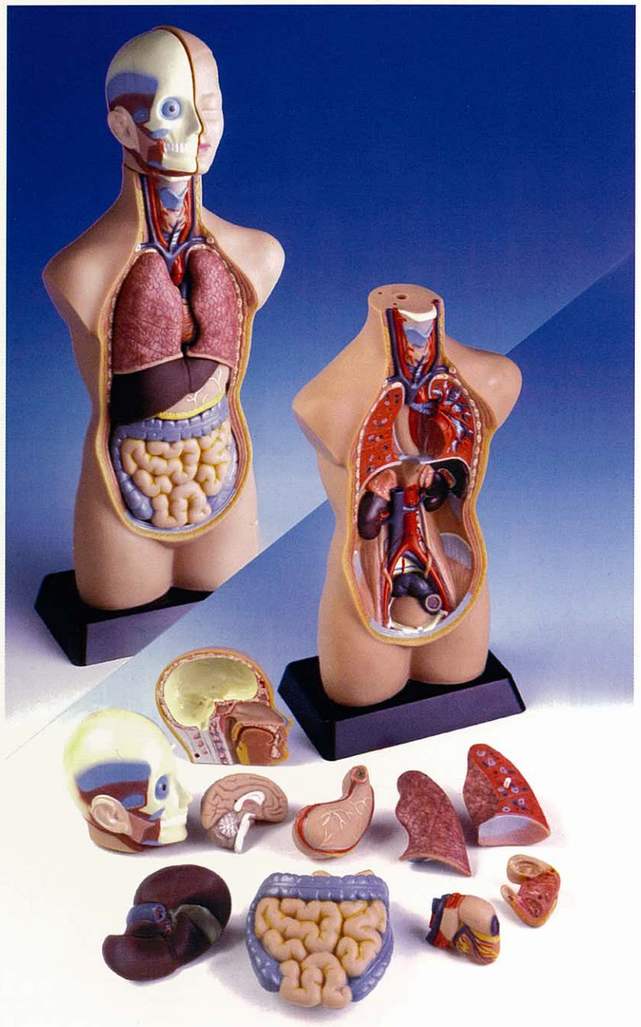
GB

7 29983 05001 6

P38-MK050-81001000

HUMAN TORSO
ANATOMICALLY ACCURATE
MODEL KIT



GUIDE TO HUMAN ANATOMY

WARNING! Product contains small parts which may pose a hazard for children under the age of three. Not recommended for children under 8 years of age.

YOUR HUMAN TORSO

Do you know that the human body is the best piece of machinery in the world? There is still no machine in the world capable of performing all the functions that your body can. Sounds unconvincing, doesn't it? If you think that humans are incredible, you are right. Everyday millions of incredible things are happening inside our body. Remember the last time you were walking on the street and enjoying an ice-cream cone? You were not as relaxed as you thought. Your brain was actually busy giving orders to your eyes, your tongue, your fingers, etc., as well as giving you the feelings of relaxation and enjoyment. Your lungs were occupied with the functions of inhaling and exhaling air, while your stomach was getting ready for that icy vanilla scoop. Everything functions smoothly, and after several hours the undigested part of the ice-cream becomes human by-products and is excreted from your body.

Nature is peculiar. The more you try to learn about it, the more you will be excited by its unexpected surprises. Start learning about nature by looking at yourself today! Below are some basic facts covering five of the systems inside your body. Remember that this booklet serves only as an elementary guide, there are more interesting facts to be discovered. Hope you do not ignore this miraculous gift from nature. Now get ready and let's start to explore your body!

I. RESPIRATORY SYSTEM

For every part of your body to stay active and functionable, they need the nutrients from the food you eat and the oxygen from the air you breathe. As oxygen is breathed in, carbon dioxide is released. The respiratory system in our body helps deliver oxygen to the red blood cells and remove the waste product, carbon dioxide.

The respiration process begins when the air penetrates through your *nostrils*. Dust from the air is filtered out by the thick hair in your nostrils. Further down in the *nasal cavity* and *sinus*, bacteria in the air are mostly removed by special hairs and special secretions. (Whenever you catch a cold, the membranes of the sinus cavities swell up to prevent infection. The nasal canals are then blocked, and you will find it hard to breathe.) Air then draws through the *pharynx* and travels down the *trachea*. The *epiglottis* (located at the top of the trachea) remains open when you are breathing.

