

Chapter 3 – Skeletal and Muscular System

Subject - Science

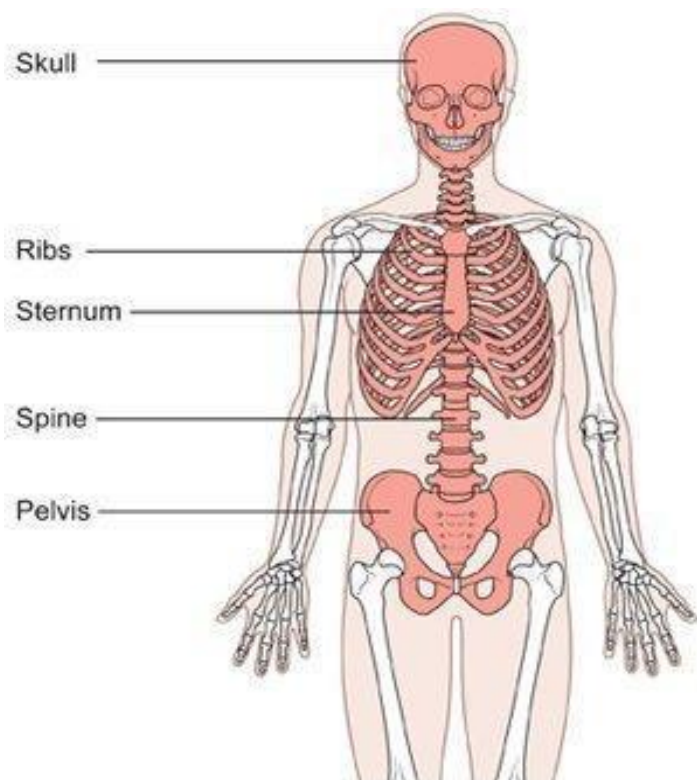
Class V

Skeletal system and its functions

Skeletal system is the framework of the body, consisting of bones and other connective tissues, which protects and supports the body tissues and internal organs.

The human skeleton contains 206 bones. The skeletal system is the body system composed of bones and cartilage and performs the following critical functions for the human body supports the body facilitates movement.

The skeletal system includes all of the bones and joints in the body. Each bone is a complex living organ that is made up of many cells, protein fibers, and minerals. The skeleton acts as a scaffold by providing support and protection for the soft tissues that make up the rest of the body.



The functions of the skeletal system are:

1. The skeleton gives shape and support to our body.
2. It protects the soft internal organs:
 - (i) The skull protects the brain.
 - (ii) The rib cage protects the heart and the lungs.
 - (iii) The backbone protects the spinal cord.
3. It allows the movement of different body parts.
4. Many bones in our body are hollow. They are filled with a jelly-like substance called bone marrow. Blood cells are made in the bone marrow.

