



Muscles and Bones

BIOLOGY • HUMAN BODY • MUSCLES AND BONES

Section 1: Muscles

• What is the difference between movement and locomotion?

Every living thing can move, even plants can grow towards the light. But not every living thing can move from place to place – known as locomotion. Many organisms, such as most plants, are sessile, meaning they are fixed to the ground, but others, like humans, can move about. Locomotion offers organisms huge advantages, such as catching food, escaping danger and finding mates.

Extension Questions

Q1. What organisms are sessile and what are the advantages?

Most plants and fungi are fixed to the ground, as are many invertebrates, for example, barnacles and some of the molluscs.

Sessile organisms do not need to use as much energy as locomoting organisms. This means that their bodies can be simpler, and they require less food from day to day.



Humans can move from place to place

• Suggested Film

– Bones

• How are we adapted to move?



Skeletal muscles are attached to the skeleton, so when they contract, bones move

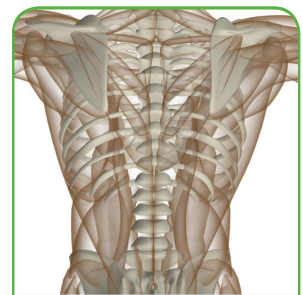
Humans have a framework called a skeleton upon which muscles act to create movement. The skeleton is made up of numerous bones which meet at joints. The muscles act across these joints, causing the bones to be moved with respect to each other.

• Suggested Film

– Skeletal Muscles

• What are muscles?

Muscle is a type of tissue capable of contracting. There are three different types of muscle tissue: cardiac, smooth and skeletal. Cardiac muscle is only found in the heart, where it compresses the blood to force it around the circulatory system. Smooth muscle is much more abundant in the body and is found in the walls of the gut, the bronchioles and several other organs. Like cardiac muscle, smooth muscle is under the control of the autonomic nervous system, and so cannot be controlled by conscious effort. Skeletal muscle, by comparison, is attached to the skeleton and can be contracted in response to conscious decision.



The muscles of the back

• Suggested Film

– Cardiac and Smooth Muscles

Section 2: Skeleton

• What does the skeleton consist of?

The human skeleton consists of hundreds of bones, and together they have a number of important functions. For example, bones provide overall shape and support to the body, whilst also acting as a series of levers against which muscles can act to create movement. Other bones, such as the skull and ribs, provide protection to the delicate organs they cover.

• Suggested Films

- Bones
- Why Is Blood Red?
- An Ancient Olympian
- Growing Pains

• Suggested Activities

- Examine a model skeleton
- Ask students to produce a large labelled drawing of the human skeleton
- Burn a bone

Extension Questions

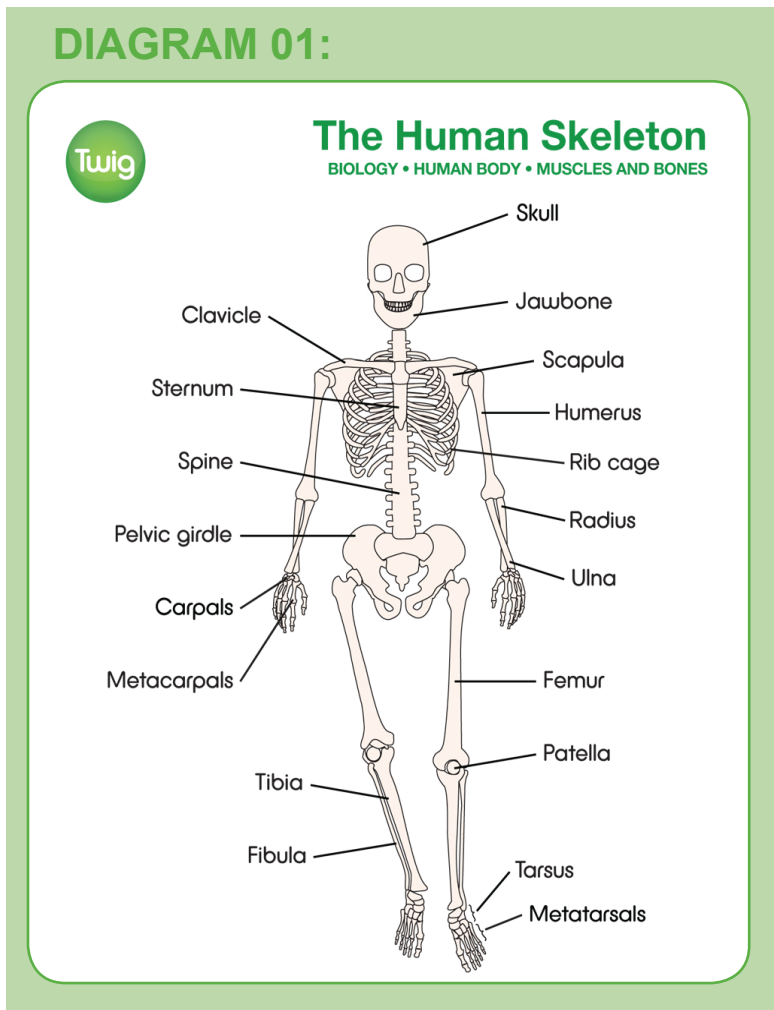
Q2. Are bones alive?

