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Transporting materials

AQA Biology B3 revision card: The heart

The human body has two transport systems called **double circulation**. One carries blood from the heart to the lungs and back, the other carries oxygenated blood from the heart to the rest of the body and back.

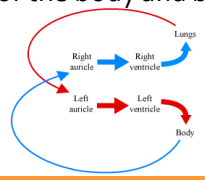

Image: www.meritnation.com

The heart cycle:
A **ventricle** fills with blood by the contraction of an **atrium**. When a ventricle contracts, blood is forced into an **artery**. When a ventricle relaxes, the backflow of blood into it is prevented by the closing of a **semi-lunar valve**. VAVA: Vein->Atrium->Ventricle->Artery

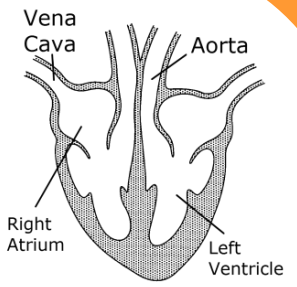

Image: www.thestudentroom.co.uk

Coronary arteries

The heart is a muscle and supplied with oxygen by coronary arteries. If these arteries get blocked, the person suffers a **heart attack** or death. **Fatty deposits** form on the lining of the arteries as people age.

Image: besthealth.bmj.com

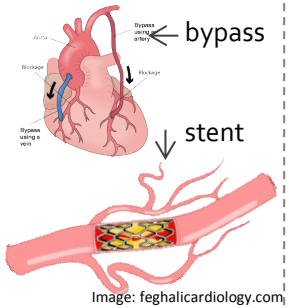

Image: feghalicardiology.com

Doctors treat narrowed blood vessels by either performing a **bypass** operation, inserting **stents** (metal mesh) or prescribing **statins**. Stents keep the arteries open, a bypass is a new blood vessel around the narrowed region, statins remove some of the cholesterol blockage.

Artificial hearts

Image: www.msichicago.org

People who need a heart transplant need to wait for a **donor** heart that is a **tissue match**. Many people die before a new heart is found as there is a shortage of donors. Receiving an artificial heart can prolong or save a life until a donor heart is found, although the **success rate** is actually quite low and many patients do not survive for very long.

The disadvantages of artificial hearts are that they need a **battery** to keep them working which can cause the patient **pain** or **discomfort**. It has a limited **lifespan** and needs constant **recharging**. There is always a risk of **blood clotting** and **infection** so patients have to take **medication** on a daily basis.

Heart valves keep the blood flowing in the right direction, however, they may weaken and start to leak. Valves can be replaced with mechanical valves which last for a very long time. The disadvantage is that patients need to take **medicines** for the rest of your life to prevent blood from clotting. **Pig valves** can also be used although some people find this unethical.

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The heart video

Artificial heart video

Questions

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Example questions & answers

biologymaster

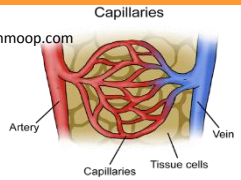
Transporting materials

AQA Biology B3 revision card: Blood and blood vessels

Arteries


These carry **oxygenated** blood away from the heart to organs of the body. **Arteries** have thick walls, a thick layer of **muscle and elastic fibres** (so they can **stretch** as blood is forced through them and go back into shape afterwards) and a **small lumen**. Blood in the arteries is under **high pressure**.

Image: www.shmoop.com



Blood flows from the artery through the **capillaries** to the vein. Substances needed by cells pass out of the blood, substances produced by the cells pass into the blood, through the **one cell thin** walls of the capillaries. The capillaries are very **narrow** so blood flows through them slowly and blood **pressure is lowered.**

Veins

These carry **deoxygenated** blood to the heart. **Veins** do not have a pulse but they do have **valves** to **prevent back-flow** of blood.

vein

valve

Image: www.ohsu.edu

Blood is a tissue and consists of the following:

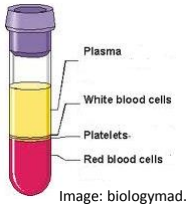


Image: biologymad.com

Blood is made of a fluid called **plasma**. Plasma transports **carbon dioxide** from the organs to the lungs, soluble products from digestion (**glucose**, amino acids, fatty acids, glycerol, minerals,), **urea**, water, blood cells, **hormones**, cholesterol, antibodies, antitoxins, bacteria, viruses, drugs.

