

# The Skeletal System



## Anatomy and Physiology

## The skeletal system

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## Introduction

You might work through this system over several weeks, days or hours, but to enhance your learning and enjoyment make sure you break it up into bite-size chunks.

Here are the sections of the skeletal system:

**Bones of the skeleton****Functions of the skeletal system****Types of bone****Microstructure of bone****Ossification****Anatomical terms and joints**

As you study the skeletal system you will learn about:

- The skeleton
- Functions of the skeletal system
- Calcium balance
- Classifications of bone
- Bone microstructure
- Ossification
- Joints
- Anatomical terms and terms of movement



(files/images/human skeleton.jpg?1611829648107)

Mikael Häggström ([https://commons.wikimedia.org/wiki/File:Human\\_skeleton\\_front\\_-\\_no\\_labels.svg](https://commons.wikimedia.org/wiki/File:Human_skeleton_front_-_no_labels.svg))/ Public domain

Make notes as you study each section, and interact fully with the activities – watch the animations and complete the quizzes.

Take a break at the end of each section– resting your eyes from the computer screen, getting some fresh air or taking a coffee break will improve your ability to focus on your study and take in information.

Give yourself time to think about what you have learned, and time to absorb and understand it.

## Bones of the skeleton

The adult human skeleton is comprised of over **200 bones**. Each bone has **joints** where the bone comes into contact with adjoining bones (**articulation**).

Bones are attached to neighbouring bones and muscle with **connective tissue** such as **cartilage, tendons** and **ligaments**.

The skeleton is split into bones which form the **axial skeleton** and bones which form the **appendicular skeleton**.

Bones of the **axial skeleton** form the centre axis of the body and consists of the skull, the vertebral column, the ribs and the breast bone (sternum).

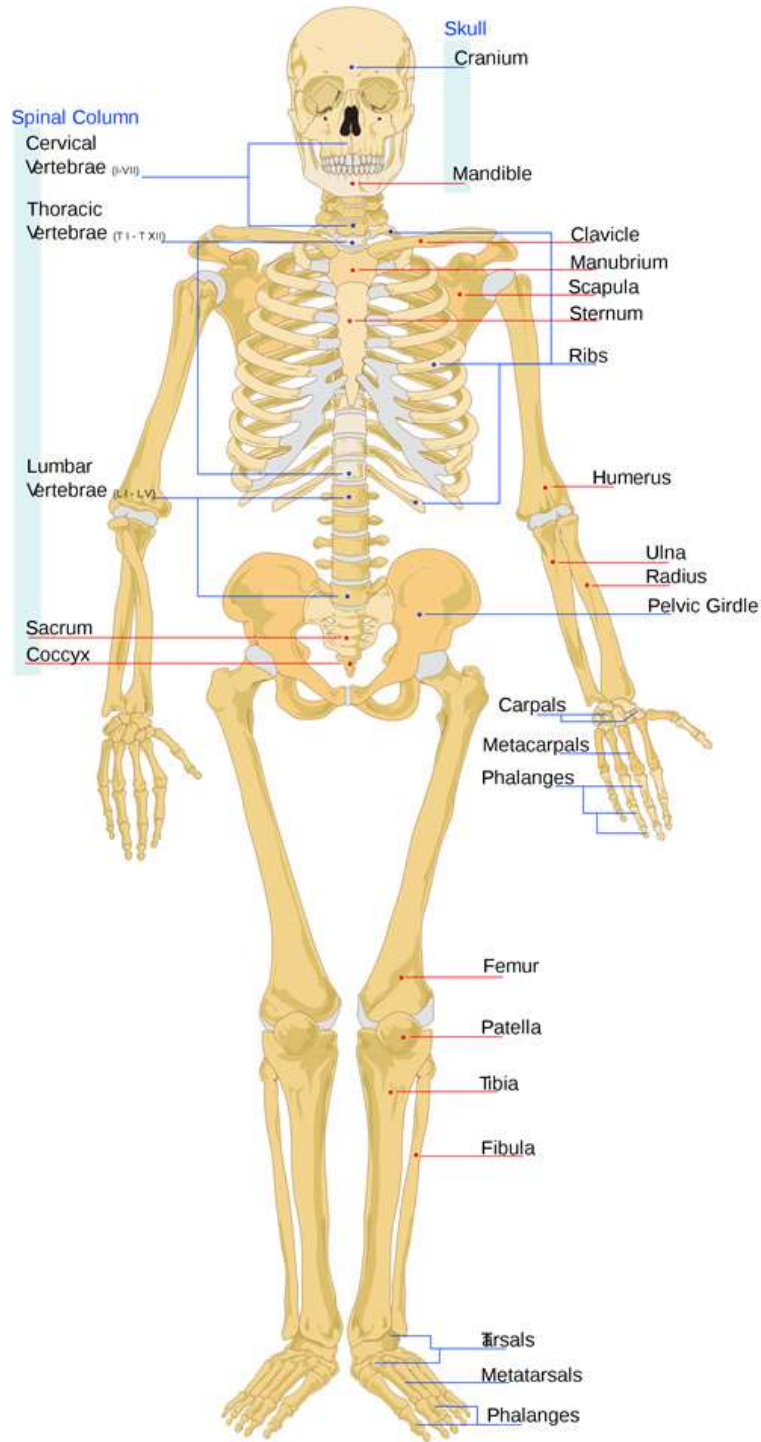
Bones of the **appendicular skeleton** are bones hanging from the central axis; the shoulder girdle, arms and hands, and the pelvic girdle, legs and feet.

