

# Bones, Muscles & Movement

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July 2020



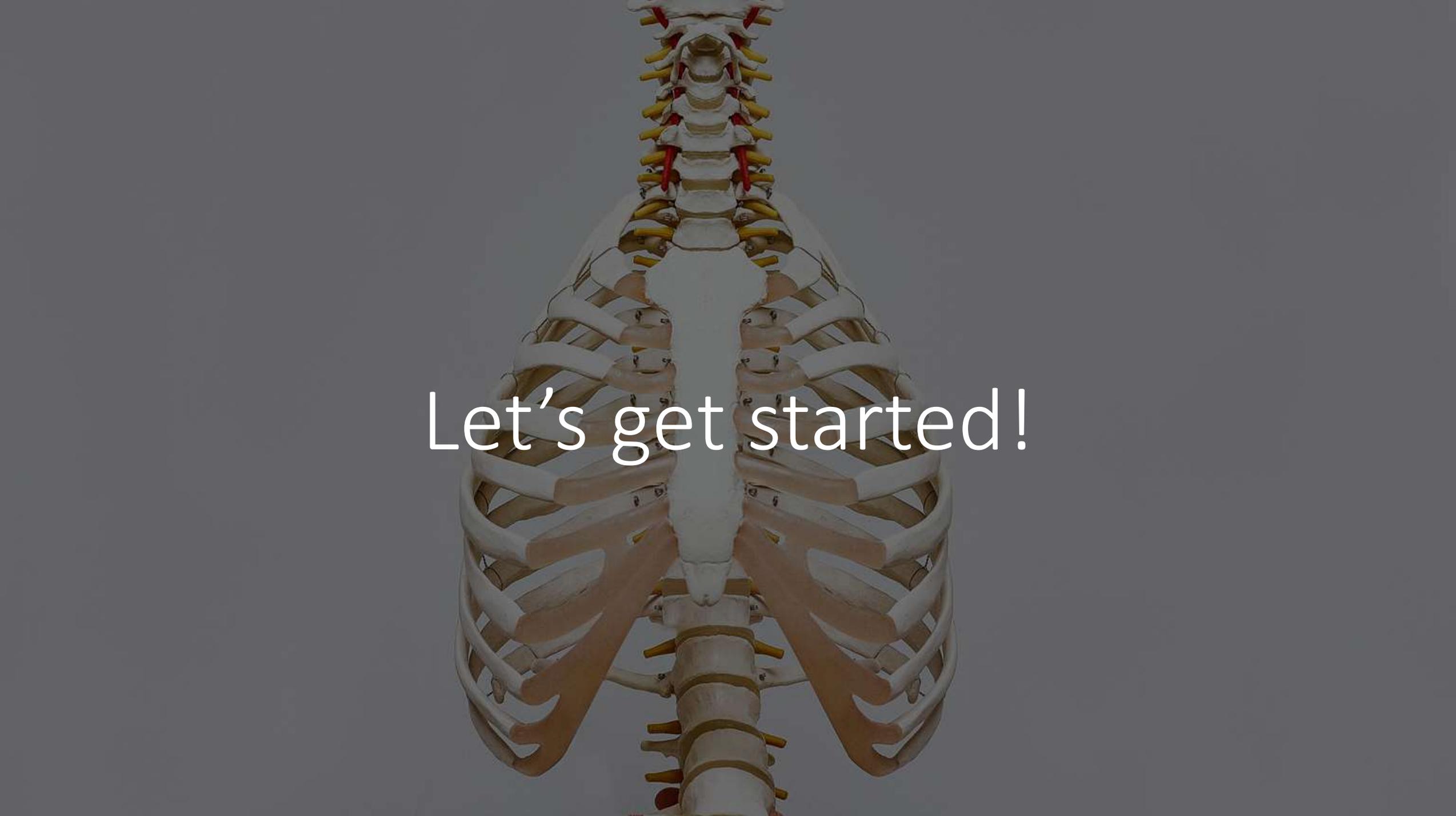
# About Me

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- Youth leader and leadership advisor
- Lifelong sports fan
- Worked for the British Olympic and Paralympic Teams
- Master's degree in Sport Psychology
- Bachelor's degree in Sport & Exercise Science from Loughborough University
- Gym fanatic
- Pathfinder to Guide level – attended Oshkosh Camporee in 2009





An anatomical illustration of the human ribcage and spine, viewed from the front. The ribs are shown in a light tan color, and the spine is shown in a light gray color. The illustration is centered on a dark gray background. The text "Let's get started!" is overlaid on the center of the image in a white, sans-serif font.

Let's get started!

# Worksheets at the ready...

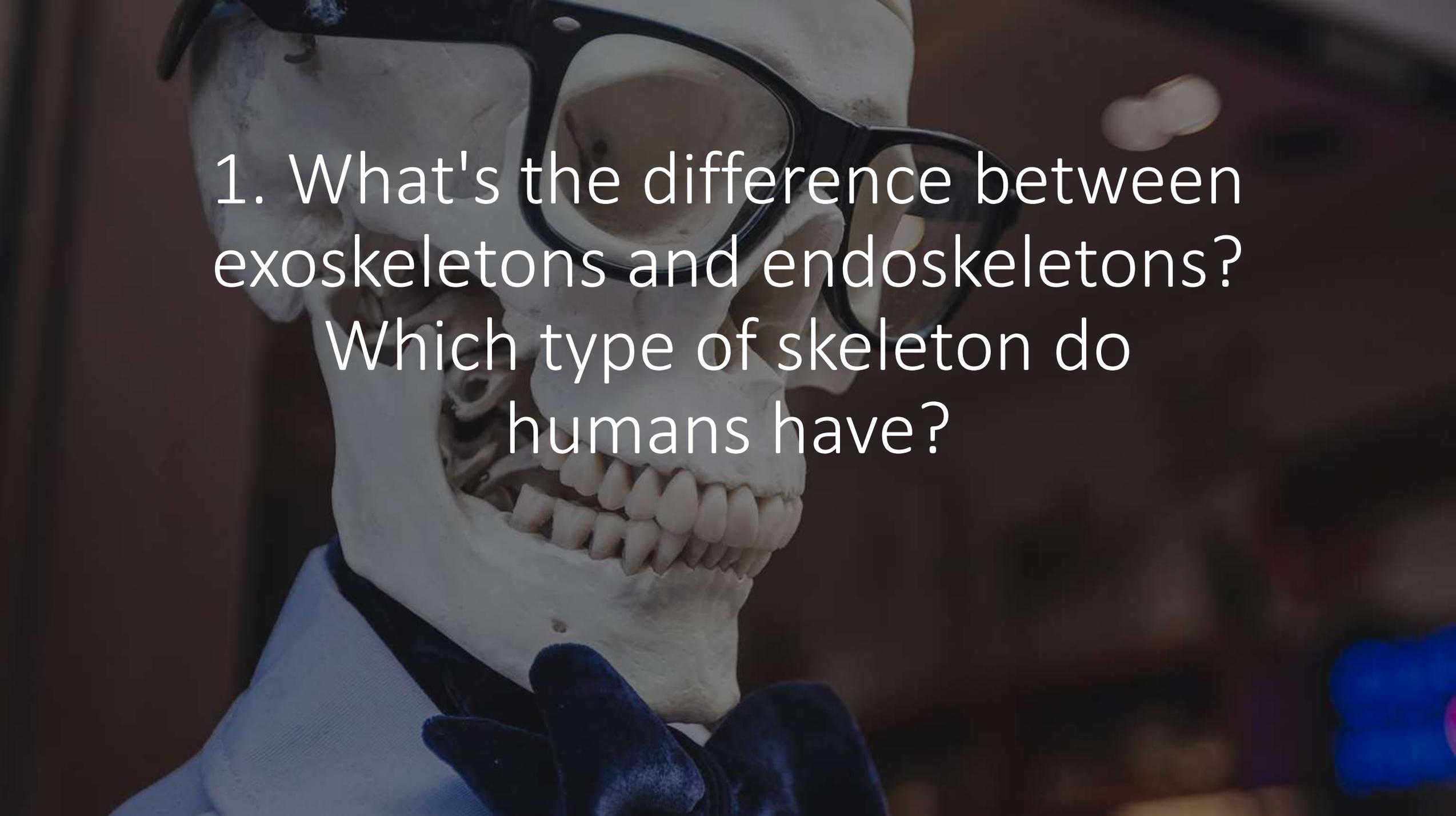


## Bones, Muscles & Movement Pathfinder Honour

### Participant Worksheet

#### Honour Requirements (available [here](#))

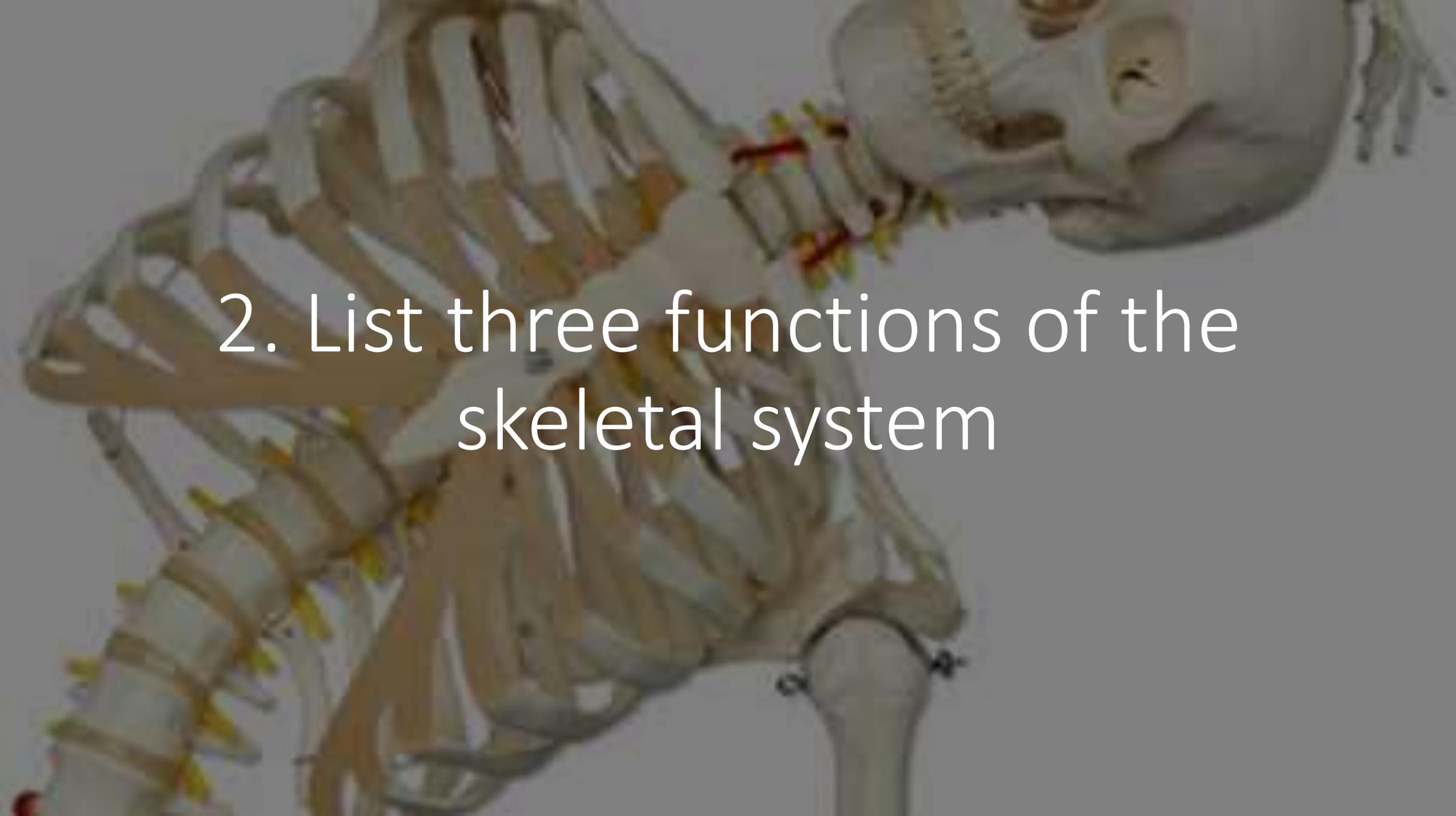
1. What's the difference between exoskeletons and endoskeletons? Which type of skeleton do humans have?
2. List three functions of the skeletal system
3. Is bone a living tissue? Explain why or why not.
4. Describe the structure and development of bone.
5. Identify the following bones of the skeletal system: Carpals, clavicle (collarbone), cranium, femur, fibula, humerus, mandible, maxillary bones, metacarpals, metatarsals, patella, pelvis, phalanges, radius, ribs, scapula (shoulder blade), coccyx (tailbone), sternum (breastbone), tarsals, tibia, ulna, and vertebrae.
6. What is a joint?
7. List the three types of joints found between bones.
8. Name and describe six types of freely moveable joints. Be able to locate an example of each of these in your body.
9. Be creative and construct a model of one of the six freely moveable joints.
10. What is another name for a broken bone? List 3 types of breaks that can occur in bones. Describe how bones heal and how doctors can help this process.
11. What is osteoporosis? Who can get it? List at least 5 health habits that deal with maintaining healthy bones and muscles.
12. What is the function of the muscular system?
13. Name and describe three types of muscle tissue. Give one example of each.
14. Be able to identify the following muscles on your body: Masseter, Trapezius, Deltoid, Pectoralis, Biceps, Abdominal, Quadriceps, Triceps, Latissimus dorsi, Gluteus maximus, Hamstrings, Gastrocnemius, and Soleus.
15. Describe the process that causes a muscle to contract.
16. Describe the difference between voluntary and involuntary muscles.
17. Using your model in # 9, show how muscles, bones, and joints work together to produce movement.
18. Find 3 texts in the Bible that mention bones and/or muscles. Tell about each one in your own words.

A human skull is the central focus, dressed in a white suit jacket, a black bow tie, and black-rimmed glasses. A hand in a blue glove points towards the skull's mouth. The background is dark and out of focus, with a blue object visible in the bottom right corner.

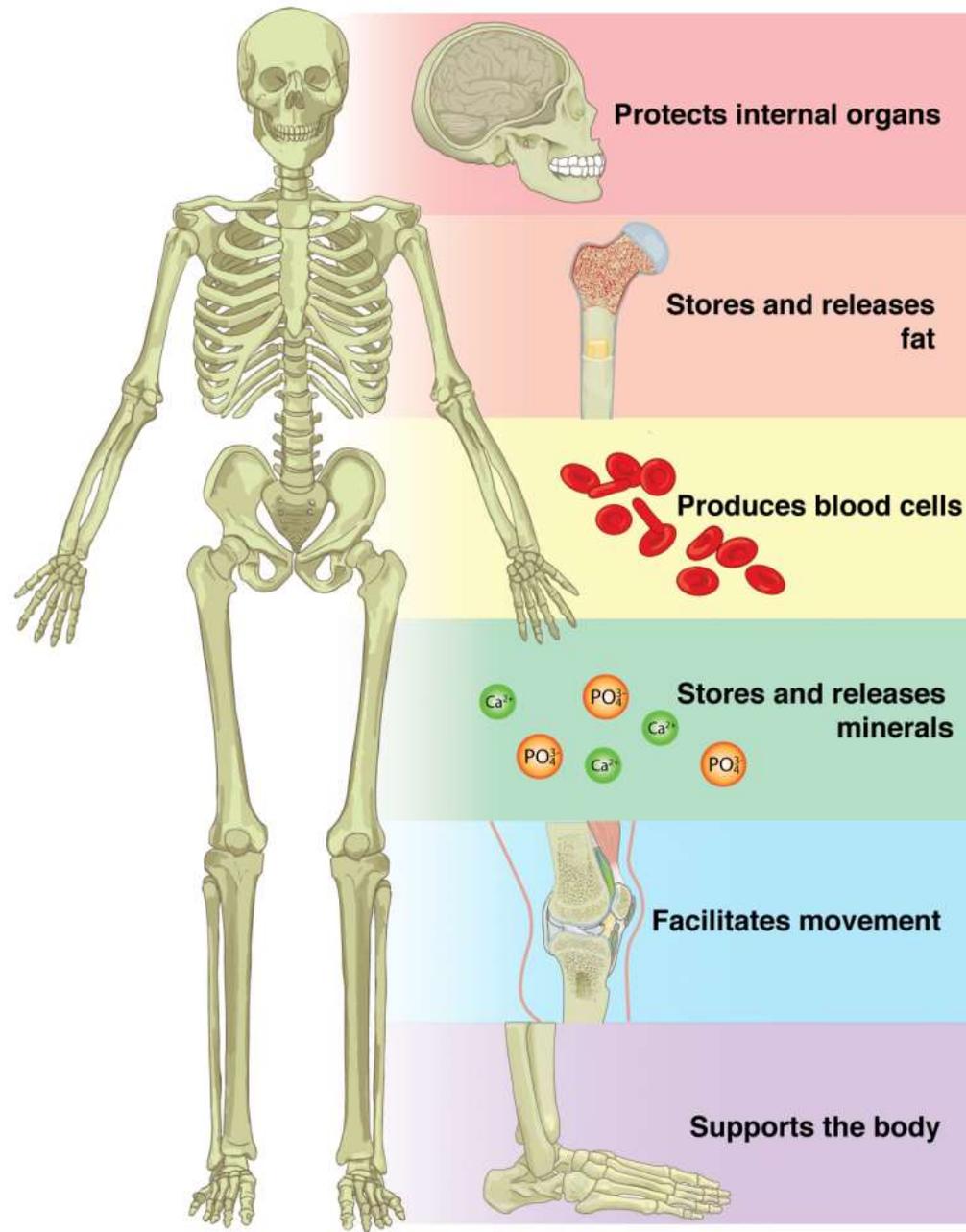
1. What's the difference between exoskeletons and endoskeletons?  
Which type of skeleton do humans have?