Red blood cells transport oxygen from the lungs to the organs. They are **biconcave discs** which increases their surface area to volume ratio. They are packed full of the red pigment **haemoglobin**. In the lungs haemoglobin combines with oxygen to form **oxyhaemoglobin**. In other organs, where the oxygen concentration is lower than in the blood, oxyhaemoglobin splits up into oxygen and haemoglobin.

Platelets are small **fragments of cells** that do not have a nucleus. Platelets help form a network of protein threads that capture lots of red blood cells and more platelets to form a **blood clot**. The clot dries and hardens to form a scab which stops microorganisms from entering.

White blood cells are bigger than red blood cells, contain a nucleus and form part of the body's **defence system** against microorganisms. Some white blood cells form antibodies, others engulf and ingest invading pathogens.

If you lose a lot of blood, you might be given a **blood transfusion**. The problems are that some people object because of religious reasons, blood has a limited shelf-life and the blood must match your blood group.

In an emergency you could be given plasma or saline to replace the volume of blood lost and buy some time. However, plasma carries little oxygen and saline does not carry any oxygen or food.

Perfluorocarbons (PFC) are non-reactive chemicals that carry dissolved gases around the body, but they are broken down quickly, have severe side-effects and are difficult to dissolve in blood.

Haemoglobin-based **artificial blood** can be made in the lab or by genetically engineered bacteria. It does not need to be kept in the fridge and it carries a lot of oxygen. However, it only lasts for 20-30 hours, does not clot or fight diseases.

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Blood video

Artificial blood video

Questions

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Transporting materials

AQA Biology B3 revision card: Xylem, phloem & transpiration

Transporting sugars

Photosynthesis produces **glucose** which is transported from the leaves to the rest of the plant in **phloem tissue** (**ph**loem-**f**ood). Food is also transported to storage organs for the winter months.

In trees the phloem is found in a ring just underneath the bark, which is why a tree dies if the entire ring of bark is removed. Sugar is needed for respiration and to make cellulose, starch and proteins.

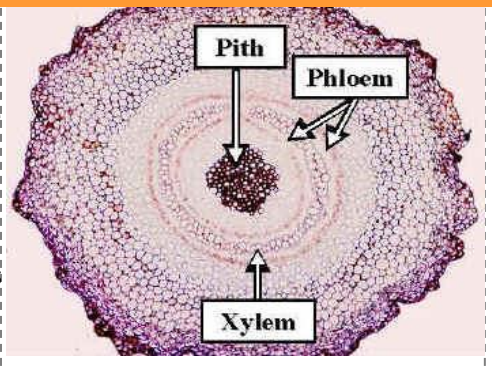
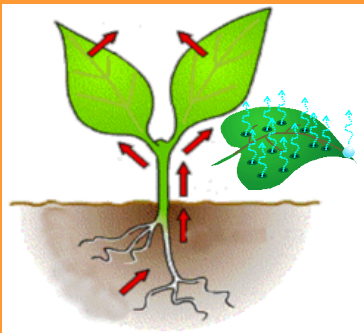


Image: www.biologie.uni-hamburg.de

Transporting water

Xylem tissue carries **water** and mineral ions from the roots to the stem and leaves. Mature xylem cells are dead and in trees the xylem makes up the bulk of the wood. Water is needed to maintain cell **turgor** and for photosynthesis.



