Vineyard Labourer Bible College

Health and Hygiene Module 3

"Beloved, I wish above all things that thou mayest prosper and be in health, even as thy soul prospereth." 3 John 1:2

"Trust in the LORD with all thine heart; and lean not unto thine own understanding.
In all thy ways acknowledge him, and he shall direct thy paths.
Be not wise in thine own eyes: fear the LORD, and depart from evil.
It shall be health to thy navel, and marrow to thy bones."
Proverbs 3:5-8

"Since the mind and the soul find expression through the body, both mental and spiritual vigor are in great degree dependent upon physical strength and activity; whatever promotes physical health, promotes the development of a strong mind and a well-balanced character. Without health no one can as distinctly understand or as completely fulfill his obligations to himself, to his fellow beings, or to his Creator. Therefore the health should be as faithfully guarded as the character. A knowledge of physiology and hygiene should be the basis of all educational effort."
Education by E. White, page 195 para. 1.

"When properly conducted, the health work is an entering wedge, making a way for other truths to reach the heart. When the third angel's message is received in its fullness, health reform will be given its place in the councils of the conference, in the work of the church, in the home, at the table, and in all the household arrangements. Then the right arm will serve and protect the body."
Vol. 6 Testimonies For The Church by E. White, page 327 para. 2.

"Never should the Bible be studied without prayer. Before opening its pages we should ask for the enlightenment of the Holy Spirit, and it will be given."
Steps to Christ by E. White, page 91 para 1.

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Vineyard Labourer Bible College Training for the Christian Walk

3a - Basic Anatomy Of The Human Body

The human body is made up of an enormous number of tiny marvellously complex units of living material called cells which if cared for work extremely well. Grouped together to form tissues are cells of different kinds. Organs with special functions are constructed from these tissues. For the purpose of this study, we will divide these organs into systems, though it should be noted that each system is very complex, closely related to that of the other systems, and the separation of these may be indistinct. In fact, the body works as a whole unit and the successful working of one system is greatly dependent upon interaction with another.

The systems are:

1. **Skeletal**
2. **Muscular**
3. **Circulatory**
4. **Respiratory**
5. **Nervous**
6. **Our 5 Senses**
7. **Digestive**
8. **Urinary**
9. **Reproductive**
10. **Endocrine**
11. **Lymphatic**
12. **Skin**

1. SKELETAL SYSTEM

The skeletal system in an adult consists of between 200 and 212 bones, as well as joints, ligaments, tendons, and cartilages which are softer than bone, less rigid, and slightly elastic. Ligaments, tendons and cartilages help tie the bones together, and form the nose, larynx, trachea, bronchial tubes, and the outer ear.

The bones, ligaments, tendons, and cartilages constitute the frame on which the body is built. They give form and strength to the body, support its various parts, and prevent it from sinking by its own weight; they serve as levers for muscles to act upon, and to defend the brain, heart, lungs, and other vital parts, from external injury, and occupy the same position in the body that the frame does in a building. The muscles, nerves, flesh and skin, are placed upon the bones as a carpenter puts boards on the frame to build the house.

Bones have four basic shapes:

- Long Bones - include those in the legs, arms, toes, and fingers.
- Short Bones - include kneecaps, and bones of the wrist and ankle.
- Flat Bones - includes the skull, ribs, sternum, hips, and scapula or shoulder blade.
- Irregular Bones - includes the vertebrae, facial bones, and other bones which are put to special purposes, including helping to support and protect the body.

The human skeleton can be divided into two subdivisions: the axial skeleton and the appendicular skeleton. The axial skeleton which serves to hold the body erect, and to protect most of the body's vital organs such as the heart, liver, and lungs, includes the skull, the vertebral column or spine, the ribs with their cartilage portions, and the sternum or breastbone or put simply the head, neck and trunk. The appendicular skeleton includes the bones of the shoulder, the rest of the upper extremities, the pelvis, and the lower extremities or put simply the arms and legs.

The skull or head consists of the facial and the cranial skeletons. The facial skeleton forms the framework for the entrance of the digestive and respiratory systems and serves for the attachments of the muscles of mastication and of facial expression. The cranial bones enclose and protect the brain and its associated structures, and act as a site for attachment of muscles of mastication and of muscles for moving the skull. The bones of the scalp consist of two layers separated by small spaces. Many holes for the passage of nerves and blood vessels are present in the skull. These are called foramina. Some of the bones have hollow spaces called sinuses, with openings into the nasal cavity. There are also cavities for the eyes and ears.

