MEGA LECTURE

1. Cells structure and Organisation

1.1 Plant Cells and Animal Cells:

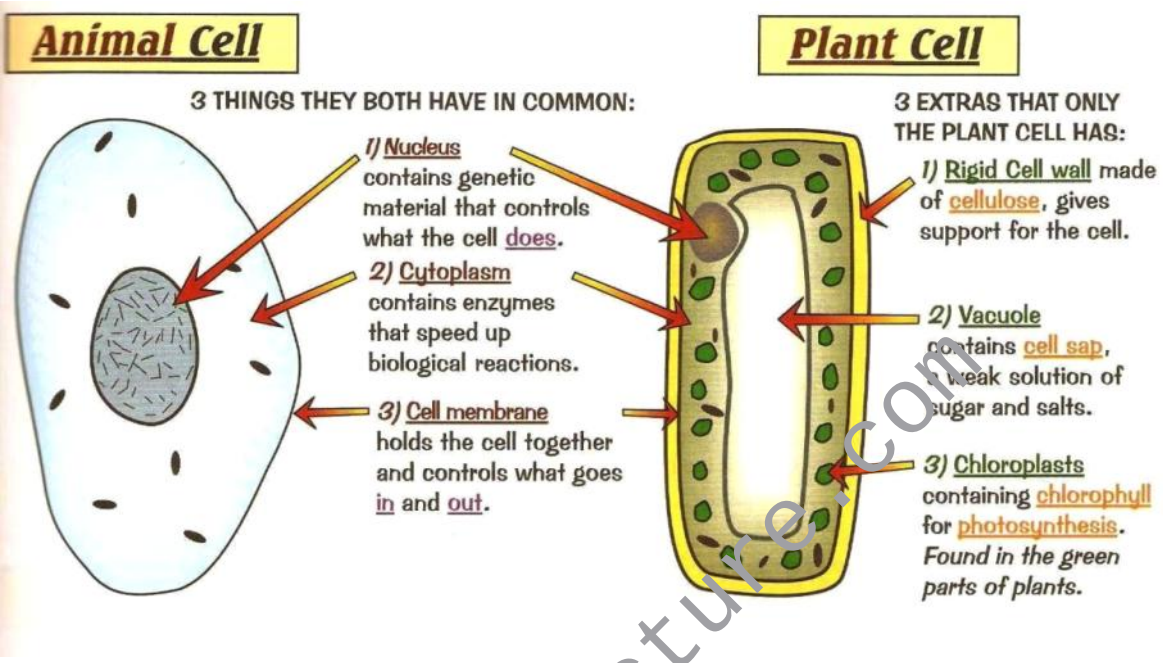

Fig.1.0 Basic structures of an animal cell and a plant cell.

1. Cell wall:
- Porous.
- Permeable.
- Non-living structure made of cellulose.

2. Cell membrane/Plasma membrane
- Semi-permeable/Partially permeable(Only certain parts can pass through it and some aren't able).

3. Cytoplasm
- Contains cell organelles.
- Food substances.
- Mostly H_2O.

4. Vacuole/Sap vacuole/Large central vacuole
- Mostly H_2O.

5. Nucleus
- Controls all activities of a cell.

6. Chloroplasts
- Contains green pigment called Chlorophyll which is important for doing Photosynthesis.

7. Differences between plant cells and animal cells
- Only plant cells have cell wall.
- Only plant cells have chloroplasts.
- Plant cells have a large central vacuole while some animal cells have small vacuoles and some doesn't have any.
- Plant cells have a regular shape while animal cells have irregular shape.

1.2 Specialized/Modified cells:

1. Root Hair Cell:
- To absorb water and minerals.
- Finger-like projection:
  - Increases surface area for absorption.
  - Has a larger vacuole to store more H_2O.

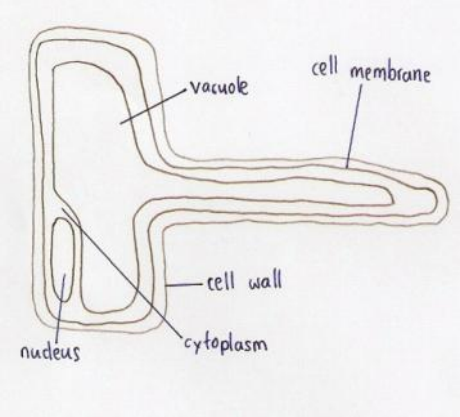

Fig.1.2 Root hair cell.

2. Red blood cell:
- To carry/transport oxygen.
- Packed with haemoglobin (red pigment).
- No nucleus.
- Biconcave shape.

Fig.1.3 Red blood cells.

3. Xylem vessels:
- To transport H_2O and minerals.
- Supporting plant body.

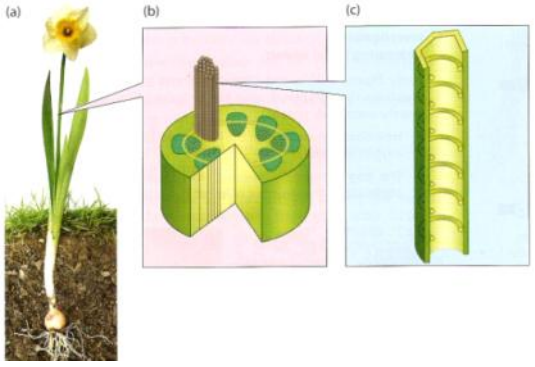

Fig.1.4(a)Whole plant, (b) plant stem and (c)xylem vessel

2. Diffusion and Osmosis

Monday, October 20, 2008
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2.1 Diffusion

1. Diffusion:

- The movement of particles form an area of higher concentration to another area of lower concentration down a concentration gradient.

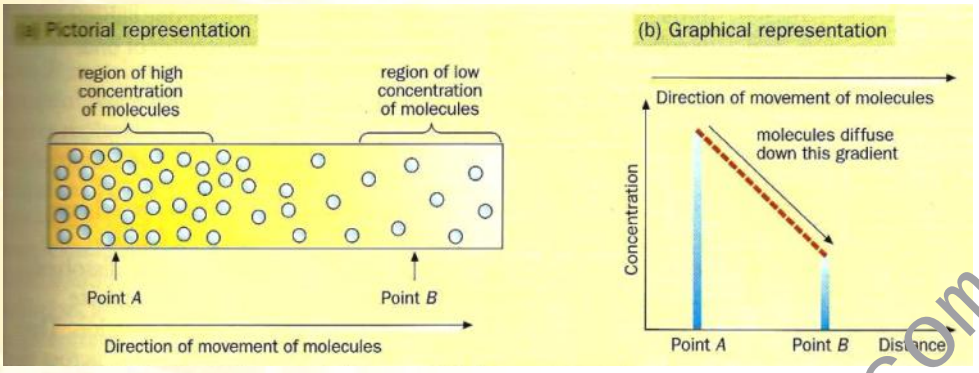

Fig. 2.1 Representation of diffusion.

2.2 Osmosis

2. Osmosis:

- The movement of water molecules from an area of high concentration to an area of lower concentration through a semi-permeable membrane.

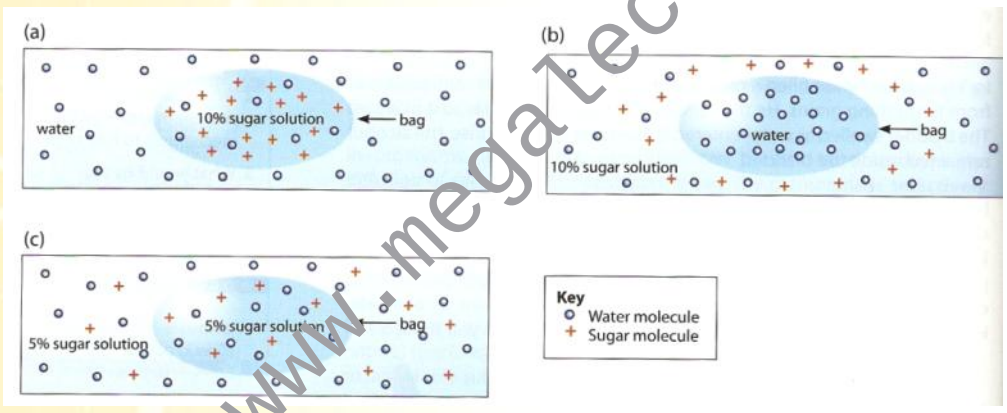

Fig. 2.2 (a)The sugar solution in the bag is more concentrated than the water outside the bag. (b)The water in the bag is more dilute than the sugar solution outside the bag. (c)The sugar solution in the bag is of the same concentration as that of the solution outside the bag.