An exoskeleton is a hard shell on the outside of a creature (such as an insect or a lobster). An endoskeleton is the system of bones on the inside of a creature (such as a human, dog, cat or a bird).

An anatomical illustration of the human skeletal system, showing the skull, spine, ribs, and arms. The text is overlaid on the center of the image.

2. List three functions of the skeletal system

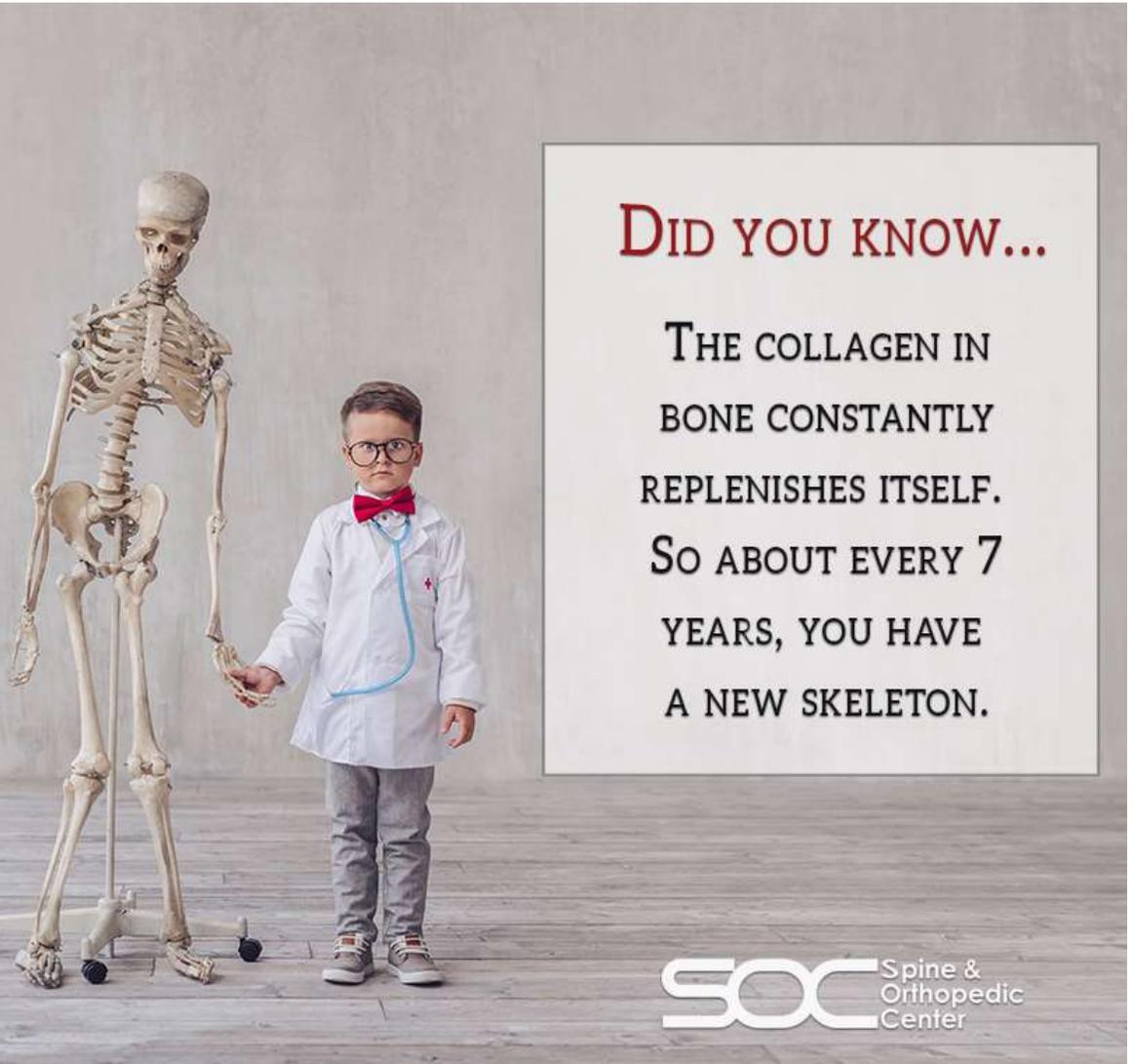


A person is walking on a paved surface, using a blue and silver walker. They are wearing light-colored pants and red sneakers. Their right leg is in a white cast, and they are using the walker for support. The background shows a paved walkway with some greenery.

3. Is bone a living tissue?  
Explain why/why not

# Bone is a living tissue

- Bones produce blood cells
- Bones heal after being broken
- Bone cells continually regenerate themselves

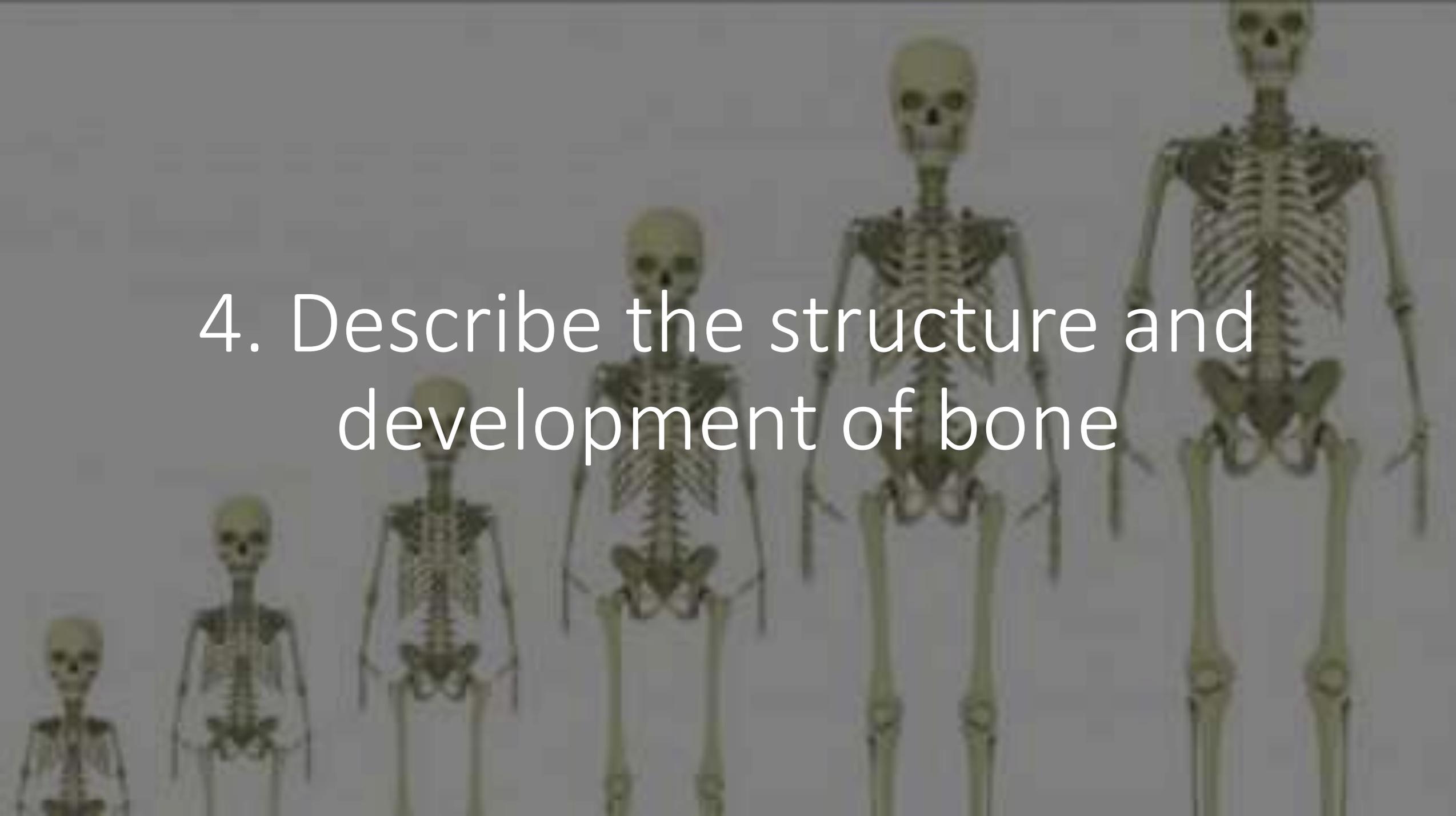
A young boy wearing glasses, a white lab coat, and a red bow tie stands next to a human skeleton. He is holding the skeleton's hand. The scene is set against a plain, light-colored background.

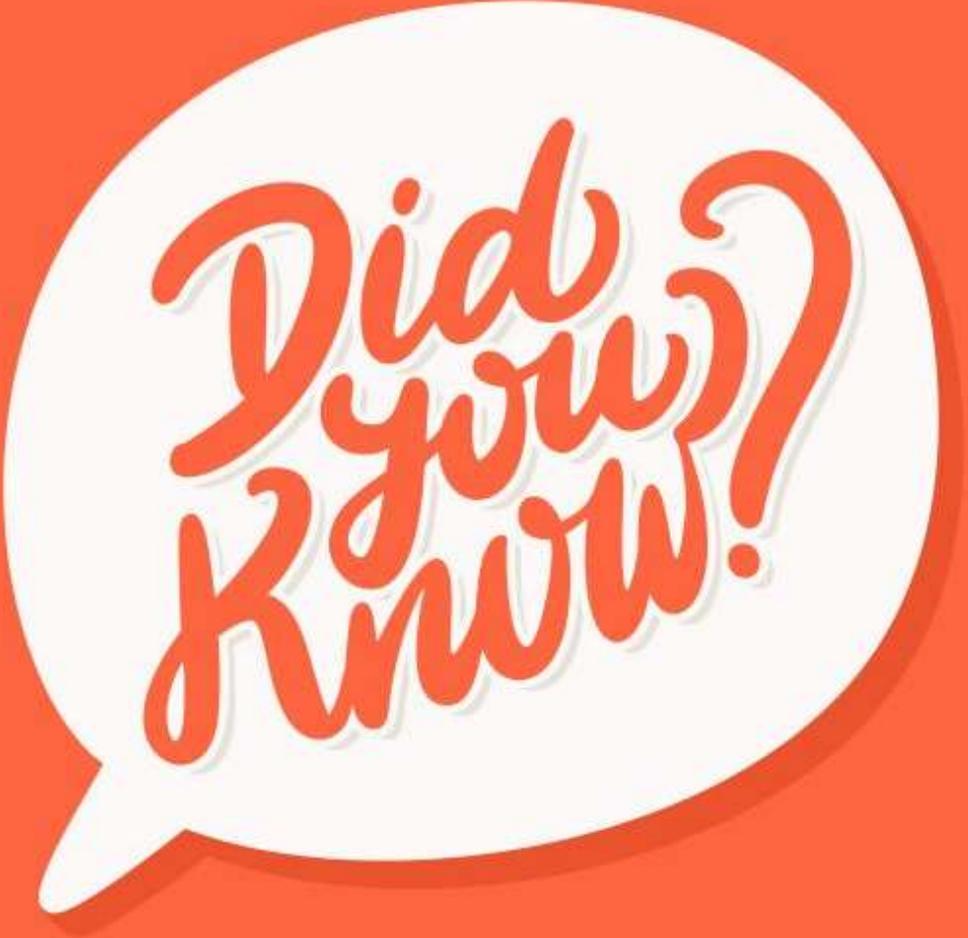
**DID YOU KNOW...**

**THE COLLAGEN IN BONE CONSTANTLY REPLENISHES ITSELF. SO ABOUT EVERY 7 YEARS, YOU HAVE A NEW SKELETON.**

**SOC** Spine & Orthopedic Center

4. Describe the structure and development of bone





Did you know?

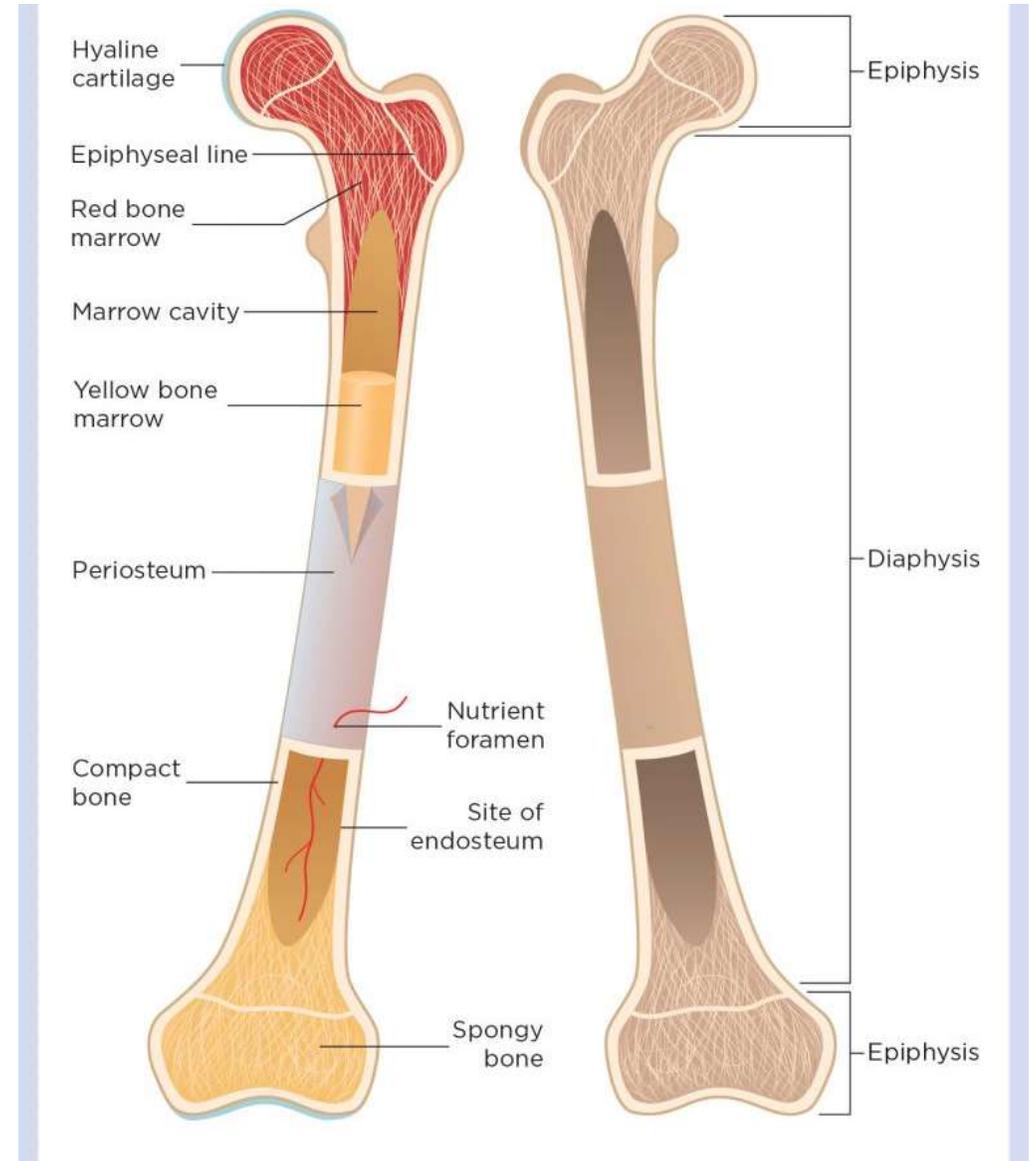
## Fun Fact!