Yes, bones are made of living tissue. This is why broken bones can heal, and why repetitive use of certain bones can cause them to change shape.

Q3. What are bones made of?

Bone consists of cells, called osteocytes, which secrete bony material made up mostly of calcium and phosphate ions. If you have a calcium deficiency as a child, you can develop a condition known as rickets in which your bones don't develop properly. The bones stay soft and the weight bearing leg bones can become deformed.

DIAGRAM 01:



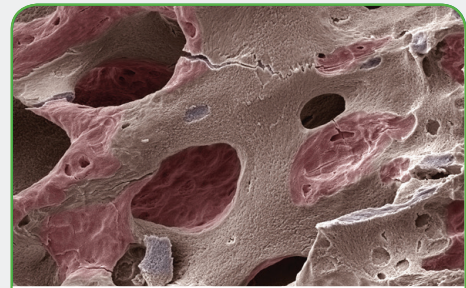
Extension Question

Q4. What is osteoporosis?

Osteoporosis is a condition, common in older women, in which the bone density declines as calcium phosphate is reabsorbed too quickly from the bones. The bones become weaker and can fracture easily.



Fractured leg bones



Magnification of human bone with osteoporosis

• **What is a joint?**

A joint is the place where two bones meet, for example the hip joint or elbow. In a joint, the ends of the bones are usually covered in a layer of smooth, protective cartilage and the bones are held in position by ligament, which prevent bones becoming dislocated.

There are several different types of joint. Some are freely moveable, such as the ball and socket joint of the shoulder and the hinge joint of the elbow, whilst others are less moveable such as those between the vertebrae of the spine. Some joints are fixed, such as those between the bones which make up the skull.

• **Suggested Films**

- Joints
- Clever Thumbs
- What Happens When I Crack My Knuckles?

• **Suggested Activity**

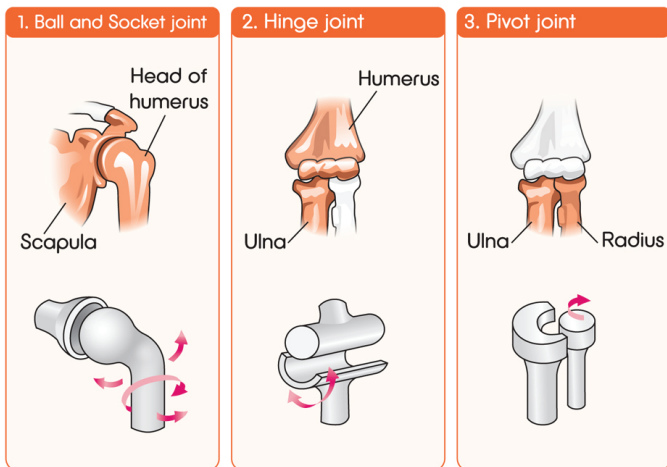
- Examine a joint of meat or dissect a chicken from the supermarket

Extension Question

Q5. What is an example of ball and socket joint and a hinge joint?

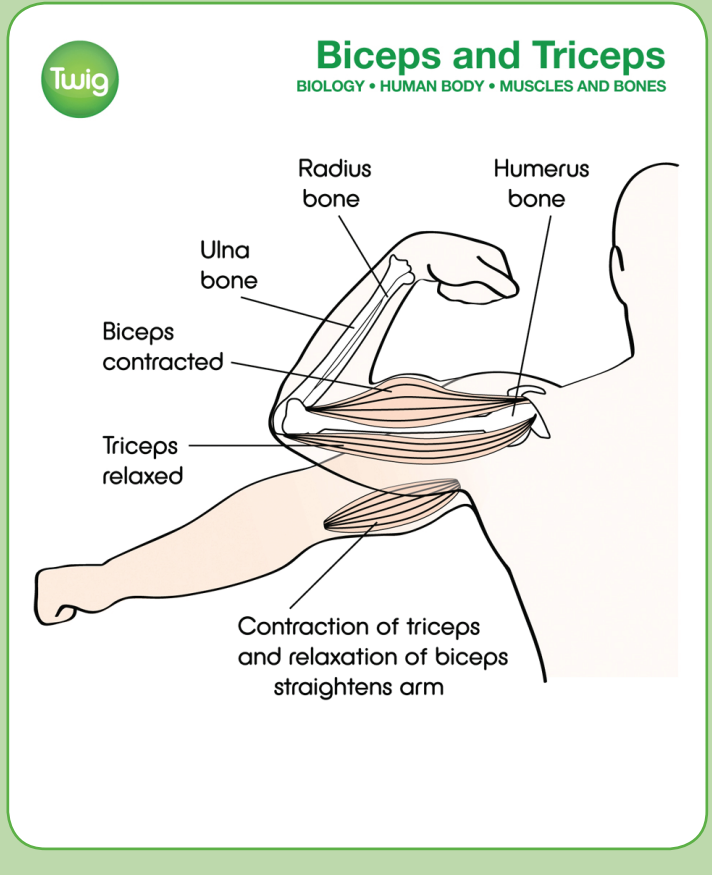
The hip joint is a ball and socket joint. The knee joint is a hinge joint.