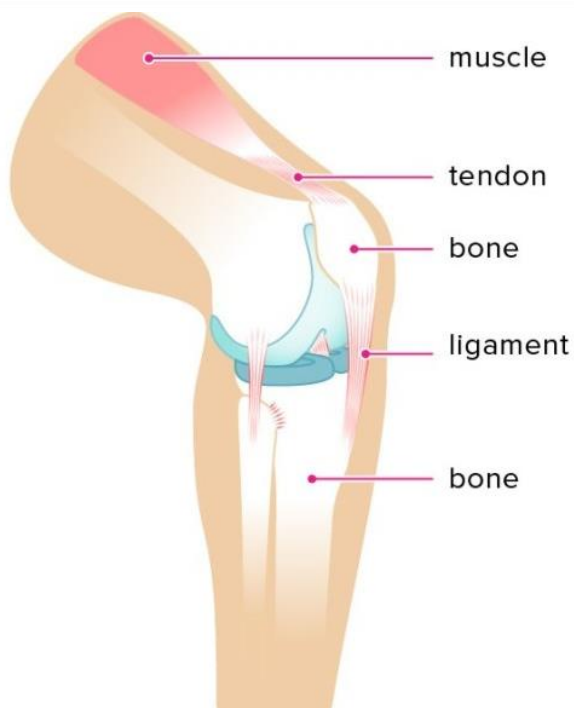
▶ **Bones (Skeletal organ)**

▶ **Joints**

▶ **Cartilage**

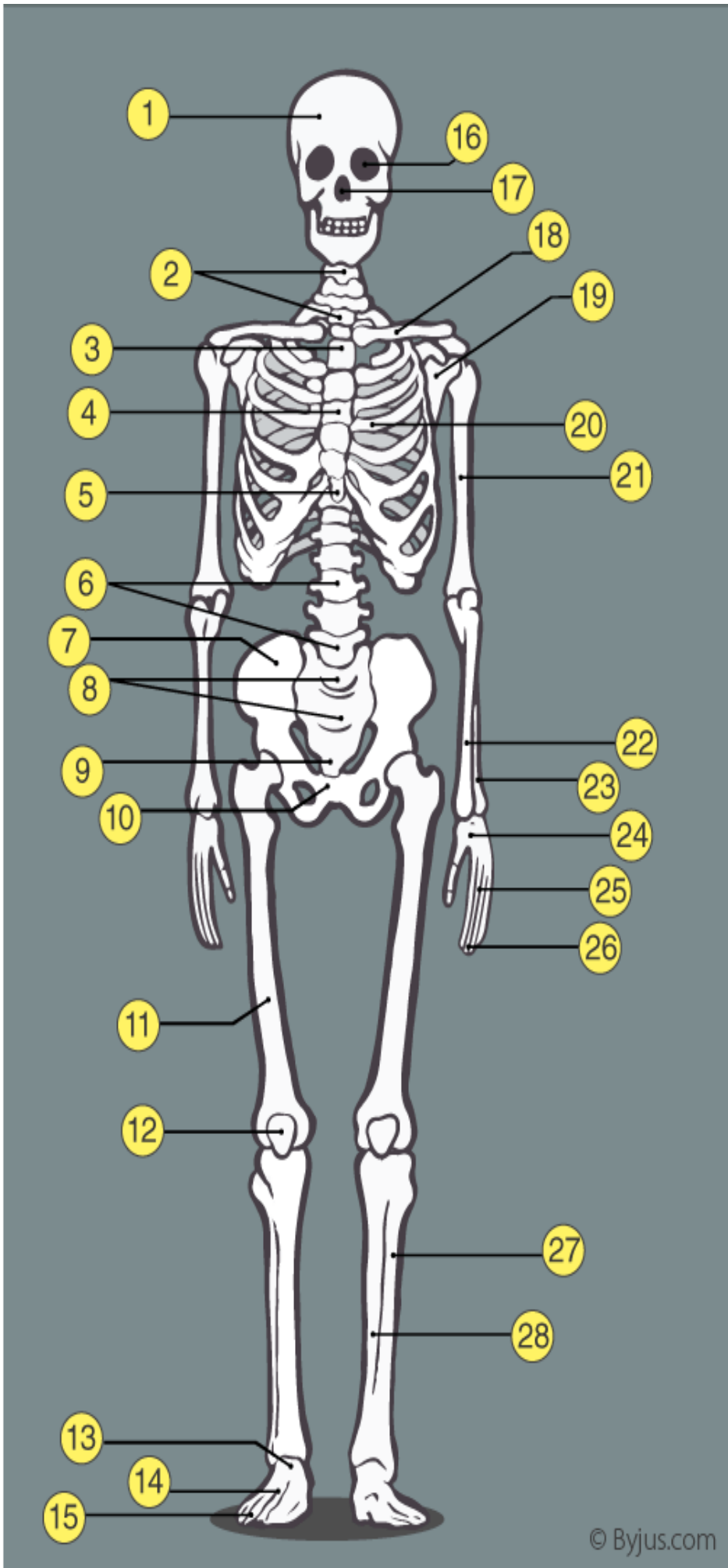
▶ **Ligaments**

▶ **Tendons**



What's the difference?

| Cartilage | Tendons | Ligaments |
|----------------|----------------------------------|-----------------------|
| Tough | Attaches bone to muscle | Attaches bone to bone |
| Flexible | Sturdy | Elastic |
| At end of bone | Non elastic | Stabilise |
| Cushions | Size changes depending on muscle | Made of many fibres |
| | Anchor | Strong |