2.3 Cells and Osmosis:

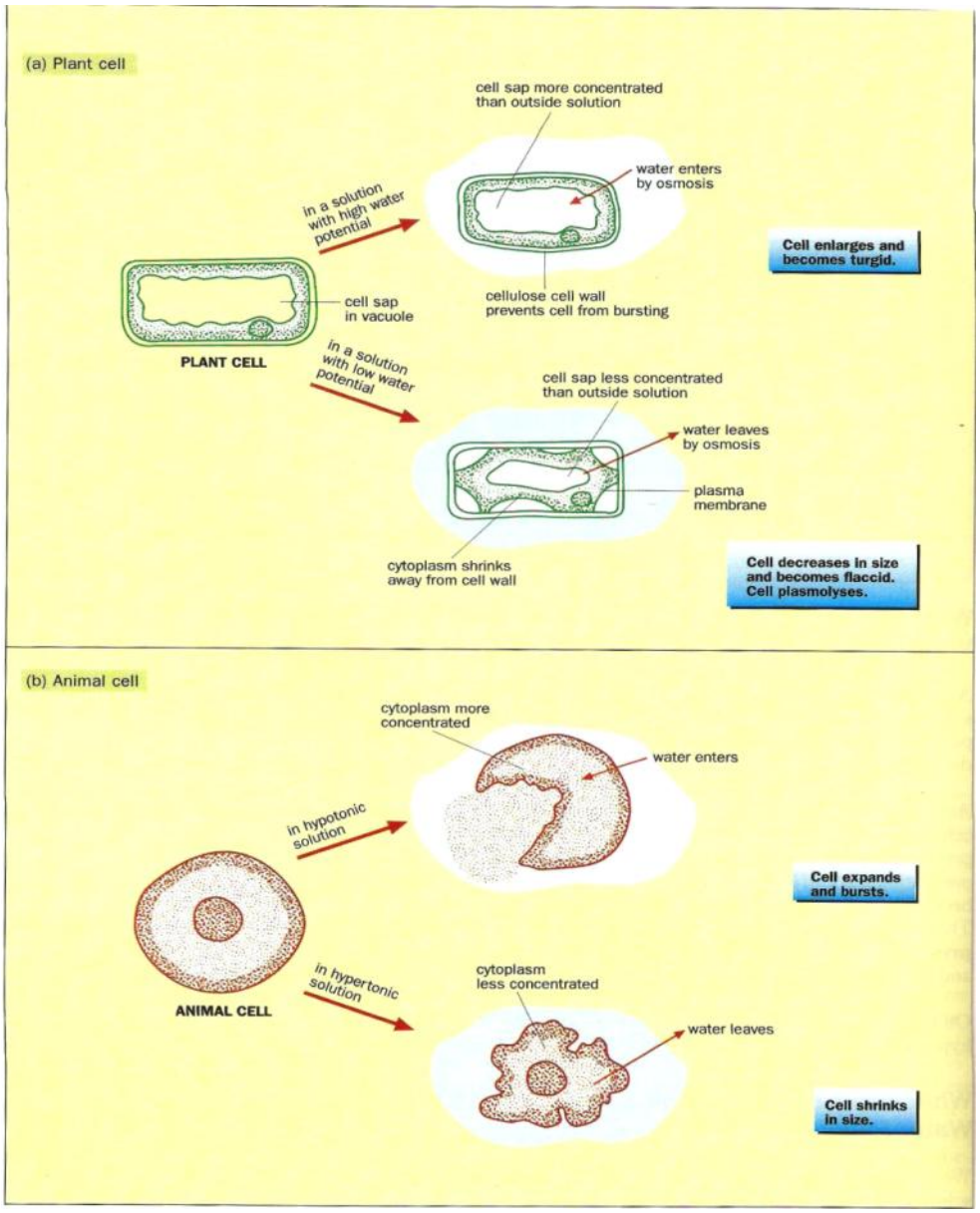

Fig. 2.3 The behaviour of cells in solutions of different concentrations.

2.4 Active Transport:

3. Active Transport:
- The movement of particle from an area of lower concentration to an area of higher concentration by using energy.

4. Active transport is involved in a number of processes occurring within an organism. This includes the absorption of:
- Dissolved mineral salts by the root hairs,
- Glucose and amino acids by cells in the small intestine of humans.

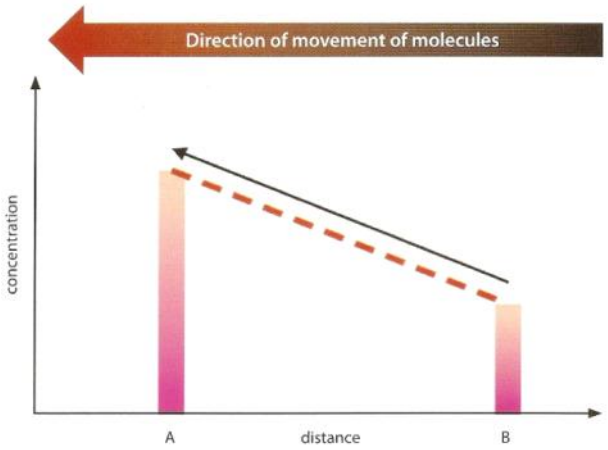

Fig. 2.4 Active transport-molecules diffuse against the concentration gradient from B to A.

Concentration gradient:

- The difference in concentration between a region of a solution or gas that has a high density of particles and a region that has a relatively lower density of particles.

3. Enzymes

Monday, October 20, 2008
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3.1 What are enzymes?

1. Enzymes:
- They are biological catalysts made of protein. They alter the rate of chemical reactions without themselves being chemically changed at the end of the reaction.

Catalysts are substances that can change the speed of a chemical reaction.

3.2 Characteristics of enzymes & Factors affecting enzyme activity.

1. Characteristics of enzymes:
- They alter or speed up the rates of chemical reactions that occur in a cell.
- They remain unchanged after a chemical reaction.
- They are specific.→"Lock & Key" hypothesis (One enzyme act on one substrate)
- They are affected by temperature.
- They are affected by pH.
- They may need other enzymes to work (Coenzymes).
- They catalyse reversible reactions.

2. Factors affecting enzyme activity:

1) Temperature.

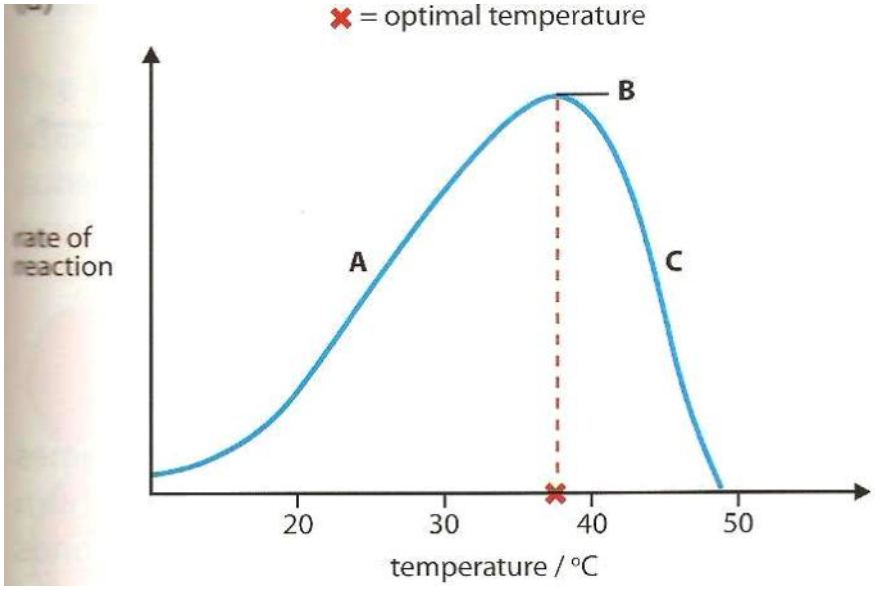


Fig. 3.1 Effect of temperature.

A) The enzyme activity is increasing from its inactive state as the temperature increases.
B) The enzyme is at its most active state at optimum/optimal temperature (the temperature of which enzyme is most active).
C) The enzyme activity decreases as it is exposed to temperature above the optimum/optimal temperature. And at extreme temperature, the enzyme stopped because they are denatured.

2) pH.

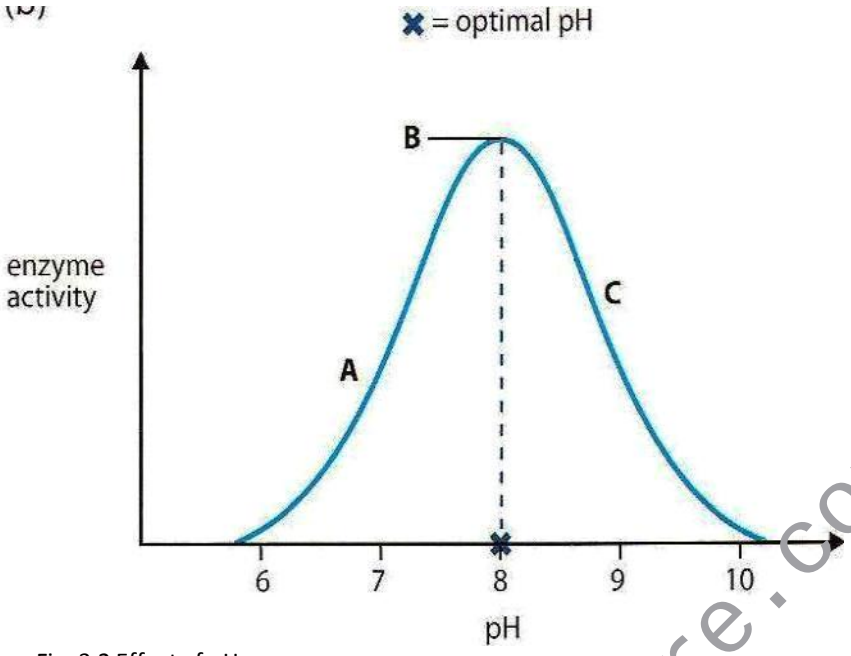


Fig. 3.2 Effect of pH.

A) The enzyme activity is increasing from its inactive state as the pH (acidity/alkalinity) increases.
B) The enzyme is at its most active state at optimum/optimal pH (optimum acidity/optimum alkalinity).
C) The enzyme activity decrease when it is exposed to above the optimum/optimal pH. And at extreme pH (too acidic/too alkaline), the enzyme stopped because they are denatured.
D) Most enzymes work best at neutral pH.
E) Some enzymes work best at acidic pH.
F) Some enzymes work best at alkaline pH.

4. Plant Nutrition

Tuesday, October 21, 2008
3:32 PM

4.1 Photosynthesis

1. Photosynthesis:
- It is the process of making food by using carbon dioxide, water, with the help of sunlight and chlorophyll by green plants.

2. Photosynthesis required:
- Carbon dioxide(CO_2),
- Water,
- Chlorophyll,
- Sunlight.

Word Equation for photosynthesis:
Carbon dioxide + water $\xrightarrow[\text{chlorophyll}]{\text{sunlight}}$ glucose + oxygen.

Chemical equation for photosynthesis:
$6(CO_2) + 6(H_2O) \xrightarrow[\text{chlorophyll}]{\text{sunlight}} C_6H_{12}O_6 + 6(H_2O)$

3. Factors affecting the rate of photosynthesis:
   1) Light intensity (The strength of light).

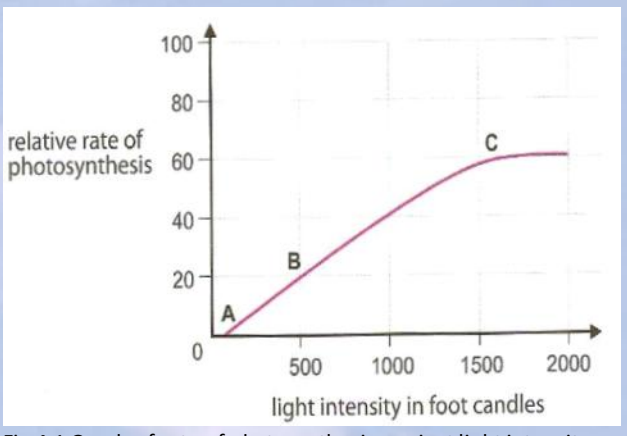


Fig 4.1 Graph of rate of photosynthesis against light intensity

A) Between regions A and B, an increase in the brightness of light increases the rate of photosynthesis.
B) This indicates that the speed at which photosynthesis is taking place is limited by the amount of light available.
C) At higher light intensities (i.e. after point C) a further increase in light intensity would not increase the rate of photosynthesis.
D) This implies that the photosynthetic process is receiving the maximum amount of light it can make use of.
E) Hence, an increase in light intensity will not increase the rate.

