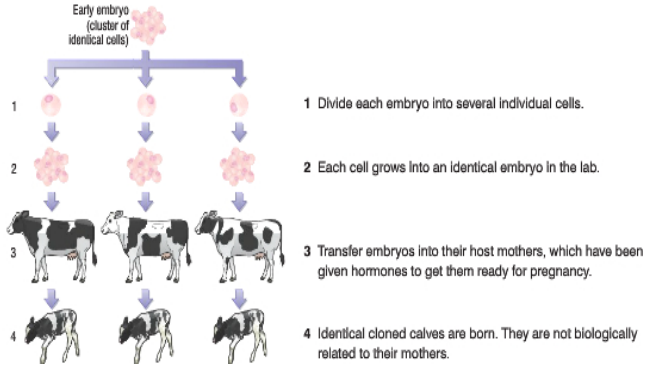
Combined causes of variety.

Many of the differences between individuals of the same species are the result of both their genes and the environment. For example, you inherit your hair colour and skin colour from your parents. However, whatever you inherit could change due to the conditions you are living in. For example if you go on holiday to a sunnier environment your skin will go darker.

B1 6.4 Cloning

- Individuals which are genetically identical to their parents are known as 'clones'.
- Cloning is used to produce new individuals that are useful in farming and agriculture.
- Cloning plants can be cheap and cost effective. This can be done by taking cuttings and growing them.

- Taking small groups of cells from part of a plant and growing them under special conditions is called tissue culture. This is more expensive, but can be used to reproduce large numbers of a rare or top quality plant.



Embryo transplants are used to clone animals. In this process an embryo with unspecialised cells is split into smaller groups of cells. Each group of genetically identical cells is transplanted and allowed to develop in a host animal.

Clones are formed by asexual reproduction.

Sometimes animals or plants are genetically modified to produce useful substances before they are cloned.

B1 6.5 Adult cell cloning

Adult cell cloning

To clone a cell from an adult animal is easy. The cells of your body reproduce asexually all the time to produce millions of identical cells. However, to take a cell from an adult animal and make an embryo or even a complete identical animal is a very different thing.

When a new whole animal is produced from the cell of another adult animal, it is known as **adult cell cloning**. This is still relatively rare. You place the nucleus of one cell into the empty egg cell of another animal of the same species. Then you place the resulting embryo into the womb of another adult female where it develops until it is born.

Here are the steps involved:

- The nucleus is removed from an unfertilised egg cell.
- At the same time the nucleus is taken from an adult body cell, e.g. a skin cell of another animal of the same species.
- The nucleus from the adult cell is inserted (placed) in the empty egg cell.
- The new cell is given a tiny electric shock that makes it start dividing to form embryo cells. These contain the same genetic information as the original adult cell and the original adult animal.
- When the embryo has developed into a ball of cells it is inserted into the womb of an adult female to continue its development.

Adult cell cloning has been used to produce a number of whole animal clones. The first large mammal ever to be cloned from the cell of another adult animal was Dolly the sheep, born in 1997.

Advantages

Development of cloned animals which have been genetically engineered to produce valuable proteins in their milk. These can be used in medicine.

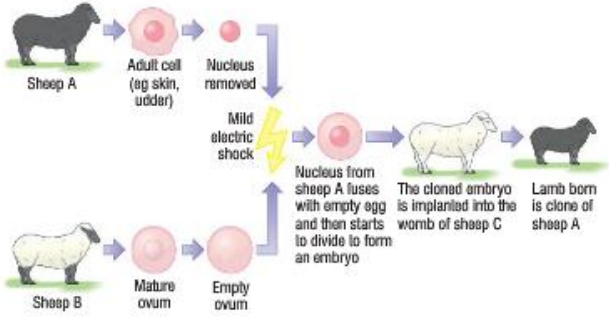
Cloning can save animals form extinction.

Disadvantages

Concerns about the ethics of cloning.