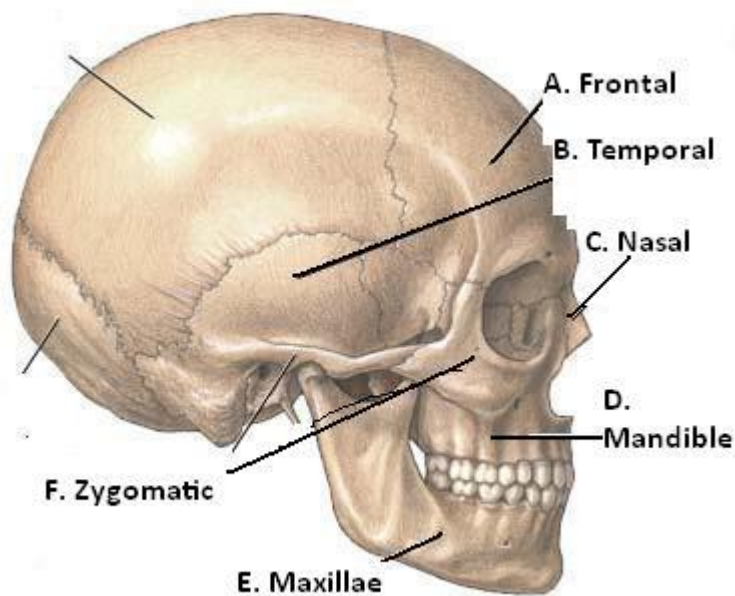
- ① Skull
- ② Cervical vertebrae
- ③ Manubri sterni
- ④ Body of the sternum
- ⑤ Xiphoid process
- ⑥ Lumbar vertebrae
- ⑦ Ilium
- ⑧ Sacrum
- ⑨ Coccyx
- ⑩ Pubis
- ⑪ Femur
- ⑫ Patella
- ⑬ Tarsus
- ⑭ Metatarsus
- ⑮ Phalanges
- ⑯ Orbital cavity
- ⑰ Nasal cavity
- ⑱ Clavicle
- ⑲ Shoulder blade
- ⑳ Rib
- ㉑ Humerus
- ㉒ Ulna
- ㉓ Radius
- ㉔ Carpus
- ㉕ Metacarpus
- ㉖ Phalanges
- ㉗ Fibula
- ㉘ Tibia

Parts of the skeleton

The different parts of the skeleton system are:-

1. Skull: The skull acts like a helmet and protect the brain.

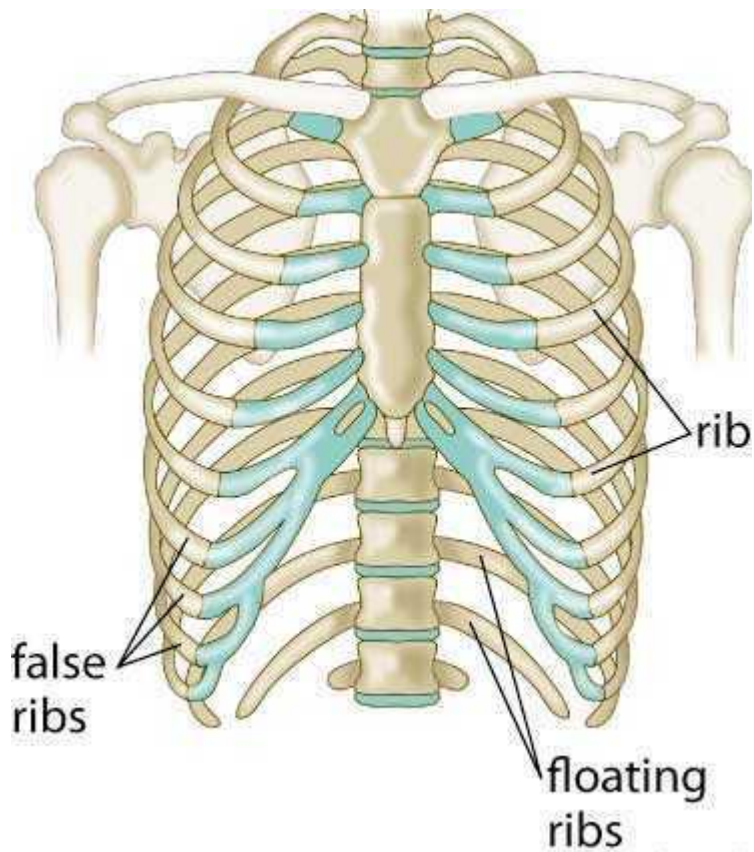
The skull or known as the cranium in the medical world is a bone structure of the head. It supports and protects the face and the brain. The adult skull has a total of 22 individual bones. They don't move and united into a single unit. The skull performs vital functions.



2. Rib cage: The rib cage protects the heart and lungs. The rib cage is the arrangement of ribs attached to the vertebral column and sternum in the thorax of most vertebrates, which encloses and protects the heart and lungs. It has 24 ribs in 12 pairs.