Transpiration stream

Water is constantly moving from the roots via the xylem to the leaves. Here it is lost through the open stomata by evaporation. As water **evaporates** from the leaves, more is pulled up through the xylem to replace the lost water. The **stomata** are opened (and closed) by the surrounding **guard cells** to allow carbon dioxide to enter which is needed for photosynthesis. At the same time water is lost.

On hot and **sunny** days when the **rate of photosynthesis** is high, the **rate of evaporation** is also high. If the rate of evaporation is higher than the rate of water uptake, the plant will **wilt** to reduce the **surface area** of the leaves to reduce water loss. The stomata also close and photosynthesis stops.

On hot and **windy** days, water vapour **diffuses** fastest as the concentration of water in the air around the leaves remains low and molecules move faster.

Measuring transpiration using a **potometer**.

The rate of transpiration is determined by monitoring the position of the **air bubble**.

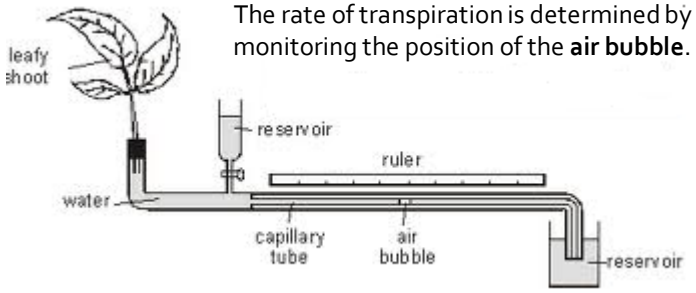


Image: biologymad.com

Video

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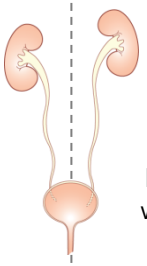
Homeostasis

AQA Biology B3 revision card: The human kidney

Urea

Excess **proteins** are broken down into **amino acids**. Inside the **liver** amino acids are broken down and converted into **urea**. Urea passes into the blood stream and is **filtered** out by the **kidneys** as it is **poisonous**. Urea is finally stored in urine in the **bladder**.



Water

Water is gained through food and drinking. It is lost from the lungs, through **sweating** and in **urine.** On hot days the kidneys produce little urine to **conserve** water Most water is **reabsorbed** into the blood. On cold days the kidneys produce more urine to remove excess water.

Ions

Food contains **mineral ions,** particularly processed food which is high in salt. Some mineral ions are lost in sweat. The kidneys filter out excess mineral ions and these pass out in the **urine** produced.

How the kidneys work

Glucose, amino acids, mineral ions, urea and water are removed from the blood and enter the **kidney tubules** by **diffusion** along the **concentration gradient**. Blood cells and large molecules such as proteins are **too large** to pass through the tubule **membrane**. All of the glucose is **reabsorbed** back into the blood by **active transport**. The amount of water and mineral ions reabsorbed varies depending on what is needed by the body (this is called **selective reabsorption**). Some water is reabsorbed by **osmosis**. Some urea diffuses back into the blood stream. The remaining water, urea and mineral ions are the components of urine. On a hot day, there is little urine and it is dark in colour as it is concentrated in urea and mineral ions (both are colourless) and **urobilins (yellow pigments** from the breakdown of haemoglobin).

Kidney transplant

Diseased kidneys can be replaced with one healthy kidney from a **donor**; ideally the donor has **the same tissue type** as the recipient. Otherwise the risk of **rejection** is high. Antigens on the surface of the donor kidney are not recognised by the recipient's antibodies and attacked. To prevent this, **immunosuppressant drugs** have to be taken daily.

The recipient is also more open to other illnesses if the immune system is suppressed. Donor kidneys also only last for around 9 years and all **operations** bring their own risks.