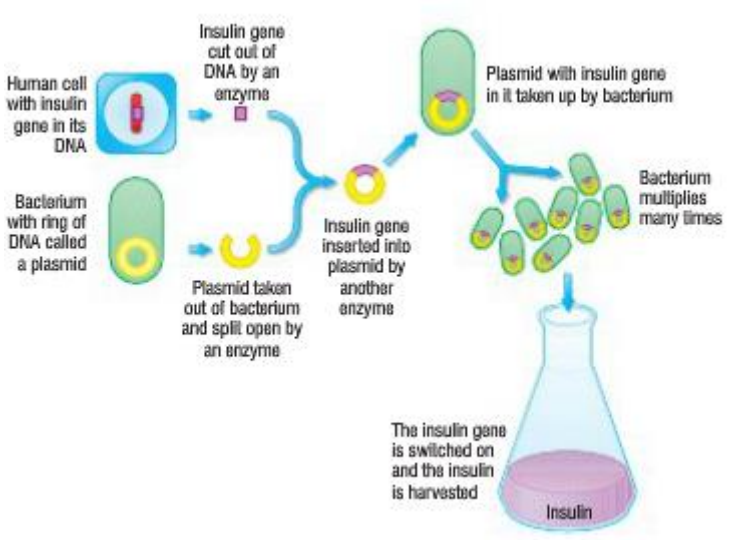
Cloning limits variation. This can effect natural selection.

Concerns about using the technique to clone humans in the future.



B1 6.6 Genetic engineering

Genetic engineering involves changing the genetic make-up of an organism.



Genetic engineering is used to transfer a gene from one organism to another.

Genes can be transferred to the cells of animals and plants at an early stage in their development.

A gene is 'cut out' of the chromosome of an organism using an enzyme. The gene is then placed in the chromosome of another organism.

The genes may be placed in an organism of the same species to give it a 'desired' characteristic.

Sometimes genes are placed in a different species, such as a bacterium. For example, the gene to produce insulin in humans can be placed in bacteria. Then the bacteria can produce large quantities of insulin to treat diabetes.

Crops with changed genes are called genetically modified (GM) crops.
GM crops may be insect or herbicide resistant and usually increase yields.

B1 6.7 Making choices about technology

There are advantages and disadvantages in the use cloning and genetic engineering.

There are a number of economic, social and ethical issues concerning cloning and genetic engineering which need to be considered when making judgements about the use of this science.

Advantages

Cloning cattle can produce herds of cattle with useful characteristics.

Adult cell cloning may be used to make copies of the best animals.

If a person has a faulty gene they may have a genetic disorder. If the correct gene can be transferred to the person they could be cured.

Several medical drugs have been produced by genetic engineering.

GM crops include ones which are resistant to herbicides or to insects.

Disadvantages

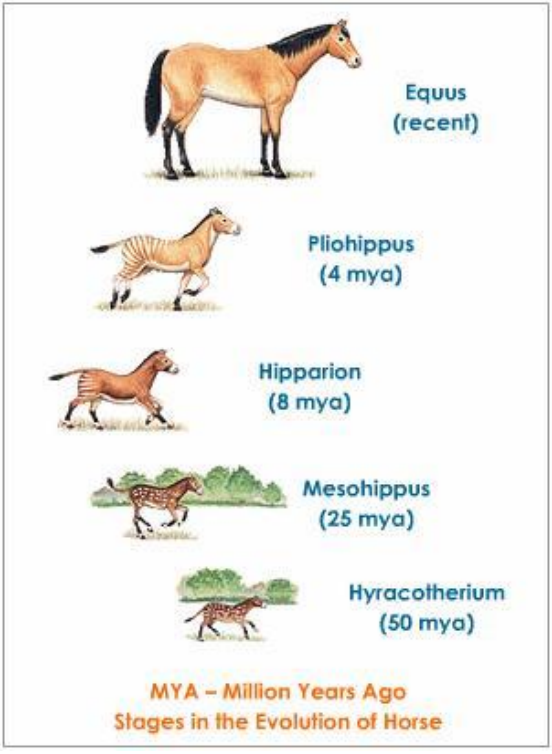
GM crops are infertile.