The rib cage has three important functions: protection, support and respiration. It encloses and protects the heart and lungs.

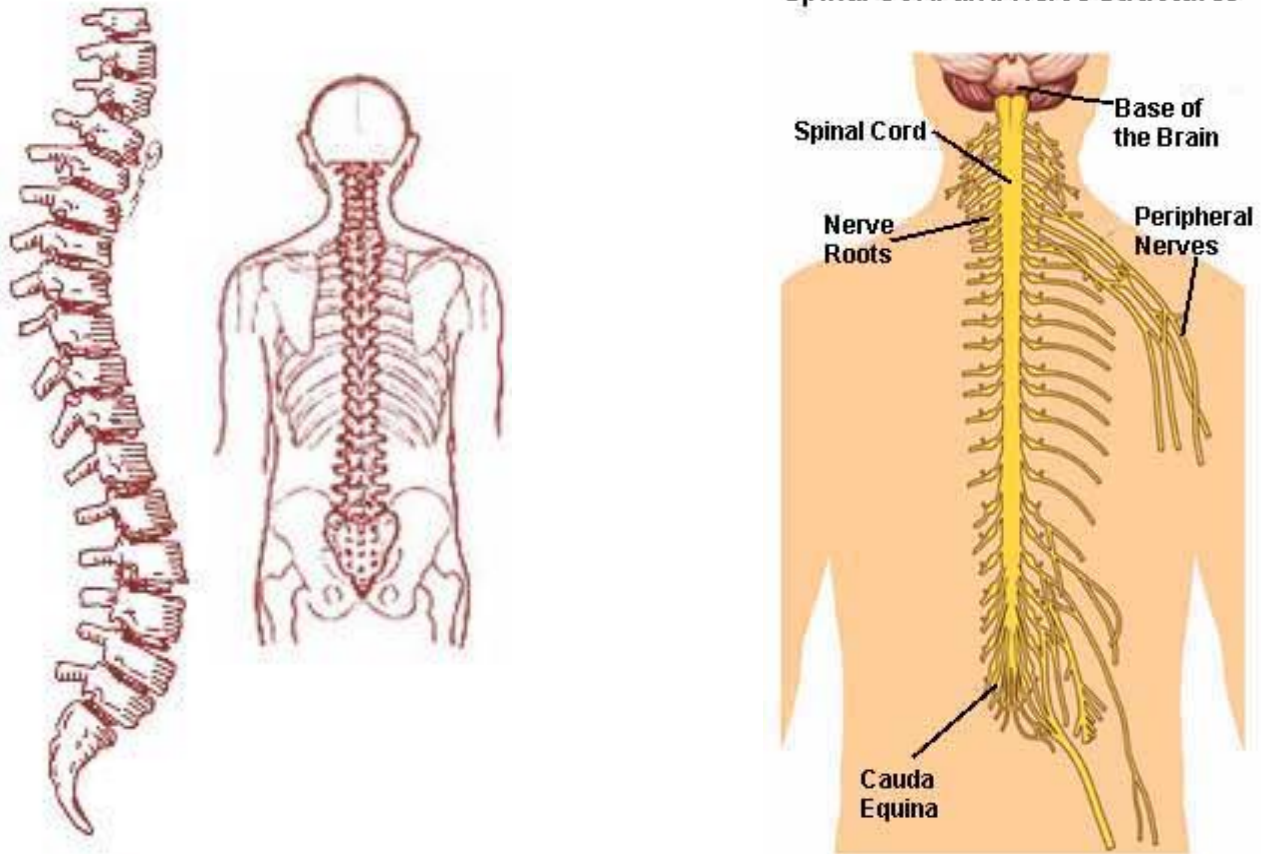
The sternum is a long, flat bone that forms the front of the rib cage.



3. Backbone: The backbone surrounds and protects the spinal cord. The spine (or backbone) runs from the base of the skull to the pelvis. It serves as a pillar to support the body's weight and to protect the spinal cord. There are three natural curves in the spine that give it an "S" shape when viewed from the side. These curves help the spine withstand great amounts of stress by providing a more even distribution of body weight.