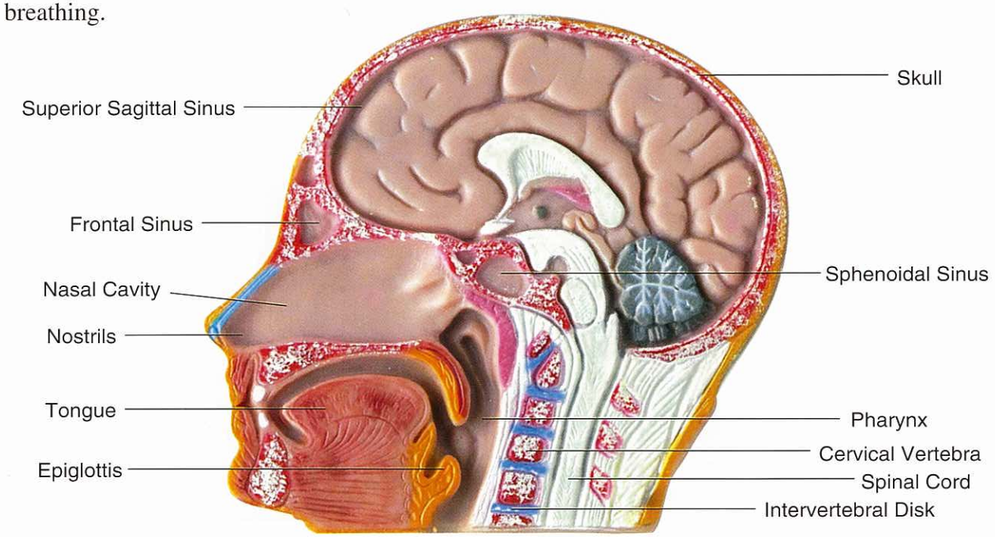


Fig. 1.1 Section through Head

Your trachea is not just as simple as a pipe. It is composed of *cartilaginous rings* that are covered with *cilia* (tiny hairs which help filter particulates). These hairs push dust back to the top of the trachea. The bottom of this big windpipe divides into two *bronchi* that go to your *lungs* respectively. Your lungs are spongy and elastic organs that are protected by moist membranes. The bronchi are similar to trees - they extend into smaller and smaller branches; at the very end of each branch, there is a moist tiny air sac called the *alveolus*. In your lungs, there are 300,000,000 air sacs! Being surrounded by a network of tiny blood vessels, these alveoli (plural), with membranes as thin as a single layer of cells, are where the oxygen and carbon dioxide are exchanged.

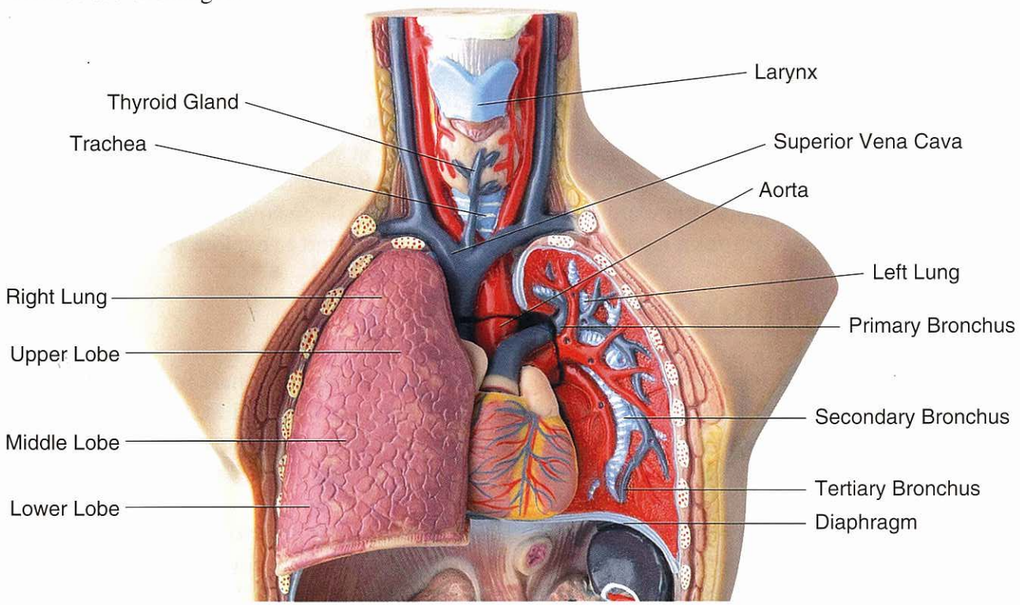


Fig. 1.2 Structures of Thoracic Cavity

The body part that helps you breathe is the *diaphragm*. The diaphragm, which separates your stomach from your heart and lungs is dome-shaped when it relaxes. When your diaphragm contracts and flattens, air is breathed in (your lungs inflate just like balloons). When your diaphragm loosens and returns to a dome-shape, the air in your lungs is breathed out; the diaphragm deflates the lungs to force out the waste air. The movement of such muscles are caused by *nerve* impulses being sent from the respiratory center in the *medulla oblongata*, which is stimulated by the high concentration of carbon dioxide in the bloodstream.

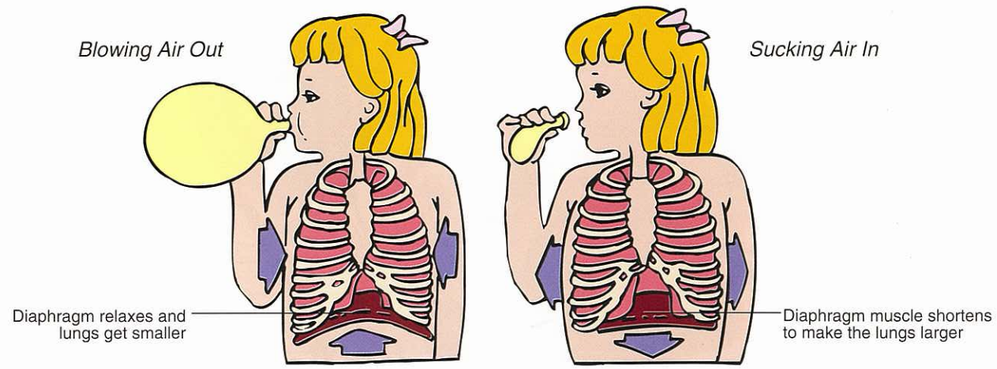


Fig. 1.3 Mechanism of Respiration

Breathing in! Breathing out!