Dialysis

The blood flows between **semi-permeable membranes** so that excess mineral ions and urea are lost and the concentration of dissolved substances in the blood is restored to normal levels. On the other side of the membranes is the **dialysis fluid** which contains the same concentration of glucose and mineral ions as the blood so that only waste substances leave the blood via diffusion along the concentration gradient. Dialysis has to be repeated on a **regular basis**. Patients have to remain **attached** to the machine for 8 hours; they also have to follow a **strict diet**. Apart from that patients lead a normal life.

Kidney video

Transplant & Dialysis video

Questions

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Homeostasis

AQA Biology B3 revision card: Body temperature

Thermoregulatory centre

Our body temperature is monitored and controlled by the **thermoregulatory centre** which is found in the **hypothalamus** in the **brain**. As blood flows through the brain, **receptors** in the centre detect the temperature of the blood (also called **core body temperature**).

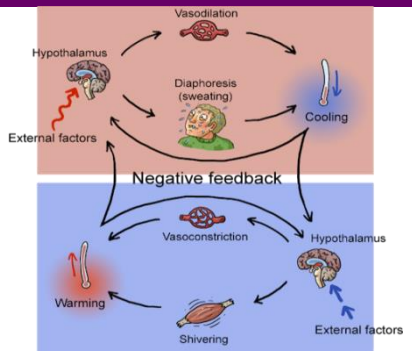

Image: www.shmoop.com

Skin

Skin temperature is monitored by temperature **receptors** in the skin. **Impulses** are then send to the thermoregulatory centre.

Regulating the core body temperature

If the core body temperature gets too low the following things happen:

The **blood vessels** close to the skin's surface **constrict**. This reduced the flow of blood to the surface and **prevents heat loss.**

Muscles begin to contract **(shiver)** as this releases energy by respiration.

Hairs stand on end to trap air which is a good insulator.

If the core body temperature gets too high the following things happen:

The blood vessels supplying the skin **dilate**. This increases the flow of blood to the surface and heat loss. (Skin will look **flushed**.)

Sweat is produced which evaporates and therefore cools the body.

Hairs lie flat so little air is trapped close to the skin.

Hypothermia

If the core body temperature falls below 35°C a person suffers from hypothermia. First signs are tiredness and an unwillingness to move. The skin feels cold to the touch, the face looks greyish-blue and puffy and the lips turn blue. Shivering will eventually stop as it is too cold for body enzymes to work.

Drinking alcohol in very cold weather increases the risk of hypothermia as alcohol makes blood vessels dilate more so more blood flows to the skin surface and more heat is lost.

Heat stroke

In humid conditions the human body can easily overheat. This is because the sweat produced cannot evaporate as the concentration of water vapour in the air is too high. This means little heat is lost from the body. Not drinking enough water in hot weather means that the body cannot produce enough sweat so little energy can be lost by evaporation. Heat stroke can lead first to hallucinations followed by coma and death.

Video

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Homeostasis

AQA Biology B3 revision card: Blood glucose

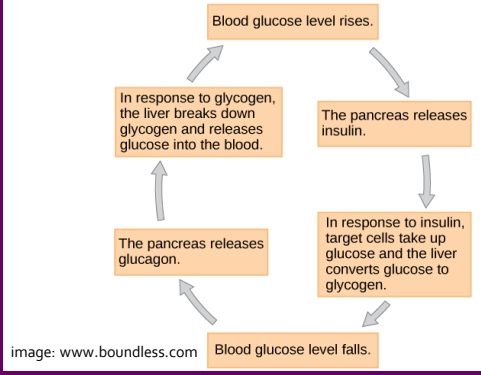


image: www.boundless.com

Pancreas

Blood glucose levels are monitored and controlled by the pancreas. Glucose is needed for **respiration.** The pancreas produces two hormones **called insulin and glucagon.**

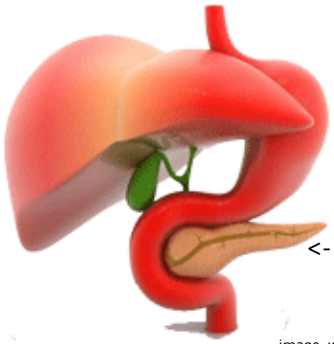

<- pancreas

image: www.rainforestherbs.com

Diabetes

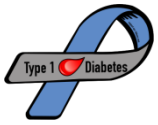
Type 1 diabetes

With this type of diabetes the pancreas does not produce any or enough insulin which means that the blood glucose level is too high.
Excess glucose is filtered by the kidneys which is why doctors can detect glucose in a patient's urine.