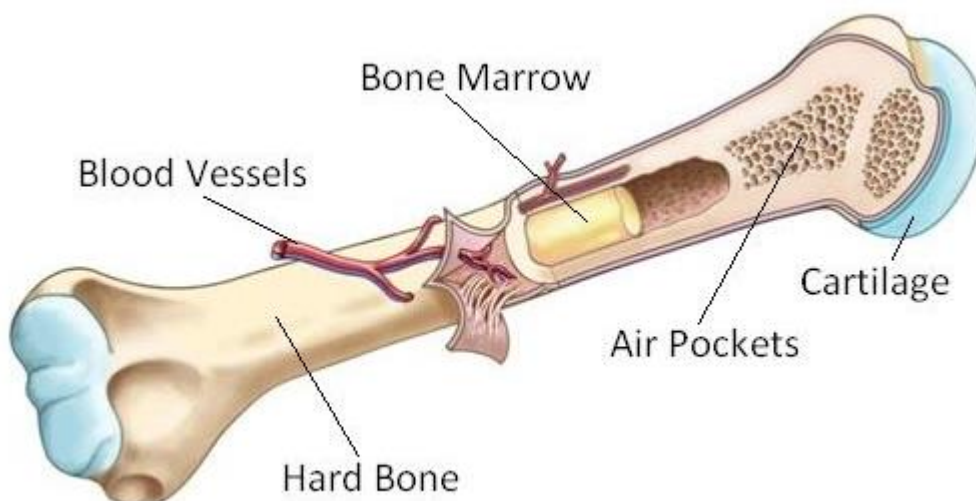
The spine is made up of a series of bones that are stacked like blocks on top of each other with cushions called discs in between to help absorb shock/load.

Spinal Cord and Nerve Structures



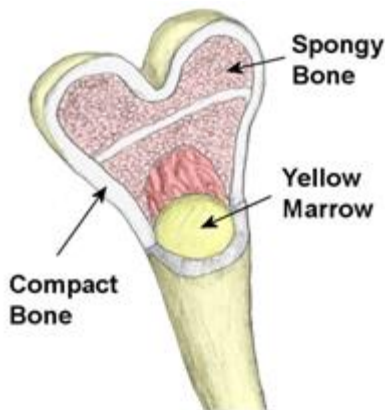
4. Limbs: (Arms and legs) help us in doing many activities and in moving from one place to another. In the human body, the arms and the legs are commonly called the upper limbs and lower limbs respectively, to include part of the shoulder and hip girdles. Arms and legs are connected to torso or trunk. Many animals use limbs for locomotion, such as walking, running, or climbing.

Structure of a bone



Bones have hard outer layer called cortical (compact) bone, which is strong, dense and tough and spongy inner layer called trabecular (cancellous) bone, which is lighter compared to compact bone. They have their own blood supply as well as nerves, which help them to grow and repair themselves. That is how they grow as we get older.

Bones are composed of calcium, phosphorus, and a fibrous substance known as collagen. Bones are strong but light in weight as they are hollow from inside. The long bones of the arms and legs, such as the femur (thigh bone), have a central cavity containing bone marrow. Bone marrow is the flexible tissue in the interior of bones. In humans, red blood cells are produced by bone marrow. Usually child is born with 300 soft bones. With the growth of child, these bones fuse together and an adult person has 206 bones. The smallest bone is stapes which is present inside our ear.



- They provide structural support and protect various organs of the body.
- They produce red blood cells.
- They enable mobility by acting as levers and points of attachment for muscles.
- They act as storage for calcium and phosphorus, essential minerals for various cellular activities throughout the body.

Joints

There are two kinds of joints:

1. IMMOVABLE JOINT

THEY ARE OFTEN CALLED FIXED JOINTS, AND ALLOW NO MOVEMENT BETWEEN BONES.

- These joints are interlocked and held together by Connective Tissue, or they are fused together.
- The places where the bones of the SKULL meet (SUTURE) meet are examples of immovable joints.
- Immovable joints are located in bones of the skulls and the ribs

2. MOVABLE JOINTS

MOST OF THE JOINTS OF THE BODY ARE FREELY MOVABLE JOINTS.

- In Freely Movable Joints, the ends of the bones are covered with a layer of Cartilage that provides a smooth surface at the joint. Joints are a place where two or more bones come together.
- Examples are the ball-and-socket, pivot, hinge, and gliding

A Hinge Joint: It is a common class of synovial joint that includes the ankle, elbow, and knee joints. Hinge joints are formed between two or more bones where the bones can only move along one axis to flex or extend.