The vertebral column or spine is made up of 33 vertebrae some of which are fused so that there are only 26 irregular or vertebral bones, all tied tightly together by ligaments, forms a strong, flexible column. These bones are usually divided into five regions- cervical, in the neck and supports the head; thoracic, in the chest; lumbar, in the lower back, sacrum which is formed of five vertebrae fused together into one triangular bone and forms part of the hip, and coccyx or tail bone of four vertebrae which are usually fused together. The spine surrounds and protects the spinal cord of the central nervous system which links the brain with the rest of the body. The spinal nerves arise from the spinal cord and pass through foramina between two successive vertebrae. Neck and truck movements are performed by muscles attached to the vertebrae. Most movements are confined to the cervical and lumbar regions because the joints between the vertebrae of these regions are more freely movable.

Jointed to the thoracic vertebrae are 12 pairs of ribs, but only the upper seven opposing pairs are attached in front to the sternum or breastbone. Three of the remaining five pairs are attached by cartilage to the rib immediately above. The last two are unattached. The breastbone, situated in the midline of the chest wall, is shaped like a blade. The sternum, ribs, and 12 vertebrae make up the framework of the thoracic cavity.

Jointed to the axial skeleton are the bones of the upper and lower extremities. These constitute the appendicular skeleton. The arms are supported by a shoulder girdle, which has on each side a collarbone, or clavicle, and a scapula, or shoulder blade. The humerus is the bone of the upper arm, and the ulna and radius form the forearm. The two parts of the arm are connected by a hinge joint. The hand has 8 carpals, or wrist bones; 5 metacarpals, which form the palm; and 14 phalanges, which make up the fingers. The combination of simple joints and levers that make up the arm can produce an astounding range of movements.

The bones of the lower extremity are built on the same plan as the upper extremity. Each of the two innominate bones or hipbones consists of three parts the ilium, the ischium, and the pubis. The hipbones unite with the sacrum and coccyx of the vertebral column to form the pelvic girdle, which supports the legs via a ball and socket joint. The femur is the thighbone, the patella forms the kneecap, and the tibia and fibula which allow for articulation, are the bones of the lower leg, with the tibia being the shinbone. The skeleton of the foot consists of three parts. The ankle joint has 7 small tarsal bones; 5 metatarsal bones form the arch; and 14 phalanges make up the toes. The leg bones must support the body's weight and are thus more solid than the arm bones, but the leg bones have a smaller range of movement.

To carry out physical movement individual bones have to be able to move or articulate against each other and connect to each other. This is the function of joints. In the case of the skull the joint connections are so close that no movement is possible. The elbow and knee are examples of hinge joints which permit movement back and forth in one plane. Movement around a single axis such as the head rotating is called a pivotal joint. Ball and socket joints such as the shoulder and hip joints allow a wide range of movements. The ends of the bones are covered with a layer of cartilage and there is fluid called synovial fluid in the space between them to make movement easier. Ligaments are the bands of connective tissue that hold the joints together.

Questions on the lesson.

1. How many bones does an adult have?
2. Apart from bones, what else is included in the skeletal system?
3. What is the main job of the skeletal system?
4. How many different shapes are there in bones? Name them.
5. What are the two subdivisions of the skeletal system?
6. What does the facial skeleton form the framework for?
7. What do the cranial bones enclose?
8. How many vertebrae comprise the spinal column and what do they protect?
9. What cavity is formed by the rib cage?
10. Describe what makes up the appendicular skeleton.
11. What is the function of joints?
12. List three different types of joints and give examples?

Further Study

If possible, acquire a drawing of the skeleton or draw one, and label all the main bones talked about in this study.

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3b - Basic Anatomy Of The Human Body

2. MUSCULAR SYSTEM

Muscles are the body's tissues, and the human body has almost seven hundred of them. All movement depends on the use of muscles. Whether the movement is as simple as opening the eyes or as complex as running the high hurdles at a track event, each is the result of a complex series of electrical, chemical, and physical interactions involving the brain, the central nervous system, and the muscles themselves.

There are three kinds of muscles: cardiac, smooth, and skeletal. There is only one cardiac muscle that is the heart. Smooth muscles are controlled by the involuntary parts of the nervous system and are found in the stomach, intestines, blood vessels, and diaphragm. Skeletal muscles are the most prominent and makes up a large portion of body weight. They are responsible for the voluntary movement of the bones.

The term muscular system is used only for the skeletal muscles which are composed of a bundle of long, cylindrical cells, called fibres. They give much of the shape to our arms, legs, torso, neck and face. Muscles are attached to the skeleton at both ends by tendons and ligaments. The muscles contain blood vessels that bring oxygen and nutrients, nerve endings that carry electrical impulses from the central nervous system, and nerve sensors that relay messages back to the brain. Each muscle consists of muscle fibres surrounded by connective tissues and has three regions: belly, origin, and insertion. The large part of the muscle is called the belly. The origin is the end attached to a bone which remains stationary when the muscle contracts and is always closer to the torso than the insertion. The insertion is the moveable end. Muscles that straighten joints are extensors. Muscles that bend joints and pull limbs toward the body are called flexors.