### The Skeleton

The bones in the axial and appendicular skeleton are listed below, along with their more commonly known names. However, as this is the study of anatomy, you should learn the correct anatomical names for each bone. In addition to the bones listed here, there are also a number of sesamoid bones such as the patella (knee cap).

These are usually nodules of bone embedded in tendons and are thought to modify pressure, reduce friction and alter the direction of the pull of a muscle.

<b>Axial Skeleton</b>	<b>No. of bones</b>
Cranium (skull) and facial bones	22
Inner ear bones	6
Hyoid (found in the throat)	1
Vertebral column (spine)	33
Sternum (breast bone)	1
Ribs (12 pairs on each side)	24



(files/images/human\_skeleton\_front.jpg?1611830228337)

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Appendicular Skeleton	No. of bones
Clavicle (collar bone)	2
Scapula (shoulder blade)	2
Humerus (upper arm)	2

Radius and ulna (lower arm)	4
Carpels (wrist)	16
Metacarpels (hand)	10
Phalanges (finger bones)	28
Pelvic girdles (hip bones)	2
Femur (upper leg bone)	2
Patella (knee cap)	2
Tibia and fibula (lower leg bones)	4
Talus (ankle bone)	2
Calcaneus (heel bone)	2
Smaller heel bones	10
Metatarsals (foot bones)	10
Phalanges (toes)	28

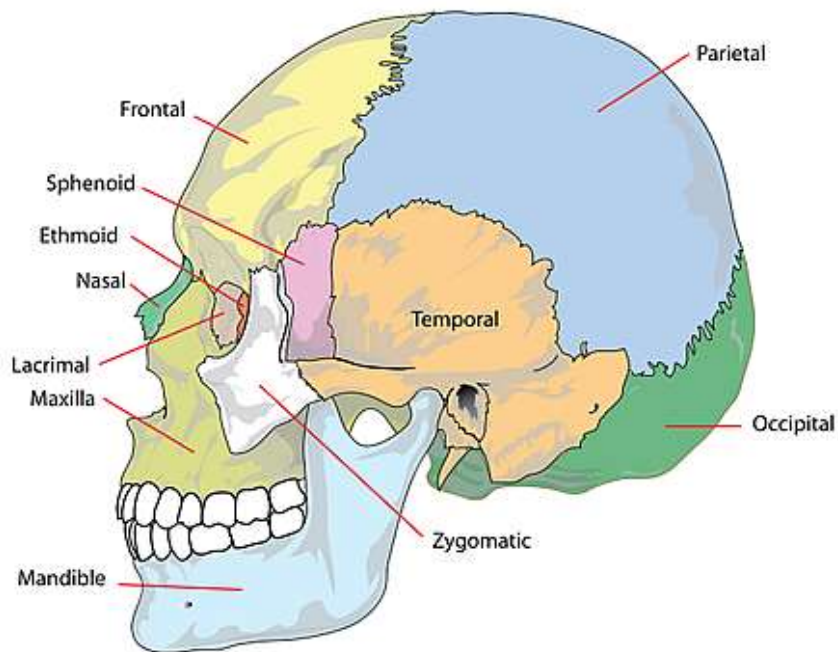
## The skull

The skull consists of 22 bones and encloses the brain almost completely. It is formed of the following parts:

- the **cranium** which envelops the brain and bones of the face,
- the **mandible** (jaw bone).

The top part of the cranium is made up of the **frontal bone**, the left and right **parietal bones** and the **occipital bone** at the back of the skull.

The bones in the cranium are fused together so that there is no movement between them. You will learn more about the different types of joint and the connective tissues that help to create them later on.



(files/images/skull.png?1611832688494)

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#### Text

Parietal  
Occipital  
Temporal  
Zygomatic  
Mandible  
Maxilla  
Lacrimal  
Nasal  
Ethmoid  
Sphenoid  
Frontal

## Ribs and sternum

### The sternum

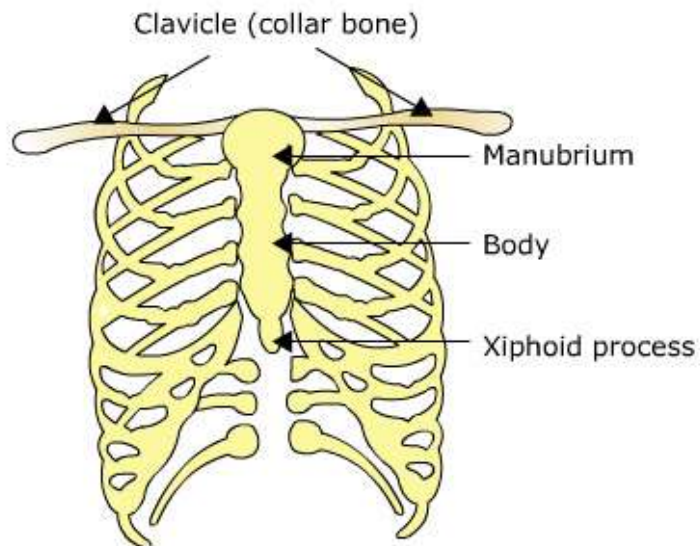
The sternum (breast bone) is a flat, narrow bone located in the middle of the thoracic cavity.