Without insulin cells cannot receive any glucose so respiration cannot take place. As a result the person will lack energy and be very tired. Instead of glucose, the body will use fats and proteins as an energy resource, so the person will lose weight.

Type 1 diabetes starts in childhood.

To treat type 1 diabetes, insulin is injected into the blood stream and a low carbohydrate diet needs to be followed.

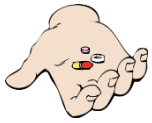


Type 2 diabetes

This type of diabetes is often a result of obesity and/or lack of exercise. The pancreas produces less insulin and the cells stop responding to the insulin.

To treat type 2 diabetes, people are advised to follow a low carbohydrate diet, exercise more and lose weight. If these methods don't work, drugs can be prescribed which help the pancreas make more insulin and reduce the amount of glucose absorbed from digested food.

Very often elderly people are affected by this type of diabetes.



Video

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Humans & the environment

AQA Biology B3 revision card: Pollution, Deforestation & Peat bogs

Deforestation

Large scale deforestation happens because of the **rising demand for timber** to build homes and to clear land for farming (cattle and rice fields, both of which increase the amount of **methane gas** in the atmosphere; methane is another greenhouse gas) or growing crops which can be converted to biofuels.

Deforestation **decreases biodiversity**, removes medicinal plants and changes the composition of the atmosphere. Burning or decaying cut down trees and using machinery both **increase** the amount of **carbon dioxide**. Less carbon dioxide is absorbed through photosynthesis and consequently less **oxygen** is released. With less transpiration happening, the amount of **water vapour** in the atmosphere is also reduced.

Peat bogs

Pleat bogs are plant material that has not fully decayed. These are also destroyed. Peat acts as a very large **carbon store**. It is burned as a fuel or added to soil in gardens. In both cases stored carbon is converted to carbon dioxide and added to the atmosphere.

Global warming

As levels of carbon dioxide, methane and other greenhouse gases rise, **global temperatures** are also increasing. If the global climate changes many organisms might **lose their habitats** and even **become extinct**. **Migration patterns** might change and some animals might disappear from an area or country.

Greenhouse gases

Greenhouse gases such as methane and carbon dioxide **absorb heat energy** radiated by the Earth's surface. This leads to a warming of the atmosphere.

The dramatic increase in the number of people populating the planet coupled with an increase in the **standard of living** means that significantly **more waste** is produced which is becoming more difficult to manage.

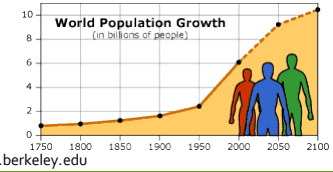

image: evolution.berkeley.edu

If the waste produced is not handled properly it can lead to pollution:

-**water pollution** through the discharge of sewage, fertilisers and toxic chemicals

-**air pollution** through the release of carbon dioxide, carbon monoxide, sulphur dioxide and soot

-**land pollution** through herbicides and pesticides.

More and more habitats are destroyed as the demand for more housing, farmland, roads and waste disposal sites increases. This leads to a reduction in **biodiversity** (the range of different species).

Deforestation video

Pollution video

Questions

Answers

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Example questions & answers

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Humans & the environment

AQA Biology B3 revision card: Biogas and Food production

Biofuels can be made from **plant material** or **manure** by **fermentation/anaerobic respiration**. **Biogas** is a biofuel that is produced when faeces/manure is broken down anaerobically by microorganisms. Biogas is mainly made of flammable **methane** gas.