The primary purpose of the skeletal muscles is to operate the skeleton as a system of levers. Movement usually involves the coordinated action of several muscles. Since muscles can only work by contracting, their action must be opposed and counteracted by extension. The muscle that initiates the action is the agonist or prime mover. As the agonist contracts, another muscle, the antagonist, relaxes or yields to it. Other muscles, synergists or fixators, help the prime mover by dampening unwanted movement or holding a limb or joint steady during the action.

Some muscles are always contracted at any point in time. They are in a state of tension, giving the body posture. The assumption of a particular posture, e.g. standing or laying, is also a result of muscular tension, a force that can only be maintained through a high consumption of energy.

Muscles of the face, head and neck

Capable of rotation and powerful movement as well as the minute coordinated actions that express slight emotional changes in the face are the complex muscles of the head and neck. They are not attached to a moving limb like most skeletal muscles. Instead they insert either into the flat bones of the skull or face or into head tissue such as the lip or skin of the chin. The muscles of the facial expression are superficial muscles. They are located near the skin and register emotion and also help you chew and speak. Apart from helping with chewing and swallowing the muscles of mastication are extremely important for making the complex movements required for human speech. Some of the tongue muscles insert into the tongue, while others have both their origin and insertion at the hyoid bone. The muscles of the neck arise chiefly from clavicle and sternum and as far down as the sixth vertebra. They allow you to rotate and extend your head.

Muscles of the trunk of the body.

The muscles that encase the trunk of the body or torso are the ones that hold us erect, or allow us to flex. They also assist in restraining the internal organs, and assist with breathing. Back muscles carry out rotation movements, as well as forward and backward movements of the trunk. The abdominal cavity is enclosed by sheet-like muscles which pass vertically, horizontally, and diagonally across it. They restrain the abdominal contents, bend the spine, and assist in breathing. For example, the spine bends sideways then the obliquus externus or external oblique muscle contracts on one side of the body only. When the whole muscle contracts or compresses the abdominal cavity, it forces the air out of the lungs or causes exhalation. The chest cavity and the abdominal cavity is divided by a dome-shaped muscle called the diaphragm. The diaphragm forms a floor for the chest cavity, its edge generally following the lower ribs outline. When this muscle is straightened or pulled downwards it increase the capacity of the chest cavity it decreases the air pressure in the lungs causing us to breathe in. When the diaphragm relaxes it goes back upwards and resumes it original shape it increases the air pressure in the lungs causing us to breathe out. During this process other muscles called external and internal intercostals also move the ribs, expanding for inhalation and relaxing for exhalation.

Muscles of the upper limbs.

Movement of the upper limbs or arms requires complex groups of opposing muscles to work together. These muscles arise from such varied places as the shoulder blade, collar bone, sternum or breastbone, ribs, lower vertebrae and even the hips. They hold the humerus in its socket and are the only attachment between the axial skeleton and shoulder and arm. By combinations of the shoulder muscles either relaxing and contracting the arm is able to flex, extend and rotate at the shoulder.

The biceps and triceps which are arguably the best known muscles of the human body, are muscles of the upper arm and extend and flex the lower arm at the elbow. The rotating or turning actions of the lower arm are achieved mainly by the supination and pronation muscles. The primary muscles for the wrist, hand, and fingers have their origin in the forearm and lower humerus. Long tendons that run from the forearm muscles and can be seen in the back of your hands, are connected to the fingers. Muscles on the upper side of the forearm extend the fingers, while those on the underside bend them. There are more than 30 pairs of muscles involved in producing hand motions.

Within the hand itself are small muscles that spread the fingers and perform the complex and importantly vary opposable thumb action - that is the thumb opposed to any of the fingers in a grasping hold. This action makes it possible to pick up and hold objects.

Muscles of the lower limbs.

The muscles of the lower limbs or legs are much more powerful than those of the arms, but their motion is more limited. Large muscles that arise from the front side and back of the hip and sacrum move and rotate the upper leg. The three gluteus or buttock muscles support and raise the trunk when the body is bent over, as well as extend, rotate, and elevate the femur. The knee is moved by the thigh muscles. The quadriceps which form the front of the thigh join in a strong tendon just above the knee. The patella or knee cap is embedded in this tendon which inserts at the top of the tibia or shin bone. The longest muscle of the body called the sartorius arises in the ilium or hip, crosses the quadriceps, and inserts into the inner side of the tibia or shin bone. The hamstrings run down the back of the thigh and extend and flex both the knee and hip. When you sit down you can feel their large tendons under your knee.