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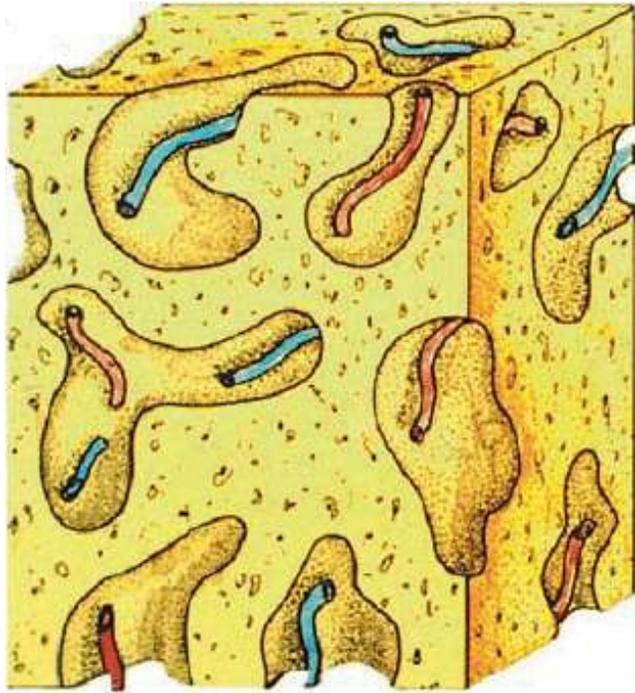
- Babies have 300 bones when they are born.
- Adults have 206 bones.
- The number of our bones actually decreases as we mature!

# Bone Structure

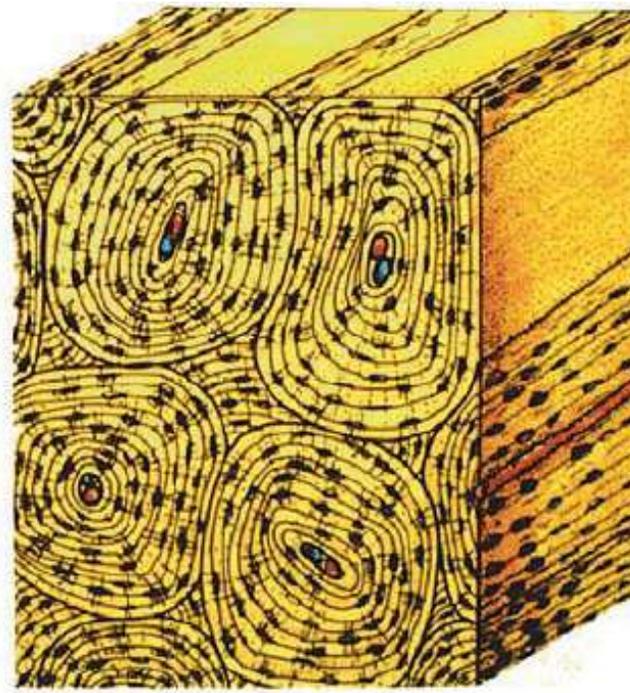
- Bone is hard, but lightweight
- Bone is primarily formed of calcium phosphate
- It has high compression strength
- It has poor tensile strength (the resistance of a material to breaking under tension)
- Bone is somewhat elastic due to its collagen
- The density of bone varies at different points



# Woven versus Lamellar Bone



Woven



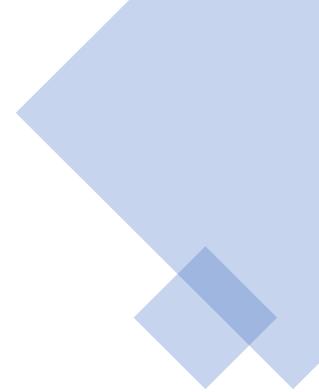
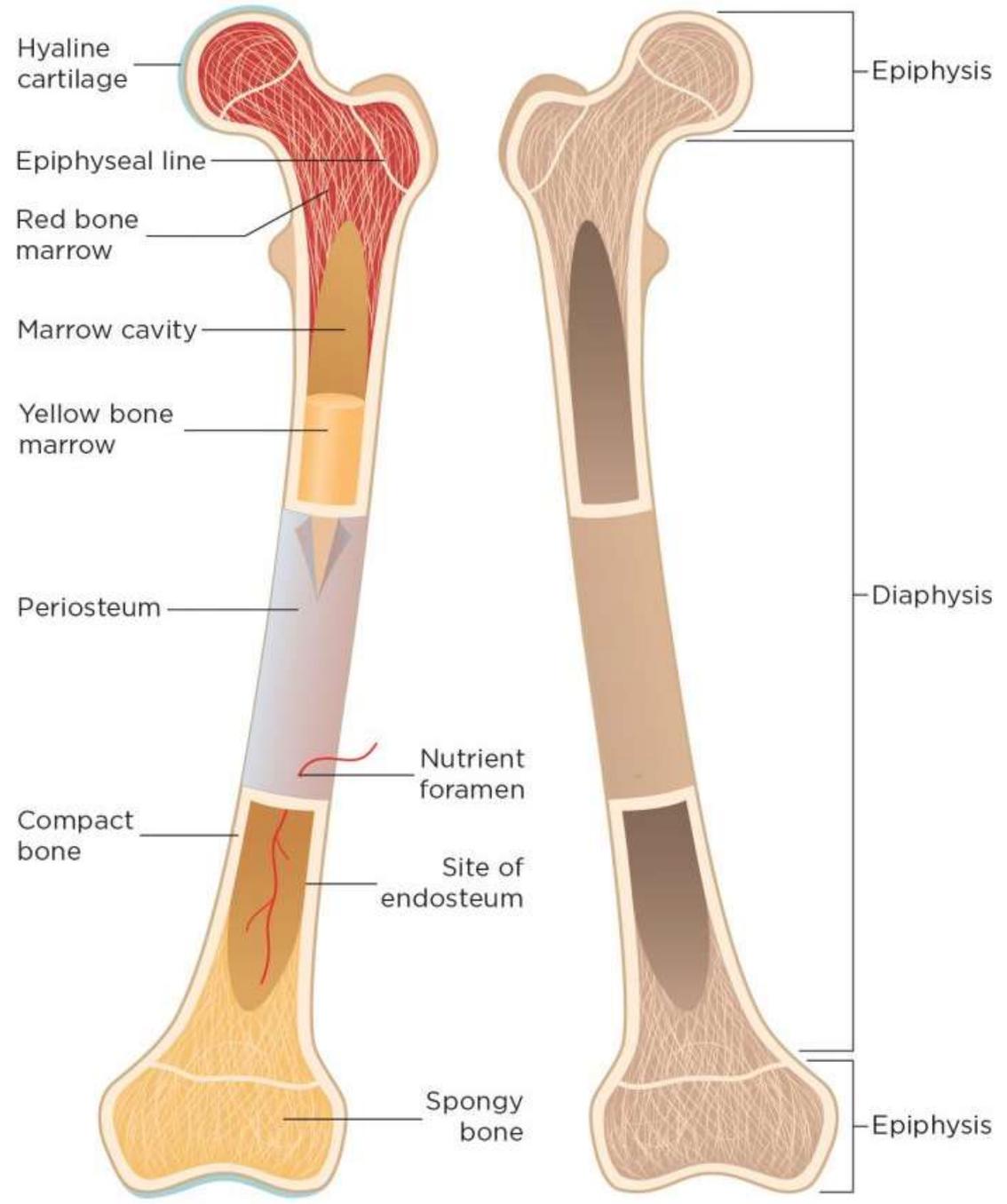
Lamellar

- There are 2 types of bone: woven or lamellar
- Woven bone is used for growth or repair. Its fibres are aligned at random, so has low strength
- Lamellar bone has parallel fibres and is therefore much stronger
- Lamellar bone replaces woven bone during growth/repair processes



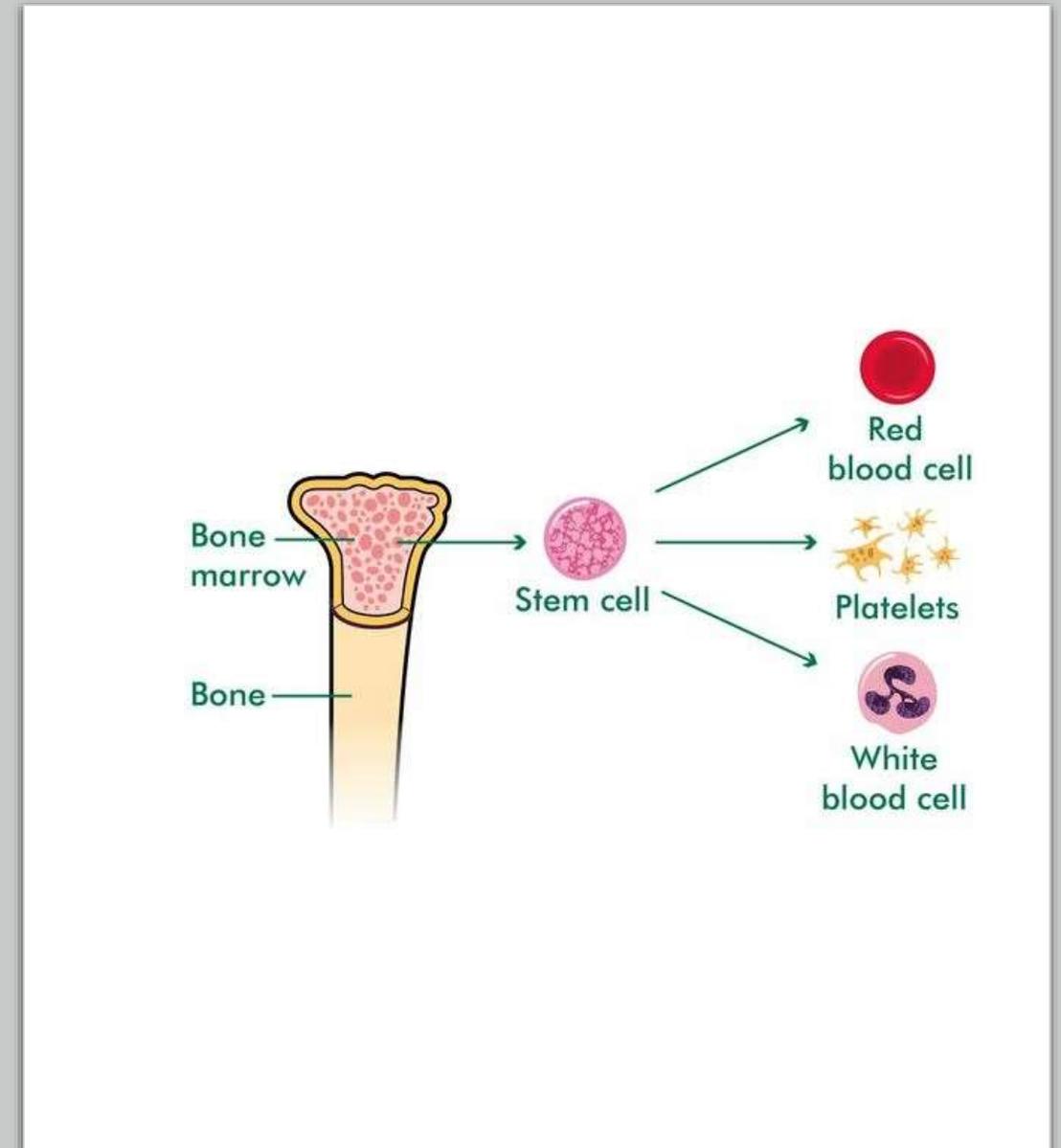
# Bone Development

- Most bone development occurs in the womb, but some bones do fuse after birth (“ossification”)
- Bone growth starts in the cartilage
- Long bones ossify and get longer as they grow and develop. These bones grow from their ends, known as the epiphysis
- If a bone has a growth plate on the end of it (the “epiphyseal line”), then that signifies that the bone is still growing
- In late teens/early twenties, a person stops growing – all of their cartilage has been replaced by bone, so no further growth in bone length is possible. However, bones can still increase in thickness. This may occur in response to increased muscle activity, such as weight training

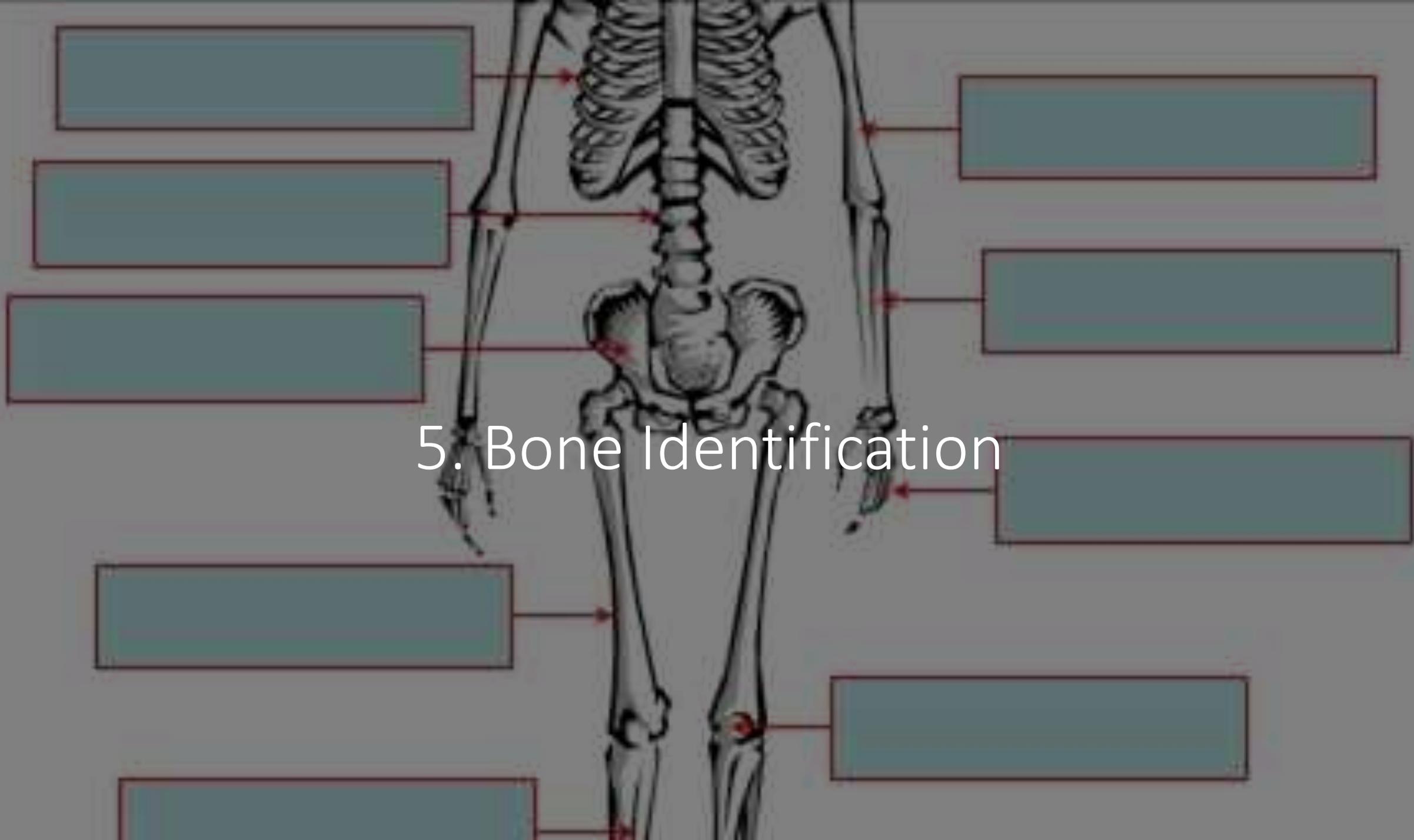


# Bone Marrow

- Bone marrow is a spongy substance found in the center of the bones
- Bone marrow makes blood cells.
- Each type of blood cell made by the bone marrow has an important job
  - Red blood cells carry oxygen to tissues in the body
  - White blood cells fight infections
- Over time, red marrow is mostly replaced by yellow marrow in large bones. Most red marrow in adults is found in flat bones, not long bones (e.g. in the skull, ribs, vertebrae and pelvis)



