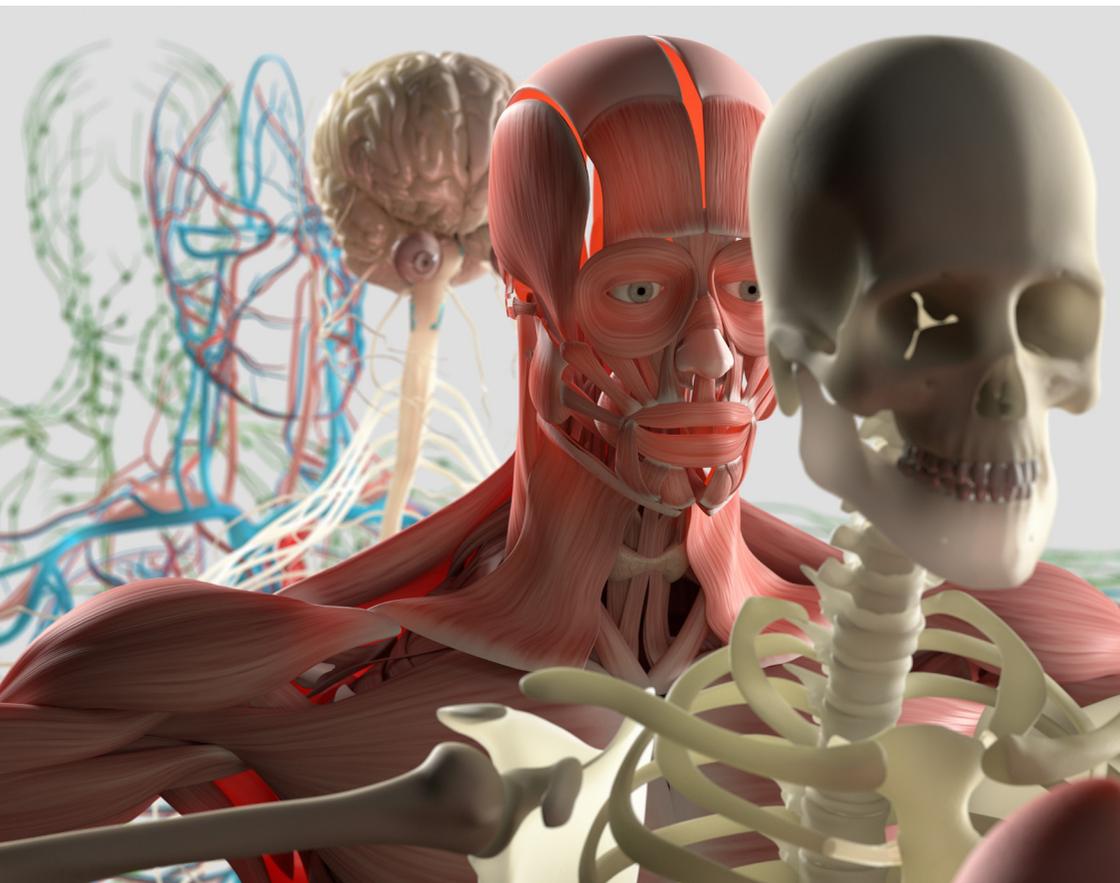




Basic anatomy and body systems



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THE BODY'S SYSTEMS

The body is made up of a number of systems. Each system performs a specific function, and together they keep the body alive and healthy.

Cardiovascular (or circulatory)

The cardiovascular system includes the heart, blood, blood vessels (veins, arteries and capillaries). Its function is to:

- transport oxygen and nutrients to all parts of the body
- remove waste products.

Respiratory

The respiratory system includes the airway, lungs, diaphragm. Its function is to:

- supply oxygen to the blood
- remove waste gases.

Digestive and urinary

The digestive and urinary systems includes the oesophagus (gullet), stomach, gall bladder, pancreas, liver, kidneys, intestines, rectum, bladder, urethra. The functions are to:

- convert food and liquid into proteins, sugars and other substances
- collect and eliminate waste products.

Nervous

The nervous system includes the brain, spinal cord, nerves. Its function is to:

- transmit messages to and from the brain using electrical impulses and chemicals.

Lymphatic

The lymphatic system includes the lymph, lymph vessels, lymph nodes, spleen. Its function is to:

- transport fluid from the tissues to the heart
- transport white blood cells to fight infection.

Musculoskeletal

The musculoskeletal system includes the bones, muscles, ligaments, tendons. Its function is to:

- provide the body's framework
- protect the internal organs
- provide the mechanical basis for movement.