The flex and rotation of the foot and extending of the toes is largely controlled by the muscles of the lower leg or calf muscles. They are attached to it by tendons passing through the ankle. These tendons insert into the phalanges and metatarsals. The ankle, above the heel, has a joint that acts as a hinge between leg and foot. The toes are jointed so that the foot bends easily, and the motion of walking is almost as smooth as the rolling of a wheel. Each foot has 26 bones and is relatively fragile. Through the progressive distribution of the body's weight from the heel to the shock-absorbing arch and ball, the foot can withstand strong forces. The dorsiflexors rotate your foot upward when you walk concentrating the majority of your weight on the heel bone as it impacts the ground. Gastrocnemius and soleus, two calf muscles, lift the heel through the achilles tendon and roll the foot forward. This distributes your weight onto the metatarsal heads and toes. A number of small muscles that help support the toes and balance the body are in the foot.

Questions on the lesson.

1. How many muscles are attached to the human skeleton?
2. How many kinds of muscles are there? Name them.
3. What attaches the muscles to the skeleton?
4. Name the three regions of a muscle.
5. What is the primary purpose of the skeletal muscles?
6. How do the muscles assume and maintain one posture?
7. What movements do back muscles perform?
8. What do the obliquus externus muscles perform?
9. What is the name of the muscle that divides the chest and abdominal cavities? What does this muscle help us do?
10. What are the best known muscles of the human body?
11. What is the longest muscle of the body? Where does it arise and insert?
12. How does the fragile foot withstand strong forces?

Further study.

- As you go about your daily work think about what muscles you are using to be able to do that work. Think about where they arise and insert.

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3c - Basic Anatomy Of The Human Body

3. CIRCULATORY SYSTEM

The circulatory system consists of blood, the heart, and a closed system of tubes called arteries and veins. The blood which is 90 - 93% water and is about 7 - 9 % of the total body weight in man, is the chief transport system of the body. It carries supplies of oxygen, nutrients and other vital substances to cells in the body while at the same time it carries away carbon dioxide and waste products. The blood also carries hormones from glands to their relevant organs. When blood is enriched with oxygen it is a light red. However, when the oxygen is depleted and the blood is carrying waste it changes to a dark blue-red colour.

The blood can only do its work when it is kept rhythmically circulating through the blood vessels. This is the job of the heart. The heart is a large, hollow, muscular organ that is about the size of a clenched fist of its owner. It is nestled in the left side of the chest and is surrounded by the lungs. Each side of the heart has two chambers, making four chambers in all. The blood enters the heart through veins on the right, and after a quick trip to the lungs to be replenished with oxygen and the liver and kidneys to remove waste, it leaves the heart through arteries on the left. The heart beats or contracts between 60 - 80 times per minute forcing or pumping about 7,000 litres or 1820 gallons of blood through the arteries each day. At the same time it works like a suction pump sucking the blood out of the veins back into itself. The beating or contracting of the heart is an involuntary muscular action, i.e. the brain does not have to send messages to the heart to keep it going. The heart has several sensors which monitor the body's activities and either increase or decrease the flow of blood as necessary.

Arteries are the blood vessels that carry the blood enriched with oxygen, nutrients and other vital substances to the rest of the body. The main artery that leaves the heart is called the aorta, is very large, and receives the high pressure of blood that leaves the heart. It divides many times into smaller and smaller branches during the course around the body maintaining an even stream in the smaller arteries called bronchioles and capillaries which are the tiniest branches of the circulatory system. Capillaries can be found throughout the tissues of the body, except in the cartilages - cuticles, nails, hair, and the cornea of the eye. The capillaries are so small that blood cells have to pass through single file. This is where the blood delivers the oxygen, nutrients, and hormones and collects the wastes to the tissue cells.

The depleted blood moves back toward the heart into ever enlarging blood vessels and finally into the largest veins. Some veins, like those in the lower leg, have valves that hold the blood until the pressure builds up sufficiently to move the blood towards the heart. The valves are forced shut by the weight of the blood when the pressure drops. In this way it overcomes gravity and prevents the blood flowing backwards. These valves sometimes weakened, usually with age, permitting blood to leak downwards and expanding the walls of the veins. This is called varicose veins. When the blood reaches the heart it pumps this blood to the lungs to exchange carbon dioxide for oxygen, and to the liver and kidneys which remove the wastes. The blood is then ready to start the journey around the body again. This whole system has several 1000 kilometres or 621 miles long of blood vessels.

Large arteries supply express, direct service to major areas of the body such as the brain, lungs, arms, and abdomen. Once these large arteries reach the appropriate area they begin to divide. You will feel the pump stroke or beat of your heart if you press your finger (not your thumb) against one of these arteries. This is your pulse. Many parts of the body have more than one artery serving them. Therefore if one blood vessel serving an area becomes damaged or restricted the flow of blood to that area will not stop completely.