In many hot countries biogas generators are used to produce methane which is used for cooking. The bacteria work best at 30°C. However, anaerobic respiration is **exothermic** so the generators are sunk below ground to ensure this temperature is maintained day and night.

image: www.mioone.ce

Efficient food production

From a **pyramid of biomass** we can see that at each stage of a food chain less material and therefore **less energy** is contained in the biomass of the organisms.

To increase the **efficiency** of food production there are several option:

- reduce the number of stages in food chains which means growing and eating only plants
- **limit** the **movement** of animals used for food to reduce energy loss
- **control the temperature** of the animal's surroundings so less energy is needed to maintain **body temperature**

Many people are against these intensive and mass farming methods. The animals do not have a lot of room to move and can be **stressed. Diseases** can spread quickly which is why animals are fed **prophylactic antibiotics**. Often **growth hormones** are given to the animals so they mature quicker and can be sold quickly.

Fish farming

Overfishing has led to a decline in fish stocks. To prevent fish such as cod and tuna from becoming extinct, the following **restrictions** have now been put in place:

- Fishing **nets** need to ensure young fish can escape the nets (to reach adulthood and breed)
- Fishing **quotas** are set by the government (although this can impact on the income of the fishermen)
- No fishing in **breeding grounds** or during **breeding season** (difficult to ensure fish do not leave their breeding grounds)

Mycoprotein (Quorn)

A protein that is produced from the **fungus 'Fusarium'** during **aerobic fermentation**. Mycoprotein contains **less fat** than beef protein and **more fibre** so is more likely to prevent **colon cancer** and heart diseases. However, it contains **less protein** than beef which is needed for **growth and cell repair**.

The fermenter have an air supply for the anaerobic respiration of the fungi and to mix the suspension inside the fermenter. Respiration releases energy so the fermenters are cooled. The pH and temperature are carefully monitored.

Biogas video

Food production video

Questions

Answers

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Example questions & answers

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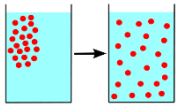
Exchange of materials

AQA Biology B3 revision card: Osmosis, diffusion, active transport

Diffusion

When particles move/spread from an area of high concentration to an area of low concentration.

Examples: CO_2 enters leaves by diffusion. Some digested food molecules enter the blood stream by diffusion.

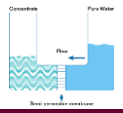


Osmosis is the diffusion of water from a dilute solution to a more concentrated solution through a semi-permeable membrane.

If an animal cell, such as a red blood cell, is placed in pure water, water will enter the cell by osmosis. The cell will swell and eventually burst. If a red blood cell is placed in a very concentrated salt solution, water will leave the cell and the cell will shrink and shrivel. In both cases the cell is damaged.

Osmosis in plants results in hard and rigid /turgid plant cells which is needed for support. Plant cells don't burst because they have an elastic cell wall. If too much water leaves the cell, the cell membrane tears away from the cell wall and the cell is damaged.

Water absorption in the large intestines and uptake of water by root cells are further examples of where osmosis is used.



Active transport

Sometimes molecules are moved from an area of low concentration to an area of high concentration. As the movement is against the concentration gradient, energy is required for this process. Cells involved in active transport have many mitochondria as the energy required is released during cellular respiration.

Plants use transport proteins during active transport to move mineral ions from the dilute solution in soil to a more concentrated solution in root hair cells. Humans use active transport to move glucose from the small intestines into the blood stream. Inside the kidneys glucose is reabsorbed back into the blood stream by active transport.