2) Temperature.

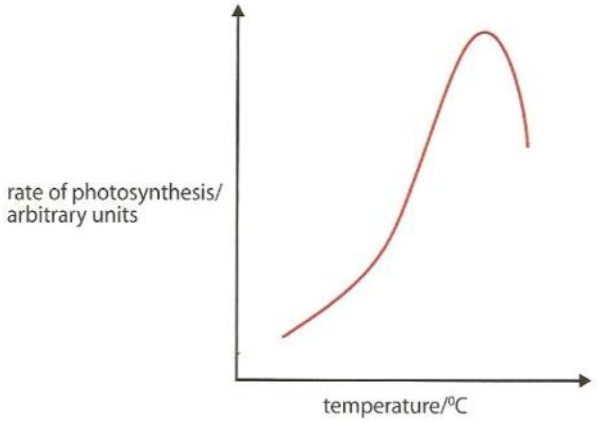


Fig.4.2 Effect of temperature on the rate of photosynthesis

A) At low temperature, photosynthesis is inactive.
B) As the temperature increase, the rate of photosynthesis also increase.
C) At optimum temperature, photosynthesis is in its most active state.
D) Above optimum temperature, the rate of photosynthesis decreases.
E) At extreme temperature, photosynthesis stops, because the enzymes involved in this process are denatured.

Since photosynthesis can be affected negatively by heat, enzymes must be involved.

3) Concentration of CO_2.

A) As there are more CO_2, the faster the rate of photosynthesis.
B) CO_2 concentration cannot exceed 0.03%, because that is the amount of CO_2 in the air.
C) It can only exceed 0.03% under experimental conditions.

4. Importance of photosynthesis:
   - It reduces the amount of CO_2 in the air which is the main cause of global warming.
   - It produces oxygen to support other organisms for doing respiration.
   - It produces food which is the source of energy of other organism and itself.

5. The leaf:

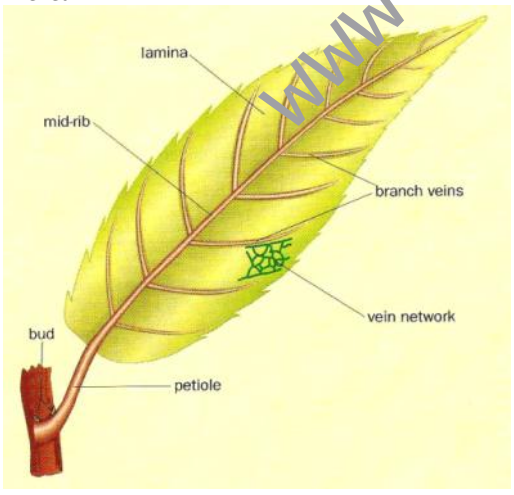


Fig.4.3 The external structure of a leaf

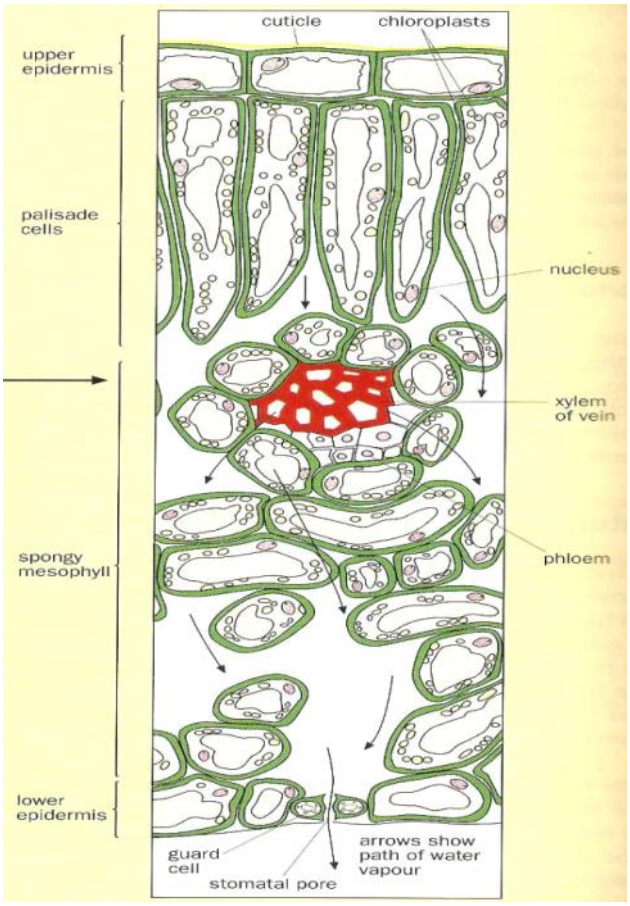


Fig.4.4 The internal structure of a leaf

6. The important features about leaves:

- The cells in the palisade layer are packed with chloroplasts which contain lots of chlorophyll. This is where the photosynthesis goes on.
- The palisade and spongy layers are full of air spaces to allow CO_2 to reach the palisade cells.
- The cells in the epidermis make wax which covers the leaf structures, especially the top surface. This is to prevent water loss.
- The lower surface is full of biddy little holes called stomata. They are there to let CO_2 in. They also allow water to escape - this is how the transpiration stream comes about.
- Xylem and phloem vessels cover the whole leaf like tiny "veins", to deliver water to every part of the leaf and then to take away the food produced by the leaf.

7. The stomata:

- Stomata closes automatically when supplies of water from the roots start to dry up.
- The guard cells control this. When water is scarce, they become flaccid, and they change shape, which closes the stomatal pores.
- This prevents any more water being lost, but also stops CO_2 getting in, so the photosynthesis stops as well.

4.2 Plant Mineral Nutrition

1. Nitrogen:
- Plants need nitrogen to make proteins. They got nitrogen from the compounds of nitrogen from the soil.

2. Magnesium:
- Important for making chlorophyll.

3. Plants lacking of magnesium:
- They will have leaves not healthily green.

4. Nitrogen ⟶ proteins ⟶ new cells.

5. Nitrogen-containing ions + carbohydrates ⟶ amino acids ⟶ proteins.

6. Plants lacking of nitrogen:
- They will not grow properly.

5. Animal Nutrition

Thursday, November 20, 2008
9:43 PM

5.1 Food

1. There are 7 types of food:
- Carbohydrates.
- Fats.
- Proteins.
- Minerals.
- Vitamins.
- Fibre or roughage .
- Water.

2. Carbohydrates can be divided into two:
- Starch (To test for starch, use iodine solution, the colour will change from orange to blue-black if starch is present).
- Glucose (To test for glucose, use benedict's reagent, the colour of the reagent will change if glucose is present).

3. Proteins:
- To test for the presence of proteins, use biuret's reagent. If the colour of the reagent changes to violet, it means that proteins are present.

4. Fats:
- Its presence can be tested by using the filter paper experiment or the alcohol test. A grease spot can be seen if fats are present using the filter paper experiment.

5. Minerals:
- They are the inorganic salts which do not provide energy but are indispensable to bodily functions.
- Examples of minerals are calcium, phosphorus, sodium, chlorine, potassium and iron.

6. Vitamins:
- They are not energy-providing food nor are they body-building food.
- They are for maintaining normal health and development.
- Lack of vitamins can cause diseases such as scurvy and rickets.

7. Fibre or roughage:
- They are the indigestible fibrous materials, e.g. cellulose, present in the diet.
- It provides bulk to the intestinal contents and helps peristalsis.
- Insufficient of fibre can cause constipation.

8. Water:
- They are the essential constituent of protoplasm.
- Insufficient of fibre can cause constipation.

9. A balanced diet is a type of diet which consists of all types of food at the correct amount.

10. Factors affecting the diet of individuals:
- Activity.
- Age.
- Sex.
- Body size.

11. Malnutrition (Unbalanced diet):
- Obesity - extremely overweight.
- Constipation - difficulty to remove faeces.

12. Carbohydrates and fats are the main source of energy. While proteins are used for growth i.e. to make new cells and repairing damaged tissues.

13. Carbohydrates are from glucose and starch. Fats are from fatty acids and glycerol. Proteins are from amino acids.

Cholesterol is a kind of sterol which is essential for the formation cell membrane.

14. Vitamin C maintains healthy skin, gum and the lining of blood vessels. Lack of Vitamin C can cause scurvy. Vitamin C helps our cells to stick together.

15. Vitamin D helps the absorption of calcium. Lack of Vitamin D can cause rickets.

16. Calcium is a type of mineral, it has the function:
    1) For strong bones and teeth.
    2) Clotting of blood.

17. Lack of calcium can cause rickets.

18. Iron is also a type of mineral, it has the function of making haemoglobin in red blood cells.

19. Lack of red blood cells can cause anaemia.

20. Stages of nutrition:
    1) Ingestion.
    2) Digestion.
    3) Absorption.
    4) Assimilation.
    5) Egestion.

5.3 Digestion and the digestive system

1. Digestion is the process of breaking down food into its simplest form. This is necessary so that food substances are small enough to be carried by the blood and able to pass into the cells.

2. Mouth:
- Chews food up into easy-to-swallow balls.

3. Salivary glands:
- Produce an enzyme called amylase to start the breakdown of starch.
- Saliva contains mucous (sticky, slippery substance).

4. Oesophagus (Gullet):
- The food chutes from the mouth to the stomach.

5. Stomach:
- It pummels food with its muscular walls.
- It produces pepsin (an enzyme for digesting proteins) and renin (an enzyme for digesting milk proteins), they are also called the protease enzyme.
- It produces hydrochloric acid for three reasons:
    1) To kill bacteria.
    2) To give the right pH for pepsin and renin to work (pH2-acidic).
    3) To neutralise the alkaline effect of saliva.
- Hydrochloric acid, pepsin and renin are called the gastric juice.