Integumentary

The integumentary system includes the skin, sweat glands, hair, nails. Its function is to:

- protect the body from infection, injury and fluid loss
- help regulate the body's temperature
- help to synthesise vitamin D.

CARDIOVASCULAR SYSTEM

The cardiovascular system includes the heart, blood and blood vessels (veins, arteries and capillaries). The system circulates blood throughout the body, transporting oxygen and nutrients to every cell, and collecting carbon dioxide, urea and other waste products to be eliminated. The cardiovascular system is also known as the circulatory system.

Heart

The heart provides the pumping action needed to keep blood flowing throughout the body. The heart is a hollow muscular organ in the chest that acts as a two-sided pump, first relaxing and filling up with blood and then contracting to squeeze (or pump) the blood out into the arteries. This pumping action is automatic and is controlled by a complex system of nerves.

The circulation of blood begins and ends at the heart, and consists of:

- pulmonary circulation – starting on the right side of the heart, blood is pumped to the lungs, where it loses carbon dioxide and absorbs oxygen, and then goes back to the left side of the heart
- systemic circulation – starting on the left side of the heart, blood is pumped to all parts of the body, where it delivers oxygen and removes carbon dioxide, and then returns to the right side of the heart.

The heart's contractions can be felt in the arteries close to the skin, primarily at the neck (carotid artery), wrist (radial artery) and groin (femoral artery). The beat felt with each contraction is the pulse.

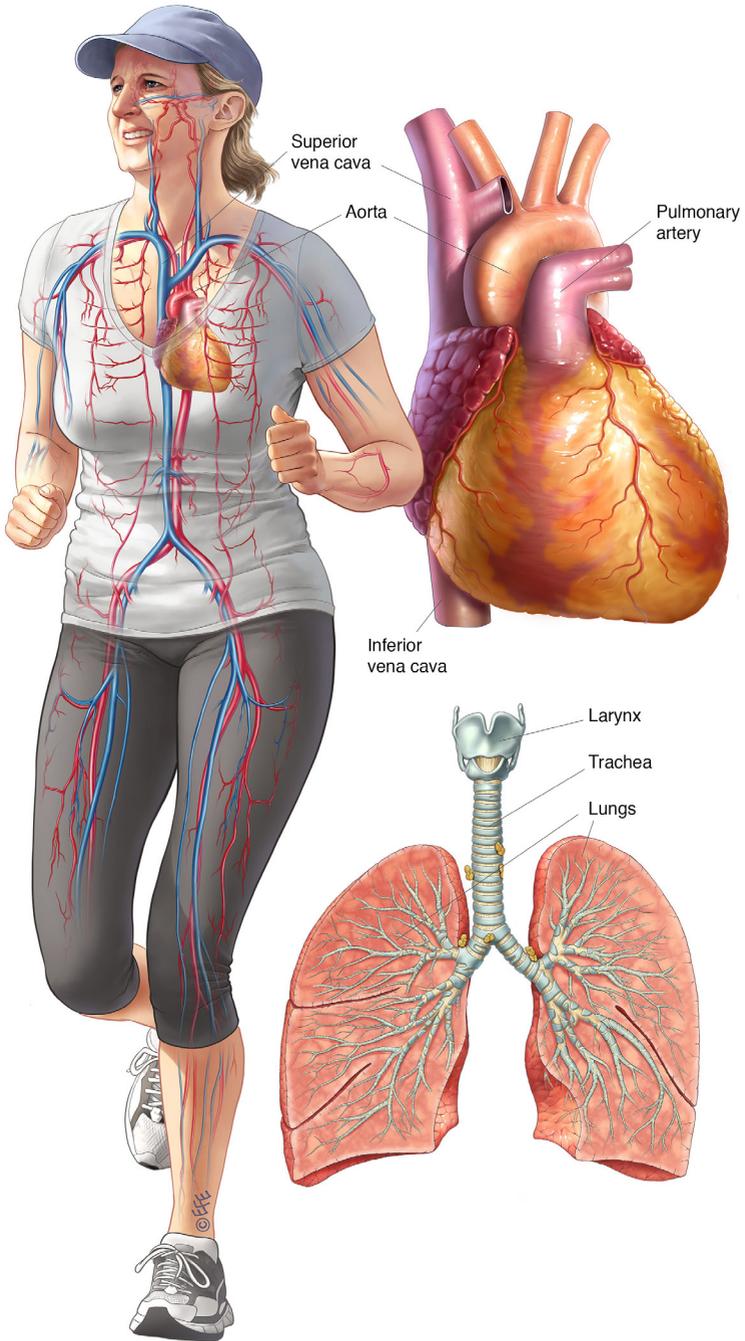
Blood

Blood is made up of:

- plasma, a pale yellow liquid in which blood cells are suspended; it contains proteins, electrolytes and nutrients
- red blood cells, which carry oxygen and plasma
- white blood cells, which protect the body from infection
- platelets, which form clots to stop bleeding.