It is made up of three sections:

- the **manubrium** at the top,
- the **body** in the centre and
- the **xiphoid process** at the bottom.

It articulates with the ribs and the clavicle (collar bone).





(files/images/sternum.jpg?1611832841663)

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### The ribs

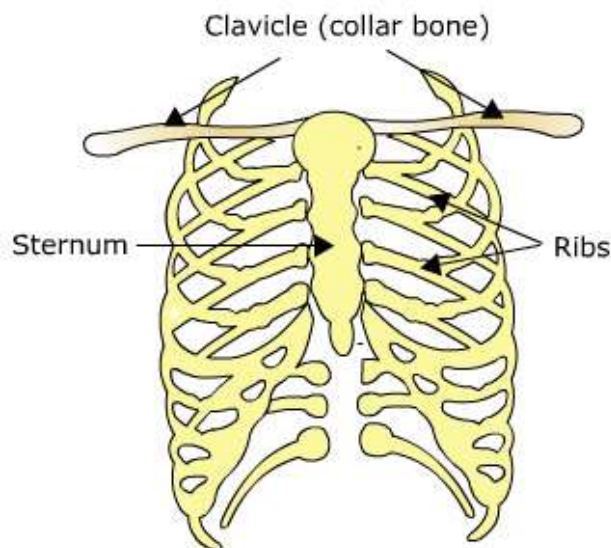
There are **12 pairs** of ribs on each side of the **thoracic cavity**, increasing in length from the 1st to the 7th rib before they begin to shorten again, giving the characteristic barrel shape.

The upper 7 ribs are connected to the vertebral column at the back and the sternum at the front and are called **true ribs**.

The remaining 5 pairs of ribs are called **false ribs** as they are not attached to the sternum directly.

The cartilage of the 8th, 9th and 10th pairs of ribs connect to the cartilage of the 7th pair of ribs.

The lower 2 pairs of ribs do not attach at the front at all and are known as **floating ribs**.



(files/images/ribs.jpg?1611832952304)

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## The spinal column

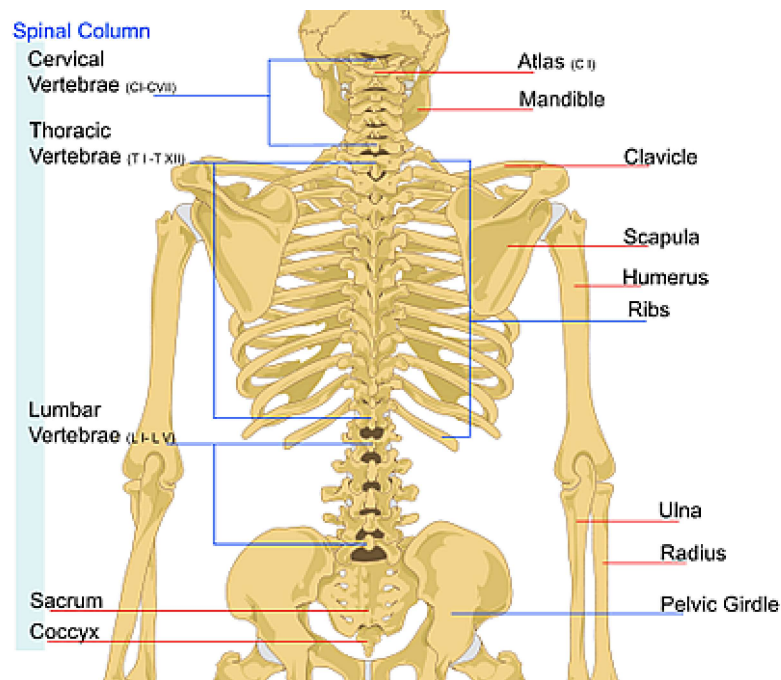
The spinal column is comprised of **33 vertebrae** which sit on top of one another creating a supportive column, separated by **cartilaginous discs**. In the adult the bones of the **sacrum** and the **coccyx** at the bottom of the spine fuse together so adults only have 26 vertebral bones.

The functions of the spinal column are:

- To support the upper body, distributing the weight through the pelvis to the legs and feet
- To absorb shock through the intervertebral discs
- To protect the spinal cord
- To allow movement.

## The vertebrae

The vertebrae are named depending upon which area of the spine they are in. The **cervical** vertebrae form the upper end of the spine, the **thoracic** vertebrae extend through the thorax (chest) region, the **lumbar** vertebrae form the spine in the small (lumbar arch) of the back, the **lumbar** vertebrae are positioned between the pelvic bones at the back and are fused together to create the **sacrum**, and the **coccygeal** vertebrae form the **coccyx** at the bottom of the spine.