6. Small intestine:
- Duodenum:
    1) Secretion of pancreatic juice which consists of the pancreatic amylase, trypsin (protease), lipase and bile.
    2) Bile are emulsifying agent created in the liver, stored in the gall bladder and transferred to the duodenum through the bile duct to emulsify fats.
    3) Sodium bicarbonate are secreted into the duodenum to neutralise the acidic effect of hydrochloric acid.

- Ileum:
  1) Secretion of intestinal juice which consists of the intestinal amylase, maltase, lipase and protease.
  2) It is where the foods are completely digested into its simplest form.
  3) Carbohydrates are digested into glucose, proteins are digested into amino acids, and fats are digested into glycerol and fatty acids.
  4) This is also where the "food" is absorbed into the blood.
  5) It is long and folded to increase surface area. Tiny finger-like things called villi cover the inner surface to increase the surface area for absorption.

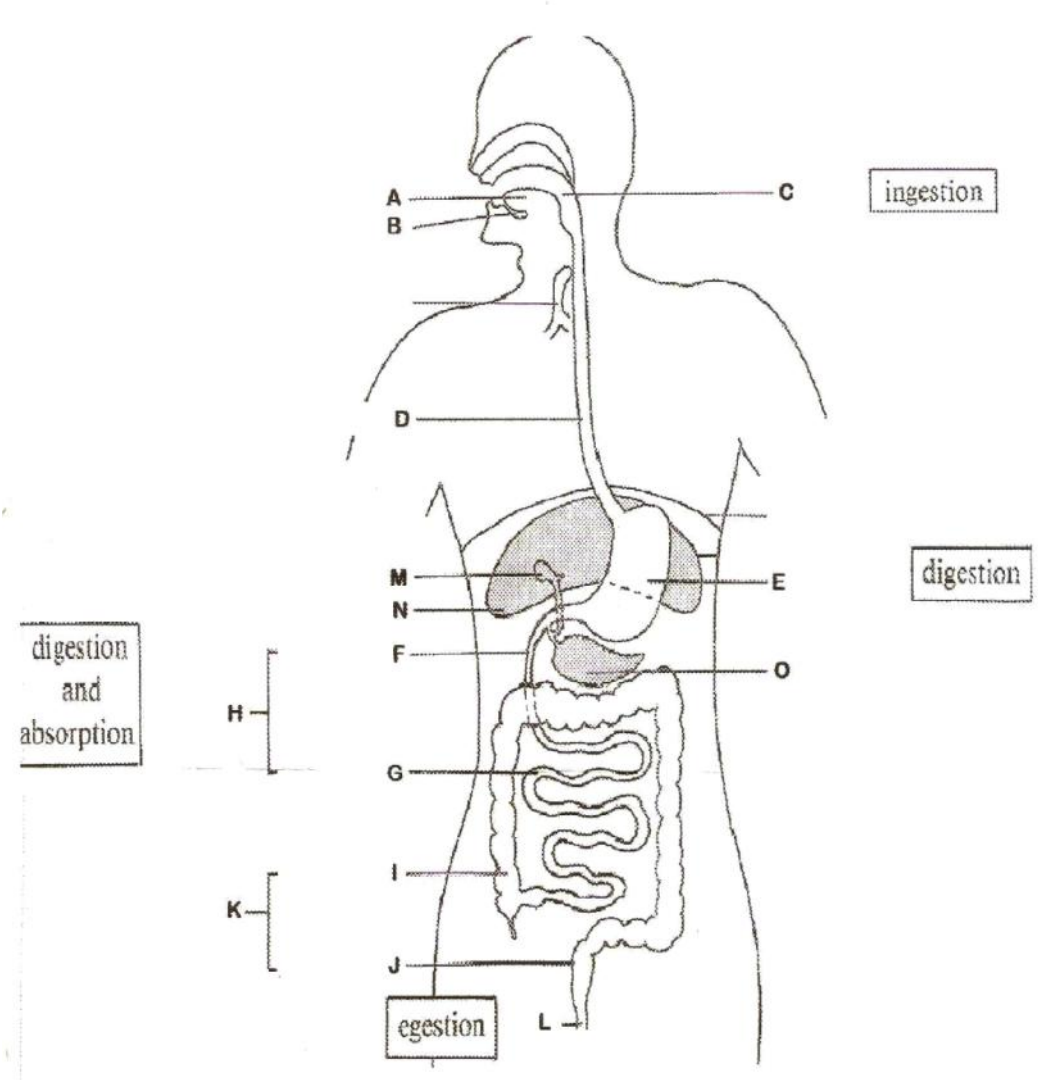
7. Large intestine:

- Colon:
  1) Excess water is absorbed from the food.
- Rectum:
  1) To store faeces.

8. Anus:

- The faeces (the indigestible food) are expelled.

HUMAN DIGESTIVE SYSTEM



A) Tongue.
B) Salivary gland.
C) Buccal cavity
D) Oesophagus/gullet.
E) Stomach.
F) Duodenum.
G) Ileum.
H) Small intestine.
I) Colon;

- Ascending colon.
- Transverse colon.
- Descending colon.

J) Rectum.
K) Large intestine.
L) Anus.
M) Gall bladder.
N) Liver.
O) Pancreas.

5.4 Absorption.

1. Absorption is the process by which digested food are transferred into the blood stream through the villi of the ileum.

2. The capillaries of the villi will join up to form the hepatic portal vein which carries blood to the liver.

3. Glucose & amino acids will be sent to parts of the body that need them.

4. Excess glucose will be converted by the liver into a storage substance called glycogen & stored in the liver.

5. Glycogen can be converted back to glucose when the body needs more glucose.

6. Any more excess glucose will be converted to fats and stored in the adipose tissues under the skin.

7. Excess amino acids will undergo a process called deamination which is done by the liver.

8. Deamination is the process by which amino acids are broken down into glucose and urea. Urea is a nitrogenous substance which is sent to the kidneys for disposal.

9. Another function of the liver is the breakdown of alcohol.
Alcohol $\longrightarrow$ carbon dioxide + water + energy.

10. Too much alcohol in the body can make the person unconscious.

5.5 Assimilation.

1. Assimilation is the process by which some of the absorbed food materials are converted into new protoplasm or used to provide energy.

2. Uses of glucose and fats:

- For energy (to respire).
- Making new cells.
- Repair & replace damaged tissues.
- Production of other proteins such as enzymes and hormones.
- Fats are used to form part of a cell such as the cell membrane and the nuclear membrane.
- Fats are used as insulators.

6. Transport in plants

Sunday, November 23, 2008
10:52 PM

6.1 Water and ion uptake.

1. Ion is taken up into the plants by:
- Osmosis.
- Active transport.

2. Water is taken up into the plants by:
- Root pressure.
- Transpiration pull.

6.2 Transpiration and translocation.

1. Transpiration is the process by which water is lost from the leaves of the plants.

2. Factors affecting the rate of transpiration:
- Humidity.
- Temperature.
- Wind.
- Light.

3. Light:
- The rate of transpiration will be high when there is light.

4. Temperature:
- The higher the temperature, the higher the rate of transpiration.

5. Humidity & wind:
- The lower the humidity, the higher the rate of transpiration.
- The wind blows away the water vapour surrounding the leaves, in other words, the humidity surrounding the leaves become low, so the rate of transpiration is high.

6. Higher rate of transpiration when it is:
- Windy.
- Hot.
- Less humid.
- Daylight.

7. How to measure the rate of transpiration:
- Using a potometer.

8. Translocation is the process by which food substances(glucose) are transported to other parts of the plant through the phloem.

9. The foods are transported to other parts of the plant because:

- For energy.
- To make new cells.

7. Transport in humans

Sunday, November 23, 2008
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7.1 The Heart.

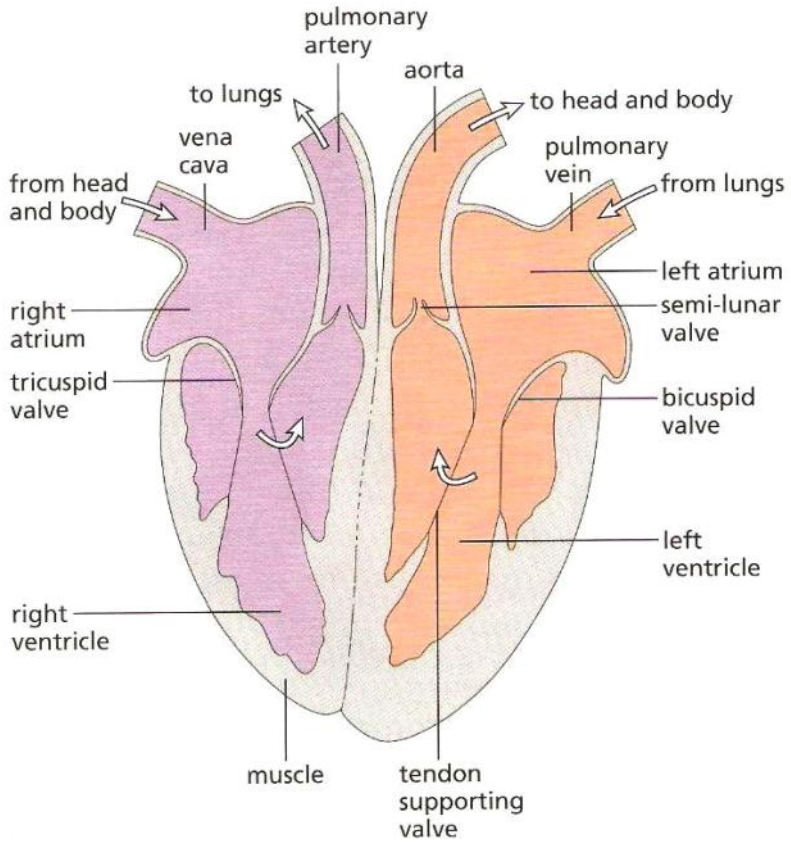


Fig.7.1 The structure of the heart.

The thickest part of the cardiac muscle indicates that it is the left part of the heart.