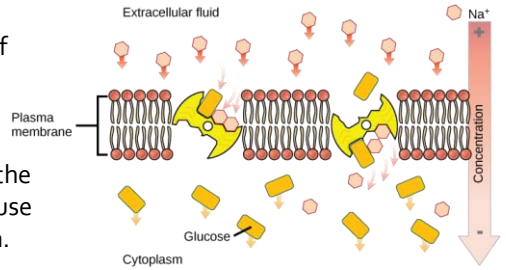
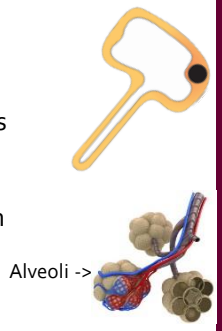


Image: www.boundless.com

Efficient substance exchange

Exchange surfaces inside the lungs, small intestines and roots have a large surface area and cells are thin (usually 1 cell thin). In animals there is also a good blood supply and animals stay ventilated.



Sports drinks dilemma

During exercise glucose is used up and water and mineral ions are lost in sweat. The more sweat is produced, the more mineral ions and water are lost. The concentration of body fluids increases. This means water leaves cells by osmosis to dilute the body fluids. If too much water leaves the cells, they shrink and shrivel and stop working. It is therefore important to replace the lost water and mineral ions during and after exercise. Sports drinks contain mainly water and glucose as well as some mineral ions. The question is, is it necessary to drink isotonic sport drinks to replace the lost water and minerals or would milk do an even better job?

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Active transport video

Osmosis video

Sports drinks video

Example questions & answers

Questions

Answers

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Exchange of materials

AQA Biology B3 revision card: The lungs

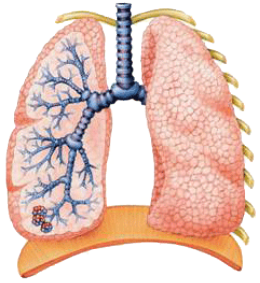


Image: take2designs.com

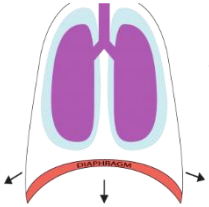
The lungs are located in the **thorax** (upper part of the body). They are protected by the **ribcage** and kept separate from the **abdomen** (lower part of the body) by the **diaphragm** muscle.
Air moves into and out of the lung to ensure oxygen diffuses into the blood while carbon dioxide diffused out of the blood into the air.

Alveoli (air sacs) have a **large surface area,** a **rich blood supply** and are only **one cell thin** so that gas exchange in the lungs is very efficient.

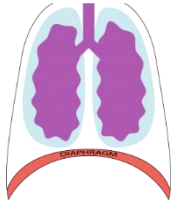
Images:hanslindgren.com

Ventilation & Breathing

Air is constantly moved into and out of the lungs to ensure the **concentration of oxygen in the lungs is always above that of blood** so that oxygen always **diffuses** into the blood.



The **ribcage moves out and up,** the **diaphragm contracts and flattens**. The volume of the thorax increases**, pressure inside the thorax decreases** and is lower than outside the body. This moves **air into the lungs** to balance out the pressure difference.



The ribcage moves in and down, the **diaphragm relaxes**. The volume of the thorax decreases**, pressure inside the thorax increases** and is higher than outside the body. This forces **air out** of the lungs to balance out the difference in pressure.

Ventilator

A tube is inserted into the **trachea**. Air is forced into the lungs by a machine. Although the patient is more **mobile** and the ventilator is **portable,** it is **uncomfortable** and **difficult** for the patient **to eat and speak**.

Image: aironusa.com

Iron lung

The body of the patient is **trapped** inside a tank and only the head and neck are free to move. Inside the tank the pressure is changed by switching a **vacuum** on and off. Air is drawn into the lungs when the vacuum is turned on whereas air is forced out of the lungs when the vacuum is switched off.
The iron lung was used on **Polio** patients as the virus paralyzed the breathing muscles.

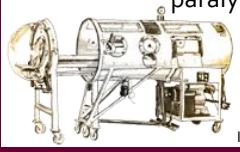


Image: woodlibrarymuseum.org

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Exchange surfaces video

Lungs video

Example questions & answers

Questions

Answers