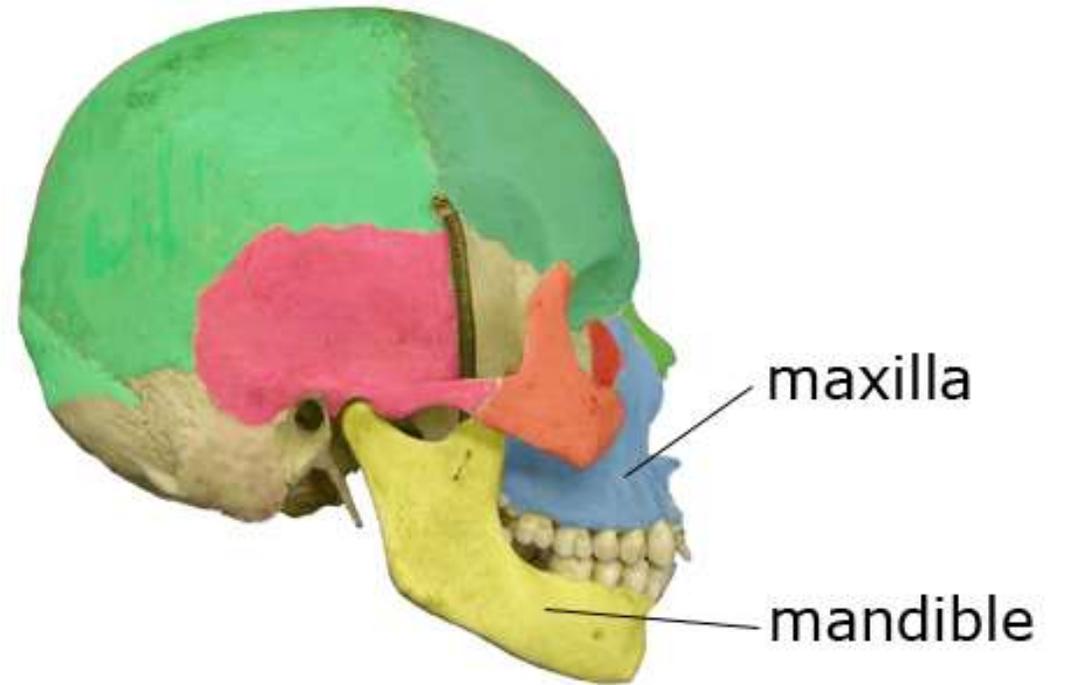
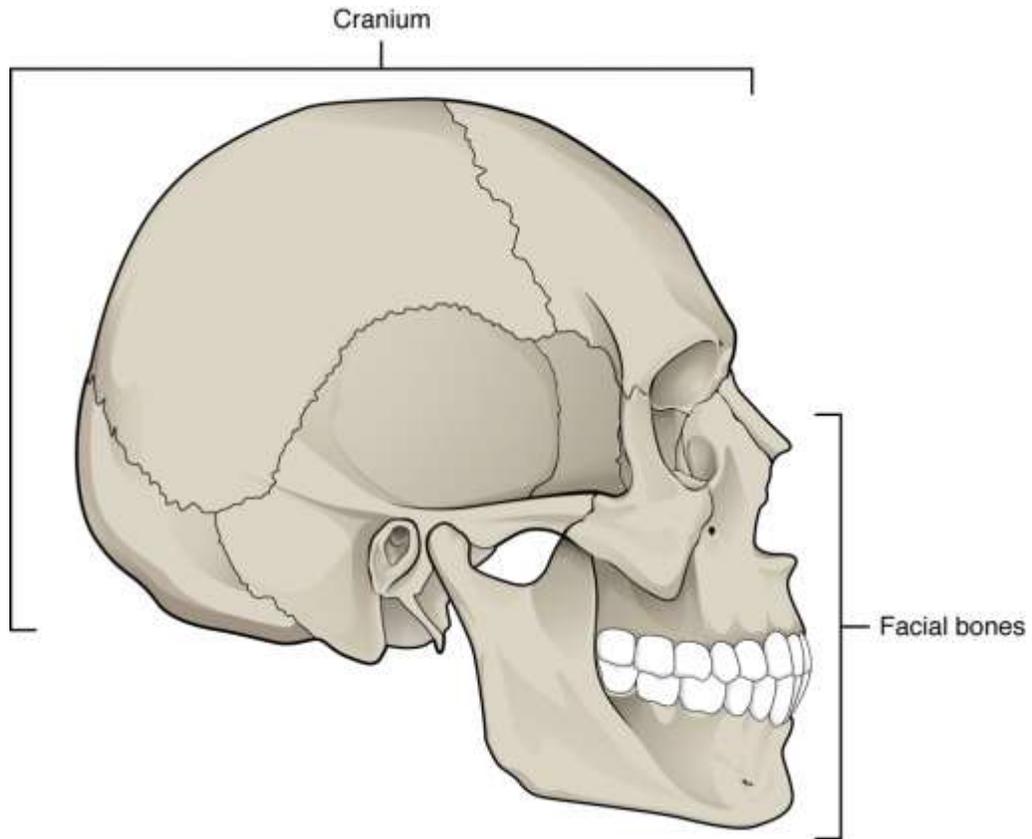
# 5. Bone Identification



# The Bones we must Identify

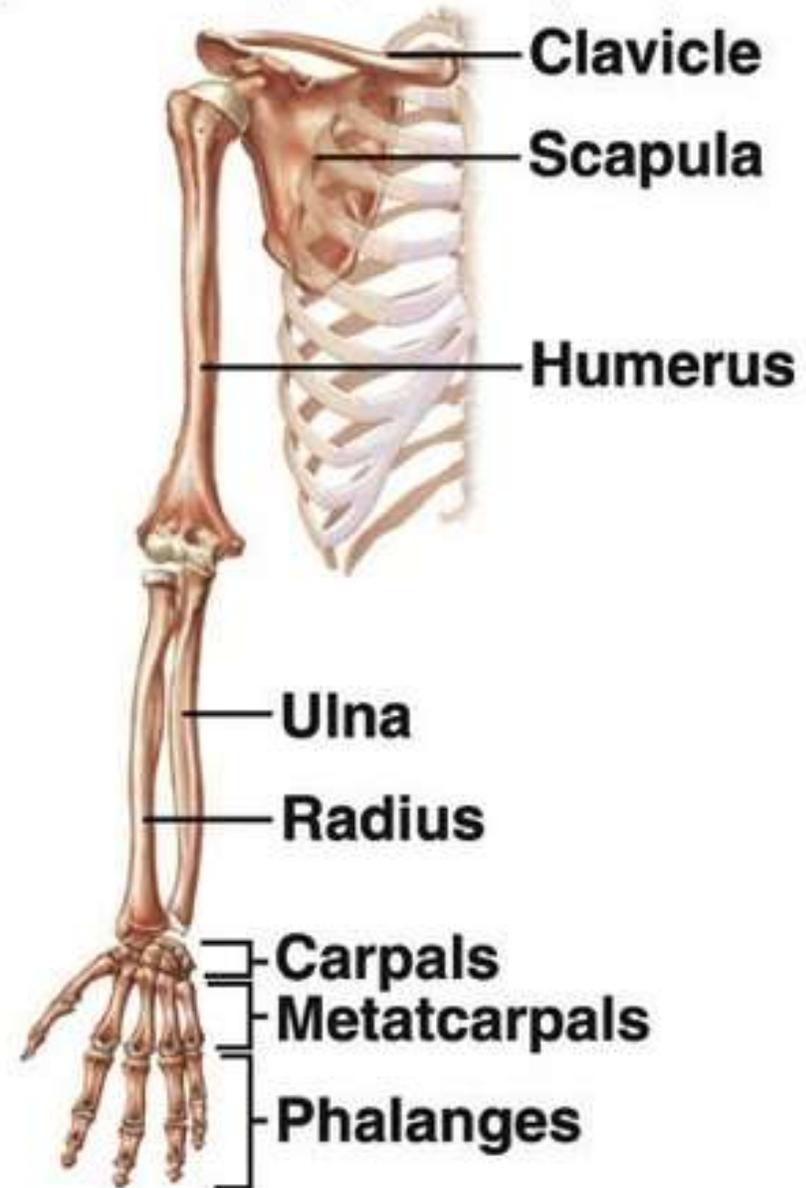
Carpals	Mandible	Radius
Clavicle (collar bone)	Maxilla	Ribs
Coccyx (tail bone)	Metacarpals	Scapula and Sternum
Cranium	Metatarsals	Tarsals
Femur	Patella	Tibia
Fibula	Pelvis	Ulna
Humerus	Phalanges	Vertebrae

# Head

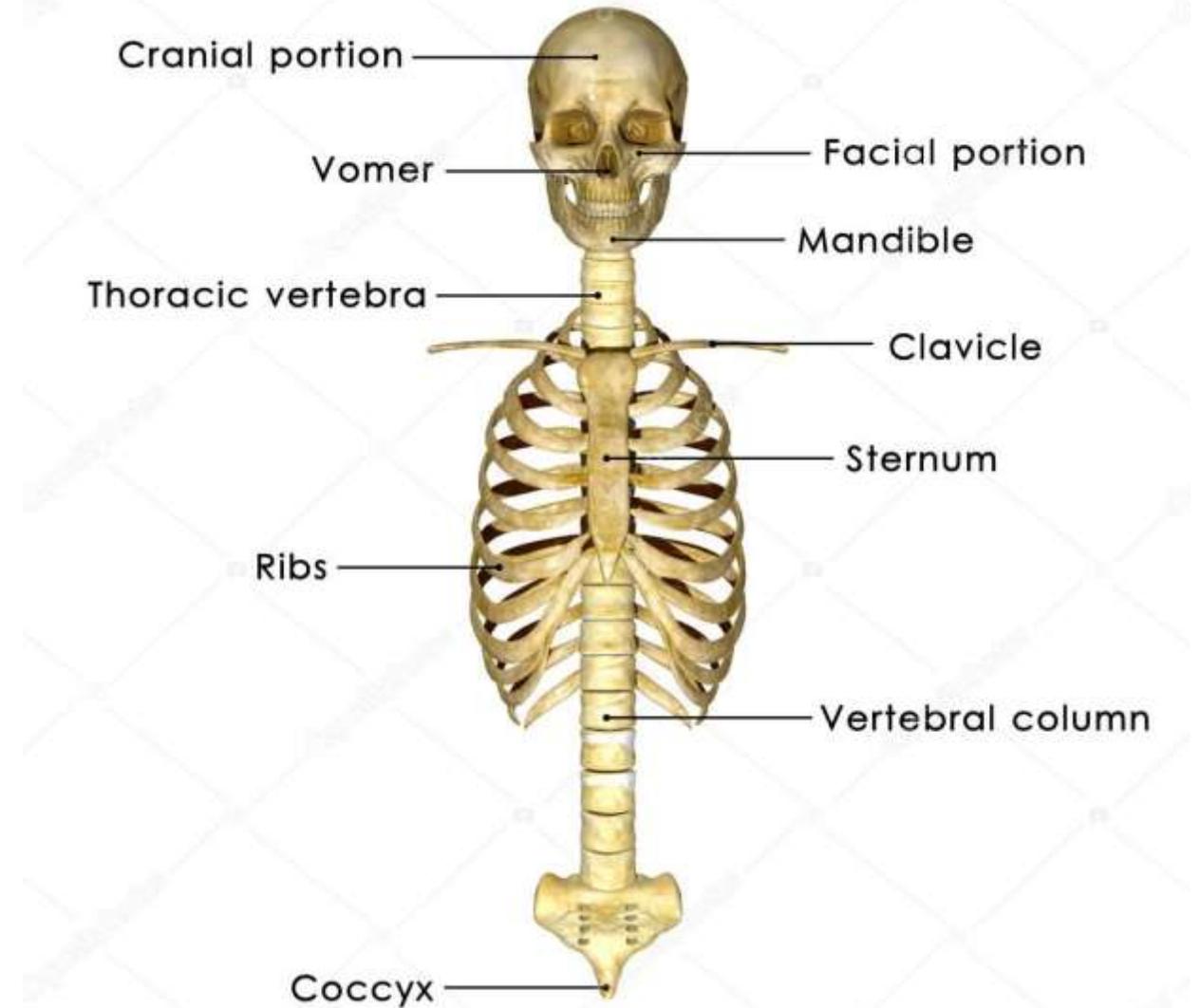


# Arms

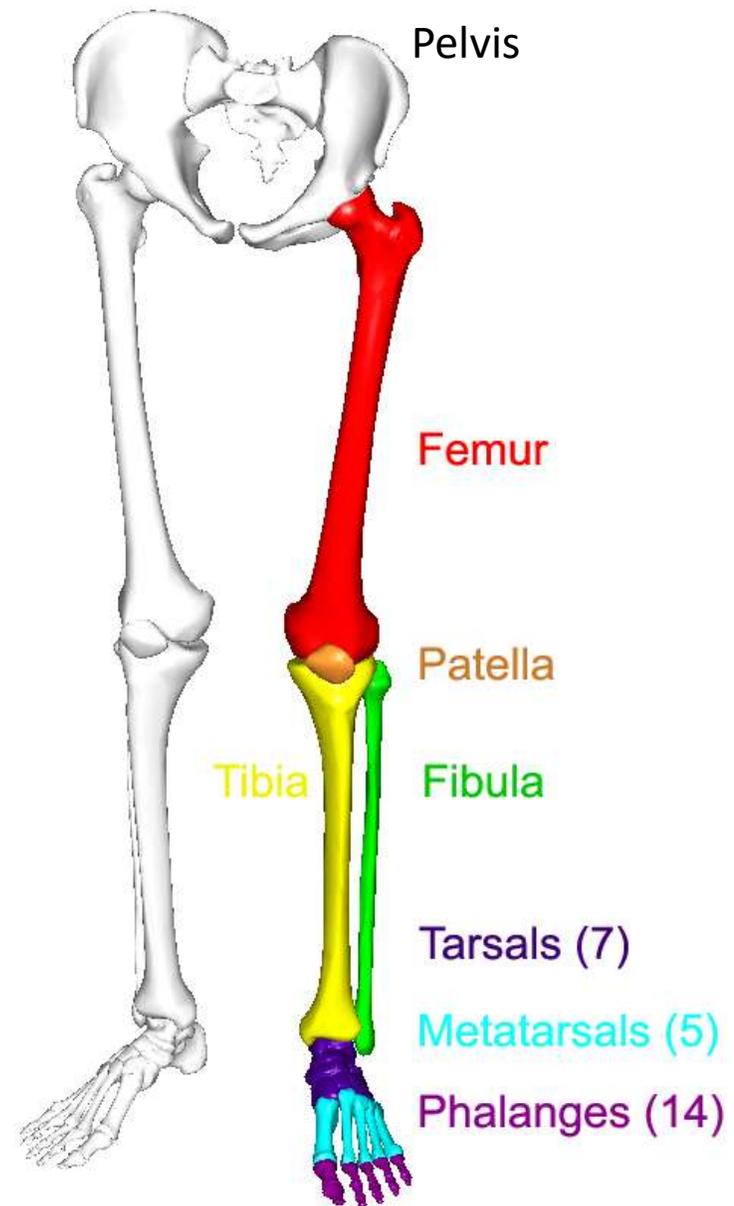
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# Upper Body



# Legs



An anatomical illustration of the human shoulder and ribcage. The image shows the humerus, scapula, and clavicle bones of the shoulder joint, along with the ribs and intercostal muscles of the ribcage. The text "6. What is a joint?" is overlaid in white on the shoulder area.

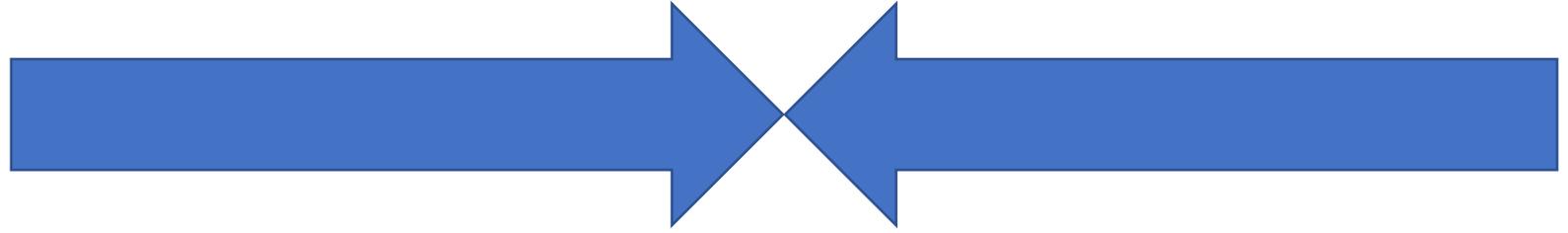
## 6. What is a joint?