1. Functions of valves:
- To allow the blood to flow in one direction only.
- To prevent the backflow of blood.

2. The Double circulation:

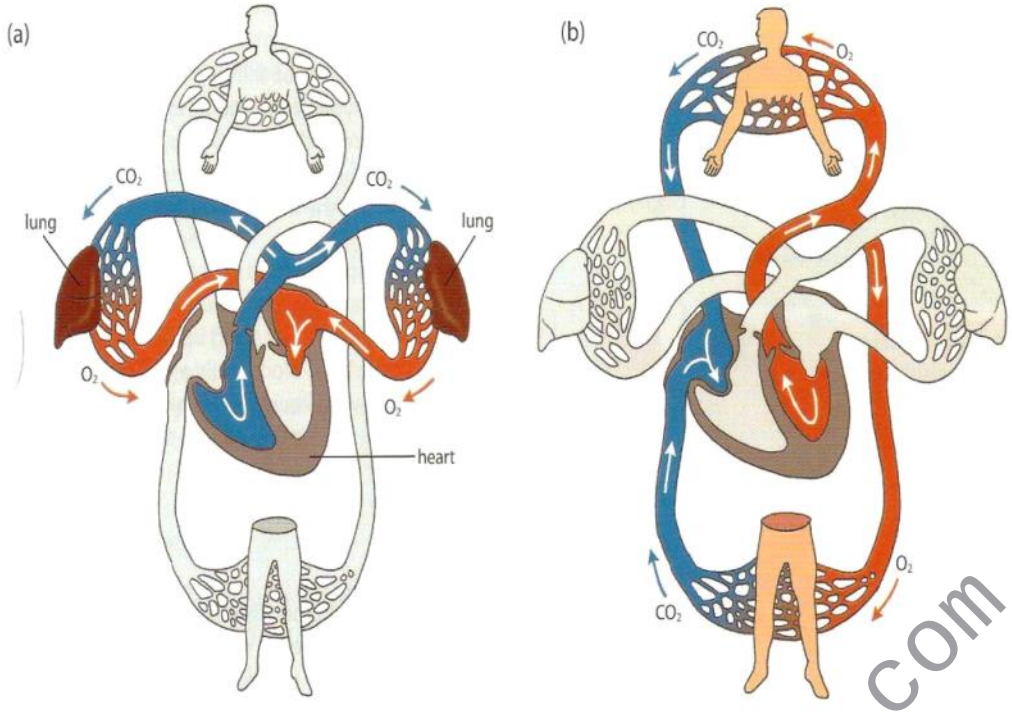


Fig.7.2 (a) Pulmonary and (b) systemic circuit.

3. The blood which carries oxygen is called oxygenated blood (from lungs to body).
   The blood which doesn't carry oxygen is called deoxygenated blood (from body to lungs).

4. The left side of the heart is more muscular and thicker because it pumps blood to all parts of the body.

7.2 The Blood Vessels.

1. There are three types of blood:
- Arteries.
- Veins.
- Capillaries. (smallest)

2. Differences between arteries and veins:
   1) Arteries have smaller central cavity than veins.
   2) Arteries have thicker elastic and muscular wall than veins.
   3) Veins have valves while arteries don't have valves.
   4) The blood flows slower, smoother and at low pressure than arteries.
   5) All arteries carry oxygenated blood except pulmonary artery while all veins carry deoxygenated blood except pulmonary veins.
   6) Arteries carry blood away from the heart to the body while veins carry blood to the heart from the body.
   7) The blood carried by arteries are bright red in colour while the blood carried by veins are dark red in colour.
   8) Blood in arteries flow due to the pumping action of the heart while veins flow due to the contraction of the heart.

Veins are big, slow and evil.

7.3 The Blood.

1. Components of the blood:
- Plasma.
- Blood cells.
- Platelets.

2. Plasma is the liquid part of the blood, it contains:
- Blood cells.
- Platelets.
- Water.
- Blood proteins.
- Waste products.
- Hormones.
- Food substances; glucose, proteins, vitamins, etc.

3. The blood cells consist of two parts:
- Red blood cells.
- White blood cells.

4. Red blood cells are also known as erythrocytes which have the function of transporting oxygen.

5. White blood cells are also known as leucocytes which have the function as a defense mechanism.

6. Platelets which are also known as thrombocytes have the function to clot blood. (involving the use of fibrinogen)

7. Fibrinogen work together with platelets to form fibrin.

8. Factors that may cause heart diseases:
    1) Smoking.
    2) Stress.
    3) Malnutrition i.e. obesity.
    4) Lack of physical exercise.

8. Respiration

Monday, November 24, 2008
12:17 AM

8.1 Respiration.

1. Respiration is the process of breaking down food to release energy in the presence of oxygen.

2. There are two types of respiration:
   1) Aerobic respiration.
   2) Anaerobic respiration.

3. Aerobic respiration is the process of breaking down food in living cells to release a large amount of energy in the presence of oxygen.

4. Anaerobic respiration is the process of breaking down food in living cells to release a small amount of energy in the absence of oxygen.

5. Aerobic respiration:
   Glucose + oxygen $\longrightarrow$ 'E' + carbon dioxide + water

   $C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$ + 'E'

6. Anaerobic respiration:
   Glucose $\longrightarrow$ 'e' + ethanol(alcohol) + carbon dioxide (Microorganism and plants)

   Glucose $\longrightarrow$ 'e' + lactic acid (Humans)

8.2 Human Respiratory System.

1. Breathing is a mechanical process that involves taking in air into the lungs & takes out air from the lungs.

2. Inspired and expired air:

Substance	Inspired air	Expired air
1. Nitrogen	78%	78%
2. Oxygen	21%	16%
3. Carbon dioxide	0.03%	4.5%
4. Noble gases	1%	1%
5. Water vapour	Varies	Saturated

3. Temperature of:
   1) Inspired air is lower than body temperature.
   2) Expired air is about the same as body temperature.

8.3 Human Gaseous Exchange.

1. The respiratory system consists of:

- Lungs.
- Nose.
- Mouth.
- Trachea.
- Bronchi (bronchus sg.)
- Bronchioles.
- Alveoli (alveolus sg.)

2. The gas exchange system in man:

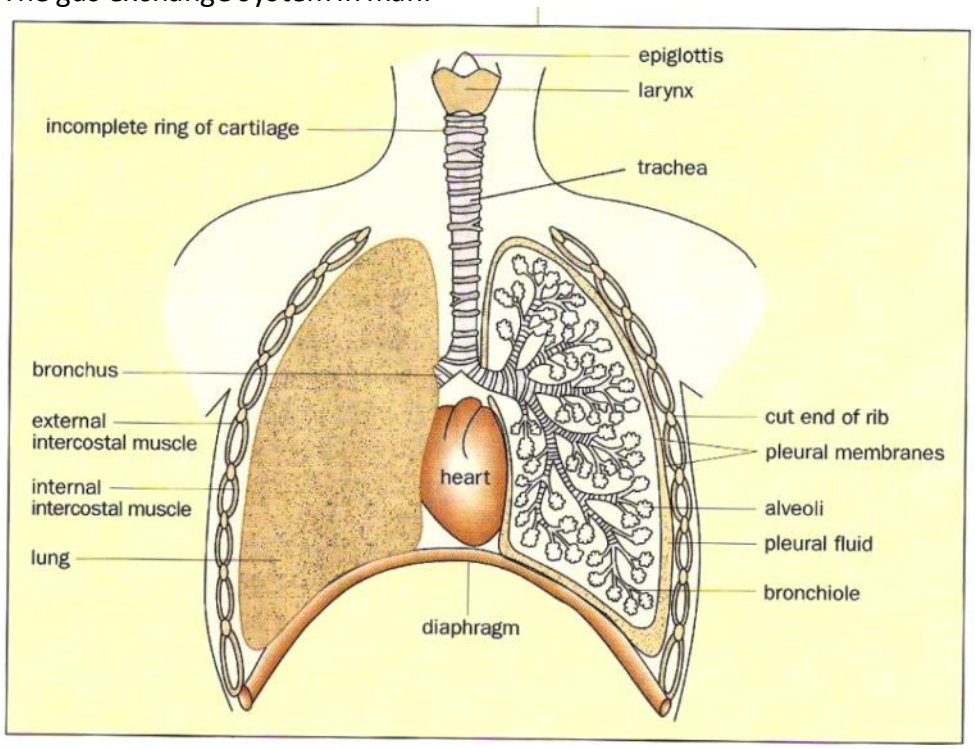


Fig.8.1 The gas exchange system in man (left lung cut open to show alveoli)

3. Inspiration & Expiration:

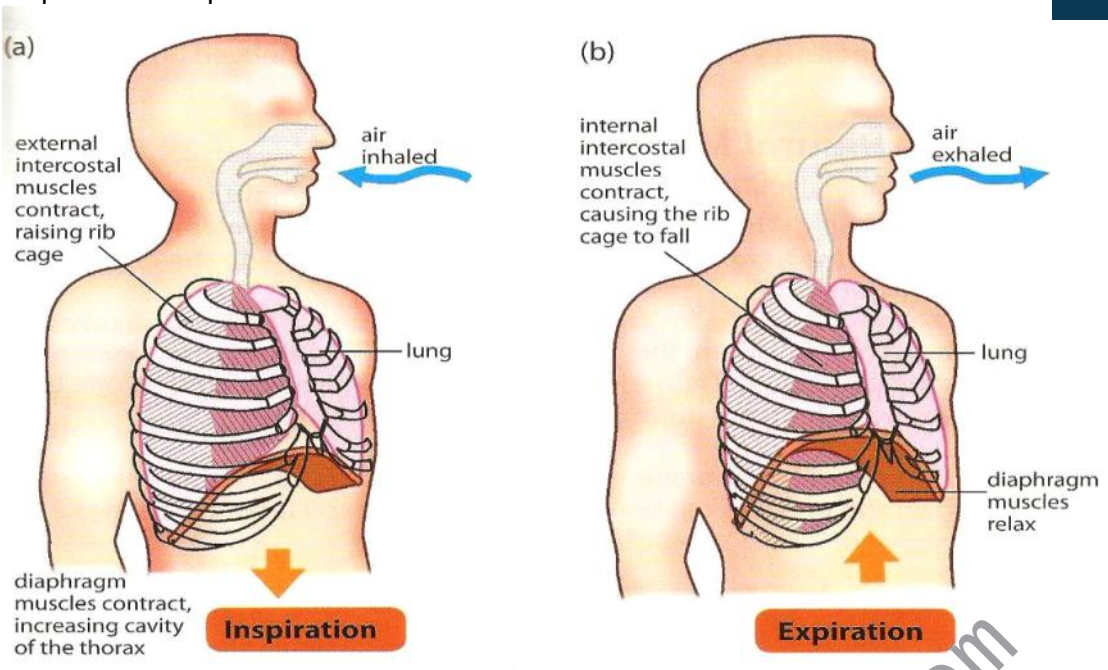


Fig.8.2 (a) Inspiration and (b) expiration.