(files/images/skeleton\_back.png?1611833196436)

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### Text

Spinal column:

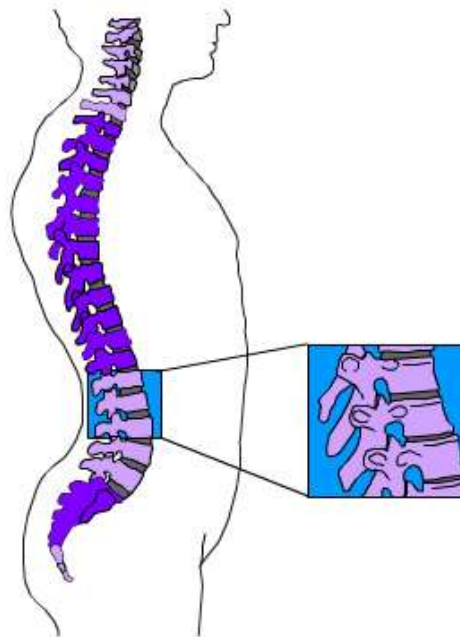
- **cervical** vertebrae
- **thoracic** vertebrae
- **lumbar** vertebrae
- **lumbar** vertebrae

- Sacrum
- Coccyx
- Atlas - top of the neck
- Mandible - jaw
- Clavicle
- Scapula
- Humerus
- Ribs
- Ulna
- Radius
- Pelvic girdle

## Curves of the spine

As we develop into adults, the spine curves to create the cervical and lumbar curves. These natural spinal curves in the backbone help us function as follows:

- by helping to maintain balance
- by adding strength to the vertebral column
- by absorbing shock as we walk and run
- by helping to protect the vertebral column from fracture.



(files/images/curves-of-the-spine.jpg?1611833643125)UHI / CC0

## Quiz

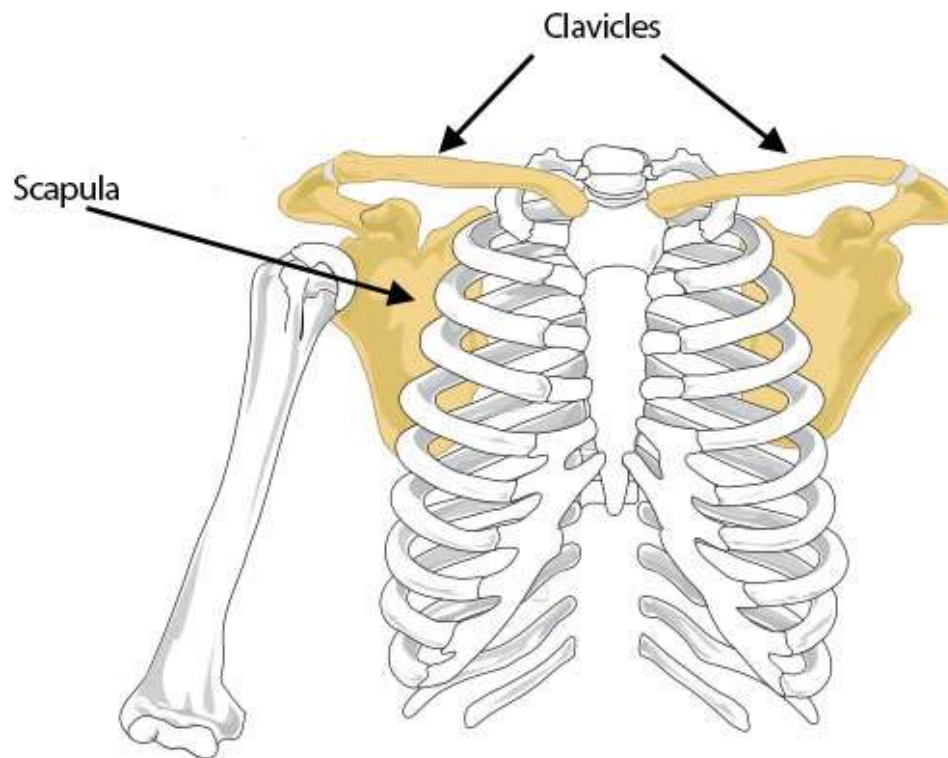
Have a go at identifying each section of vertebrae and see if you can remember how many vertebrae make up each section.

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## The pectoral girdle

The **appendicular skeleton** consists of the **pectoral** and **pelvic girdles** and the limb bones. The upper (anterior) limbs are attached to the pectoral (shoulder) girdle and the lower (posterior) limbs are attached to the pelvic (hip) girdle.

The pectoral girdle consists of two shoulder blades (**scapulae**) and two collar bones (**clavicles**). These bones articulate with one another, allowing movement.