The air that you breathe in contains around 20.9% oxygen and 0.04% carbon dioxide, while the air that you breathe out contains around 16.3% oxygen and 4.5% carbon dioxide. You can see the amount of carbon dioxide you breathe out is 100 times more than what you breathe in as a result of gaseous exchange.

An average person's breathing rate is 20 times per minute. The volume of air per breath is about 500 cm^3. You may find that you breathe faster when you exercise. When you exercise, your body needs more oxygen which can be met by higher breathing rate.

II. CIRCULATORY SYSTEM

Being the main transportation system inside your body, the circulatory system brings oxygen and nutrients to every part within and carries away the carbon dioxide through the bloodstream. Your *heart* and *blood vessels* (which consist of *arteries*, *veins* and *capillaries*) play an important role in "telling how the blood to flow."

What does your heart look like? Your heart is unlike those you have seen in the cartoons, neither smooth looking nor flat. Your heart consists of 4 chambers: the *left atrium* and the *right atrium* are on the top while the *left ventricle* and the *right ventricle* are at the bottom. The left side of the heart is separated from the right by the *septum*.

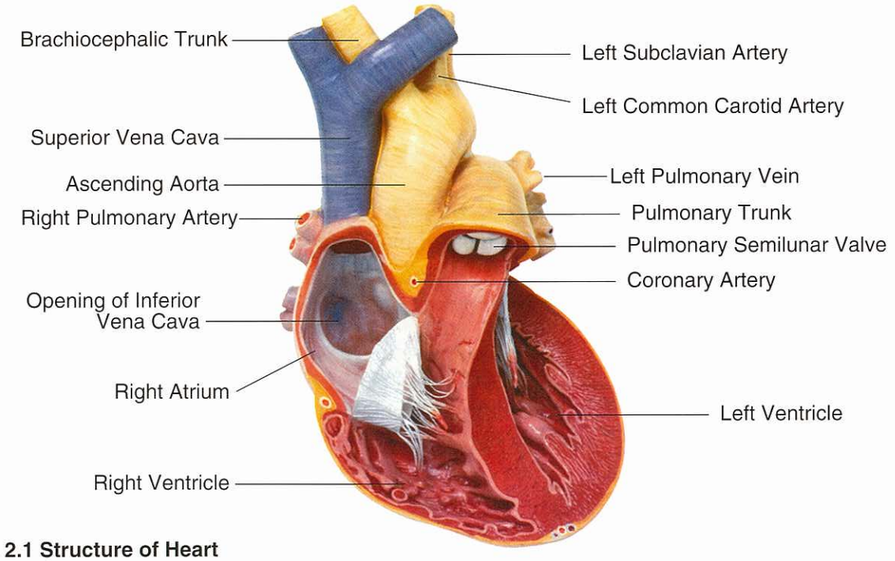


Fig. 2.1 Structure of Heart

Blood carrying carbon dioxide and wastes released by the organs enter the right atrium of your heart through the *vena cava*. After passing through the first valve (this valve prevents blood from flowing backward), the blood enters the right ventricle where it is then pumped to your lungs through the *pulmonary arteries*. In the lungs, oxygen is collected while carbon dioxide is released. When the process is completed, the oxygenated blood is pumped back to the left atrium of the heart through the *pulmonary veins*. Then the blood is circulated into the left ventricle where it is pumped throughout your body.

Table 2.1 Paths of oxygenated and deoxygenated blood

ARTERIES	VEINS
• Thick wall • No valves because blood flowing through is at high pressure • Small lumen • Oxygenated	• Thin wall • Have valves because blood flowing through is at low pressure • Large lumen • Deoxygenated

After being pumped out of your heart through the *aorta*, the blood follows the network of arteries and *arterioles* to all parts of your body. In the smallest blood vessels (*capillaries*), oxygen and carbon dioxide are exchanged. After passing through the capillaries, the deoxygenated blood returns to the right side of the heart through the network of veins.