Insects which are not pests may be affected by GM crops.

People worry about the effect GM crops have on human health.

Some people say that it is unethical. What are long term effects?

B1 7.1 Theories of evolution



All species of living things have evolved from simple life forms. These simple forms developed more than 3 billion years ago.

Jean-Baptiste Lamarck suggested a theory called 'the inheritance of acquired characteristics'. His theory stated that characteristics which develop during an organism's lifetime can be passed on to the next generation.

This would mean that if two parents were to build up muscle in the gym, they would pass this characteristic onto their offspring.

Charles Darwin suggested the theory of 'natural selection' after he had made a journey to the Galapagos Islands.

He stated that small changes in organisms took place over a very long time. All organisms in a species vary and therefore some are more likely to survive (natural selection). Those that are better adapted breed and pass on their characteristics.

B1 7.2 & 7.3 Darwin's ideas & Natural selection

Darwin's theory was only gradually accepted for several reasons.

- His theory challenged the idea that God had created every living thing on Earth.
- Many scientists were not convinced because there was insufficient evidence.
- Darwin could not explain why there was variety in organisms, or how inheritance worked. Scientists did not know about genetics until about 50 years later.
- Darwin had tried to show that birds, such as finches on the Galapagos Islands, could change over time if they lived under different environmental conditions. During his lifetime he could not explain, in terms of genes, why offspring inherited the useful adaptations.

Natural selection

- Natural selection works because the fittest organisms survive and breed.
- Variation occurs because of differences in their genes.
- Organisms with characteristics most suited to the environment will survive. Examples are; better camouflage, best eyesight, quickest to run away from predators.
- The genes that have enabled these organisms to survive are then passed on to their offspring.
- Sometimes a gene accidentally changes and becomes a new form of the gene. This is called a mutation. If the mutated gene makes the organism better adapted then it will be passed on to the offspring.
- Mutations may be particularly important in natural selection if the environment changes. For example, when the rabbit disease myxomatosis killed most of the rabbits in the UK, a few rabbits had a mutated gene which gave them immunity, and so they survive and were able to breed.

B1 7.4 Classification and evolution

- There are millions of different types of living organisms. By putting organisms into groups we can make more sense of how closely they are related. Grouping organisms is called classification.
- Natural classification system studies the similarities and differences between organisms in order to classify them.
- The largest groups are called kingdoms. The plant kingdom, the animal kingdom and kingdoms that contain microorganisms.
- The smallest groups are called the species. Members of a species are very similar and can breed together.
- Evolutionary trees are models that are drawn to shown the relationships between different groups of organisms.
- Ecological relationships tell us how species have evolved.

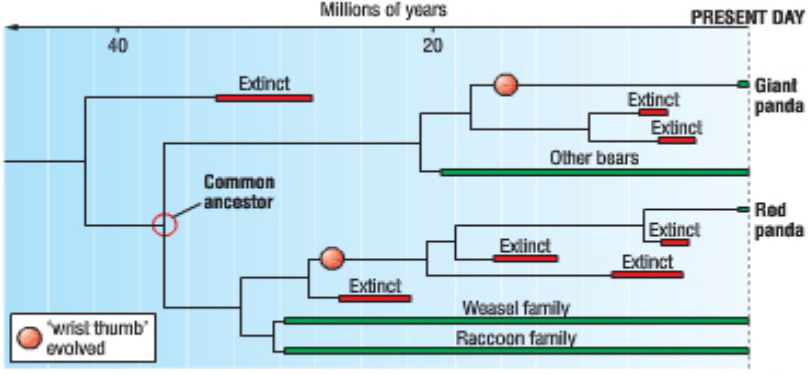


Figure 3 Evolutionary trees like this show us the best model of the evolutionary relationships between organisms

Often scientists come up with different hypotheses to explain similar observations.
The only way to find out whose hypothesis is right is to find evidence to support or disprove each one.
Fossils provide us with the evidence of how much – or little organisms have changed over time.