(files/images/pectoral\_girdle.jpg?1611841757758)

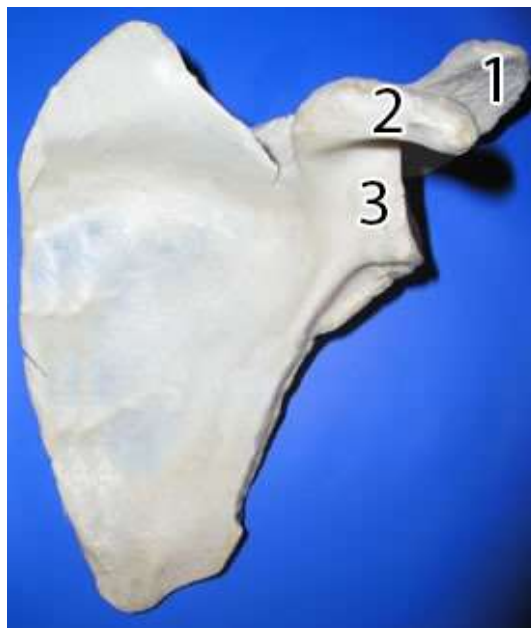
LadyofHats ([https://commons.wikimedia.org/wiki/File:Pectoral\\_girdle\\_front\\_diagram.svg](https://commons.wikimedia.org/wiki/File:Pectoral_girdle_front_diagram.svg)) / Public domain

### The scapula (shoulder blade)

The scapula is a flat triangular bone which stretches from the shoulder to the vertebral column at the back. On the posterior side it has a bony ridge above the shoulder joint called the **acromion**. This is a place of muscular attachment. Beneath the clavicle on the inside of the shoulder joint, is another bony projection of the shoulder blade called the **coracoid process**, which also serves for the attachment of muscles. The head of the **humerus** (upper arm bone) fits into the **glenoid fossa** of the outer scapula, forming a **ball and socket joint**.

#### Key

1. Acromial process
2. Coracoid process
3. Glenoid cavity



(files/images/scapula\_1.jpg?1611844803550)

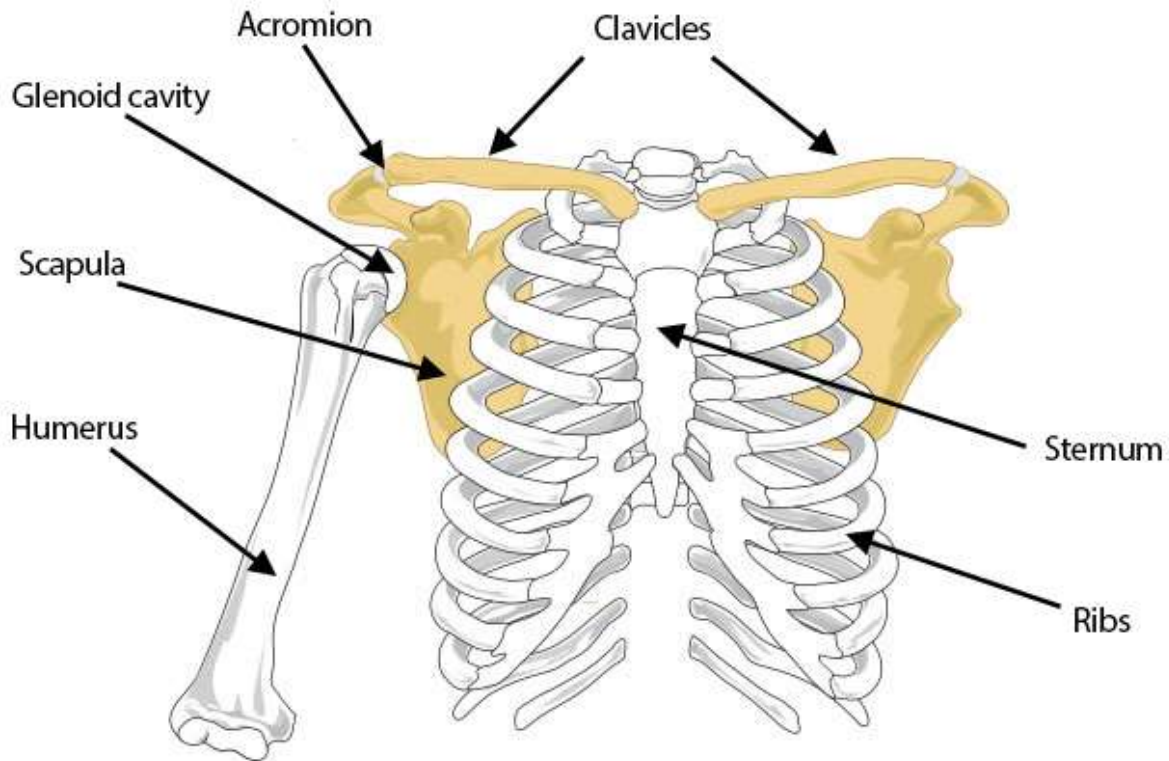
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### The clavicles

Each collar bone is rod-shaped and roughly S-shaped. It lies horizontally and articulates with the upper end of the sternum just above the first rib. The lateral (outer) end of each clavicle articulates with the acromion of the scapula.

The clavicles support the scapulae (shoulder blades), also keeping them back so that the arms can hang freely at the sides of the body. The clavicles form part of the pectoral girdle and keep the shoulder joint in place.



(files/images/the clavicles.jpg?1611845062867)

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#### Text

Labelled diagram showing the clavicles, acromion, glenoid cavity, scapula, humerus, ribs and sternum.