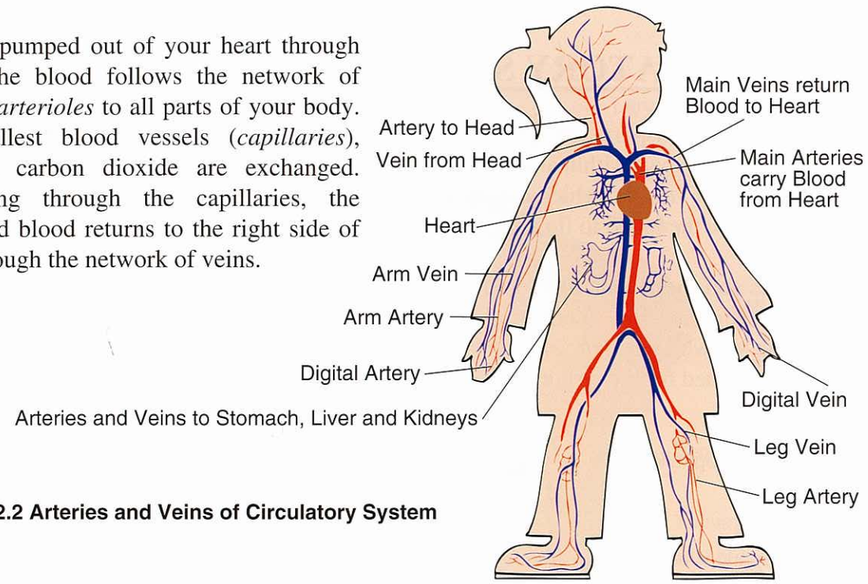


Fig. 2.2 Arteries and Veins of Circulatory System

Blood

Your body holds around 6 to 8 liters of blood. Blood is a connective tissue in which the cells are separated by a liquid called *plasma*. The contents of blood are shown below.

Table 2.2 Properties of blood components

RED BLOOD CELLS	• Carry oxygen • Round and biconcave in shape • Contain a red pigment called *hemoglobin* • 5 million per mm^3 in numbers • 4 months life span
WHITE BLOOD CELLS	• Kill germs • Produce *antibodies* to clump germs together
PLATELETS	• Much smaller in size comparing to blood cells • Trigger chemical reactions for blood clotting

The old red blood cells are absorbed by the *liver* and the *spleen*. The spleen also stores active red blood cells that can be retrieved later when is needed.

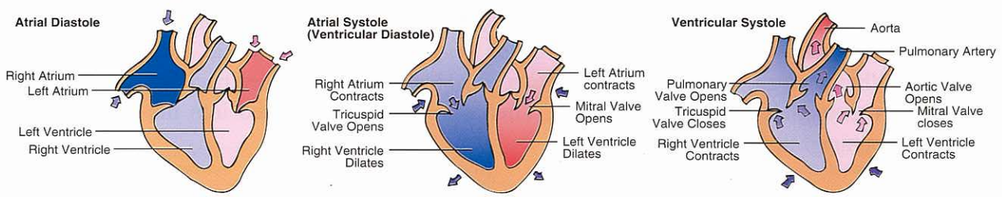


Fig. 2.3 Heartbeat Sequence

Interesting Facts

YOUR HEART IS BEATING? It is the time when your heart pumps blood into the arteries. The rate is normally 70 times a minute and this is your pulse rate.

The total length of the blood vessels in your body is about 99,800 km which is equivalent to two trips around the world!

FASTER THAN BULLETS? In just 30 seconds, a blood cell can travel all around your body once. (So how many kilometer does it move in a second?)

III. NERVOUS SYSTEM

The body's communication network consists of the *brain*, *spinal cord*, and *nerves*. The brain and the spinal cord form the Central Nervous System (*CNS*) which is the body's main control center. The nerves are actually billions of *neurons* grouped together and forms the Peripheral Nervous System (*PNS*). The nerves are grouped in pairs and are distributed in sensory organs such as the head and the neck and extend from the spinal cord to the body trunk and limbs.

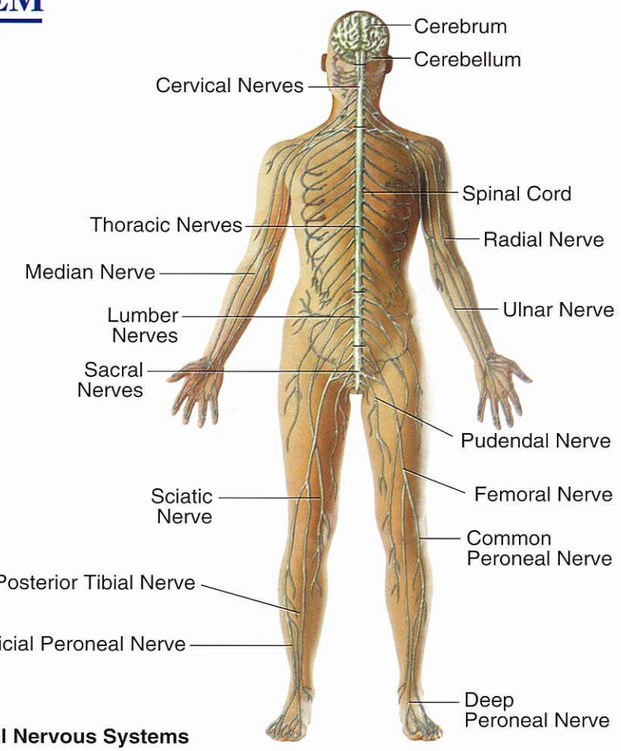


Fig. 3.1 Central Nervous Systems

The brain is the most complicated computer in the world. It receives, sorts out the information, and decides on appropriate responses to be taken.