In case of an accident where an arterial blood vessel is cut it will spurt out blood under pressure, while blood from a venous blood vessel will flow steadily and be darker in colour. The spurting blood from an artery cut can be stopped by applying pressure between the heart and the cut. But to stop the steady flow of a vein cut you have to apply pressure on the side of the cut furthest from the heart.

Questions of the lesson.

1. Of what does the circulatory system consist?
2. What percentage of the blood is water?
3. What does the blood do?
4. How does the blood move around the body?
5. Which side does the blood enter and exit the heart?
6. How many litres of blood does the heart pump every day?
7. Give the three names given to blood vessels in this article.
8. What happens in the capillaries?
9. How do veins overcome gravity?
10. How do you stop the blood flow from an artery and a vein?

Further Study

- Do a basic drawing of the body showing how the blood flows around the body.
- Try and find the main arteries and veins in your own body and compare their colour.
- By applying pressure to a main artery with your fingers count how many times you feel your heart beat for one minute. This figure is your pulse rate.

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4. RESPIRATORY SYSTEM

Respiration or breathing is the process of absorbing oxygen and expelling carbon dioxide and water vapour. This system is made up of the nose, the nasal passages, the pharynx or throat, the larynx or voice box, the trachea or windpipe, the lungs, the bronchi or the air tubes that branch out in the lung, and the alveoli or air cells where the exchange of oxygen and carbon dioxide and waste takes place.

The act of breathing is usually an unconscious process which is controlled by special section of the spinal cord. It can, however, be controlled voluntarily to a certain extent. Usually an adult breathes 12 - 17 times per minute, and child 20 - 25 times. The air chambers of the lungs are open to the outside atmosphere, so there is the same air pressure inside the lungs and outside the body when the lungs are relaxed. When the rib cage expands and the diaphragm is pulled down or contracted, the air pressure in the lungs is lowered. Air comes rushing in to equalize the pressure inside the lungs and outside the body. This is called inhalation. When the rib cage relaxes by decreasing in size and the diaphragm is relaxed back into the pulled up position, the air pressure in the lung is increased. This causes the air in the lungs to rush out so that the air pressure is the same as outside the body. This is called exhalation.

During inhalation air first enters the nose or two nostrils (as long as we breathe with our mouths shut), then the nasal passages or cavities. These passages are separated by the septum which is a cartilage divider. The walls of these passages are lined with sticky mucous. In the nasal passages the air is warmed to body temperature by the network of blood vessels, and it is humidified by the mucous membrane. Dust and germs that are in the air are filtered out party by the hairs around the nostrils and partly by adhesion to the slimy mucus. Millions of hair like projections that cover the membrane are called cilia and move the trapped particles to the pharynx or throat where it is swallowed. The sneezing mechanism also protects the nasal passage when irritants stimulate a reaction from the brain. This reaction includes a deep breath in and an explosive exhalation which carries away the foreign matter. The olfactory nerve endings in the mucosa of the upper parts of the nasal passage detect smells in the air.

From the nasal passages the air passes through the three sections of the pharynx or throat. On the top near the nasal cavities is the nasopharynx, in the middle behind the oral cavity is the oropharynx, and above the voice box and esophagus is the laryngopharynx. The pharynx is also part of the lymphatic system because of a muscular tube which contains the tonsils, placed one on each side. There is also a tube that connects the middle ear with the pharynx. This is called the eustachian or auditory tube. These tubes drain secretions from the middle ear and connect the middle ear with the atmosphere so that the air pressure on both sides of the eardrum are equal.

The larynx or voice box is the next part of the respiratory system. Foods and liquids which also pass through the pharynx, but are prevented from entering the larynx and the rest of the respiratory system by the epiglottis. The epiglottis is a small flap that snaps shut over the larynx when solids or liquids stimulate special touch receptors. Sometimes this is not 100% accurate and we get a little food, liquid, or particles down the larynx, and into the trachea. Cilia and mucous membrane line the walls of the trachea and trap food, liquids, and particles that get through the epiglottis and the upper respiratory passages. When this happens it causes us to cough. The lungs fill with air, the epiglottis closes, and the rib cage and diaphragm are suddenly, sharply pushed against the lungs increasing the air pressure in them. The epiglottis suddenly flips open and air rushes out nearly at the speed of sound. This fast flowing air dislodges the food, liquids, or particles and carries it out.

Situated in the larynx are two pairs of mucous membrane folds which extend from the front to the back. The upper set are the false vocal folds or cords. The lower set are the true vocal cords. Only the true vocal cords produce sound. When the muscles are slack and the slit wide the air passes through, both in and out, noiselessly. But, when the muscles tighten and the slit is narrow the passing air causes the fold to vibrate, making sounds. The pitch of these sounds vary with the tension. The volume of the sound is increased by the mouth and nasal passages. Speech is formed by altering the vibrations of the vocal cords, and the shape of the tongue, teeth, lips, and the soft pallet.