A) Inspiration is an active process involving the contraction of:
   - The external intercostal muscles; and
   - The diaphragm muscles.

B) Contraction of the external intercostal muscles pulls the rib cage upwards and outwards, while contraction of the diaphragm muscles result in the flattening of the diaphragm.

C) The net result is an increase in the volume of the thorax (the part of the body between the neck and the abdomen where the heart and lungs lie).

D) Pressure in the thorax is thus reduced.

E) Air is then sucked into the lungs, inflating the alveoli until the internal pressure equals that of the atmosphere.

F) Expiration is a passive process.

G) During expiration, only the internal intercostal muscles contract. The rib cage drops, mainly due to its own weight.

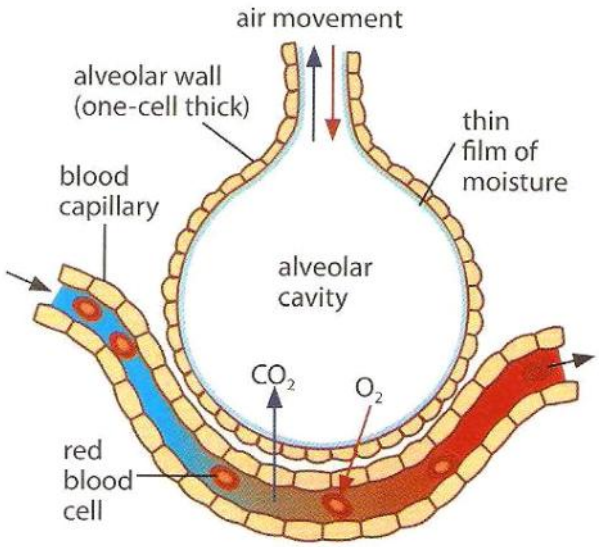
H) The diaphragm relaxes and is forced into a dome shape by the falling rib cage.

I) The volume of the thorax is decreased.

J) Pressure is then exerted on the air in the lungs, forcing it out.

K) During forced breathing, such as during exercise or sneezing, expiration becomes a much more active and forceful process as the ribs are moved more vigorously downwards and the diaphragm is moved upwards.

4. Structure of the alveolus:



A) The alveoli are where gaseous exchange takes place between the air in the sacs and the blood in the capillaries surrounding each alveolus.

B) The distance over which the gases must diffuse is about 0.01 mm - two cell layers thick.

C) A thin film of moisture covers the surface of the alveolar wall. This has been found to contain a chemical which lowers surface tension. This makes it easier for the lungs to be inflated during breathing in. Without this chemical or surfactant, the alveoli would collapse and become stuck together each time air passes out of the lungs.

5. Diffusion across the alveoli is enhanced by the following features:

- Large surface area of the alveoli;
- Short distance between the air and the blood;
- Steep concentration gradient maintained by constant movement of blood through the tissues and ventilation of the lungs; and
- Ability of blood to carry oxygen and carbon dioxide.

6. Exchange of oxygen:

- Each haemoglobin molecule present in red blood cells can combine reversibly with up to four molecules of oxygen, forming the compound oxyhaemoglobin.
- As the red blood cells move through the blood capillaries surrounding the alveoli, the narrowness of the capillaries forces them to slow down and become distroted.
- This increases the time available for gaseous exchange to take place, as well as exposes a larger surface area of the cell.

7. Exchange of carbon dioxide:

- Carbon dioxide is transported in a variety of ways by blood.
- A very small percentage is dissolved in plasma as carbonic acid.
- Some carbon dioxide becomes attached to haemoglobin to form the compound carbamino haemoglobin.
- Most of the carbon dioxide is carried by the plasma as hydrogen carbonate ions.

9. Excretion

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9.1 Excretion.

1. Excretion is the process by which waste products and toxic materials are removed from the body of an organism.

2. Excretory organs:
- Kidneys;
- Lungs;
- Liver.

3. The urinary system in man:

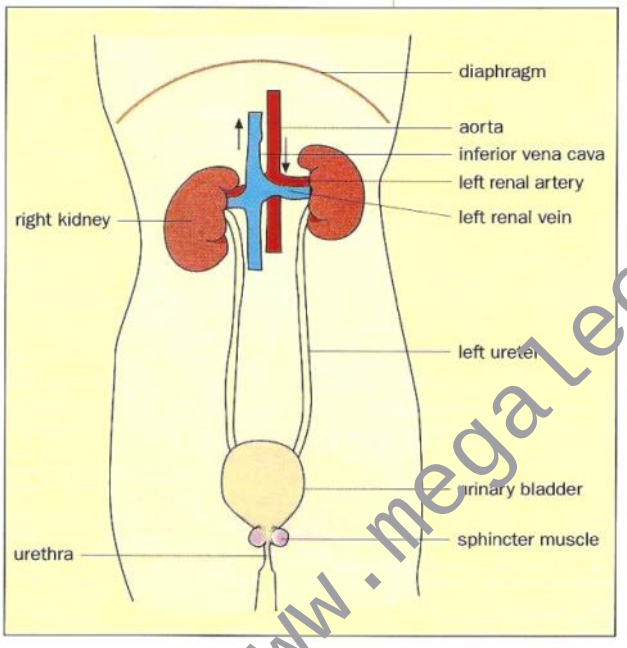

Fig.9.1 The urinary system in man.

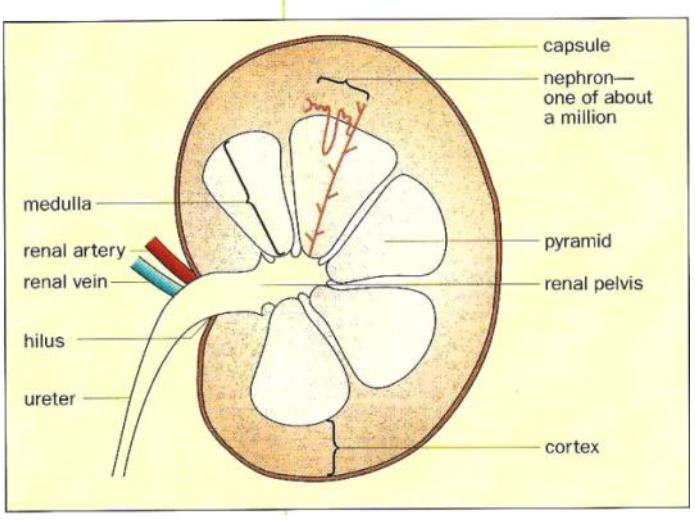

Fig.9.2 The structure of the kidney.

4. Lungs:
   The lungs supply the body with oxygen, but they are also excretory organs because they get rid of carbon dioxide. They also lose a great deal of water vapour, but this loss is unavoidable and is not a method of controlling water content of the body.

5. Kidneys:
   The kidneys remove urea and other nitrogenous waste from the blood. They also expel excess water, salts, hormones and drugs.

6. Liver:
   The liver breakdown haemoglobin to produce yellow/green bile pigment, bilirubin. Bilirubin is excreted with the bile into the small intestine and expelled with the faeces. The pigment undergoes changes in the intestine and is largely responsible for the brown colour of the faeces.

7. Skin:
   Sweat consists of water, with sodium chloride (salt) and traces of urea dissolved in it. These substances are excreted when we sweat. But, sweating is a response to rise in temperature and not a change in the blood composition. Therefore, skin is not an excretory organ.

8. Kidney failure may result from an accident involving a drop in blood pressure, or from a disease of the kidneys. A dialysis machine is required to replace the function of the kidneys should the kidneys are damaged.

10. Homeostasis

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10.1 Homeostasis.

1. Homeostasis is the maintenance of a constant internal environment.

2. For any homeostatic control to occur there must be:
- a stimulus which is a change in the internal environment,
- a receptor which can detect the stimulus,
- an automatic or self-regulatory corrective mechanism, which bring about a negative feedback.

3. Homeostasis may include the regulation of the following:
- Blood glucose level,
- Blood water potential,
- Temperature.

10.2 Blood glucose regulation.

1. The regulation of blood glucose level is done by the pancreas.

2. Homeostatic control of blood glucose level:

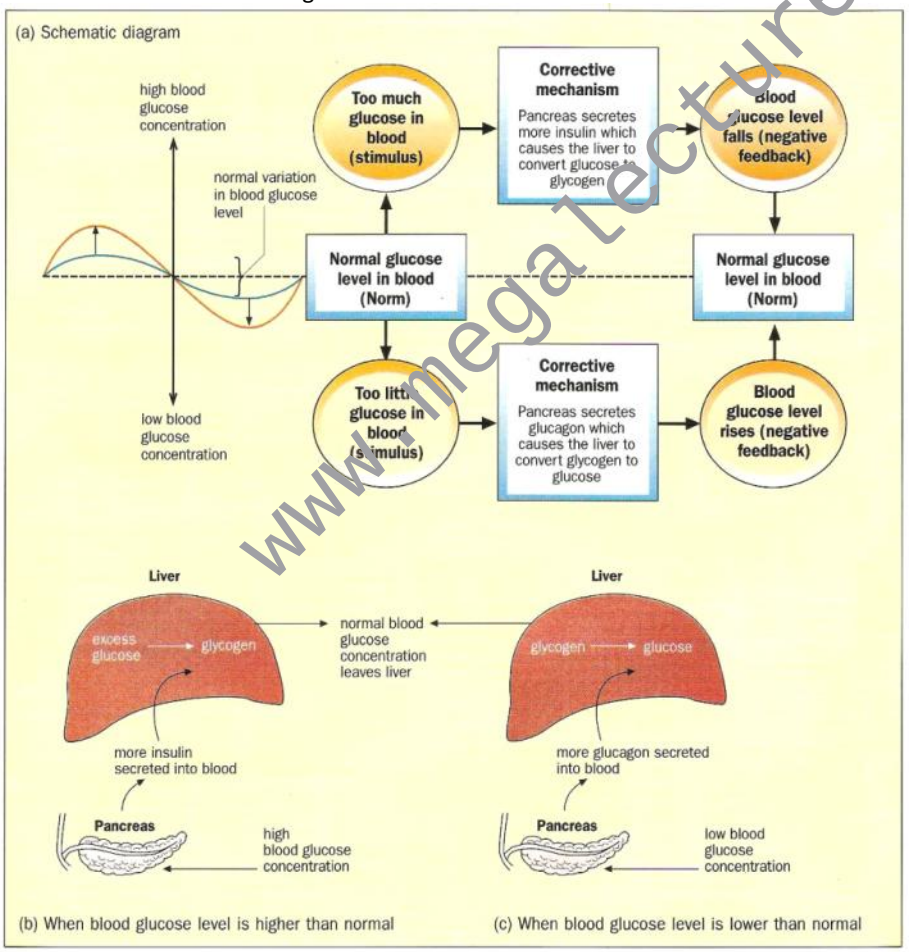

Fig.10.1 Homeostatic control of blood glucose level.