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# Joints



- A joint is the place where two or more bones meet
  - What examples can you think of, of joints within the body?
-



**Fibrous**  
(Immoveable)



**Cartilagenous**  
(Semi moveable)



**Synovial**  
(freely moveable)

7. List the three types of joints found between bones



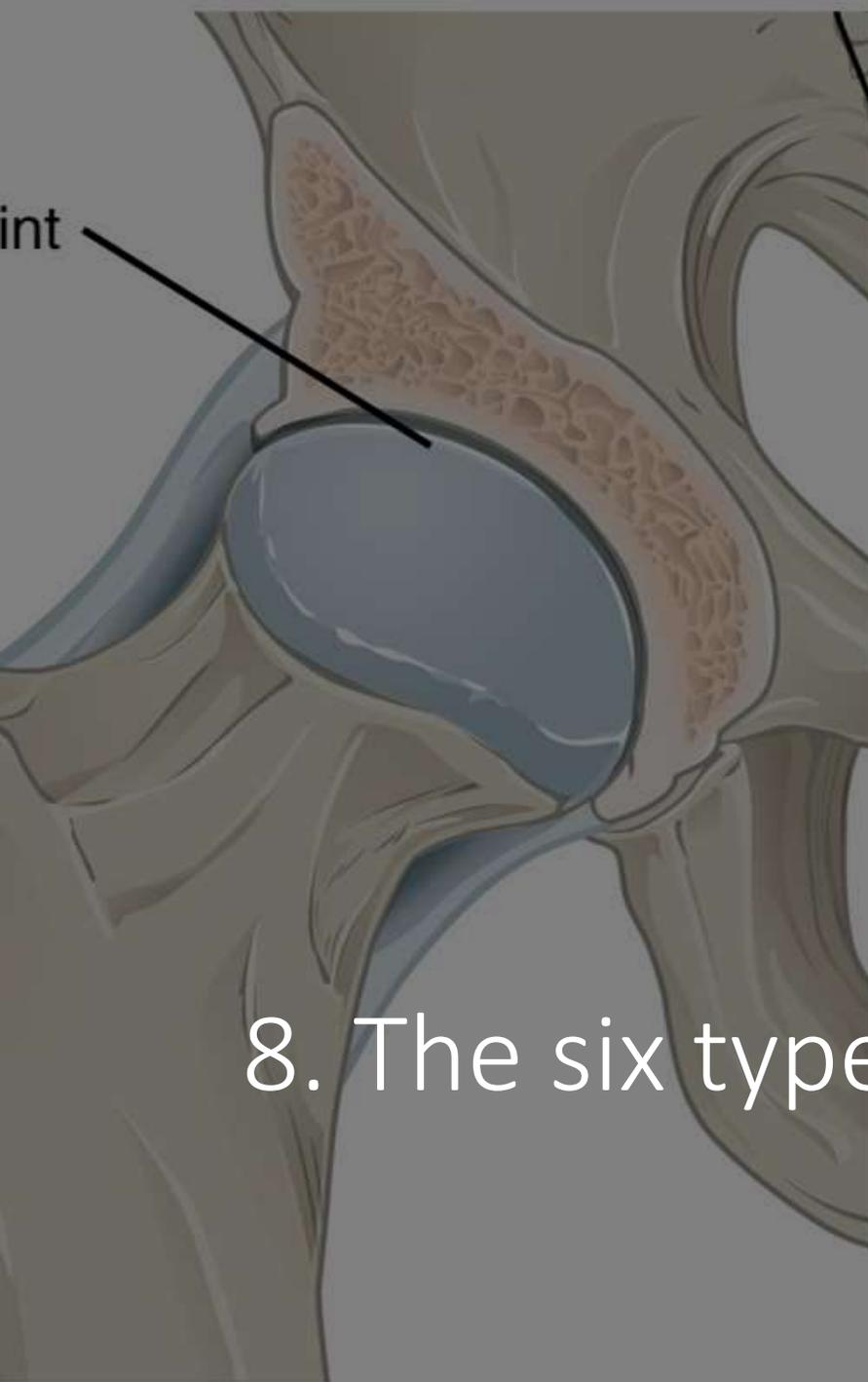
**Fibrous**  
(Immoveable)



**Cartilagenous**  
(Semi moveable)



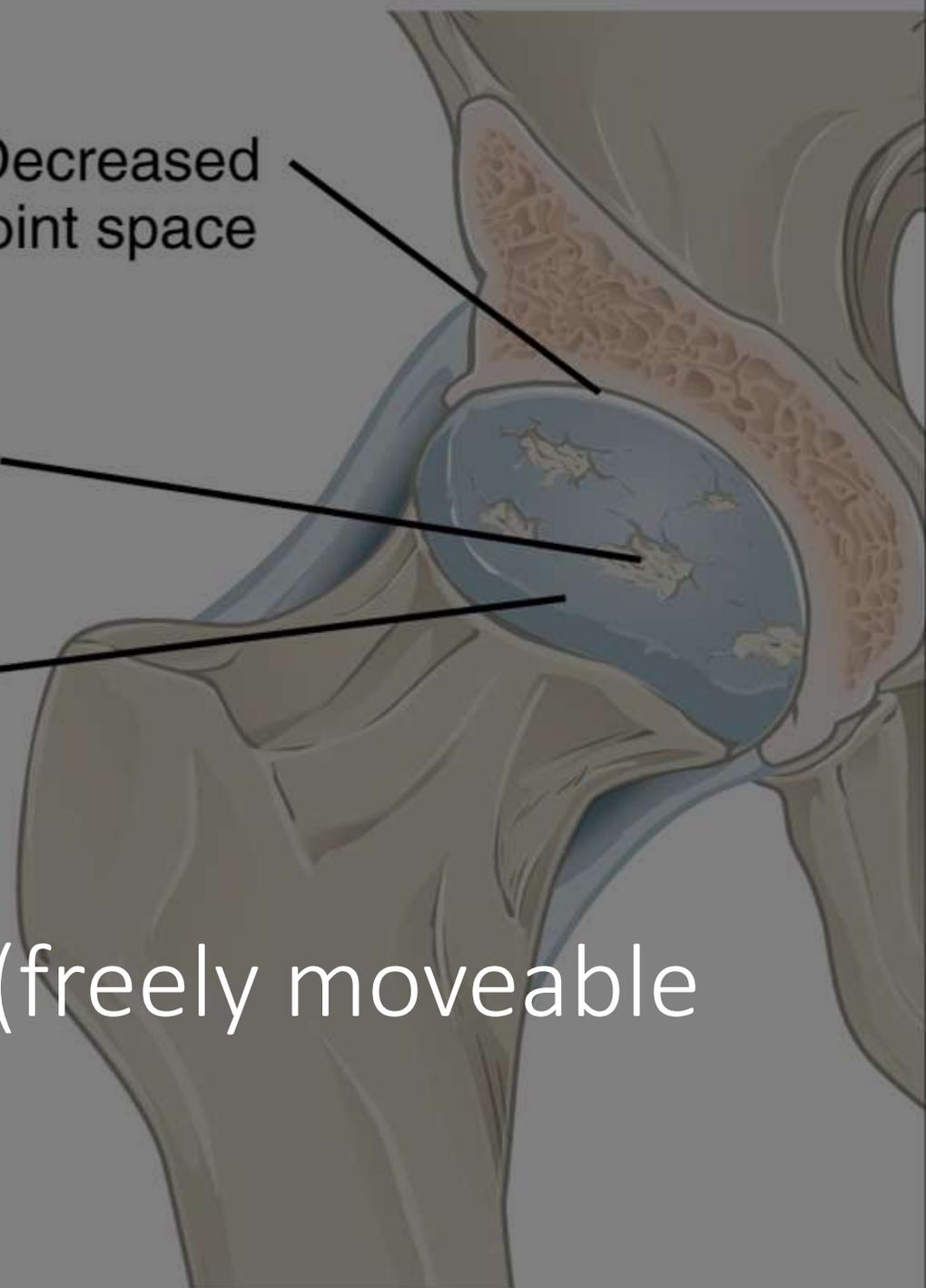
**Synovial**  
(freely moveable)



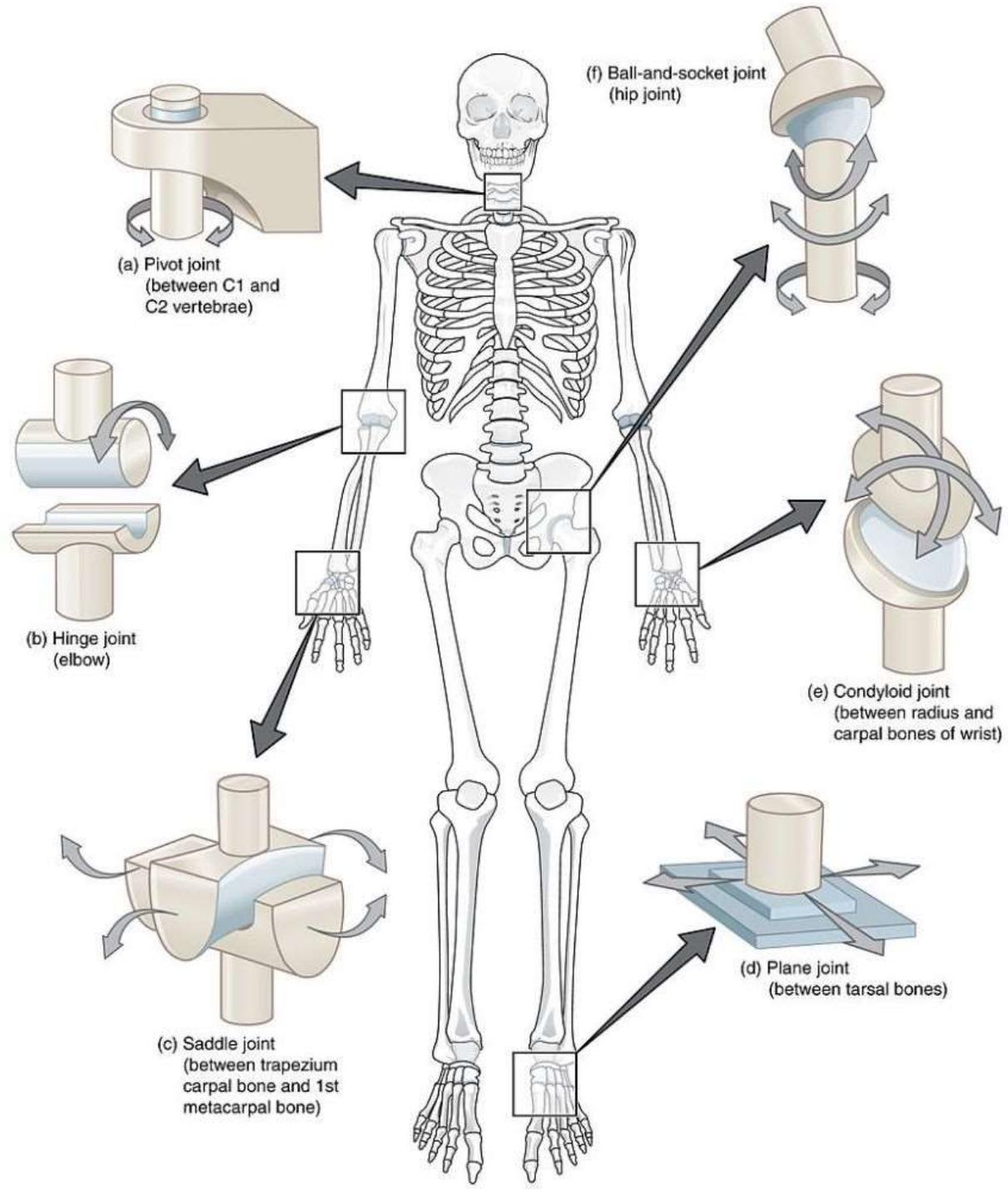
Decreased joint space

Exposed bone

Worn cartilage



8. The six types of synovial (freely moveable joints)



# Types of Joints

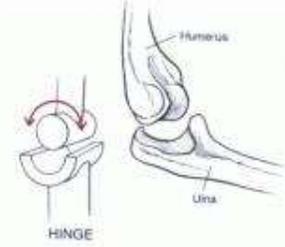
6. \_\_\_\_\_ and \_\_\_\_\_ joints, (like your hip and shoulder joints) are the most mobile type of joint in the human body. They allow you to swing or rotate your arms and legs in many different directions



The shoulder joint

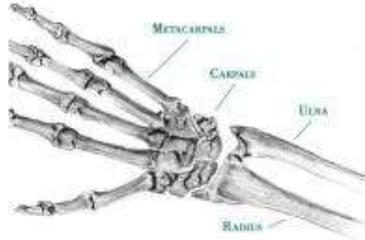


1. \_\_\_\_\_ joint (Like in your neck) allows you to turn your head from side to side.

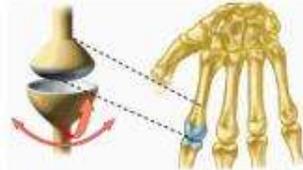


2. \_\_\_\_\_ joints, like in your knee and elbow, enable movement similar to the opening and closing of a hinged door.

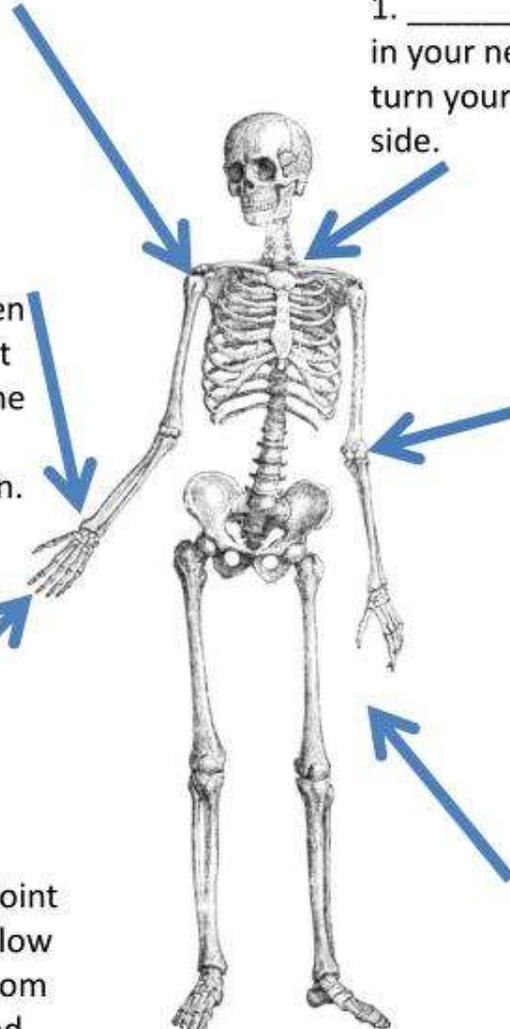
5. \_\_\_\_\_ joints occur between the surfaces of two short bones that are held together by ligaments. (Some of the bones in your wrists and ankles); have limited range of motion.



4. \_\_\_\_\_ joints, such as the joint at the base of your index finger, allow bending and extending, rocking from side to side, but rotation is limited.



3. \_\_\_\_\_ joints (in your thumbs) The bones in a these joints can rock back and forth and from side to side, but they have limited rotation.



A hand-drawn anatomical model of an arm joint. The model is constructed from cardboard, balloons, and sticks. A central cardboard cylinder is labeled "ARM MUSCLES". Two red balloons are attached to it, labeled "BICEP" and "TRICEP". A hand is attached to the left end of the model, and a stick is attached to the right end. The model is set against a dark background.

9. Be creative and construct a model of one of the six freely moveable joints



10. Broken bones

Open



Closed



Broken bones are otherwise known as fractures. There are 2 main types of fracture

1. Open fractures
2. Closed fractures



Transverse



Stress



Oblique,  
Displaced



Greenstick



Comminuted

## Sub- Categories of Fractures

# How do bones heal and how can doctors help?

- Living bones are in constant change. Cells die and are replaced on a regular basis. Because of this, a bone will heal all by itself if allowed to.
- Doctors can help this process in two ways:
  1. They can **set** the bone. This is done by making sure the pieces of the bone are aligned properly. In a comminuted fracture this may involve surgery
  2. They can **immobilise** the bone - that is, keeping it from moving around. This can be done by surrounding the broken limb with a cast or by embedding pins inside the body. Some bones do not need to be immobilised when broken (e.g. the nose)



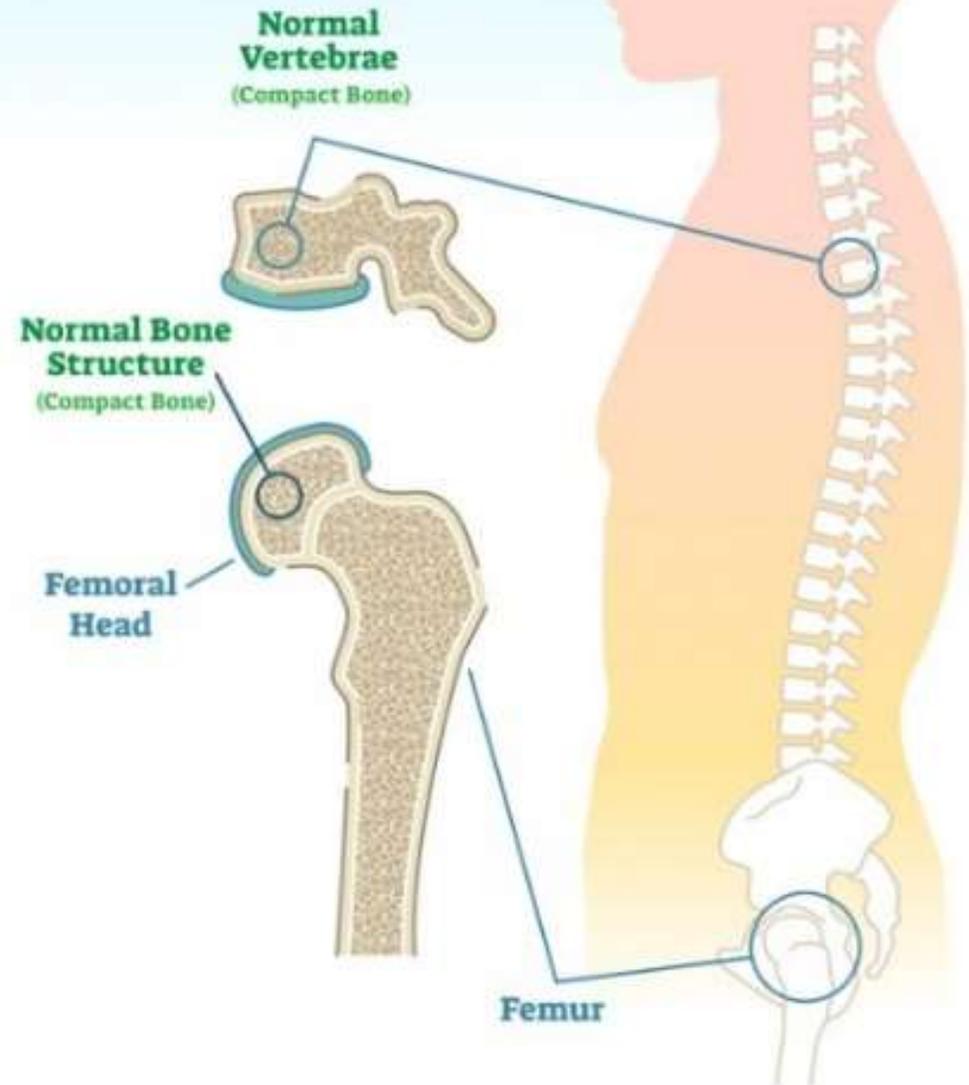
The image features three human silhouettes in profile, illustrating the progression of osteoporosis. The spine is highlighted in a light tan color, with individual vertebrae and intervertebral discs shown in a darker tan. The first silhouette on the left shows a normal, healthy spine with a slight natural curve. The middle silhouette shows a spine with a more pronounced curve, indicating the onset of osteoporosis. The third silhouette on the right shows a spine with a very pronounced, exaggerated curve, representing advanced osteoporosis. The text '11. Osteoporosis' is centered in white over the middle silhouette.