Table 3.1 Three main components of the brain

Brainstem	Cerebellum	Cerebrum
• Controls involuntary actions such as heart beat, digestion, breathing, sneezing, vomiting, and blinking	• Coordinates muscles movements • Body posture and balance	• Consists of 2 half hemispheres • Largest part of brain • Receives messages about sight, sensation, hearing, and taste • Responsible for movements of all involuntary muscles and intellectual activities such as language, logic, memory and art

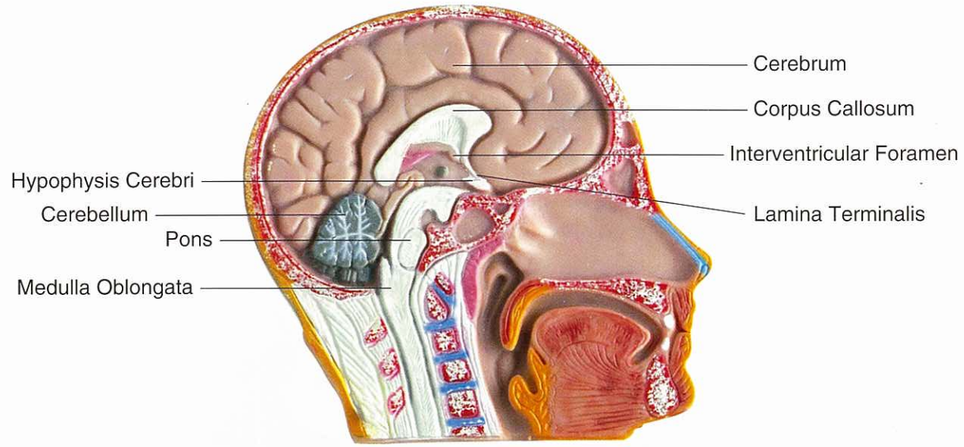


Fig. 3.2 Section through Brain

Although the brain is enclosed in the *cranium* of the skull, it does not work independently. Rather, it relies on the sense organs to obtain information about the environment. Normally information is collected by the sense organs, for example the skin and eyes. The information is passed to the CNS by means of electric signals created by the neurons* in the PNS.

*Neurons**

Each neuron has a cell body and two types of nerve fibers:

a) *dendrites* - conduct electrical signals toward the cell body
b) *axons* - conduct electrical signals away from the cell body

The motor neuron (efferent neuron) transmits nerve impulses from the CNS to the effectors. The *axon* branches at its end to form many motor end-plates which are attached to the muscle fibers. As impulses reach the motor end-plates, the muscle fibers contract to give out a response.

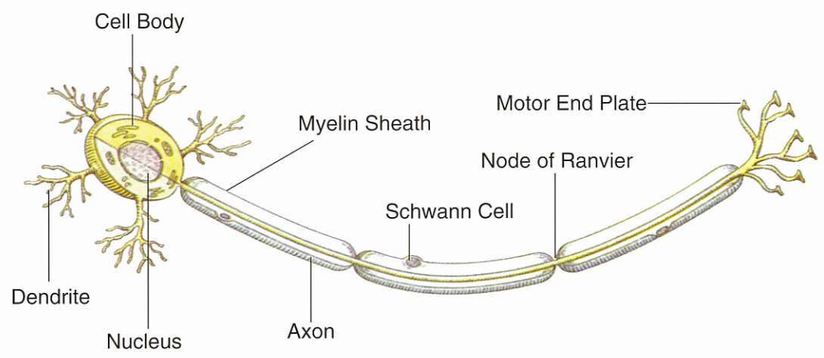


Fig. 3.3 Multipolar

The sensory neuron (afferent neuron) transmits nerve impulses from the *receptor* to the CNS. Its *dendrite* ends on the receptors.

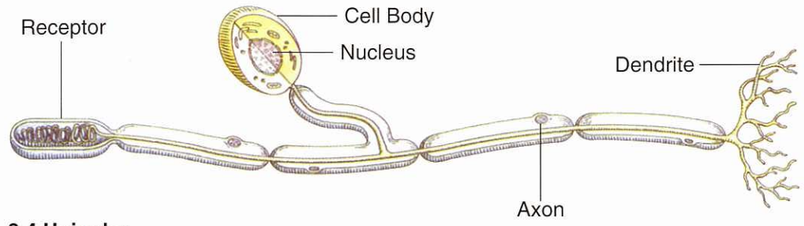


Fig. 3.4 Unipolar

The association neuron (intermediate neuron) connects the sensory neuron to the motor neuron and also the neurons in the CNS.

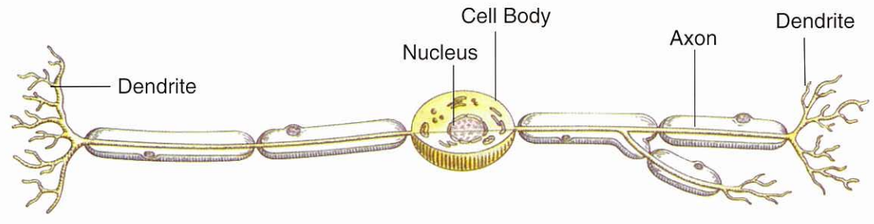


Fig. 3.5 Bipolar

TALKING ABOUT THE SPINAL CORD... The spinal cord is actually a whole bunch of nerve fibers grouped together. The length of the spinal cord is around 50 cm and it is enclosed in the vertebral column. It serves as the intermediate point where impulses travel to and from the brain. Also the spinal cord is the main control center for the involuntary reflex actions. That means, the spinal cord can make orders to cause actions without receiving instructions from the brain.

TEST YOUR REFLEX. Sit down and cross your legs. Slightly hit your crossed leg just below the kneecap. Does it jerk up?