Air is moved down from the larynx to the trachea or wind pipe. The trachea is about 12 cm (4.75 inches) in length in an adult. This tube is flexible and can follow the movement of the head. The trachea branches into the two main bronchi, one for each lung. The bronchi divide over and over again becoming smaller and more numerous. Although these branches keep getting smaller because they divide so numerously the air pressure remains the same. Alveoli or air cells line the very small respiratory bronchioles. An adult has about three hundred million of these small projections. If spread out the alveoli would nearly cover a football field. The membrane that separates the alveoli from the blood capillaries is very thin. When we breathe in the average air composition is: nitrogen 78%; inert gases 1%; oxygen 21%; negligible amounts of carbon dioxide; and variable water vapour. The blood cells coming to the lungs have already given their oxygen to the body cells and have collected more carbon dioxide, making a chemical imbalance between the alveoli and the capillaries. The two gasses try to equalize their pressure causing oxygen to pass from the alveoli to the capillaries, and carbon dioxide from the capillaries to the alveoli. The average air composition that we breathe out is: nitrogen 78%; inert gases 1%; oxygen 17%; carbon dioxide 4%; water vapour to the point of saturation at body temperature. The exchange is very efficient because of the large area of the alveoli. It only takes about one-fifth of a second to replenish the blood cells with oxygen.

Questions on the lesson.

1. What process does respiration do?
2. From this article make a list of the different parts of the body that air passes through from the nose to the alveoli.
3. Describe the basic process of breathing.
4. What happens to air in the nasal passages?
5. How does sneezing happen?
6. Why is the pharynx part of the lymphatic system?
7. What is the epiglottis and what does it do?
8. Describe how a cough happens.
9. When does air pass silently through the vocal cords?
10. How many and how large an area would an adult's alveoli take up, and what is their job?

Further Study

Make a list of all the respiratory diseases that you know, and if they are common diseases in your local area.

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5. NERVOUS SYSTEM

The nervous system is an electrical impulse communication system and the control centre for the whole body. It controls involuntary organs like the heart and lungs, as well as involuntary muscle movement. Physical actions and reactions to both internal and external stimuli both originate and are coordinated within the nervous system, which also maintains a balanced state within the body. This system consists of the brain, spinal cord, nerve cells, and nerve fibres that run throughout the whole body.

The brain which has more than a hundred nerve cells, is the most specialized and complex organ of the human body. It controls and coordinates every process and system within the body. Including our thoughts, feeling, emotions, memories, nearly all our movements, and our unconscious and conscious actions. It also stores impressions for future use, and finally becomes the seat of the intelligence. The brain and the spinal cord which are both part of the central nervous system, are protected by fluid called cerebral spinal fluid, tissue and bone.

The brain can be divided into three main parts: forebrain, midbrain, and hindbrain. The forebrain or cerebrum and thalamus, is located at the front as the name suggests, and is the location of complex functions of human thought and action. Some of these functions include the formation of words, speech, judgment including that of moral principles, reasoning, creativity, and memory. It is also the location of our personality traits, emotions, and receives and sends messages to other parts of the brain than control less complex functions. The cerebrum is divided into two parts known as the right and left hemispheres. Each hemisphere contains both 'grey matter' which is on the outside, where the nerve cells are situated, and 'white matter' which is in the centre ,where the nerve fibres lie. The motor and sensory layer of one hemisphere of the cerebrum is connected to the opposite side of the body as they cross in the oblongata. However, the dominant hemisphere, usually the left, controls most aspects of language.

The midbrain is part of the brainstem through which some nerves enter and leave the brain. It connects the top of the spinal cord to the brain. Vision and eye reflexes, hearing, many internal body organs, including respiratory and digestive organs, the heart and glands, and motor responses of the head and torso are controlled by the midbrain. The midbrain connects the forebrain to the hindbrain.

The hindbrain consists of the cerebellum and pons, and is positioned behind and below the cerebrum. It is responsible for the unconscious muscular control of balance, coordinating muscular activity, and increasing the cerebral stimuli on their way to the muscles. It can keep muscles in a state of semi-contraction, but it cannot originate a muscle contraction. The pons connects the cerebral of one hemisphere with the cerebellum of the other hemisphere. It is also the origin of some of the facial nerves and plays a role in breathing.

The spinal cord is the other main part of the central nervous system. It descends from the midbrain down a specially formed canal in the vertebrae in the back. Coming out on the left and right in-between each vertebrae are spinal nerves which are the peripheral nervous system. The spinal cord has two functions: 1. As the sensory motor mechanism for reflex actions; 2. The two way transmitter of impulses, reactions, and stimuli triggered by various internal and external conditions. It does this by relaying impulses coming in and going out at the same level, relaying impulses up and down the cord to other levels, and relaying impulses to and from the brain.