DIAGRAM 02:



- How do we move the skeleton?

DIAGRAM 03:



Muscles are attached to the skeleton by tough fibres called tendons. When a muscle contracts, it pulls on the tendon, which in turn pulls on the bone. This causes the bones either side of the joint to move with respect to each other. Some muscles cause joints to flex (for example, the biceps in the upper arm), while others cause joints to extend (for example, the triceps).

• **Suggested Film**

– Cardiac and Smooth Muscles

• **Suggested Activity**

– Dissect a chicken and pull on the breast muscles to move the wings

Extension Questions

Q6 . What is your hamstring?

Your hamstring is the big muscle behind your thigh. When it contracts it causes your leg to bend at the knee. You can feel the hamstring tendons behind your knee.

Q8. Where is your Achilles tendon?

Your Achilles tendon attaches your calf muscle to your heel bone. It is called the Achilles tendon because in Greek mythology, Achilles' mother dipped him in the River Styx in order to protect him. However, she held him by his heel, which was the only part of his body left unprotected. During the Trojan war, Achilles was killed when a poisoned arrow hit him in his heel.

Section 3: Muscles

• How do muscles contract?

Muscles are made up of long cells which contain overlapping protein fibres. When stimulated, these fibres are able to slide over each other, thereby shortening the length of the muscle cells and causing the muscle to contract. However, muscles can only contract, so they need to be pulled back to their original length by an opposing muscle, called an antagonistic muscle. For example, if your bicep contracts to flex your arm it cannot re-extend the arm. This is the job of the triceps which operates antagonistically.



Bending your knee requires antagonistic muscle pairs

• Suggested Film

– Skeletal Muscles

Extension Question

Q9. Are there any other antagonistic muscle pairs in your body?

The hamstring behind your thigh contracts, causing your leg to bend at the knee. Your quadriceps (quads) contracts to cause the leg to straighten again. Obviously these muscles are crucial in walking, running and kicking footballs.

• What's the difference between a strain and a sprain?



Ice should be applied to a sprained ankle

When muscles are stretched too far and tear, we say someone has strained their muscle. When a ligament is stretched too far, we say someone has sprained a joint. For example, you sprain your ankle, whereas you strain your hamstring.

The acronym RICE is used to explain the first line of treatment for strains and sprains. It stands for Rest, Ice, Compression and Elevation. The aim is to minimise further damage and reduce swelling and pain, while the tissues gradually repair themselves.

• Suggested Film

– Joints

• Suggested Activity

– Ask students to research and produce a poster on joint replacements

• Quizzes

Muscles

Basic

• What are the three different types of muscle in the human body called?

- A – smooth, rough, skeletal
- B – smooth, rough, cardiac
- C – smooth, cardiac, skeletal
- D – smooth, coronary, skeletal

• Where is cardiac muscle found?

- A – the intestines
- B – the lungs
- C – the heart
- D – the arm

• Which of the following functions does smooth muscle control in the body?

- A – contraction of the heart
- B – running
- C – speaking
- D – focusing the eyes

• Which of the following functions does skeletal muscle control in the body?

- A – contraction of the heart
- B – running
- C – speaking
- D – focusing the eyes

Advanced

• What are the three different types of muscle in the human body called?

- A – smooth, rough, skeletal
- B – smooth, rough, cardiac
- C – smooth, cardiac, skeletal
- D – smooth, coronary, skeletal

• What of the following are examples of involuntary muscles?

- A – smooth and skeletal
- B – smooth and rough
- C – cardiac and skeletal
- D – smooth and cardiac

• Which of the following functions does smooth muscle control in the body?

- A – contraction of the heart
- B – balancing
- C – speaking
- D – focusing the eyes

• Which of the following functions does skeletal muscle control in the body?

- A – contraction of the heart
- B – running
- C – peristalsis
- D – focusing the eyes

Bones

Basic

• Which part of the skeleton protects the heart and lungs?

- A – the rib cage
- B – the pelvis
- C – the spine
- D – the skull

• Which mineral is important for healthy bones?

- A – iron
- B – copper
- C – calcium
- D – sulphur

• What is the proper name for the collection of fused bones that protect your brain?

- A – osteocytes
- B – vertebrae
- C – ulna
- D – cranium

Advanced

• What are bone cells called?

- A – calcium
- B – osteocells
- C – osteocytes
- D – hepatocytes

• What minerals are important constituents of bone tissue?

- A – iron and calcium
- B – copper and calcium
- C – phosphorus and calcium
- D – sulphur and calcium

• What is the scientific name for bones of the spine?

- A – osteocytes
- B – vertebrae
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• Answers

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