Information can be sent as fast as 298 km/hr. in your nervous system!

With its weight of merely 1.2 kg ~ 1.4 kg, the brain contains 10,000,000,000 nerve cells! Furthermore, the left hemisphere of the brain controls the right side of the body, and the right hemisphere of the brain controls the left side of the body.

The gray matter, which covers the outer layer of the *cerebrum*, is similar to a piece of irregularly folded cloth which is more than 1 m long (comparable to the length of an ironing board)!

IV. DIGESTIVE SYSTEM

The digestive system converts the food you eat into soluble particles for the body parts to absorb and use. The digestive process starts when the food enters the *mouth*, it is ground by the *teeth* and reacts with the chemicals in the saliva. The process of swallowing takes place next. A flap called the *epiglottis* closes the windpipe (trachea) to prevent food from entering the lungs and forces the food to enter the *esophagus*. The food is pushed down the esophagus by *peristalsis* (contractions of the involuntary muscles along the esophageal wall).

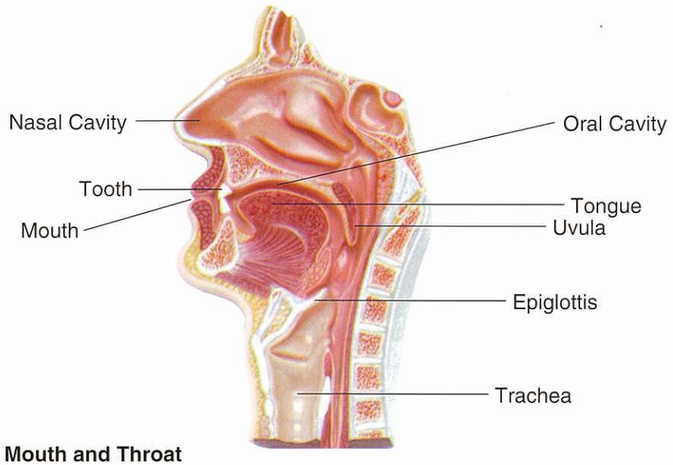


Fig. 4.1 Section through Nose, Mouth and Throat

These automatic movements are maintained all along the 9 m long *alimentary canal*, which is composed of the mouth, esophagus, *stomach, small intestine, large intestine* and *rectum*. Food particles are constantly mixed with the digestive acid in the stomach for about 3 to 5 hours; this acid is so powerful that it can burn holes on your clothes! (If you feel hungry but resist to eat, your empty stomach will be harmed by the acid because there are no food particles for the acid to mix with.) As the food particles become porridge-like, it leaks out slowly to the small intestine, where the next stage of digestion takes place.

With a length of approximately 6.4 m (distance between the net and the service line of a tennis court), the small intestine plays an important role in the absorption of nutrients from the food you eat. The food particles here are blended with 3 digestive juices, originating from the *liver*, *pancreas* and the intestine itself. The *duodenum* which is connected to the stomach is the reaction site for the *bile* (from the liver) and pancreatic juice (from the pancreas). The long *ileum* secretes juices with chemicals that breaks down the food; its inner wall is covered with microscopic finger-like projections, *villi*, which increase the absorption surface of the intestinal wall. The broken down food mixture is further absorbed as it passes through the large intestinal wall into the bloodstream.

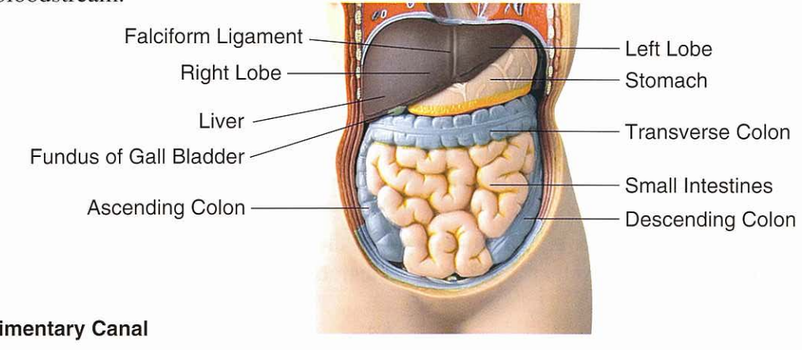


Fig. 4.2 Alimentary Canal

Table 4.1 Digestion in the small intestine

LIVER	GALL BLADDER	PANCREAS
• Produces green bile that helps to break down dietary fats and neutralize the digestive acid • Decreases and increases blood sugar level by transforming sugar into storage form, or vice versa • Destroys old red blood cells, stores iron released from them • Stores vitamin A, D, E, K • Blood stocking	• Stocks up bile	• Pancreatic juice transforms carbohydrates, proteins and fats into chemical substances

About 95% of the water in the alimentary canal is reabsorbed into the cells of the large intestine. When the large intestine fails to reabsorb the water, the person will have fluid bowel. This symptom is called *diarrhea*, which can result in serious water and ion loss from the body.

After the absorption, the undigested food, together with the dead and living bacteria, as well as the lining cells on the wall of the large intestine join to form *feces* which are brown and semi-solid. The feces are stored in the rectum. At a certain point, they will be pushed out of the *anus* at the end of the alimentary canal. This action is call the bowel movement.