Blood vessels

- Arteries are large, strong blood vessels that carry oxygen-rich blood to the body.
- Capillaries are tiny, thin-walled blood vessels, subdivided from the arteries that transport blood to all cells of the body.
- Veins carry blood low in oxygen to the heart and then to the lungs.



RESPIRATORY SYSTEM

The respiratory system keeps the body supplied with oxygen and removes carbon dioxide. The body needs a constant supply of oxygen to survive and function.

The system includes the

- lungs
- windpipe or trachea — airway from larynx to lungs
- bronchi — two tubes branching off the lower section of the trachea
- bronchioles — tiny air tubes repeatedly subdividing off the bronchi
- alveoli — millions of tiny, elastic air sacs where the exchange of oxygen and carbon dioxide takes place
- diaphragm — a dome-shaped smooth flat muscle under the lungs, separating the chest and abdomen.

Mechanics of breathing

When a person inhales, the muscles between the ribs (intercostal muscles) contract and the diaphragm moves downwards. This expands the chest cavity, decreasing the air pressure inside the chest and pulling air into the lungs.

Air enters through the mouth or nose, and passes down the windpipe to the bronchi and the lungs.

When a person exhales, the intercostal muscles and diaphragm relax, the chest returns to its usual size and the air is forced out.

Using extra muscles in the neck and shoulders can increase the force and rate of breathing. These are used in exercise or when a person is suffering from chest disease.

Oxygen-carbon dioxide balance

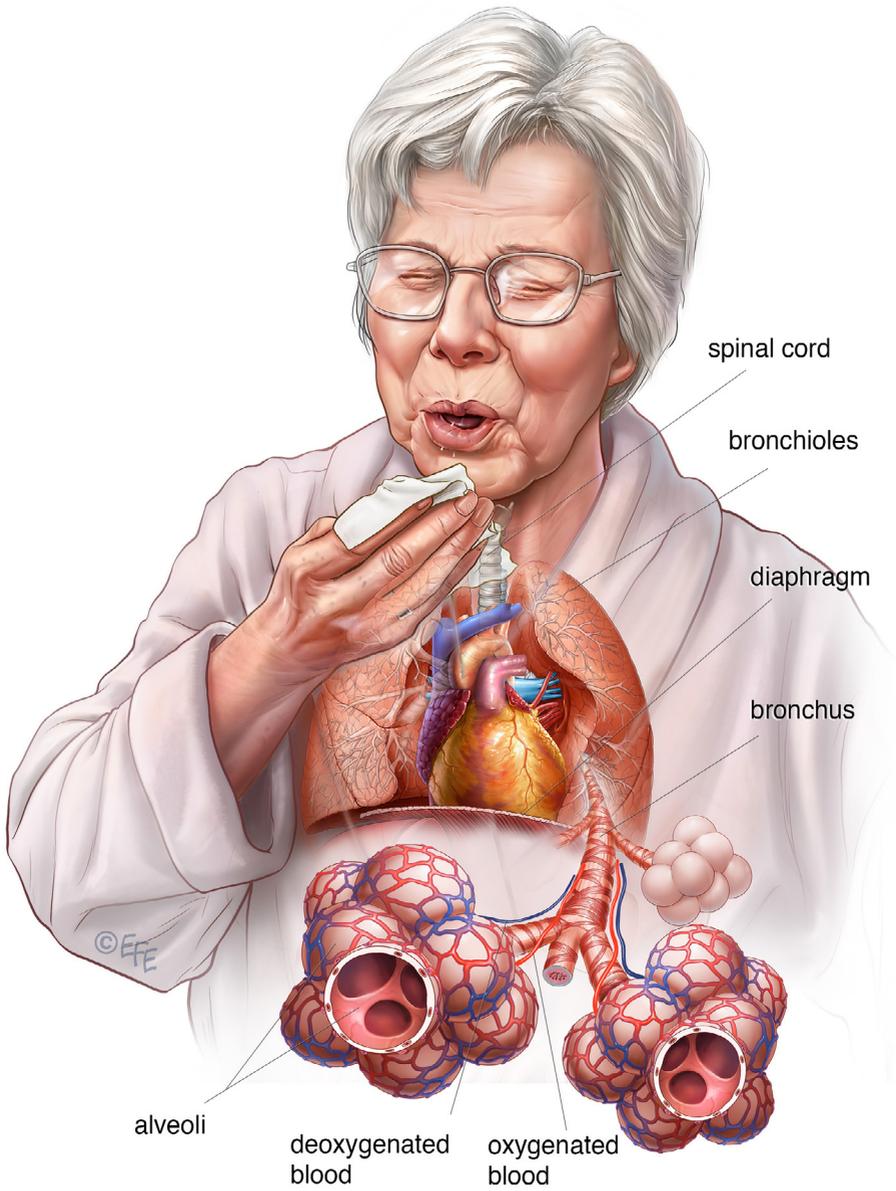
When a person inhales, air is taken into the alveoli. The walls of the alveoli and the capillaries around them are thin so that oxygen and carbon dioxide can cross through them.