3. The two hormones, insulin and glucagon have different effects on the glucose level in the blood. They are produced by the same region of the pancreas, the islets of Langerhans, but by different cells. Their secretion into the blood is controlled by the negative feedback mechanism depicted in Figure 10.1.

4. Insulin converts glucose to glycogen which reduces the blood glucose level.

5. Glucagon converts glycogen to glucose which increases the blood glucose level.

10.3 Regulation of blood water potential.

1. The regulation of blood water potential is done by the kidneys.

2. Homeostatic control of water potential:

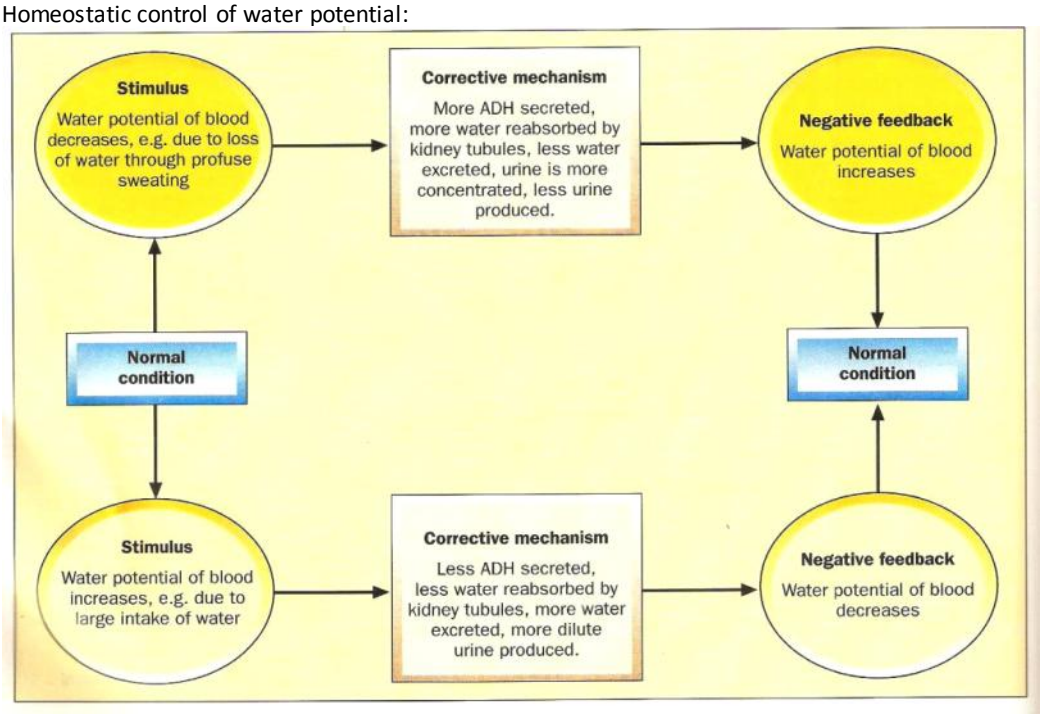

Fig.10.2 Homeostatic control of water potential.

3. On a cold day, if you don't sweat, you'll produce more urine which will be pale and dilute.

4. On a hot day, you sweat a lot, your urine will be dark-coloured, concentrated and little of it.

10.4 Temperature regulation.

1. The regulation of temperature is done by the skin.

2. The skin:

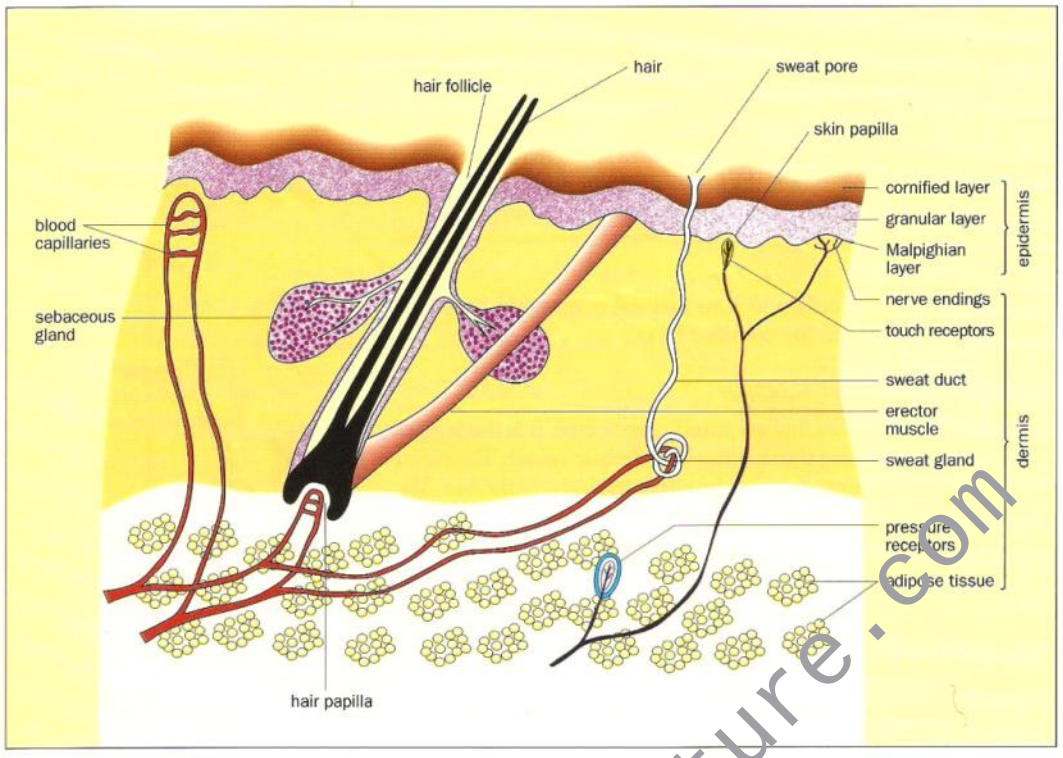

Fig.10.3 The structure of the skin.

3. When the body is exercising vigorously or when the surrounding is hot:
   1) Thermoreceptors in the skin detect an increase in environmental temperature or heat sensors in the hypothalamus detect a rise in the temperature of the blood.
   2) The sweat glands increase the production of sweat.
   3) Vasodilation, increases the internal diameter of blood vessels so that more blood is brought to the capillaries.
   4) Body loses heat as sweat evaporates.
   5) Body loses heat as more blood is brought to the skin surface, leading to increased heat loss by conduction, convection and radiation.
   6) Metabolic rate is lowered leading to the decreased heat production by cells.
   7) Body temperature is lowered.

4. When the body is at rest or when the surrounding is cold:
   1) Thermoreceptors in the skin detect decrease in the environmental temperature or heat sensors in the hypothalamus detect drop in temperature of blood.
   2) The sweat glands stop production of sweat.
   3) Vasoconstriction, reduces the internal diameter of blood vessels so that less blood is brought to the capillaries.
   4) Body gains heat as erector muscles in the skin contract causing the hairs to stand up, creating a layer of air which will act as insulation.
   5) Skeletal muscles contract and relax repeatedly; this shivering resulting in production of heat.
   6) Less blood is brought to the skin surface so that less heat will be lost.
   7) Metabolic rate is raised leading to increased heat production by cells.
   8) Body temperature is raised.

5. The skin is:
- A waterproof structure;
- One of the organs of the sense of touch.

6. The skin has three parts:
   1) Epidermis:
      i. Cornified layer;
      ii. Granular layer;
      iii. Malphigian layer.
   2) Dermis.
   3) Hypodermis.

11. Coordination & Response

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11.1 The Nervous System.

1. The nervous system of a mammal consists:
   - The central nervous system (CNS) comprising the brain and the spinal cord.
   - Te peripheral nervous system (PNS) comprising the cranial nerves, spinal nerves and sense organs.

2. A neurone is a nerve cell. A nerve fibre is a long protoplasmic extensions of the cell body of a neurone. It serves to transmit impulses.

3. A nerve is a collection of nerve fibres.

4. Neurones:
   1) Sensory neurones:
      - It is a receptor neurone,
      - It transmits impulses from the sense organ (receptor) to the CNS.
   2) Motor neurone:
      - It is an effector neurone.
      - It transmits impulses from the CNS to the effectors.
   3) Relay neurone:
      - It connects sensory neurones to motor neurones.

5. A synapse is a junction between two neurones. A dendron transmits impulses towards the cell body of a neurone. An axon transmits impulses away from the cell body of a neurone.