Do you have difficulty in your bowel movement? Lacking vegetable roughage nay result in *Constipation* because the former stimulates the movement of involuntary muscles along the passage.

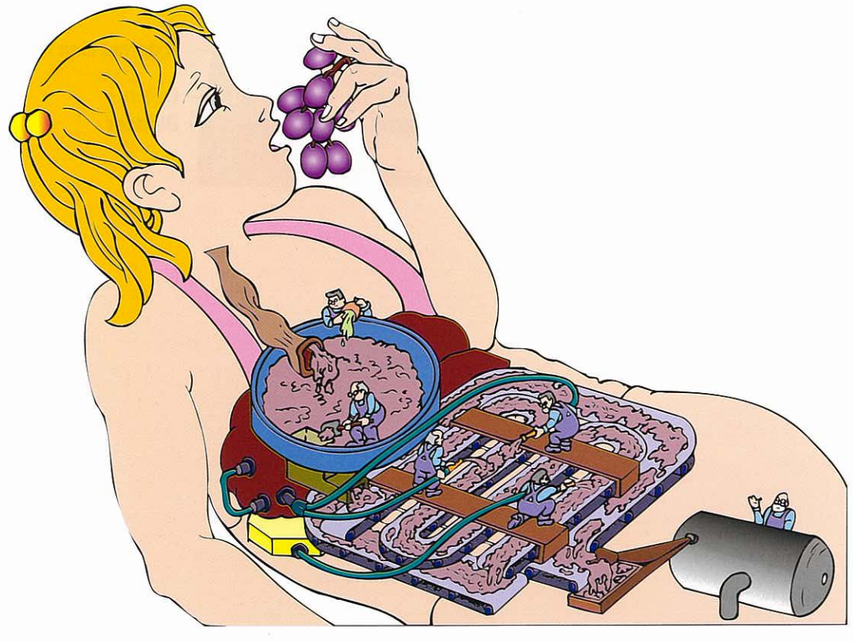


Fig. 4.3 Digestive System

V. URINARY SYSTEM

The waste in your blood is filtered and diffused into your *kidneys*. The red renal arteries bring the contaminated blood to the kidneys, while blue deoxygenated renal veins carry the clean blood back to the circulatory system. In the kidneys, water and useful components, such as amino acids, glucose (sugar) and some other nutrients are reabsorbed into the bloodstream. Excess water and waste, in the form of *urine*, are transported through the *ureters* to the muscular *bladder* for storage. At the bottom of the bladder is a sphincter muscle, which is tightly contracted to prevent the urine from leaking out. However, when the urine reaches the volume of approximately 320 ml, the bladder is uncomfortably distended. If your bladder is full, nerve endings in the bladder wall will be touched off. They then send impulses to the brain, which sends back messages to trigger your bladder to contract and the sphincter to relax, forcing out urine out of your body through the *urethra*.

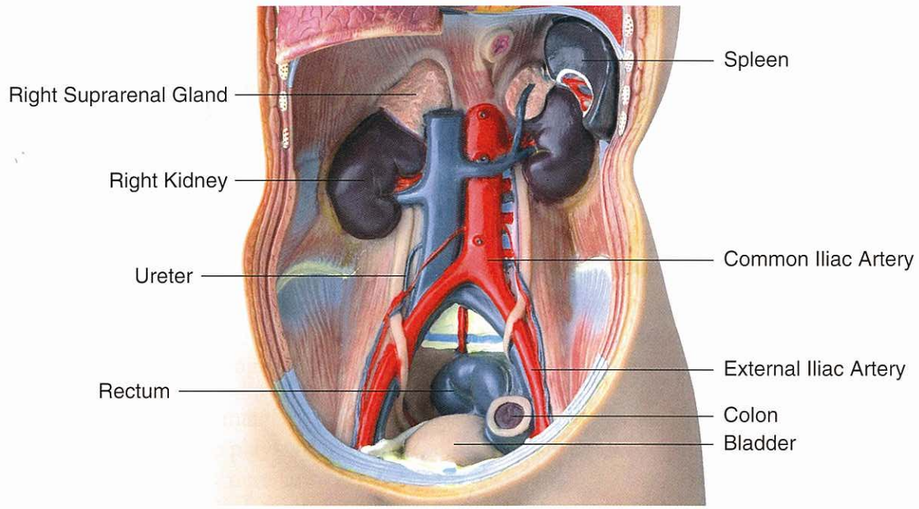


Fig. 5.1 Urinary Tract

WORKSHEET

GLOSSARY

Alimentary canal: The tubular passage that extends from the mouth to the anus. It is also known as the digestive tract.

Alveoli: Plural of alveolus.

Alveolus: The tiny sacs at the ends of the bronchial tree of the lungs.

Antibodies: Antibodies are produced in response to certain foreign particles and micro-organisms that enter your body.

Anus: The opening at the lower end of the alimentary canal through which feces is eliminated from the body.

Aorta: The body's largest blood vessel, the aorta, arches out of the heart and down toward the lower body. It has a diameter of about one inch and blood rushes through it at a speed of about eight inches per second.

Arteries: Blood vessels which carry oxygenated blood from the heart throughout the body to nourish tissue cells.

Arteriole: A small blood vessel that branches off an artery to link it to a capillary.