The alveoli bring oxygen that crosses to the blood in the capillaries to be transported to all parts of the body.

The capillaries bring carbon dioxide and other waste gases to the alveoli, where they are removed from the body when the person exhales.

- Inhaled air contains 78% nitrogen, 21% oxygen and 1% other gases.
- Exhaled air contains 78% nitrogen, 16% oxygen, 5% carbon dioxide and 1% other gases.

The brain monitors the levels of oxygen and carbon dioxide in the blood and responds to changes in these levels by changing the rate and depth of breathing. The amount of oxygen being used by the body is related to the amount of physical activity. The more energetic the activity, the greater the amount of oxygen required and the more carbon dioxide produced. Fever and illness may also increase the body's need for oxygen.



DIGESTIVE AND URINARY SYSTEMS

DIGESTIVE SYSTEM

The digestive system converts food to simpler substances and a finer consistency so it can be absorbed into the blood and taken to all parts of the body.

The digestive system includes the:

- oesophagus — is a muscular tube that connects the mouth to the stomach. The sphincter at the bottom of the oesophagus stops digestive acids refluxing up from the stomach
- stomach — contains gastric juices. Partly digests food adding other digestive juices as the contents are expelled into the small intestines
- liver — is the largest internal organ that processes nutrients from food; stores energy; produces proteins, fats and some vitamins, filters toxics
- gall bladder — stores bile produced by the liver
- kidneys — filter and clean the blood of waste products. There are two kidneys, each weighing about 135 grams and producing 1–2 litres of urine daily.
- pancreas — assists in the digestion of food and produces insulin which controls the amount of sugar in the blood stream
- small and large intestines — the digestive process is completed in this organ where the nutrients are absorbed into the blood. Any material left after this process moves to the large intestine.

Food and drink moves from the mouth, where saliva has begun the process of breaking the food down, through the oesophagus to the stomach, where it is partly digested by gastric juices.