## Quiz

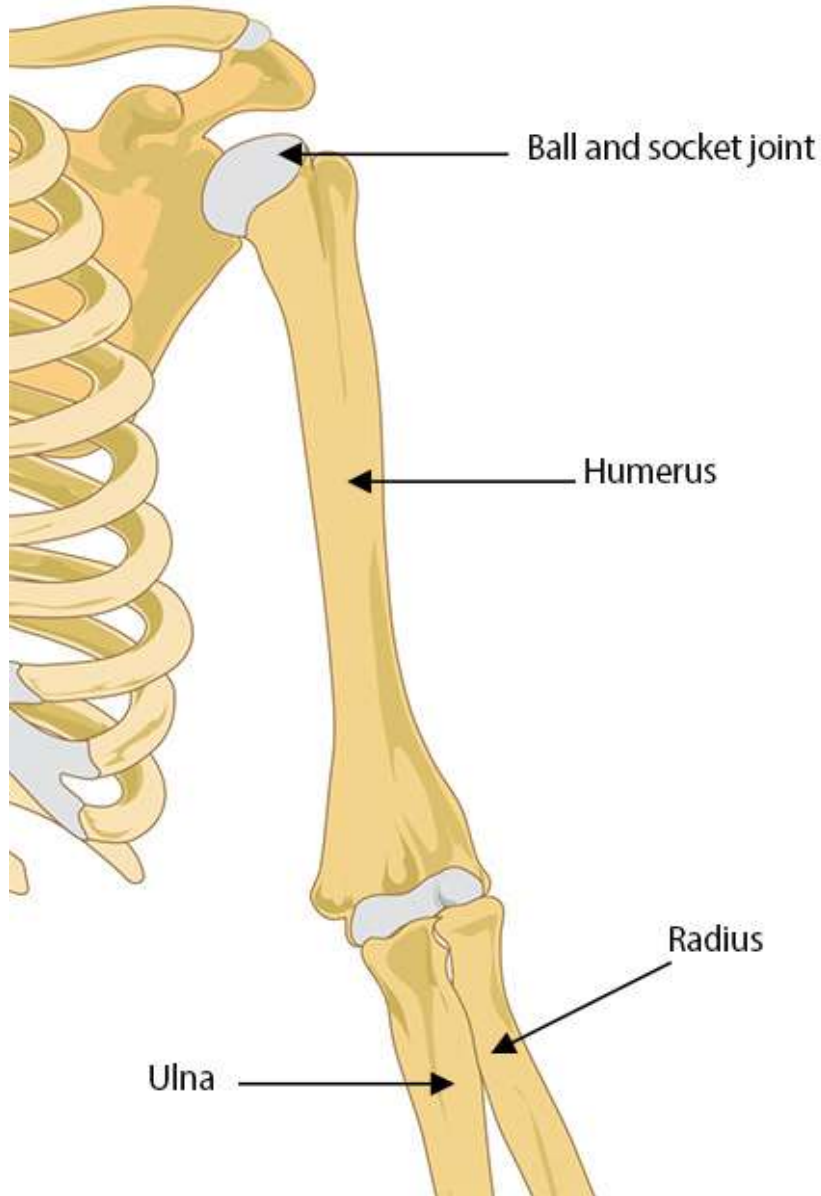
Now have a go at identifying the bones of the shoulder girdle and the joints that enable movement.

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## The arm and hand

### The humerus

The upper arm is a single long bone called the **humerus**. The upper end consists of a hemispherical ball which fits into the socket of the shoulder blade to form the **shoulder joint**. The lower end of the humerus forms a **pivot joint** with the **radius** and a **hinge joint** with the **ulna** in the elbow.



(files/images/the humerus.jpg?1611845719630)

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**Text**

Ball and socket joint

Humerous

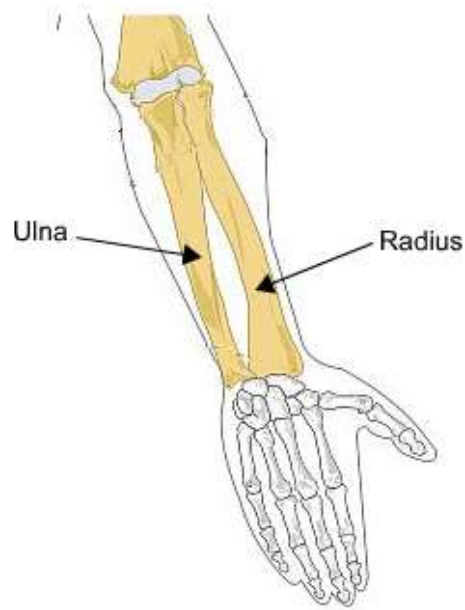
Ulna

Radius

**The radius and ulna of the forearm**

The two long bones of the forearm are the **radius** and the **ulna**. The ulna is the larger of the two bones and is situated on the inner side (the little finger side) of the forearm. The upper end of the ulna articulates with the lower end of the humerus forming the hinge joint of the elbow. The lower end of the ulna forms part of the wrist joint.

The radius is situated on the thumb side of the forearm. Its upper end articulates with the humerus and the ulna. The broad, lower end of the radius forms part of the wrist joint, where it articulates with the wrist bones (**carpals**). The radio-ulnar joints are pivot joints where the moving bone is the radius, allowing the forearm to be rotated.