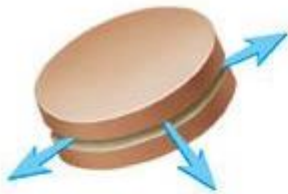
A Gliding Joint: It is also known as a plane joint or planar joint, is a common type of synovial joint formed between bones that meet at flat or nearly flat articular surfaces.

Ball and socket joints: This is the type of joint in which ball shape surface of one bone fitted into the hollow space of another bone also called socket. In this type of joint movement can be done in all the directions.

Pivot Joint: This type of joint allows movements in many planes, viz. up and down, side to side movements.

Pivotal joints allow for rotation, twisting, extension, and flexibility. This is the joint where our neck joints head and allow the movement of forward, backward, left and right direction.

Saddle joint: It is also known as sellar joints. These highly flexible joints are found in various places in the body, including the thumb, shoulder, and inner ear.



Plane Joint



Saddle Joint



Hinge Joint



Pivot Joint



Ball-and-Socket Joint



Ellipsoid Joint



Muscular system and its functions

The main function of the muscular system is movement. Muscles are the only tissue in the body that has the ability to contract and therefore move the other parts of the body. Related to the function of movement is the muscular system's second function: the maintenance of posture and body position.

The main functions of the muscular system are as follows:

1. Mobility

The muscular system's main function is to allow movement. When muscles contract, they contribute to gross and fine movement. Gross movement refers to large, coordinated motions and includes:

- walking
- running
- swimming

Fine movement involves smaller movements, such as:

- writing
- speaking
- facial expressions

The smaller skeletal muscles are usually responsible for this type of action. Most muscle movement of the body is under conscious control. However, some movements are reflexive, such as withdrawing a hand from a source of heat.

2. Stability

Muscle tendons stretch over joints and contribute to joint stability. Muscle tendons in the knee joint and the shoulder joint are crucial in stabilization. The core muscles are those in the abdomen, back, and pelvis, and they also stabilize the body and assist in tasks, such as lifting weights.

3. Posture

Skeletal muscles help keep the body in the correct position when someone is sitting or standing. This is known as posture. Good posture relies on strong, flexible muscles. Stiff, weak, or tight muscles contribute to poor posture and misalignment of the body. Long-term, bad posture leads to joint and muscle pain in the shoulders, back, neck, and elsewhere.

4. Circulation

The heart is a muscle that pumps blood throughout the body. The movement of the heart is outside of conscious control, and it contracts automatically when stimulated by electrical signals. Smooth muscle in the arteries and veins plays a further role in the circulation of blood around the body. These muscles maintain blood pressure and circulation in the event of blood loss or dehydration. They expand to increase blood flow during times of intense exercise when the body requires more oxygen.

5. Respiration

Breathing involves the use of the diaphragm muscle. The diaphragm is a dome-shaped muscle located below the lungs. When the diaphragm contracts, it pushes downward, causing the chest cavity to get bigger. The lungs then fill with air. When the diaphragm muscle relaxes, it pushes air out of the lungs. When someone wants to breathe more deeply, it requires help from other muscles, including those in the abdomen, back, and neck.

6. Digestion

Smooth muscles in the gastrointestinal or GI tract control digestion. The GI tract stretches from the mouth to the anus. Food moves through the digestive system with a wave-like motion called peristalsis. Muscles in the walls of the hollow organs contract and relax to cause this movement, which pushes food through the esophagus into the stomach. The upper muscle in the stomach relaxes to allow food to enter, while the lower muscles mix food particles with stomach acid and enzymes. The digested food moves from the stomach to the intestines by peristalsis. From here, more muscles contract to pass the food out of the body as stool.

7. Urination

The urinary system comprises both smooth and skeletal muscles, including those in the:

- bladder
- kidneys
- penis or vagina
- prostate
- ureters
- urethra

The muscles and nerves must work together to hold and release urine from the bladder.

Urinary problems, such as poor bladder control or retention of urine, are caused by damage to the nerves that carry signals to the muscles.

8. Childbirth

Smooth muscles in the uterus expand and contract during childbirth. These movements push the baby through the vagina. Also, the pelvic floor muscles help to guide the baby's head down the birth canal.