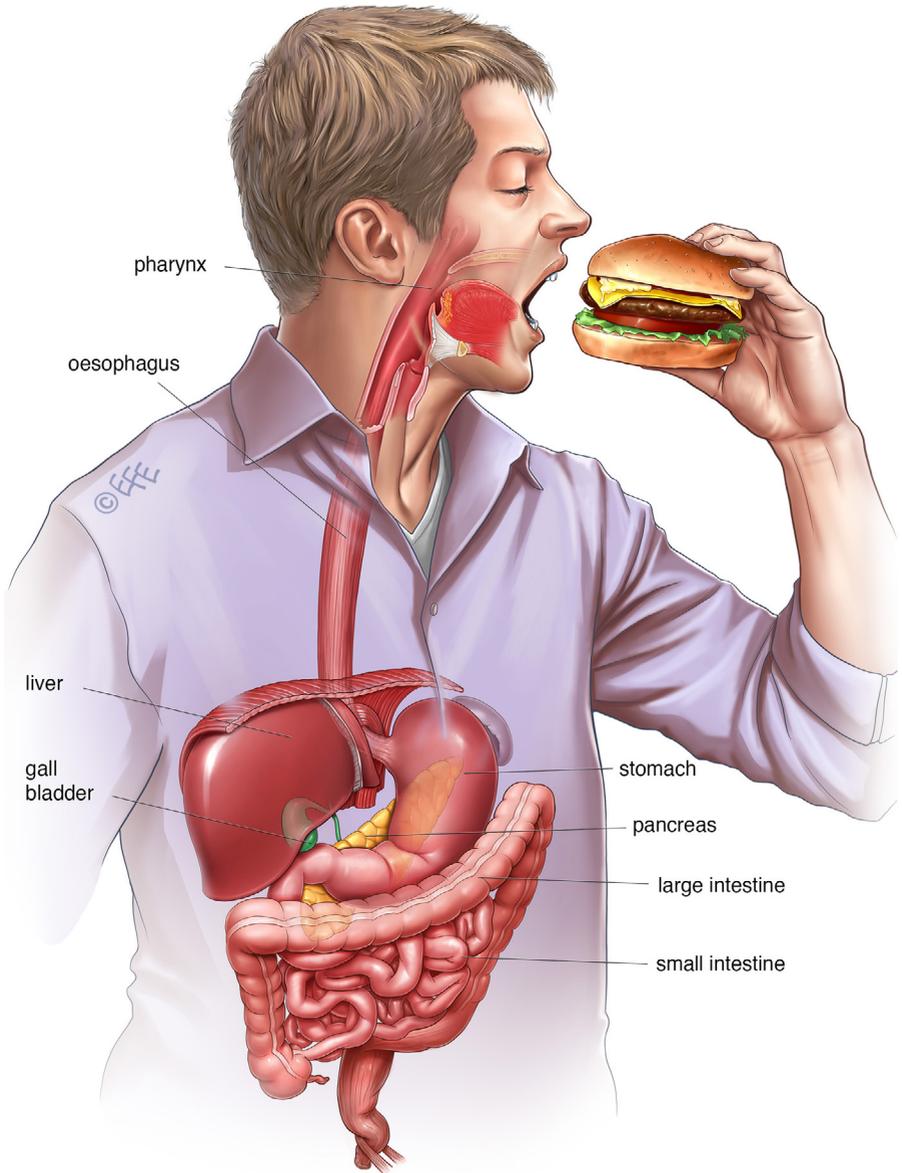
As the food moves from the stomach into the first part of the small intestine (the duodenum), it is mixed with other digestive fluids from the pancreas (insulin), liver and gall bladder. These fluids help to break down the complex structure of the food into simpler forms. Insulin helps control blood sugar levels.

The food then moves from the small intestine, where the digestive process is completed and the nutrients are absorbed into the blood.

URINARY SYSTEM

The material left after the digestive process moves to the large intestine and is eliminated from the rectum as faeces.

Other waste products are extracted from the blood by the kidneys, which produce between 1–2 litres of urine daily. Urine moves down the ureter to the bladder, where it is held until it is removed from the body through the urethra during urination.



NERVOUS SYSTEM

The nervous system is spread throughout the body, transporting information from one part of the body to another, using electrical impulses and chemicals.

The system includes the:

- brain
- spinal cord
- autonomic nervous system
- voluntary nervous system
- sensory nerves
- motor nerves.

Brain

The brain is the controlling organ of the body and regulates all body functions. Through the body's network of nerves, the brain receives and transmits information as electrical impulses and chemicals.

The brain is protected by the skull and floats in watery fluid called cerebrospinal fluid, which cushions it from impact during movement.

Spinal cord

The spinal cord is a large group of nerves that extend from the brain, down the backbone, and through a canal in the spine.

The spinal cord is encased within the spine and is also cushioned by cerebrospinal fluid. The spinal cord is a continuation of the brain, and its nerves radiate out into the rest of the body.

The spinal cord and nerves carry messages as electrical impulses, from the brain to the rest of the body, and from the body back to the brain.

Voluntary and autonomic systems

The body has two nervous systems:

1. the **voluntary** nervous system controls the functions directed by the conscious mind e.g. walking, running and eating
2. the **autonomic** nervous system controls involuntary functions e.g. heartbeat, breathing, digestion and blood pressure.

Sensory and motor nerves

Nerves extend from the brain and the spinal cord to every part of the body. At each vertebra of the spine, two nerves branch out from the spinal cord, one to each side of the body:

1. **sensory nerves** that transmits impulses from the body to the brain, relaying information about touch, sight, sound, smell, taste, spatial awareness and pain
2. **motor** nerves that control movement by initiating muscle contraction.



LYMPHATIC SYSTEM

The lymphatic system is responsible for transporting lymph, a fluid containing white blood cells that fight infection.

The system includes

- lymph
- lymph vessels
- lymph nodes
- spleen.

White blood cells

White blood cells are found throughout the body. White blood cells:

- produce antibodies
- fight infection
- remove and repair old tissue
- repair wounds.