6. Structure and functions of the human brain:

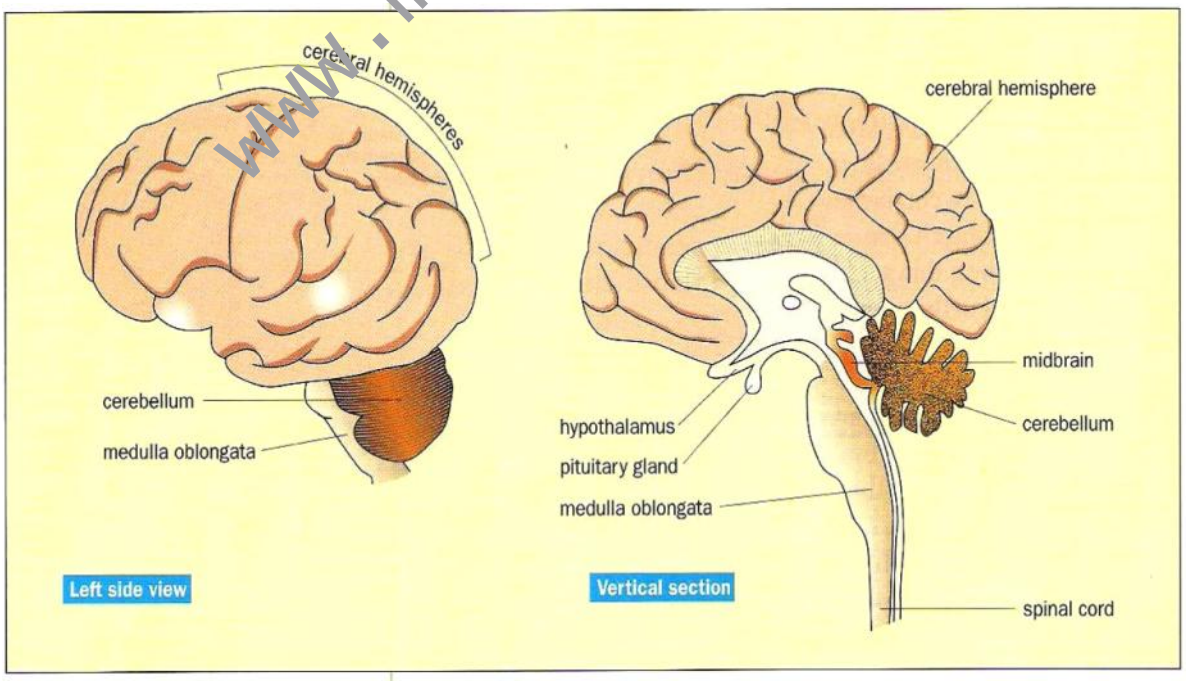

Fig.11.1 The structure of the human brain.

Parts of mammalian brain	Function(s)
1. Cerebral hemisphere (Cerebrum)	Intelligence, memory, voluntary actions, sensations.
2. Hypothalamus	Regulation of body temperature and osmotic pressure in blood; appetite and emotions.
3. Pituitary gland	Secretes a number of hormones.
4. Optic lobes	Concerned with sight and movement of eyeball.
5. Cerebellum	Muscular coordination and bodily balance.
6. Medulla oblongata	Involuntary actions, e.g. heartbeat, respiratory movements, peristalsis.

7. Reflex actions involve messages being transmitted from the sensory neurone to the motor neurone without involving the conscious part of the brain.

8. A reflex arc is the shortest pathway by which impulses travel from the receptor to the effector in a reflex action.

11.2 The Eye.

1. Structure and functions of the eye:

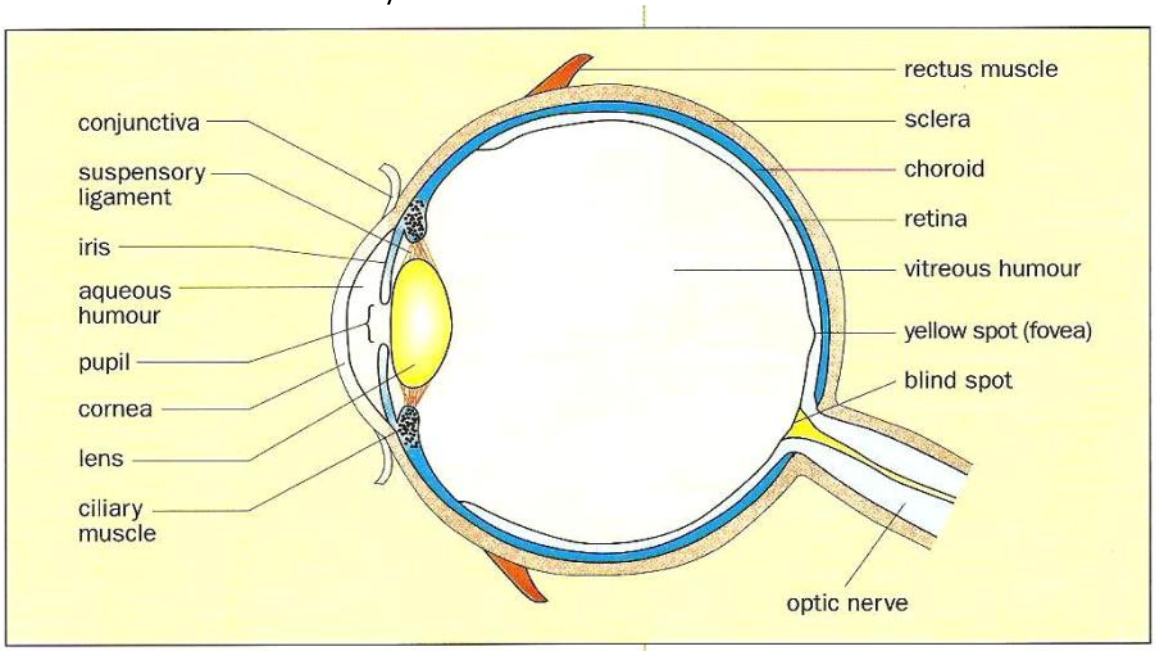

Fig.11.2 Structure of the eye.

Parts of the eye	Function(s)
1). Aqueous humour	Refracts light; keeps eyeball firm.
2). Vitreous humour	Refracts light; keeps eyeball firm.
3). Cornea	Refracts light rays into pupil.
4). Suspensory ligament	Attaches lens to ciliary body.
5). Iris	Controls amount of light entering the eye.
6). Pupil	Allows light to enter the eye.

7). Lens	Focuses light rays into retina.
8). Ciliary muscle	Controls curvature or thickness of the lens.
9). Rectus muscle	Movement of eyeball.
10). Sclera	Protection against mechanical injury.
11). Choroid	Pigmented black to prevent internal reflection of light.
12). Yellow spot (fovea)	Region of acute vision.
13). Optic nerve	Transmits impulses from eye to brain.
14). Blind spot	No photoreceptor cells; no vision when image falls on it.
15). Retina	Light sensitive layer, contains: (i). Cones concerned with colour vision in bright light. (ii). Rods concerned with vision in dim light.

2. Accommodation is the ability to change the curvature of the lens, so that light rays continue to be focused on the retina.

11.3 Hormones.

1. Hormones are chemical substances produced by a gland, carried by the blood, to the target organ(s), and produce a response, and destroyed in the liver.

2. Since hormones are proteins, therefore they are affected by pH and temperature.

3. The pituitary gland plays an important role as a "controller". It secretes a number of hormones, each of which controls the activity of a particular gland, hence the pituitary gland is sometimes referred to as the "master gland".

4. Location of endocrine gland:

Endocrine gland	Secretion	Effects
1). Thyroid	Thyroxine	Stimulates and maintains metabolic processes; regulates growth and development.
2). Adrenal glands	Adrenaline	Increases blood glucose level; increases metabolic activities.
2). Adrenal glands	Other hormones	Increase blood glucose level; increases blood volume and pressure.
3). Ovaries	Oestrogen, progesterone	Stimulate and regulate menstrual cycle; maintain female secondary sexual characteristics.
4). Testes	Testosterone	Supports sperm formation; maintains male secondary sexual characteristics.
5). Pancreas	Insulin, glucagon	Control blood glucose level.

5. The islets of Langerhans are the special group of cells in the pancreas which secrete the hormone insulin into the bloodstream.

6. Adrenaline:

Target organ	Effects of adrenaline	Biological advantage	Effects or sensation
1). Heart	Beats faster	Sends more glucose and oxygen to the muscles	Thumping heart
2). Breathing centre of the brain	Faster and deeper breathing	Increased oxygenation of the blood; rapid removal of carbon dioxide	Panting
3).Arterioles of the skin	Constricts them	Less blood for the going to the skin means more is available to the muscles	Person gets paler
4). Arterioles of the digestive system	Constricts them	Less blood for the digestive system allows more to reach the muscles	Dry mouth
5). Muscles of the alimentary canal	Relax	Peristalsis and digestion slow down; more energy available for action	'hollow' feeling in stomach
6). Muscles of body	Tenses them	Ready for immediate action	Tense feeling; shivering
7). Liver	Conversion of glycogen to glucose	Glucose available in blood for energy production	No sensation
8). Fat depots	Conversion of fats to fatty acids	Fatty acids available in blood, for muscle contraction	No sensation

7. Insulin:

Endocrine gland and secretion	Causes of secretion	Effect(s)
Islets of Langerhans in pancreas produce the hormone insulin	Increase in concentration of blood glucose	Decreases blood glucose concentrations by: • Increasing the permeability of cell membranes to glucose thereby increasing the rate of glucose uptake by cells. • Increasing the conversion of glucose to glycogen. • Increasing the oxidation of glucose to carbon dioxide and water in respiration. Thus, there is an overall increase in the utilization of glucose by cells. Effects of lack of secretion: • Glucose cannot be stored or utilized by tissue cells, so blood glucose concentration rise and some is subsequently lost in the urine-diabetes mellitus. • Since muscle cells have no reserve of glycogen, body weakness follows; continuous loss of weight. • Body oxidizes fats instead of glucose to produce energy and this result in production of poisonous substances called ketones which are excreted in urine. Death can occur. Effects of oversecretion; • Abnormal decreases in blood sugar concentration. • Shock results. • Coma and death may follow.

11.4 Diabetes Mellitus.

1. Signs of diabetes mellitus:

- A persistently high blood glucose level and glucose in the urine after a meal are signs of diabetes mellitus.

2. Treatment:

Type of diabetes mellitus	Causes	Treatments
1). Type 1 diabetes (Juvenile-onset diabetes)	• The inability of the pancreas to produce sufficient insulin. • The cells producing insulin have been destroyed.	• Supplying insulin by injection. • Balancing the amount of insulin supplied with the amount of total carbohydrate intake and exercise.
2). Type 2 diabetes (Adult-onset diabetes)	• The fall in the production of insulin by the pancreas. • Failure of the target cells to respond well to it.	• Regulating the carbohydrate content in their diet. • Doesn't usually require insulin injections.

3. An insulin-dependent person is a person who needs daily injections of insulin.

4. An insulin-independent person is a person who doesn't usually require any injections of insulin.

- Type 1 diabetes (Juvenile-onset diabetes=early-onset diabetes=insulin-dependent diabetes)

- Type 2 diabetes (Adult-onset diabetes=late-onset diabetes=insulin-dependent diabetes)