9. Vision

Six skeletal muscles around the eye control its movements. These muscles work quickly and precisely, and allow the eye to:

- maintain a stable image
- scan the surrounding area

- track moving objects

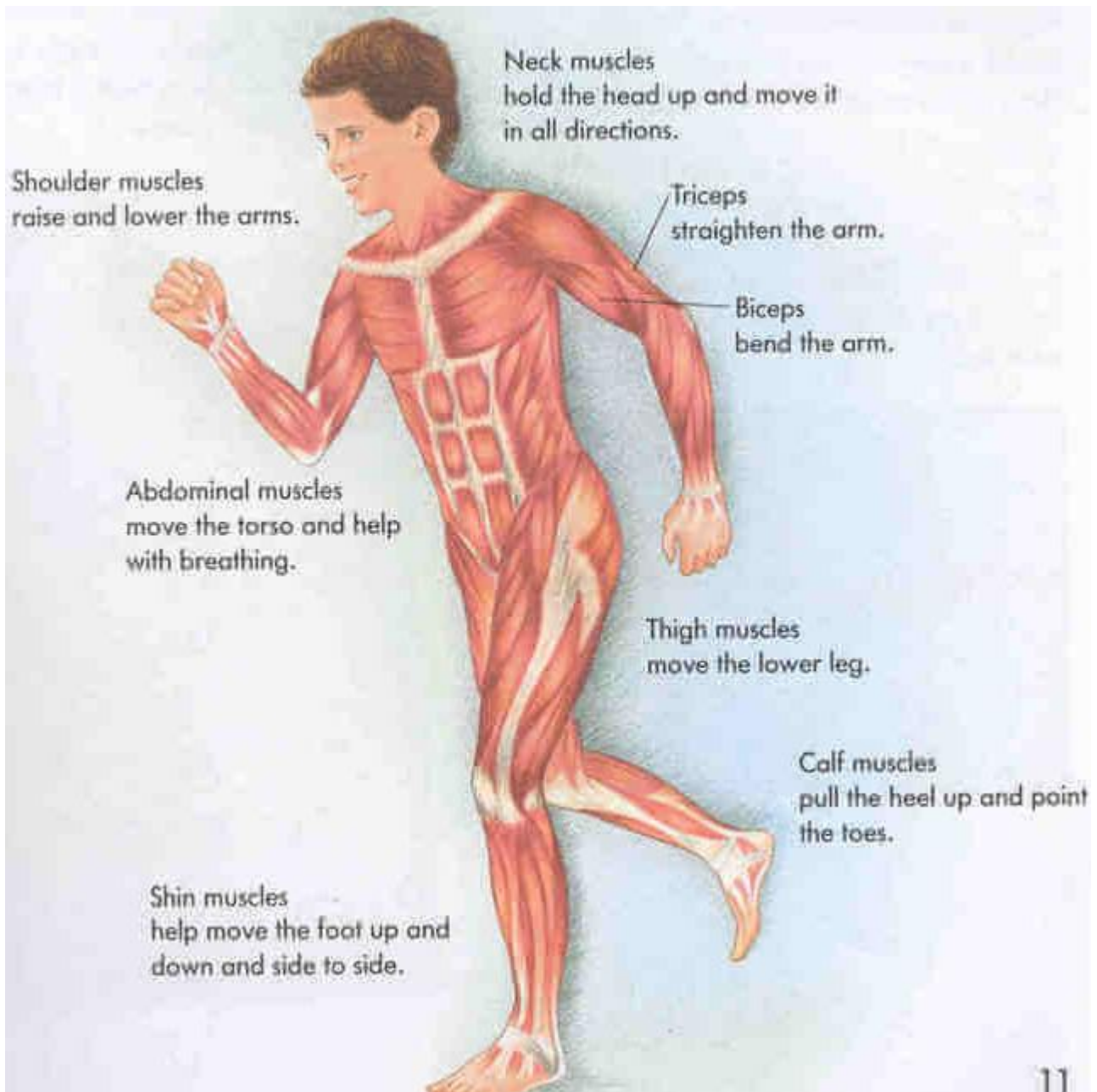
If someone experiences damage to their eye muscles, it can impair their vision.

10. Organ protection

Muscles in the torso protect the internal organs at the front, sides, and back of the body. The bones of the spine and the ribs provide further protection. Muscles also protect the bones and organs by absorbing shock and reducing friction in the joints.