(files/images/radius-and-ulna.jpg?1611845911499)

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**Text**

Ulna

Radius

## The carpals, metacarpals and phalanges (wrist, hand and fingers)

### The Wrist

The wrist consists of eight carpal bones. These are small, short bones that are arranged in two rows of four. They slide over one another, creating **gliding joints**.

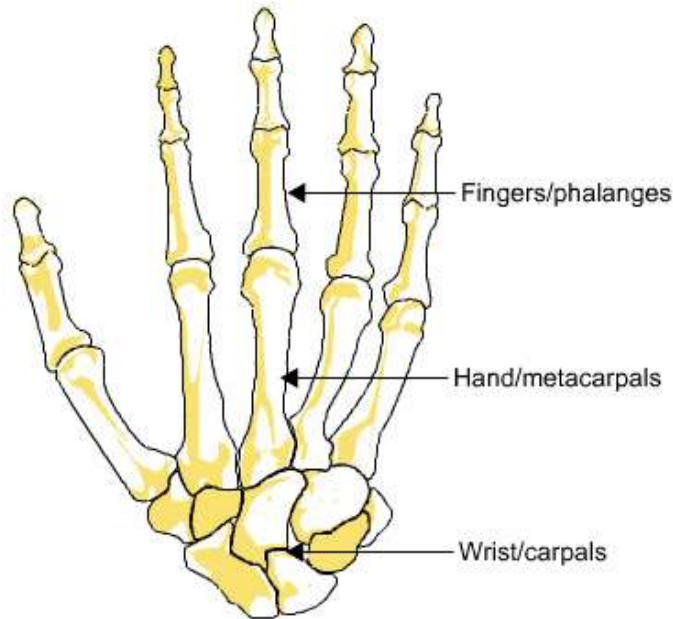
### The Hand

The palm is supported by five long metacarpals. The metacarpals articulate with carpals at one end and with the phalanges (fingers) at the other end.

### The Fingers



The fingers are made up of fourteen phalanges. There are three phalanges in each finger but only two in the thumb.



(files/images/bones-of-hand.jpg?1611845992696)

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#### Text

Fingers/phalanges

Hand/metacarpals

Wrist/carpals

## Quiz

Now have a go at identifying the bones of the arm.

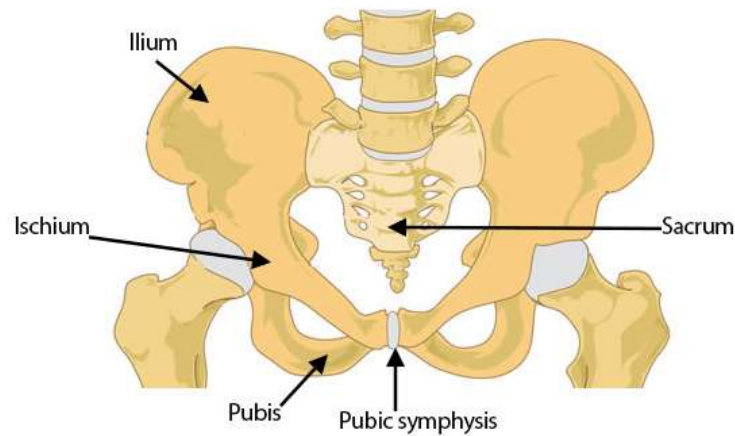
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([https://edu-dev.wp.uhi.ac.uk/wp-admin/admin-ajax.php?action=h5p\\_embed&id=154](https://edu-dev.wp.uhi.ac.uk/wp-admin/admin-ajax.php?action=h5p_embed&id=154))

## The lower body

### The pelvis

The pelvis consists of two large, sturdy hip bones. Each hip bone consists of three fused bones, the **ilium**, **ischium** and the **pubis**. The ilium is the largest of the three and forms the upper part of the hip bones. The ischium forms the inferior (lower) part of the hip bone, and the pubis is the central front section. The two pubic bones are attached at the front by the **pubic symphysis** which consists of fibrocartilage and ligaments,

and at the posterior via the **sacrum** forming a complete bony ring. The sacrum has a large, flat surface on each side for articulation with the ilia. On the outer side of the pelvis there is a deep hip socket into which the head of the femur (leg bone) fits.



(files/images/pelives.jpg?1611846323032)

Mikael Häggström ([https://commons.wikimedia.org/wiki/File:Human\\_skeleton\\_front\\_-\\_no\\_labels.svg](https://commons.wikimedia.org/wiki/File:Human_skeleton_front_-_no_labels.svg))/ Public domain