There are 31 pairs of spinal nerves in the peripheral nervous system. All but one pair arise from the spinal cord, which arises in the medulla part of the midbrain. Each pair of nerves is named for the number of the vertebra over which it leaves the spinal cord and controls a particular area of the body. Each nerve is attached to the spinal cord by two roots, therefore most spinal nerves contain both motor and sensory nerve cell fibres. These fibres join together into one nerve before leaving the vertebral column. Outside of the column each nerve divides to form several branches or rami which control general area of the body. The peripheral nerves often take the same route as the blood vessels and have similar names.

Pain in an important part of our vital warning system. It can range from mild to intense, dull to stabbing. When we injure ourselves an acute sensation of pain is sent by electrical impulse through the sensory nerve, to the spinal cord, and onto the brain. Pain which is dull and persistent takes a slower path than does intense stabbing pain. A reaction or stimulus is only experienced when the pain reaches a certain level. This level varies with circumstances, from different parts of the body, as well as in different people. When this level is reached the brain processes the electronic impulse and sends out a signal as to the location of the pain. If the very middle of the spinal cord is damaged or broken, it can lead to paraplegia or paralysis of the area affected. All parts of the body from the break down will no longer be connected to the brain.

Although it only takes a brief moment for these electrical impulses to reach the brain, be assessed, and return as a muscle command to the appropriate body part, sometimes this process is too slow. This is where reflex action comes into play. Reflex actions are not voluntary, and many take place without the mind being aware of them. For example, the pain stimulus of touching a sharp pin or something hot with your finger will send a message to your spinal cord, where it is transferred to a neuron that connects right to the motor neuron. A response stimulus is immediately sent to instantly pull your arm away. More serious damage could have been sustained if this message had to travel all the way to the brain and back. The knee jerk reflex, sneezing, coughing, tears due to irritants like when cutting onions, vomiting, and ducking are all reflex actions.

There is another part of the nervous system which works to regulate the body's life-sustaining functions almost independently of the central nervous system. This system is called the autonomic nervous system. It controls the involuntary actions of organs like: the lungs, stomach, intestine, heart, blood vessels, and bladder. The autonomic nervous system is part of the peripheral nervous system and carries communications from the central nervous system outward to create responses in involuntary muscles and tissues.

The autonomic nervous system has two main parts: the sympathetic and parasympathetic. These systems send different communications which produce opposite reactions. For example, increased physical activity causes oxygen deficiency, the depth and rate of breathing automatically increases. This leads to an increase in cardiac activity and an increase in oxygenated blood. When the body is properly oxygenated both the breathing and cardiac activity reduces. Another example is one nerve may react to high blood pressure by decreasing the heart beat; the other nerve will increase the heartbeat when the blood pressure is too low.

Questions on the lesson.

1. What is the nervous system?
2. What is the most specialized and complex organ of the human body?
3. Name the three main parts of the brain and some of their functions.
4. The right hemisphere of the cerebrum controls which side of the body?
5. Which hemisphere of the cerebrum controls speech?

6. Apart from the brain, what is the other main part of the central nervous system and where is it located?
7. Where do each pair of spinal nerves arise, and how are they named?
8. What can happen when the very middle of the spinal cord is damaged or broken?
9. Describe how our reflex actions work.
10. What does the autonomic nervous system do?

Further Study

- Test out a few reflex actions on yourself and others - with their consent of course. Note if there is any variation is reaction and speed.
- Think about how different people handle pain. Some can handle a lot more than others. Why?

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3f - Basic Anatomy Of The Human Body

6. OUR 5 SENSES

The five senses of the human body include: 1. Sight; 2. Hearing and balance; 3. Taste; 4. Smell; and 5. Touch. These senses help keep us in touch with what is happening around us.

1. Sight.

At its simplest form sight is the ability to detect light. In its most complex form it allows discernment of colour, shape, pattern, depth, and movement. Vision is the result of light impulses being processed by the brain, and is aided by memory. The human eyes are located deep in the fluid-lubricated eye socket in the skull. They can be moved in unison in all directions by muscles. An eye lid lubricated with tears, and a thick fibrous capsule modified in front as a transparent disc called the cornea, protect each eye. Behind the cornea is the iris which changes in size to allow more or less light in. When light coming in is too bright, it closes or shrinks in size, but when it is too dull it opens more. The lens of the eye is located behind the iris. Muscles can relax the lens to make it thicker for looking at close-up things, and can contract to make the lens thinner for looking long distances. Inside the back of the eye is the retina which is lined with photoreceptor neurons called rods and cones. Cones can detect coloured light, while the rods are responsible for black and white images. The area between the lens and the retina is filled with a transparent jelly called the vitreous humour.