Lymph

Lymph is a fluid carrying the white cells around the body. It is used in the fight against infection.

Lymph vessels

The lymph vessels:

- transport lymph fluid
- pick up fluid left behind in the tissues by the circulatory system
- transport the lymph fluid back to the main veins just before they reach the heart.

The lymphatic vessels provide the major route by which many venoms enter the circulatory system. By using a pressure bandage and keeping a limb immobile by splinting, it is possible to slow or even stop lymph fluid entering the circulation.

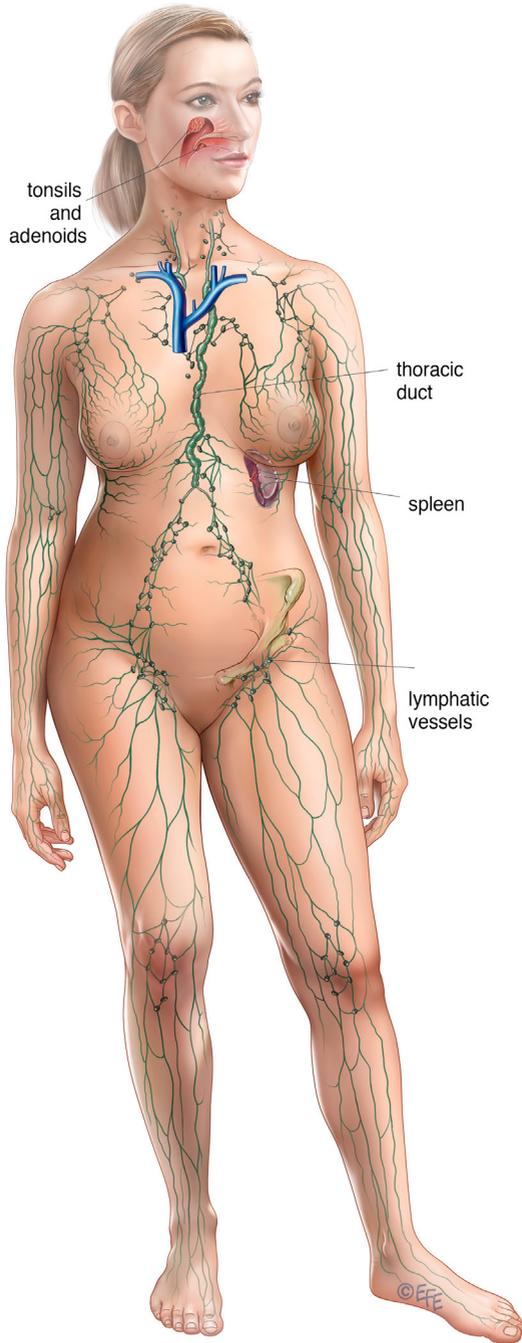
Lymph nodes/glands

There are about 500–700 lymph nodes (also known as lymph glands) spread throughout the body, connected by lymph vessels.

These nodes act as a filter, removing potentially harmful material from the body. White blood cells in the nodes form antibodies that target bacteria, viruses and other foreign substances. When they become activated, lymph nodes will sometimes become enlarged. This can occur before and during many common infections (eg influenza, glandular fever, septicaemia and skin infections).

Spleen

The spleen filters the blood and removes abnormal cells. It also makes the disease-fighting components of the immune system



MUSCULOSKELETAL SYSTEM

The skeleton is the supporting structure of bones, that gives the body its general shape and provides a strong framework to which muscles are attached.

It also protects many of the organs: the brain is protected by the skull, the heart and lungs are protected by the rib cage, and the spinal cord is protected by the vertebrae of the spine.

The system includes:

- the body's bones
- muscles and tendons
- ligaments and joints.

Bones

The body has some 206 bones of various shapes and sizes. Bones are hard, dense, strong structures that have an ample supply of blood and nerves.

Some bones store and make red blood cells in the marrow. Calcium is important for bone growth and repair.

A lack of calcium in the diet can cause bones to weaken over time, because the body uses calcium from the bones to meet its needs. A decrease in the calcium content of bones from about the age of 60 means that bones can become frail, brittle and less dense and, therefore, more susceptible to fractures.

Tendons

Tendons are flexible, strong and fibrous tissues attaching a muscle to a bone.

Ligaments

Ligaments are a flexible and tough connective tissue that connect two bones or holds together a joint.