#### Text

Ilium

Ischium

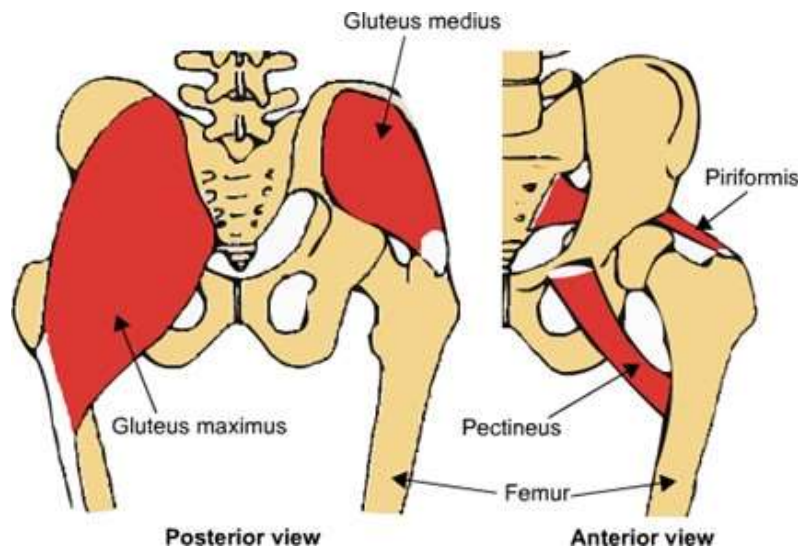
Pubis

Pubic symphysis

Sacrum

### The pelvic girdle

The pelvic girdle forms a strong support for the attachment of the lower limbs. Strong muscles of the back, the legs and the buttocks are attached to it.



(files/images/pelvic\_girdle.jpg?1611846427419)

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### Text

#### Posterior view:

- Gluteus medius
- Gluteus maximus
- Femur

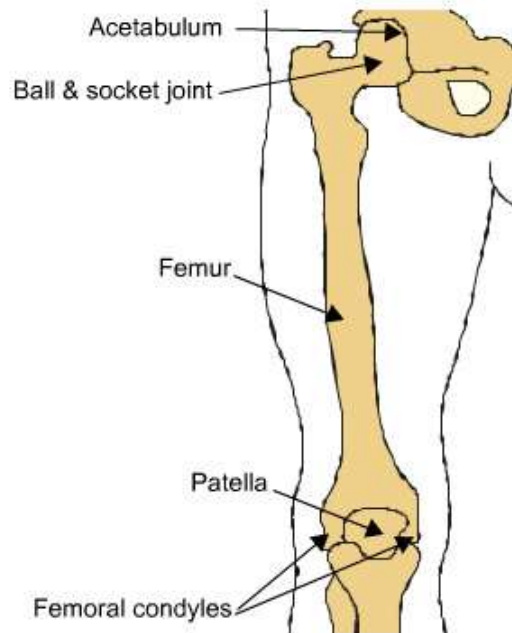
#### Anterior view:

- Piriformus
- Pectineus
- Femur

### The femur

The upper leg bone is the **femur** and is the longest bone in the body. The head of the femur is turned slightly inwards and has a large, rounded portion which articulates in the **acetabulum** forming a **ball-and-socket joint**. At its distal (lower) end, the femur widens to form two large knobs (**condyles**) which form the hinged knee joint with the **tibia** (shin bone) of the lower leg.

The **patella** (kneecap) slides over the anterior (front) of the **femoral condyles**. The patella is a small, triangular, flat bone which develops on the tendon of the thigh muscle and is attached by ligaments to the tibia.



(files/images/femur.jpg?1611846630815)

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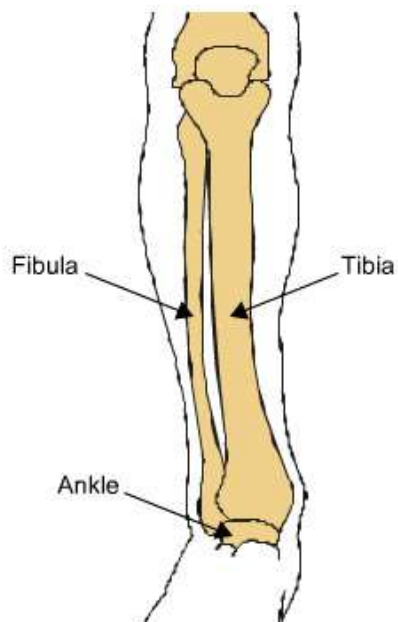
### Text

Acetabulum  
 Ball and socket joint  
 Femur  
 Patella  
 Femoral condyles

## The tibia and fibula (lower leg)

The two bones of the lower leg are the **tibia** (shinbone) in front and the **fibula** behind. The tibia is the larger of the two and extends from the knee to the ankle. The upper end of the tibia has two articulating facets into which the **condyles of the femur fit** to form the knee joint.

The lower end of the tibia articulates with one of the **tarsals** to form the ankle joint. The fibula is smaller than the tibia and is situated slightly behind it on the outside. The upper end articulates with the tibia but does not form part of the knee joint. The lower end forms part of the ankle joint.



(files/images/tibia-and-fibula.jpg?1611846770597)

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#### Text

Fibula

Tibia

Ankle

### The tarsals, metatarsals and phalanges (ankles and toes)

There are seven short, thick **tarsal** bones, the largest of which is the heel bone (**calcaneus**) which presses firmly onto the ground when we stand, walk or run. The calf muscles are attached to the calcaneus which allows the heel to be lifted up.

The arch of the foot is formed partly by some of the tarsals but mainly by the five long **metatarsals** which extend from the tarsals to the toes. The arch is supported by a sheet of connective tissue called the **plantar fascia**, which helps to support the weight of the body.