## 11. Osteoporosis

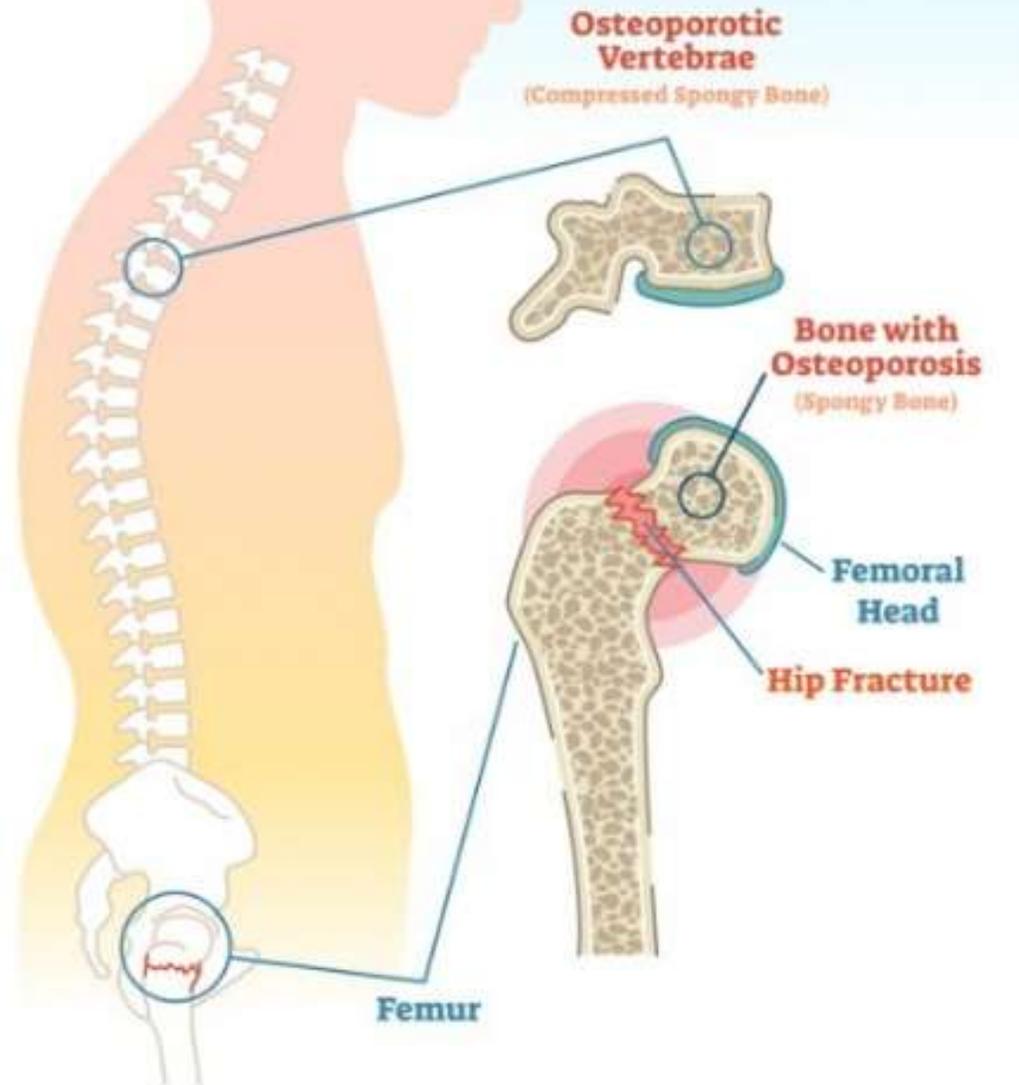
# What is osteoporosis and who can get it?

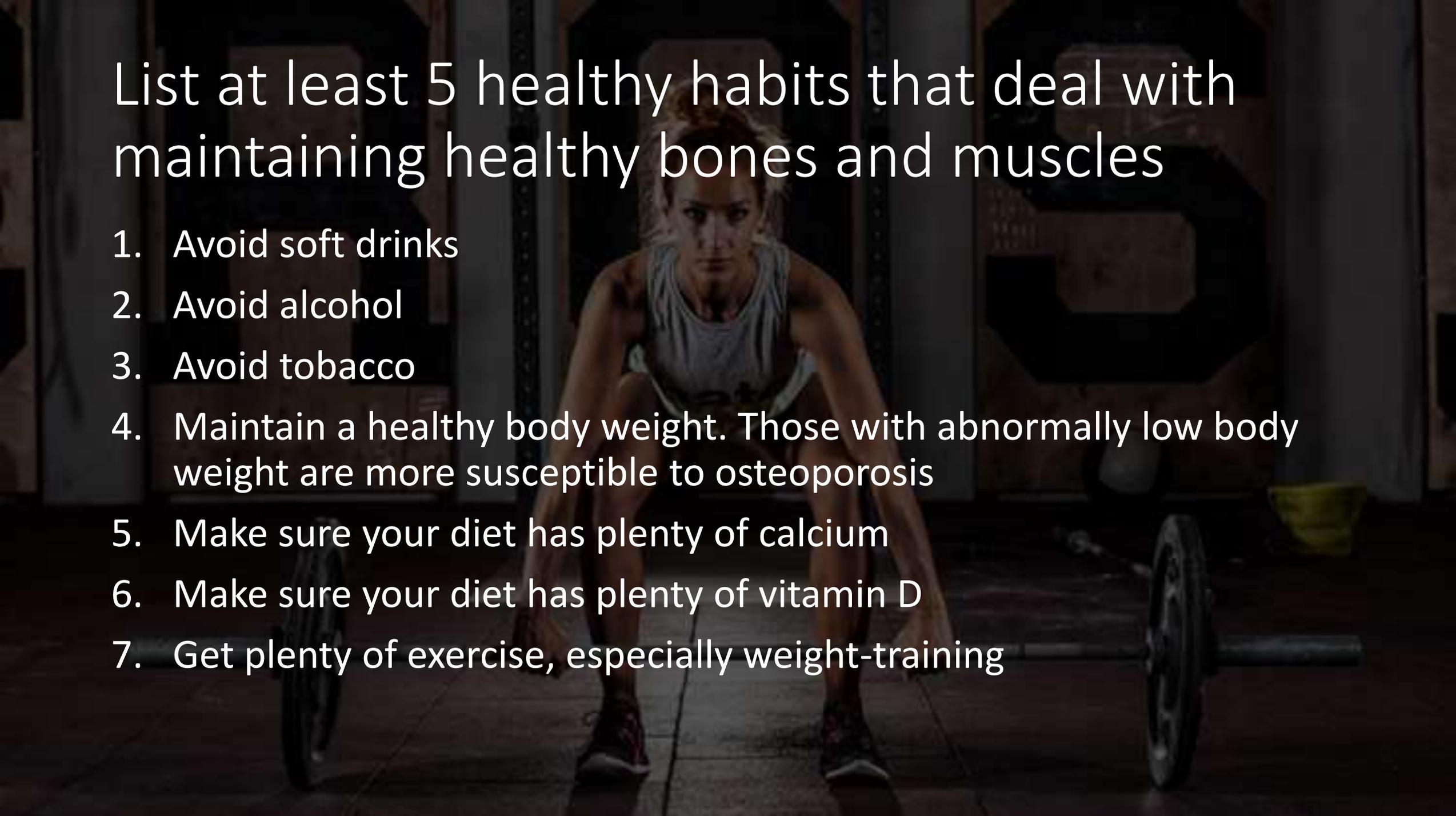
- Osteoporosis is the depletion of minerals from the bone
- Minerals in bones give them their strength, so a bone with a low **bone mineral density** (or BMD) is more susceptible to breakage, even when stressed only lightly
- Anyone can get osteoporosis, but it is more common in older women
- Some of the risk factors of getting osteoporosis cannot be reduced by modifying behaviour (e.g. being a woman, having dementia, having a history of weak bones/fractures and/or being of European descent), but other factors can be avoided by healthful living

# Healthy Bones



# Osteoporotic Bones



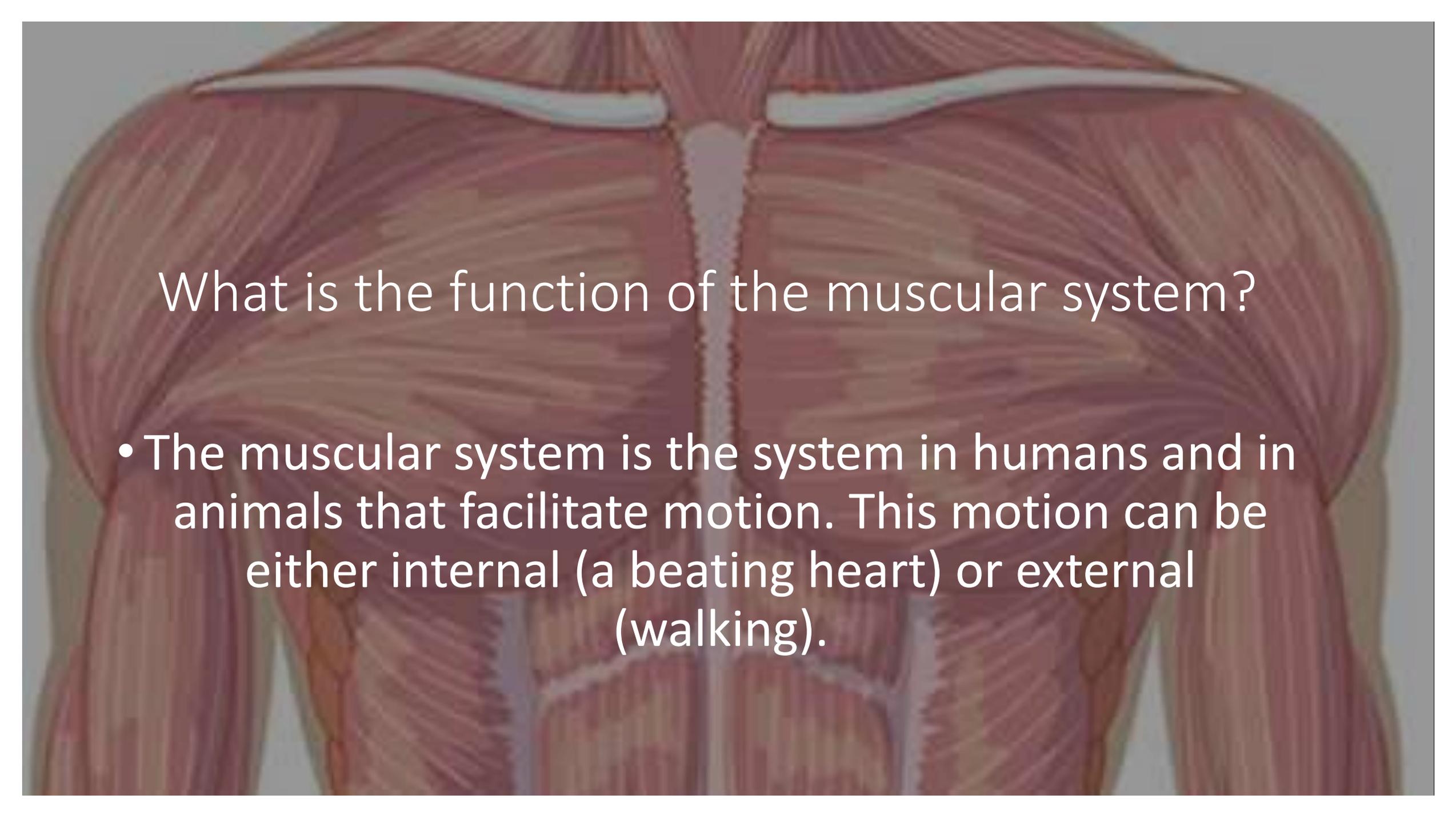


# List at least 5 healthy habits that deal with maintaining healthy bones and muscles

1. Avoid soft drinks
2. Avoid alcohol
3. Avoid tobacco
4. Maintain a healthy body weight. Those with abnormally low body weight are more susceptible to osteoporosis
5. Make sure your diet has plenty of calcium
6. Make sure your diet has plenty of vitamin D
7. Get plenty of exercise, especially weight-training

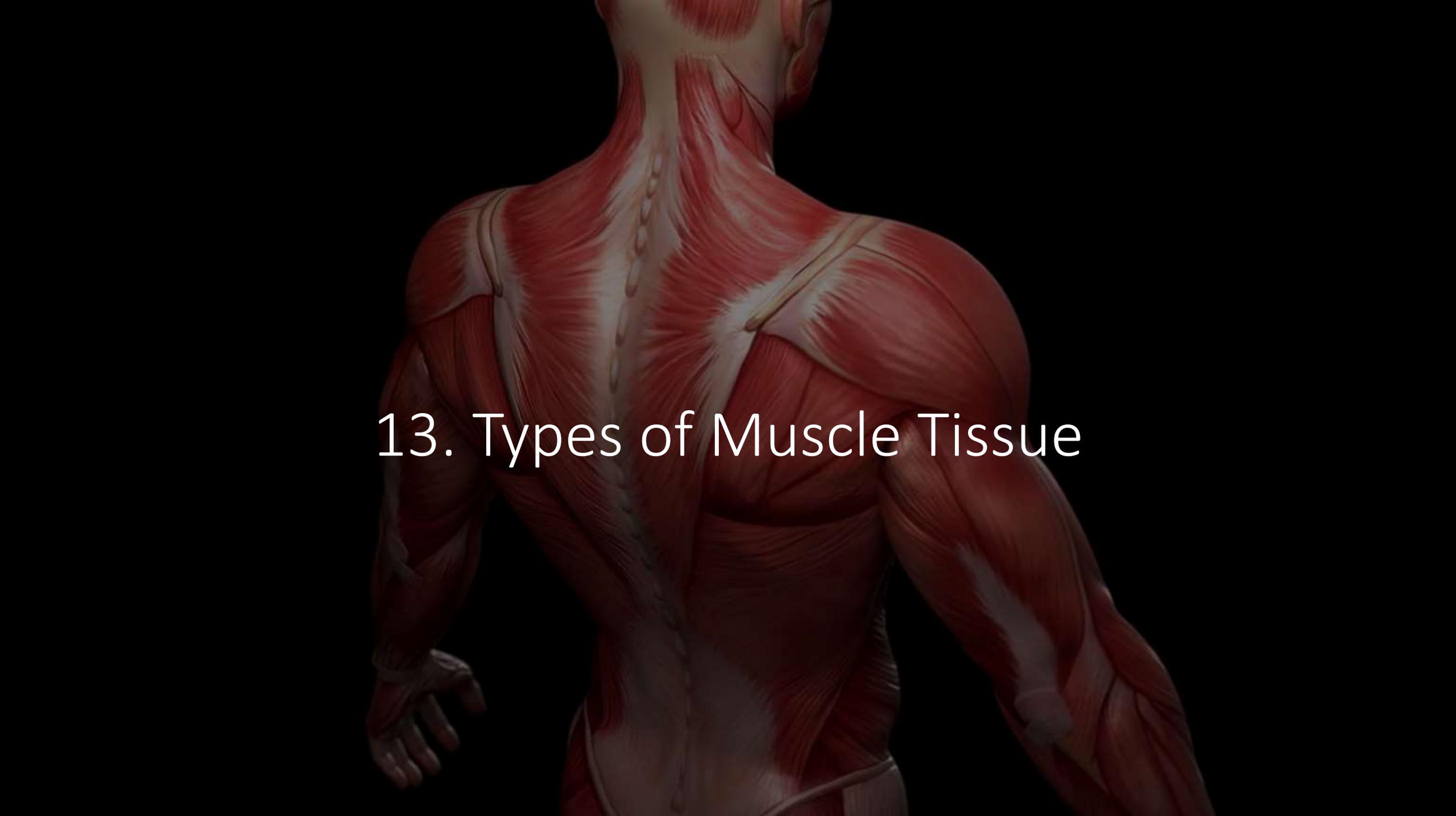
# 12. The muscular system



An anatomical illustration of the human muscular system, showing the back, shoulders, and arms. The muscles are depicted in a reddish-pink color, with white lines indicating the fibers and tendons. The spine is visible in the center, and the shoulder blades are on either side. The overall image is semi-transparent, allowing the text to be overlaid.