Light enters the eye through the cornea, lens and the transparent jelly and is focused on the retina. The lens inverts the image which projected onto the retina, but as nervous transmission is not in image form, the object is seen the right way up as a learnt experience. When lighting is poor colours cannot be seen because the cones need high light intensity to operate correctly. Rods, however, respond to lower levels of light and are used to discern moving objects and shapes. The photoreceptors send impulses to the optic nerve, which transmits them to the visual centre in the brain. The brain processes these impulses to become what we see.

2. Hearing and balance.

The human ear can register many sounds, but it requires the cooperation of the brain to actually hear something. There are three main parts in the ear: the outer ear; the middle ear; and the inner ear. The outer ear consists of a fleshy flap called the auricle, a tube lined with hairs and wax glands called the auditory canal, and the eardrum or tympanum which is at the internal end of the auditory canal. The auricle helps collect sound waves and directs them into the auditory canal and on to the eardrum. When the sound waves hit the eardrum it vibrates.

The middle ear is comprised of an air-filled tube called the tympanic cavity, three bones commonly called the hammer, anvil, and stirrup which span this cavity, and the eustachian tube. The hammer, anvil and stirrup link the inside of the eardrum to the cochlea which is part of the inner ear. These bones relay the vibrations from the eardrum to the cochlea. The eustachian tube connects with the nasopharynx or top part of the throat, so that air pressure both inside and outside the eardrum can remain the same. This is essential for good hearing and balance.

In the inner ear we have the bony and membranous labyrinths both of which are filled with fluid. The bony labyrinth houses the membranous labyrinth which is the true hearing organ. Part of the labyrinth is called the cochlea (which is Greek for snail) because of its shape. The vibrations that were transferred from the eardrum to the cochlea by the three bones, move through the liquid to the sensors, are converted to electrical impulses, and transmitted by the auditory nerve to the auditory centre of the brain. Different sounds stimulate different sensory cells. This is how we tell the difference between high and low notes.

Also in the inner ear are the mechanisms for determining movement and position. This includes the utricle which is a complex structure consisting of three fluid-filled, bony tubes or semicircular canals, and two sacs containing sensory cells for the sensations of position. The fluid in these tubes moves as we move sending messages to the brain of the changed position or movement.

3. Taste.

Taste is what we experience when food is mixed with saliva and enters pores in the tongue and pharynx. There are approximately 2000 taste buds, most of which are situated on the tongue. Taste buds react selectively to various substances and determine if something is sweet, salty, bitter, or sour. Sweet things are detected by the very front of the tongue, then salty a little farther back, then sour behind that, and bitter things right at the back of the tongue.

4. Smell.

Smell is usually considered to involve airborne substances. The olfactory organ which detects airborne substances or particles, is situated at the beginning of the respiratory tract in the nose. It is about the size of a penny. The olfactory nerve cells detect particles given off by something or someone. These particles produce an impulse that travels over the olfactory tract to the cortex of the brain. If a smell lasts for a long period of time the olfactory nerve cells don't detect the particles as well, as they seem to tire. Olfactory nerve cells die after about 4 weeks and are replaced with new ones. The dead ones are excreted through the nose with mucus.

5. Touch.

The skin is the largest organ in the body and is the organ of touch. It possesses numerous special receptors and nerve endings making it able to register touch, pressure, pain, and temperature. Touch sensors are nearest the skin's surface on your fingertips and near strands of hair. Lying deeper are the pressure sensors. Bare, branched nerve endings sense pain. Randomly placed all over the body are heat and cold sensors which differ from one another. Over stimulation of any of these sense receptors and nerve endings may cause pain. Different parts of the body are more sensitive than others because there is a variation in the number of the receptors and nerve endings, and in the thickness of the epidermis the outer layer of the skin.

Questions on the lesson.

1. What is vision?
2. How is the eye protected?
3. What happens to the eye when light enters?
4. What are the three main parts of the ear?
5. What is the true hearing organ?

6. Describe how sound waves travel from the auricle to the brain.
7. How does the brain know that we have moved or changed positions?
8. How many taste buds do we have and what do they do?
9. What organ detects smells and how does it do this?
10. What is the largest organ of the body?
11. What are the receptors and nerve endings in the skin able to register?
12. Which sensors are placed randomly all over the body?
13. Why are some parts of the body more sensitive than others?

Further Study

- As you go about your daily life think about how you use your five senses.
- Think of ways that you could cope if you lost one or more of your senses.
- Make a list of people close to you who have lost one or more of their senses, and work out ways that you can help that person.
- Think about the injuries that can be sustained by these sensory organs by inserting foreign bodies.

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