Joints

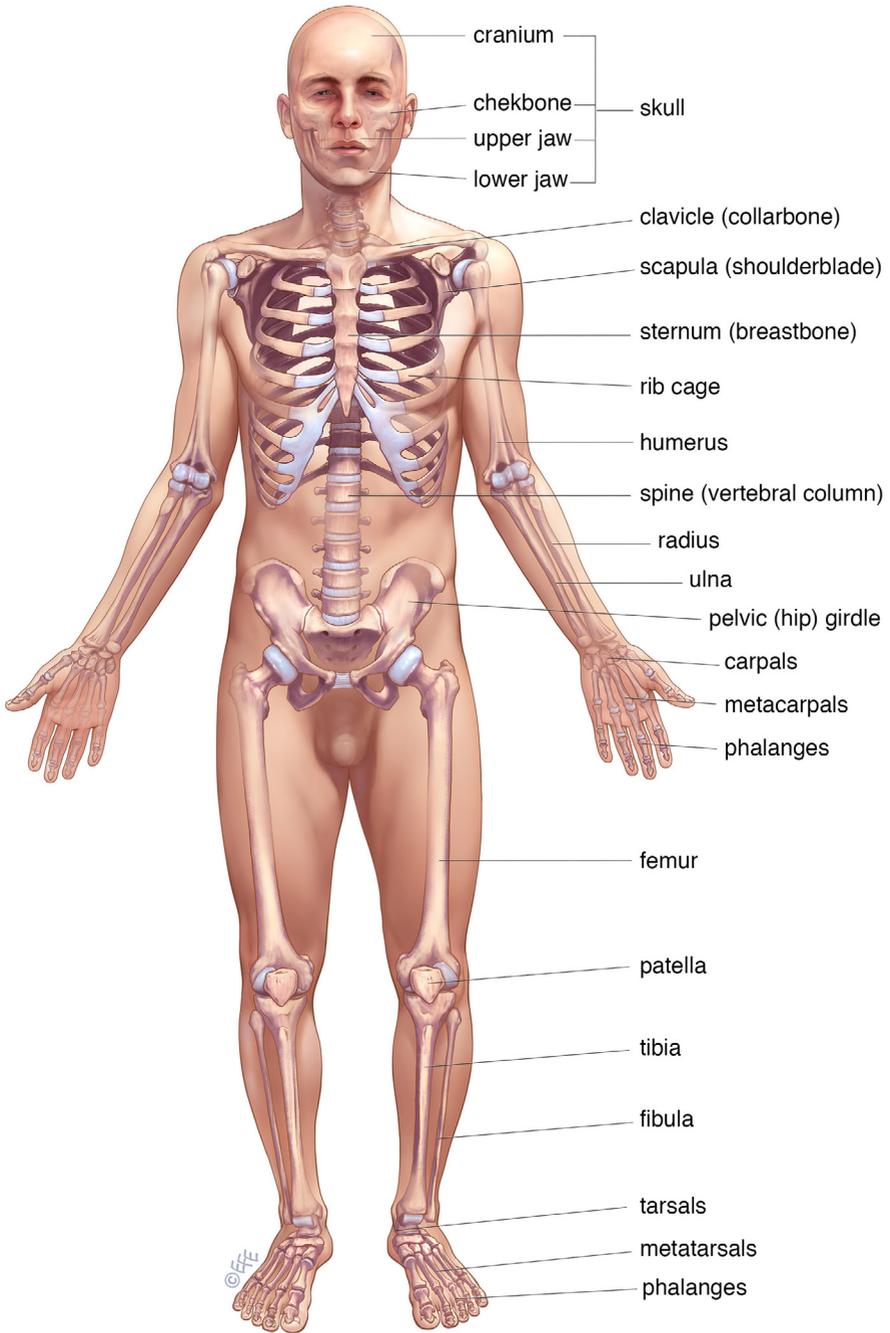
Joints are found wherever bones meet, and are held together by ligaments. The number and strength of the ligaments determines the amount of movement that can occur. Some joints are highly mobile, such as the shoulder, hip and knee, while others, such as those between the vertebrae in the spine, move only a little. Sometimes, the bones are tightly joined or fused – such as the 'joints' between the bones of the skull.