What is the function of the muscular system?

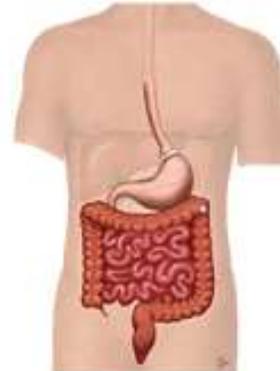
- The muscular system is the system in humans and in animals that facilitate motion. This motion can be either internal (a beating heart) or external (walking).

An anatomical illustration of the human back and neck muscles, showing the trapezius, rhomboid, and latissimus dorsi muscles in a reddish-pink color against a dark background. The illustration is viewed from the back, showing the spine and the musculature of the neck, shoulders, and upper back.

## 13. Types of Muscle Tissue

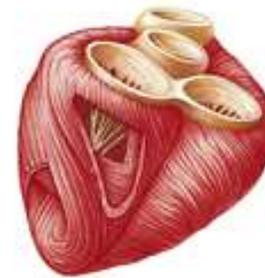
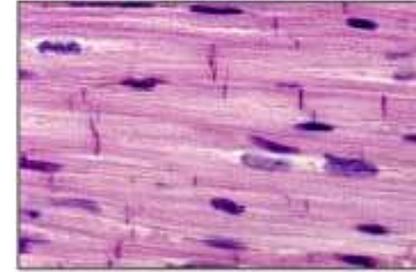
13. Name and describe three types of muscle tissue. Give one example of each

Smooth Muscle Tissue



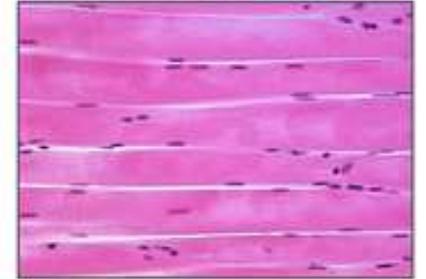
Involuntary Control

Cardiac Muscle Tissue

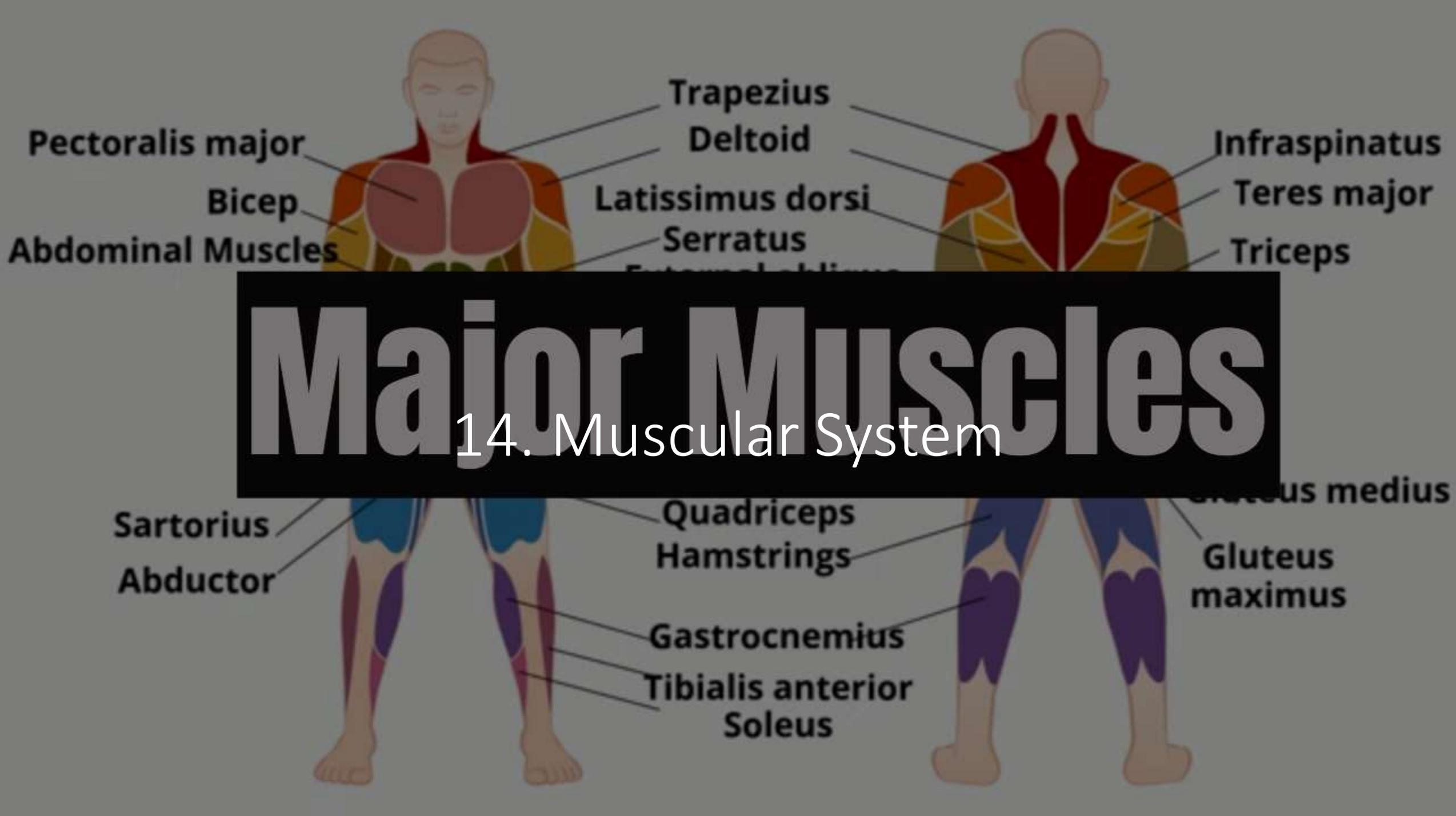


Involuntary Control

Skeletal Muscle Tissue



Voluntary Control



Pectoralis major

Bicep

Abdominal Muscles

Trapezius

Deltoid

Latissimus dorsi

Serratus

External oblique

Infraspinatus

Teres major

Triceps

# Major Muscles

14. Muscular System

Sartorius

Abductor

Quadriceps

Hamstrings

Gastrocnemius

Tibialis anterior

Soleus

Gluteus medius

Gluteus maximus

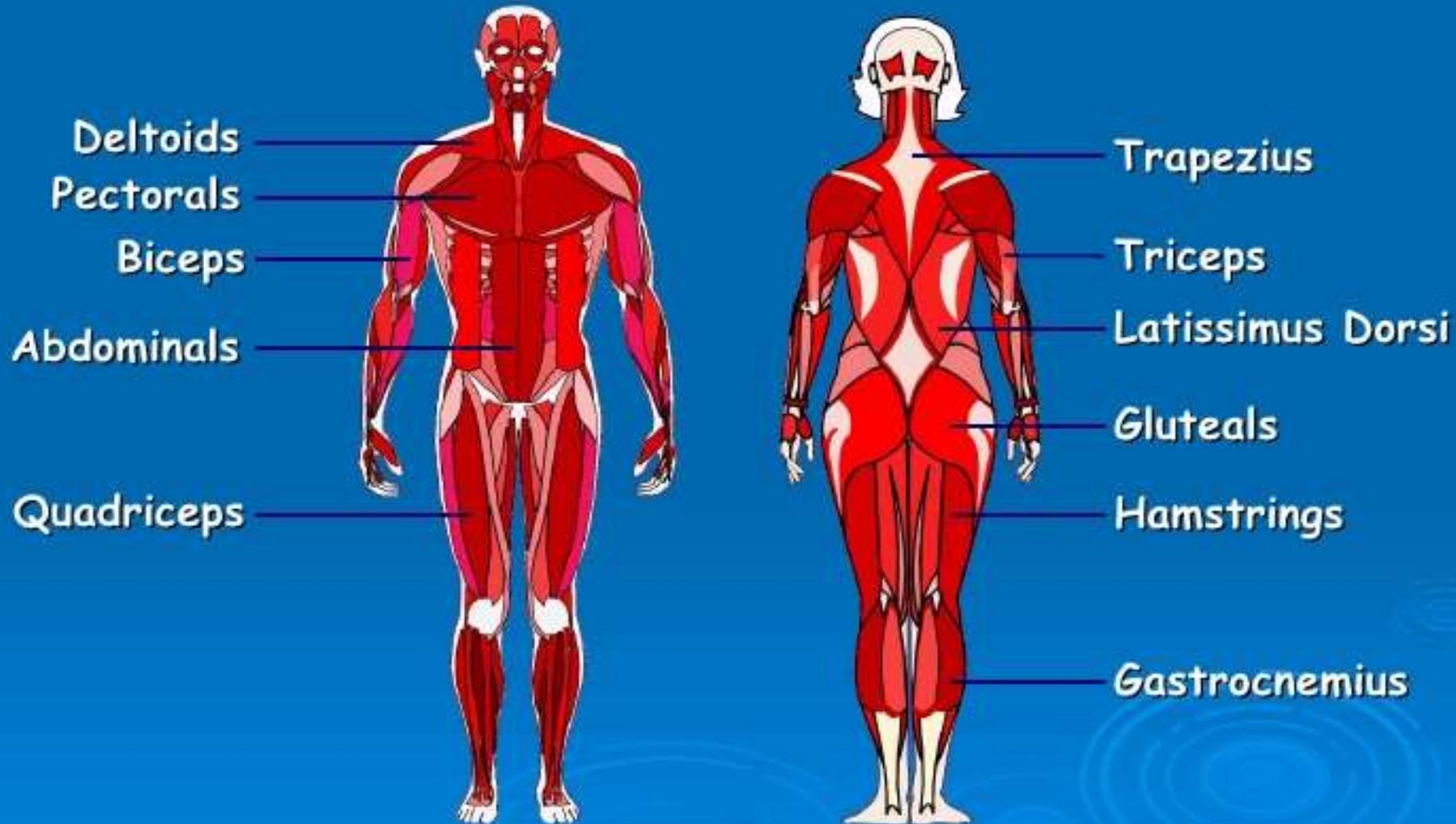
# The Muscles we must Identify

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Abdominal	Masseter
Biceps	Quadriceps
Deltoid	Pectoralis
Gastrocnemius	Soleus
Gluteus maximus	Trapezius
Hamstrings	Triceps
Latissimus dorsi	

# The Muscular System

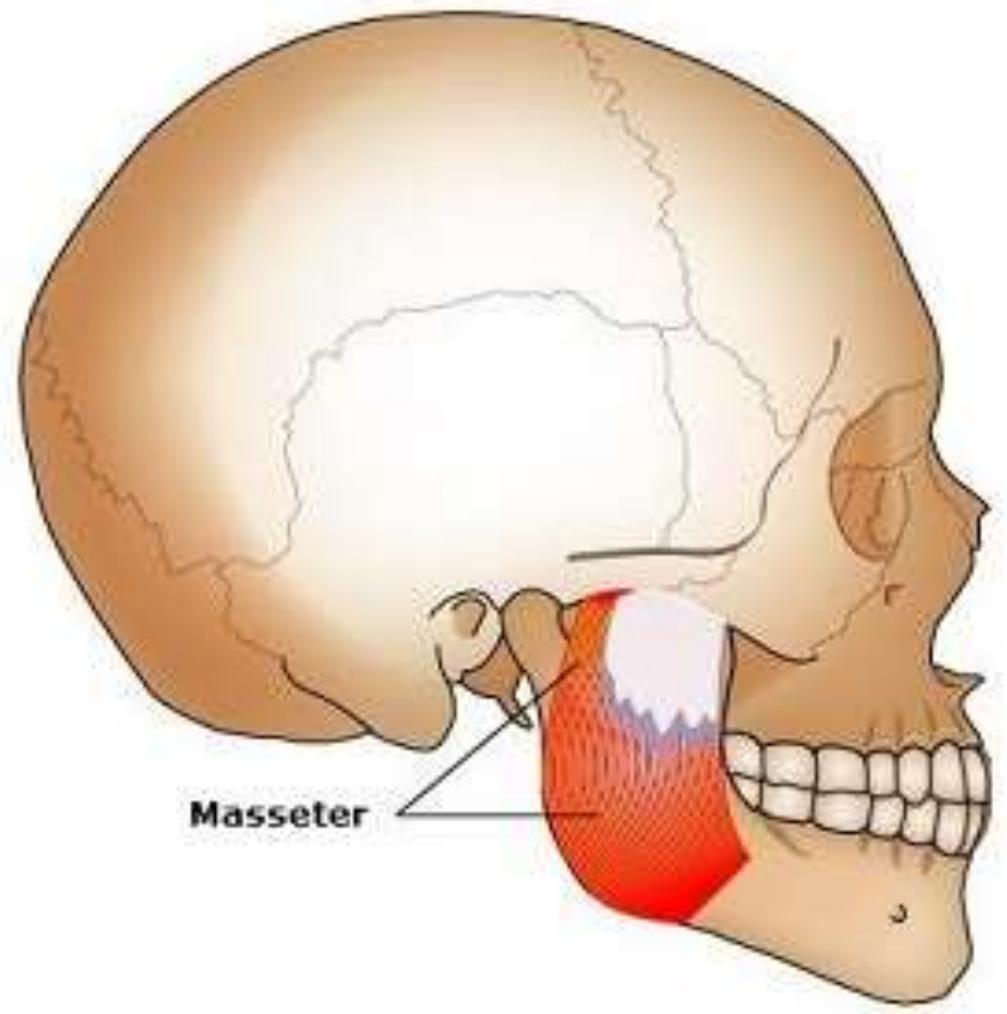
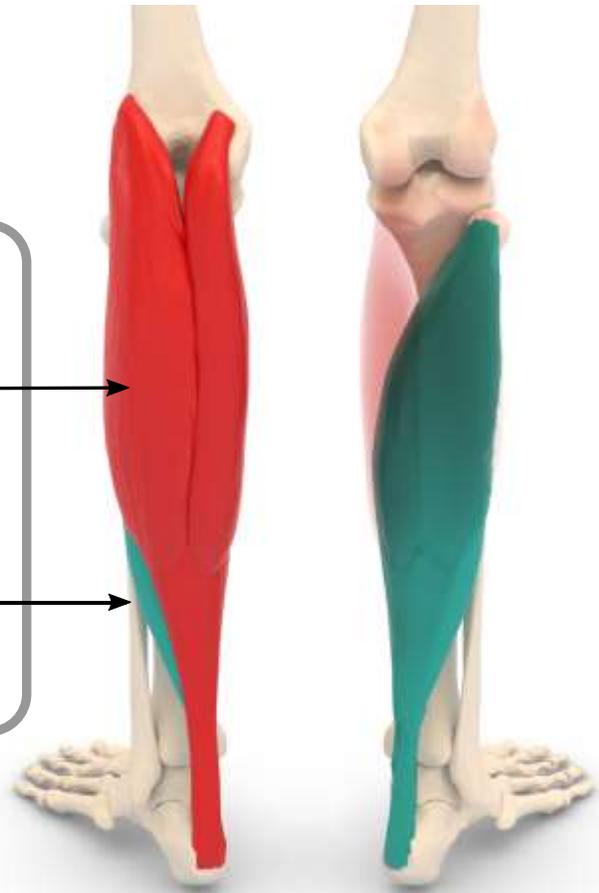
These are the major muscles of the body...