Axon: A nerve fiber that conducts nerve impulses away from the body of the nerve cell.

Bile: A bitter, alkaline, brownish-yellow or greenish-yellow fluid that is secreted by the liver, stored in the gallbladder, and discharged into the small intestine and aids in the digestion of fats.

Bronchi: The bronchi are the tubes which carry air from the trachea to the inner recesses of the lungs, where it can transfer oxygen to the blood in small air sacs called *alveoli*.

Bronchus: Singular of Bronchi.

Capillaries: These blood vessels form a complex network throughout the body for the interchange of various substances, such as oxygen and carbon dioxide, between blood and tissue cells.

Cerebellum: Area of the brain responsible for the regulation and coordination of complex voluntary muscular movement as well as the maintenance of posture and balance.

Cerebrum: The large, rounded structure of the brain occupying most of the cranial cavity. It controls and integrates motor, sensory, and higher mental functions, such as thought, reason, emotion, and memory.

Cilia: Tiny hairs, as in the eyelashes, fallopian tubes, or in the nasal mucous layer. They work either to filter particulates or push material along a mucous lining in wave-like movements.

CNS: Medical abbreviation for: Central nervous system which is the portion of the vertebrate nervous system consisting of the brain and spinal cord.

Constipation: Difficulty in excreting fecal waste due to compaction or hard, dry characteristics of feces. It can result from physiological disorders or poor diet.

Cranium: The part of the skull that encloses the brain.

Dendrite: Extension of a nerve cell that conducts impulses from adjacent cells inward toward the cell body. A single nerve may possess many dendrites.

Diarrhea: The frequent passage of loose, watery stools, and usually is the symptom of some types of flu, food poisoning, and can even occur after eating spicy foods. Untreated, diarrhea can lead to dehydration.

GLOSSARY

Duodenum: The beginning portion of the small intestine, starting at the lower end of the stomach.

Epiglottis: The thin elastic cartilaginous over structure located at the root of the tongue that folds the glottis to prevent food and liquid from entering the trachea during the act of swallowing.

Esophagus: The muscular, membranous tube for the passage of food from the pharynx to the stomach.

Feces: The unused food material excreted from the body via the anus as solid waste.

Gray matter: The white, myelinated fibers of the nerve bundles within the brain and spine account for the white matter found there.

Hemoglobin: The oxygen-transporting molecular constituent of blood.

Inferior vena cava: It is larger than the superior vena cava. It returns blood from the lower half of the body to the right atrium of the heart.

Left atrium: It is a small upper cavity of the heart. Oxygenated blood returns from the lungs through the pulmonary veins into the left atrium.

Left ventricle: It is the large lower cavity of the heart. Its walls are three times thicker than those of the right ventricle, making it the most powerful chamber in the heart.

Medulla oblongata: The lowermost portion of the brain, continuous with the spinal cord, responsible for the control of respiration, circulation, and certain other bodily functions.

Nasal cavity: It is situated between the lachrymal sac (tear duct) and the inferior meatus of the nose. Cilia line the mucous membrane of the nasal cavity.

Nerve: One or more bundles of signal-carrying fibers that connect the brain and the spinal cord with other parts of the body.

Peristalsis: The involuntary muscular contractions that occur in various tubular vessels of the body.

Pharynx: It is the upper portion of the airway and the digestive tract. It connects with openings into four general areas: the mouth cavity (at the back of the tongue), the nasal cavity, the larynx (which leads to the trachea), and the esophagus.

Plasma: The watery, colorless fluid in lymph and blood in which the white and red blood cells and platelets are suspended.

Platelets: Small disk-shaped bodies in blood that play an essential role in clot formation.

PNS: PNS stands for peripheral nervous system which consists of the cranial nerves and spinal nerves leaving the CNS. They run out to every part of the body.

Pulmonary artery: Carries blood from the right ventricle of the heart to the lungs.

Pulmonary vein: Carries oxygenated blood from the lungs to the left artium of the heart.

Rectum: One of the last portions of the large intestine. About five inches long, fecal wastes are stored in the rectum until they are expelled by passing them through the anal canal and out of the anus.

Septum: The thin wall dividing two cavities, the left side and the right side of the heart.

GLOSSARY

Sinus: A hole or cavity in a bone or organ. The facial bones, for example, feature a number of sinus cavities within them.

Spinal cord: The thick, whitish cord of nerve tissue that extends from the medulla oblongata down through the spinal column and from which the spinal nerves branch off to various parts of the body.

Spleen: A large organ located to the left of the stomach below the diaphragm, serving to store blood, disintegrate old blood cells, filter foreign substances from the blood, and produce lymphocytes.

Superior vena cava: The second largest vein in the body. It returns the blood from the head, arms and upper body to the right atrium of the heart.

Urine: The colorless to yellowish liquid, slightly acidic waste material secreted by the kidneys.

Ureter: The long, narrow duct that transports urine the kidneys to the urinary bladder.

Urethra: The canal through which urine is discharged from the bladder.

Vein: Blood vessels which carry deoxygenated blood from the tissue cells to the heart.

Villi: Villi are fingerlike folds covering the surface of the small intestines.

White blood cells: The colorless or white cells in the blood that have a nucleus and cytoplasm and help protect the body from infection and disease.

INDEX