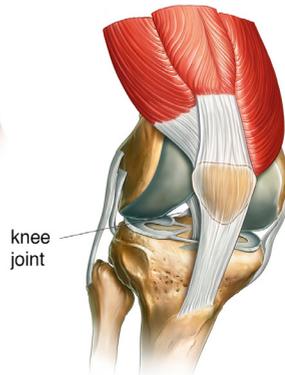
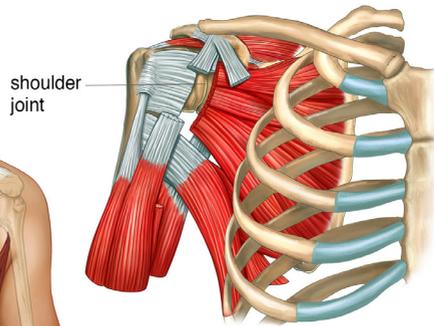
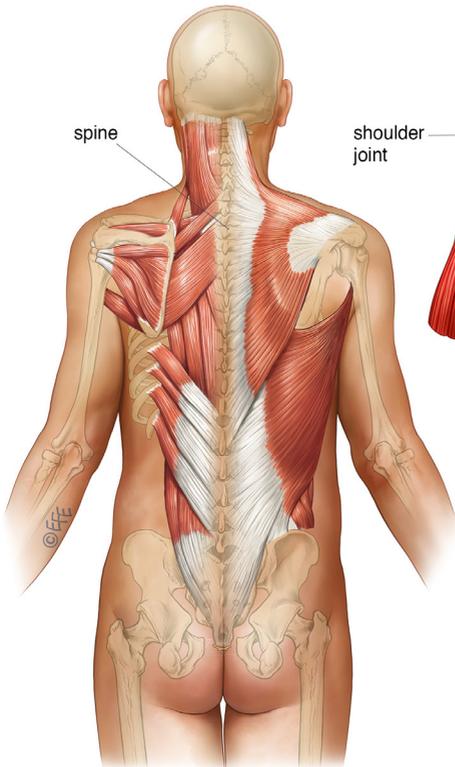
Muscles

Muscles are mostly (but not all) attached to bones by tendons. Muscles account for up to 50% of a person's body weight. By contracting and relaxing, muscles move the bones, causing the limbs and digits to move.

Some muscles are voluntary and can be moved at will in response to messages from the brain.

Some muscles are involuntary and work automatically to operate the internal organs such as the heart or gut.





INTEGUMENTARY SYSTEM

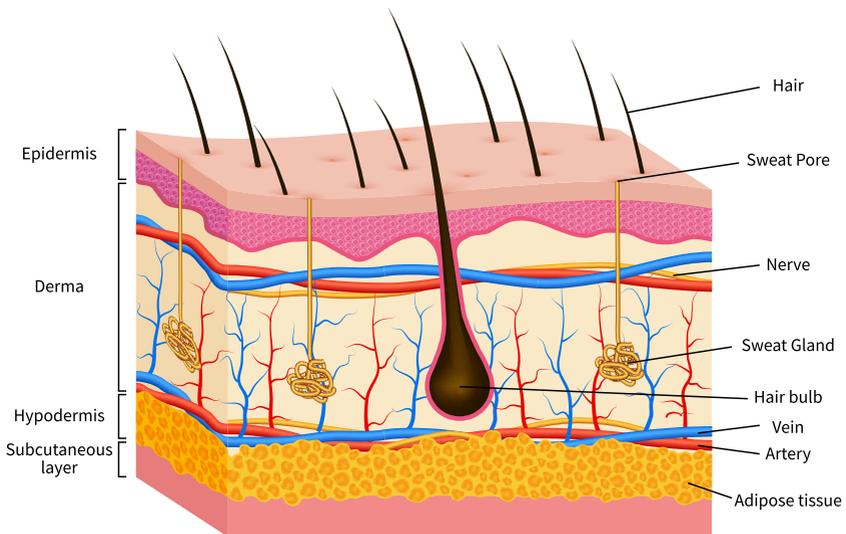
The integumentary system includes the skin, sweat glands, hair and nails.

The skin is the body's largest organ. The skin has several functions:

- it serves as a barrier against the external environment
- it protects underlying tissues
- it is waterproof
- it helps regulate the body's temperature
- it plays a role in vitamin D synthesis
- it alerts the brain to changes in the environment.

There are three layers of skin, the:

1. **epidermis** — acts as a barrier to bacteria and other organisms that cause infection. The surface of the skin contains sensory receptors that are sensitive to touch, heat, cold and pain, and transmit these sensations to the brain.
2. **dermis** — contains tough connective tissue, the main nerve structures, sweat and oil glands, hair follicles, and blood vessels.
3. **hypodermis** — is made of fat and connective tissue. The lower two layers include connective tissue and adipose tissue, which cushion the body and provide energy.



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