11. Temperature regulation

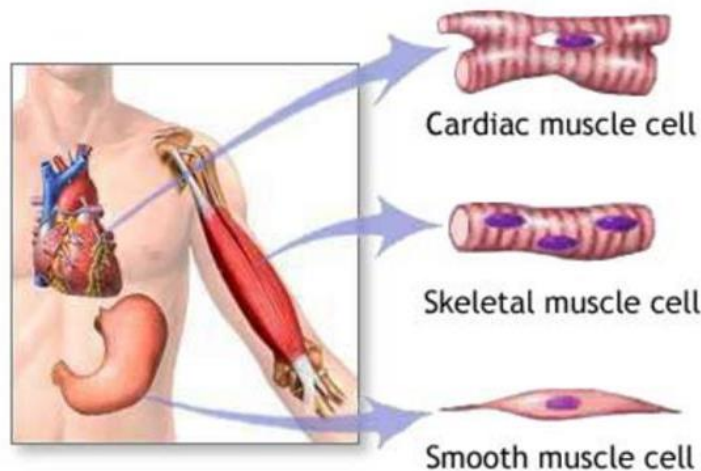
Maintaining normal body temperature is an important function of the muscular system. Almost 85 percent of the heat a person generates in their body comes from contracting muscles. When body heat falls below optimal levels, the skeletal muscles increase their activity to make heat. Shivering is one example of this mechanism. Muscles in the blood vessels also contract to maintain body heat. Body temperature can be brought back within normal range through the relaxation of smooth muscle in the blood vessels. This action increases blood flow and releases excess heat through the skin.



Different types of muscles

Types of Muscle

- Skeletal – striated & voluntary
- Smooth – involuntary
- Cardiac - heart



Types of Muscles

Smooth

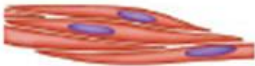
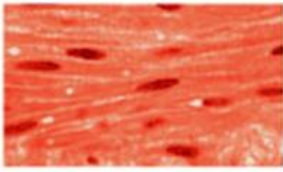
- ◆ Involuntary muscle; controlled unconsciously
- ◆ In the walls of blood vessels and internal organs

Cardiac

- ◆ Controls itself with help from nervous and endocrine systems
- ◆ Only in the heart

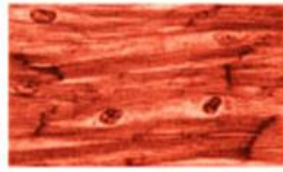
Skeletal

- ◆ Voluntary muscle; controlled consciously
- ◆ Over 600 throughout the body



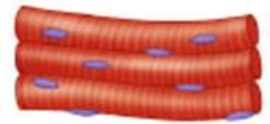
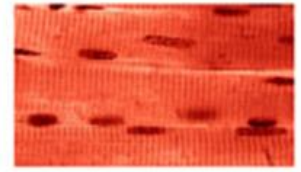
Smooth muscle

- has spindle-shaped, nonstriated uninucleated fibers.
- occurs in walls of internal organs.
- is involuntary.



Cardiac muscle

- has striated, branched, uninucleated fibers.
- occurs in walls of heart.
- is involuntary.



Skeletal muscle

- has striated, tubular, multinucleated fibers.
- is usually attached to skeleton.
- is voluntary.

QUESTION & ANSWER

Q1. What is the skeletal system? Name the parts of the skeletal system.

A1. The skeletal system is the body system composed of bones and cartilage and performs the following critical functions for the human body: supports the body, facilitates movement and protects internal organs.

Q2. What are the functions of the skeleton?

A2. The functions of the skeletal system are:

1. The skeleton gives shape and support to our body.
2. It protects the soft internal organs:
 - (i) The skull protects the brain.

- (ii) The rib cage protects the heart and the lungs.
- (iii) The backbone protects the spinal cord.
- 3. It allows the movement of different body parts.
- 4. Many bones in our body are hollow. They are filled with a jelly-like substance called bone marrow. Blood cells are made in the bone marrow.

Q3. What is a joint?

A3. A joint is the connection made between bones in the body which link the skeletal system into a functional whole. They are constructed to allow for different degrees and types of movement. Joints are classified both structurally and functionally.

Q4. Differentiate between movable and immovable joints.

A4.

There are two kinds of joints:

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- Examples are the ball-and-socket, pivot, hinge, and gliding

Q5. Why are at least two muscles needed to move any joint in the body?

A5. Generally, two skeletal muscles are joined to one bone, so that when one muscle contracts in one direction for enabling the bone to move in that specific direction; the other muscle becomes relaxed to facilitate the movement of the bone.

Q6. Why is posture important?

A6. Good posture relies on strong, flexible muscles. Stiff, weak, or tight muscles contribute to poor posture and misalignment of the body. Long-term, bad posture leads to joint and muscle pain in the shoulders, back, neck, and elsewhere.