**Triceps surae**

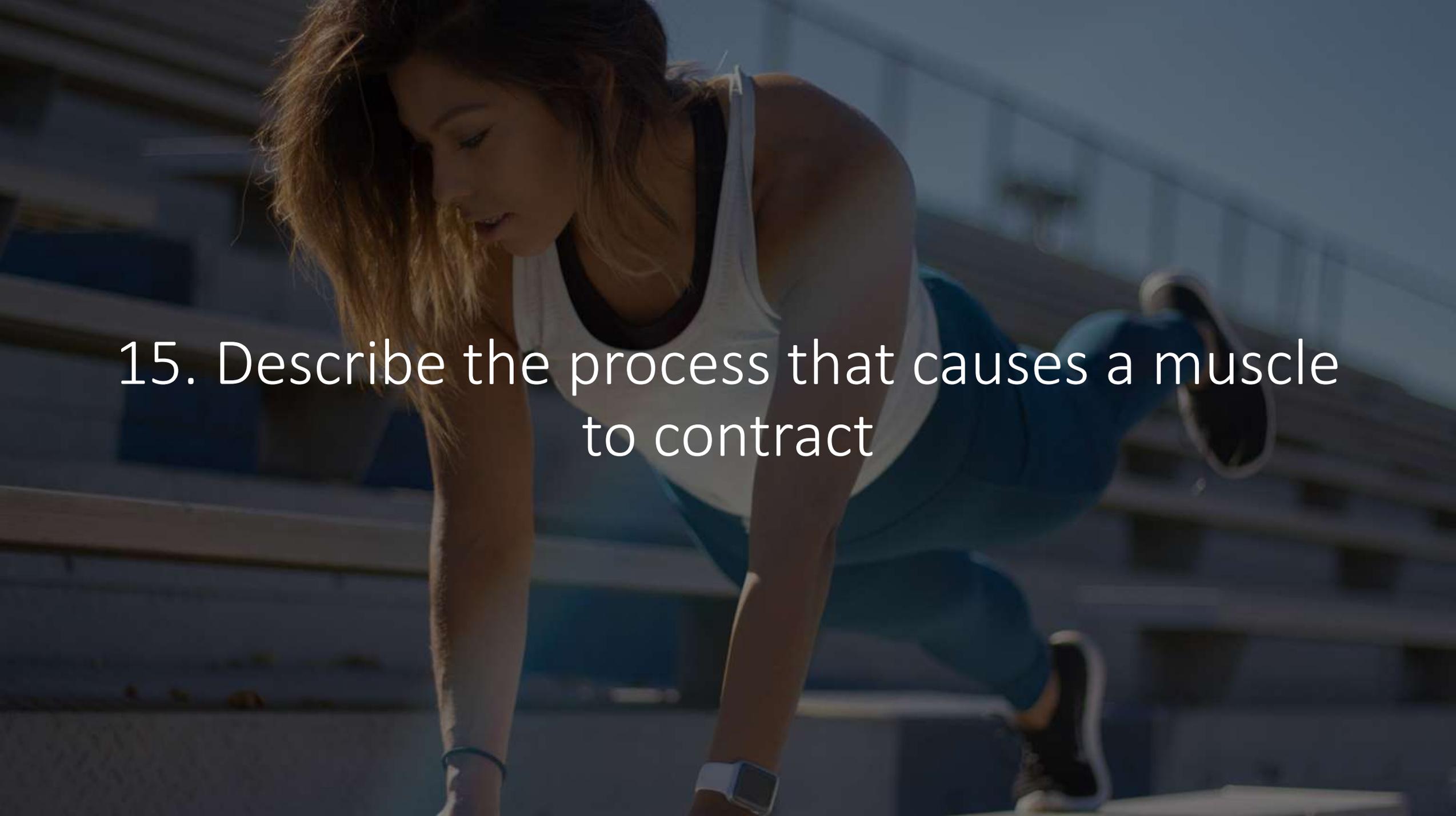
Gastrocnemius muscle

Soleus muscle

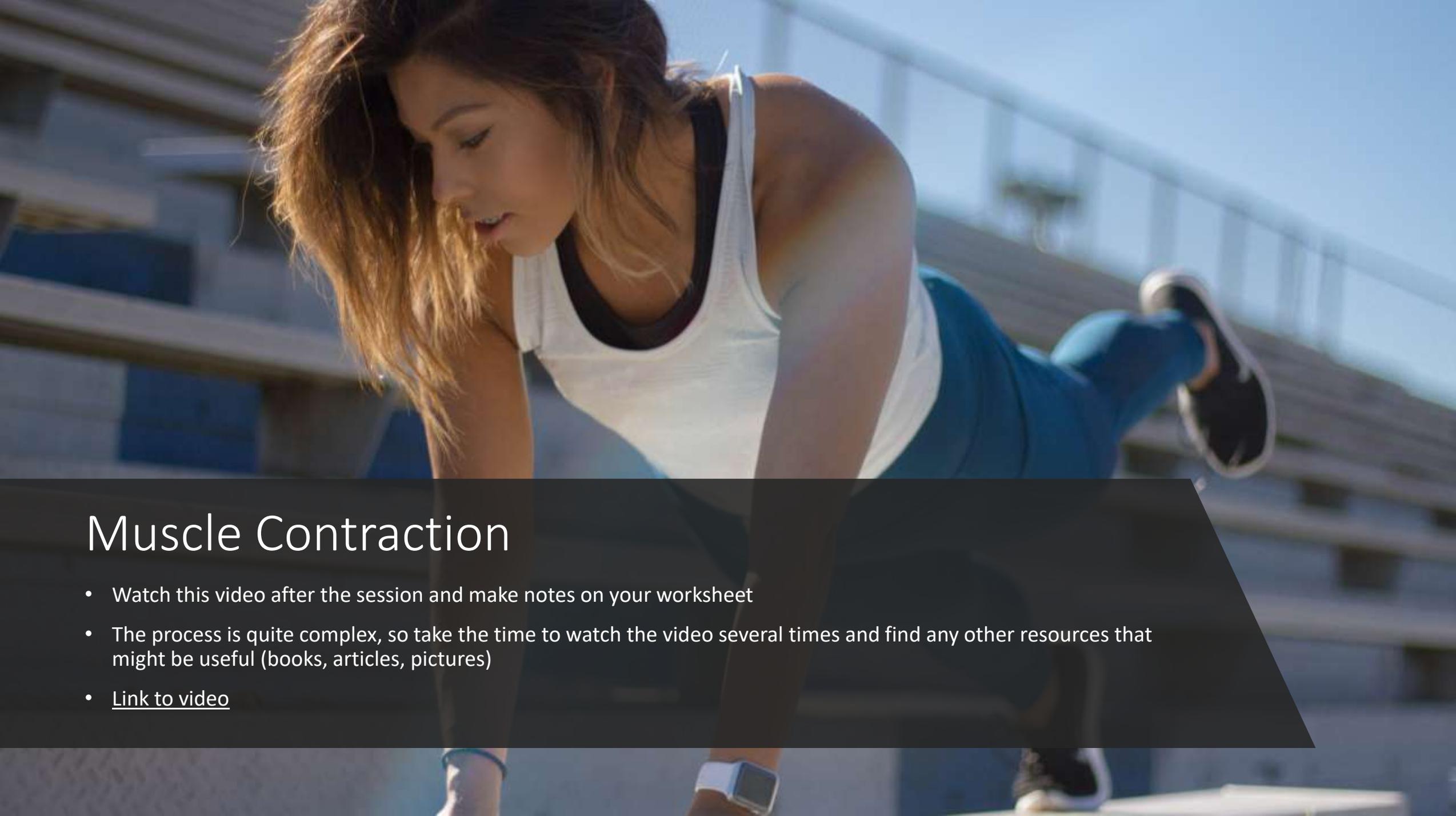


A woman with her hair in a braid is lying on a black mat on a wooden floor, performing a sit-up. She is wearing a white tank top, orange leggings, and orange and black sneakers. Her hands are clasped behind her head, and she is looking upwards. The background shows a large window with a view of a green outdoor area.

## 15. Muscle contractions

A woman with long brown hair, wearing a white tank top and blue leggings, is captured in the middle of a burpee on a track. She is in a low, athletic stance with her hands on the ground and one leg kicked back. The background shows a blurred track and stadium seating. The text "15. Describe the process that causes a muscle to contract" is overlaid in white on the image.

15. Describe the process that causes a muscle to contract

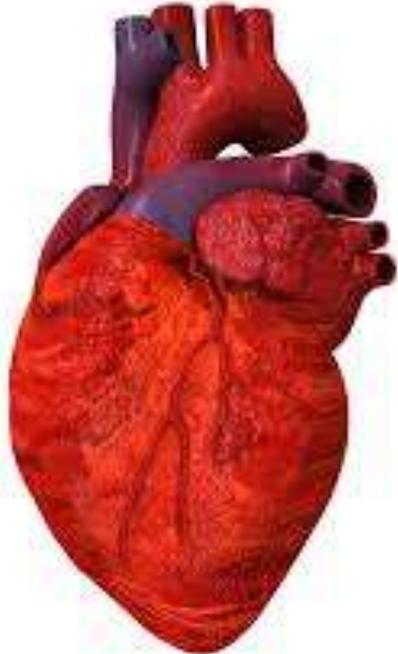
A woman with long brown hair, wearing a white tank top and blue leggings, is performing a plank exercise on a wooden bench. She is leaning forward with her arms extended, supporting her weight. The background shows a wooden structure and a clear blue sky.

# Muscle Contraction

- Watch this video after the session and make notes on your worksheet
- The process is quite complex, so take the time to watch the video several times and find any other resources that might be useful (books, articles, pictures)
- [Link to video](#)

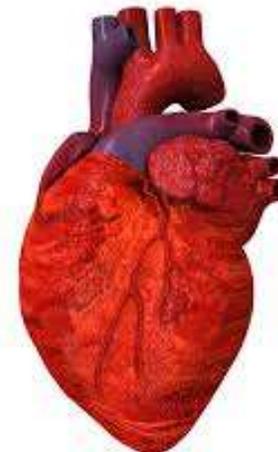
# 16. Voluntary & involuntary muscles

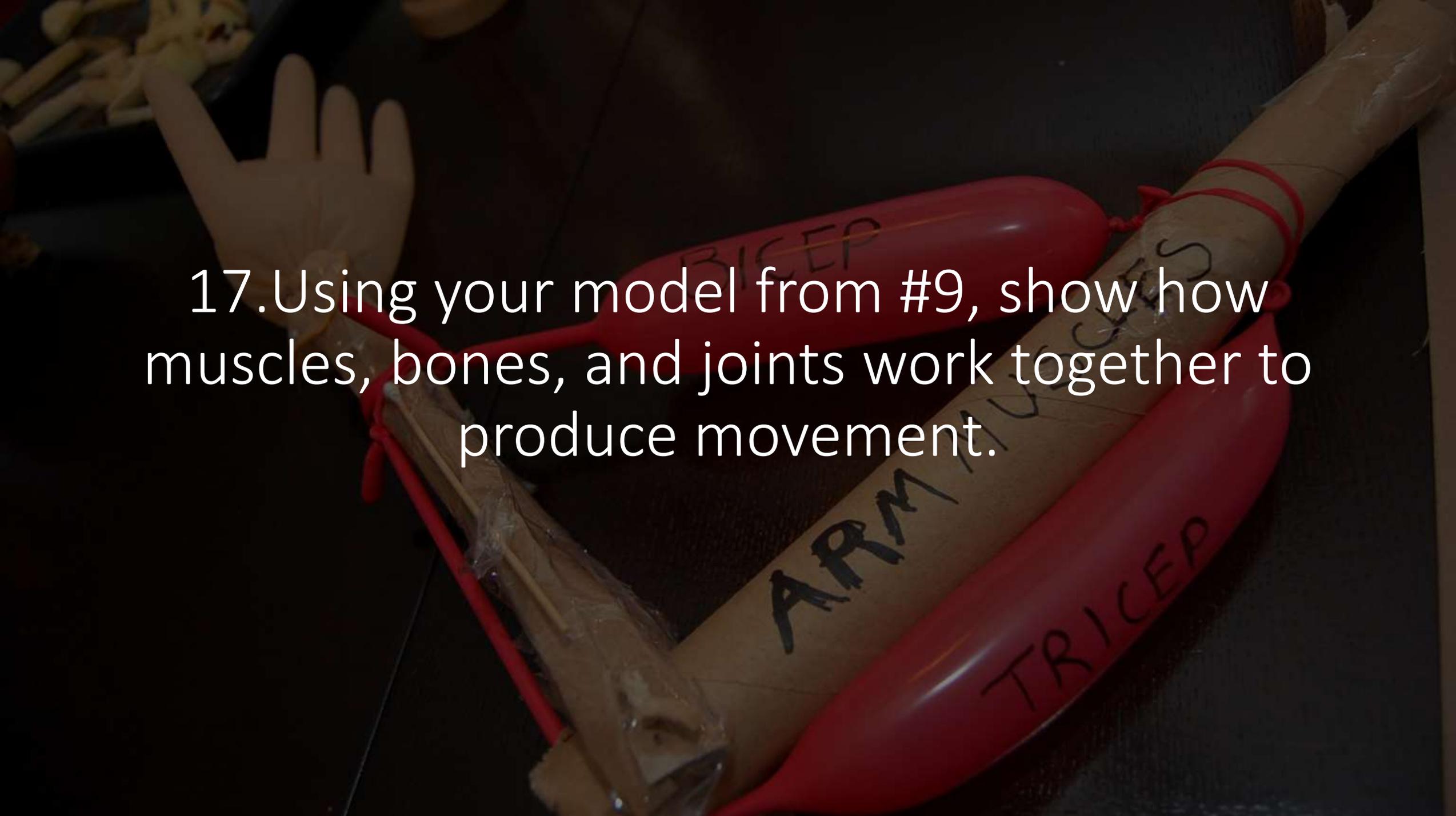
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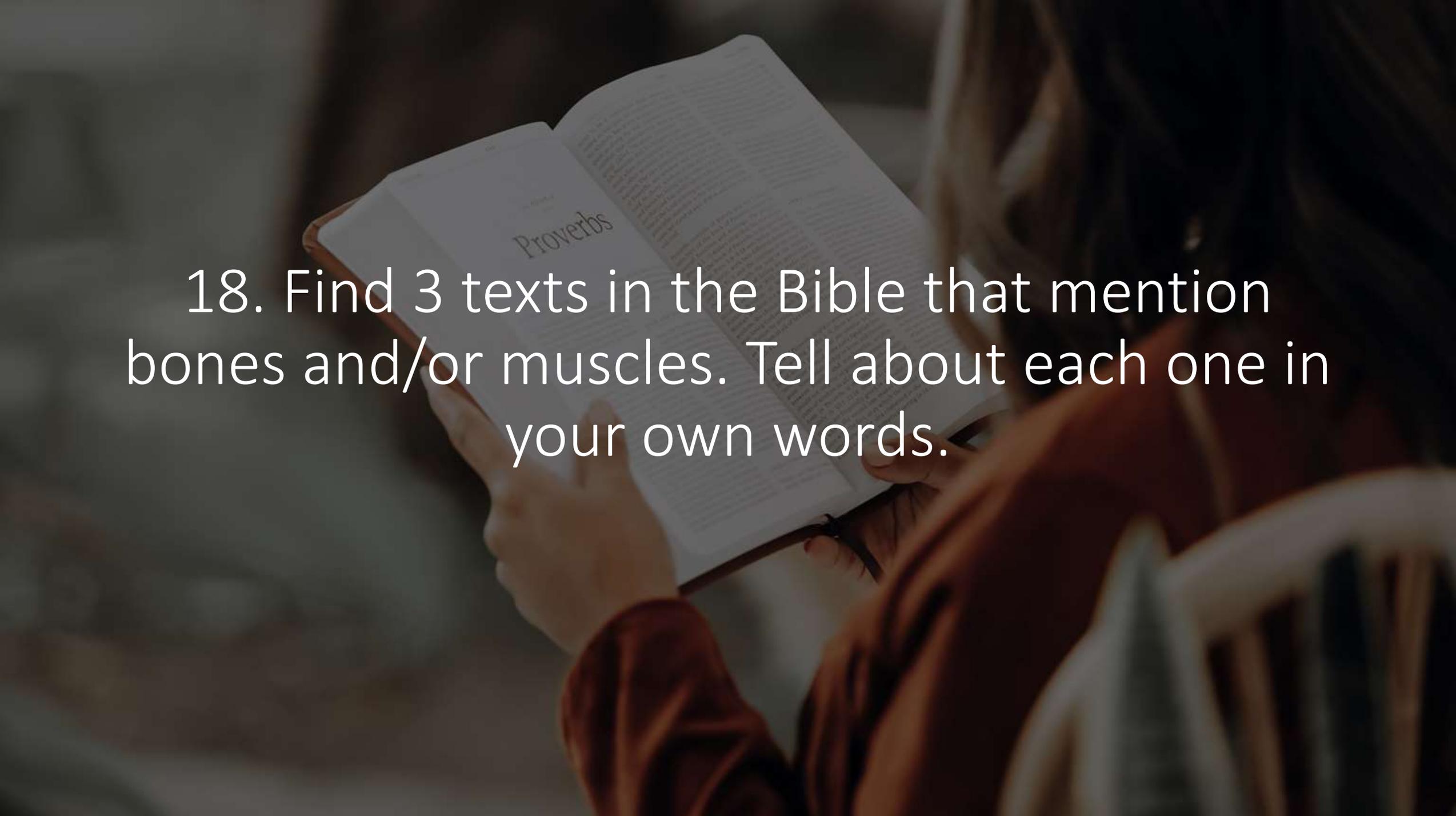
# Voluntary v Involuntary Muscles

	Voluntary Muscles	Involuntary Muscles
Anatomy	Attached to the skeletal frame	Most are organs
Control	Generally under the control of the person to whom they belong	Controlled by the autonomic system without the conscious control of the individual
Examples	Arms Legs	Heart Digestive system





17. Using your model from #9, show how muscles, bones, and joints work together to produce movement.

A person is shown from the chest up, wearing a dark red long-sleeved shirt, holding an open Bible. The Bible is held with both hands, and the left page is clearly visible, showing the word "Proverbs" in a large, dark font. The right page is also visible but less legible. The background is dark and out of focus, suggesting an indoor setting. The overall lighting is soft and focused on the Bible.

18. Find 3 texts in the Bible that mention bones and/or muscles. Tell about each one in your own words.



Questions