

# **Musculoskeletal System**

# **Skeletal System**

## Functions of skeletal system

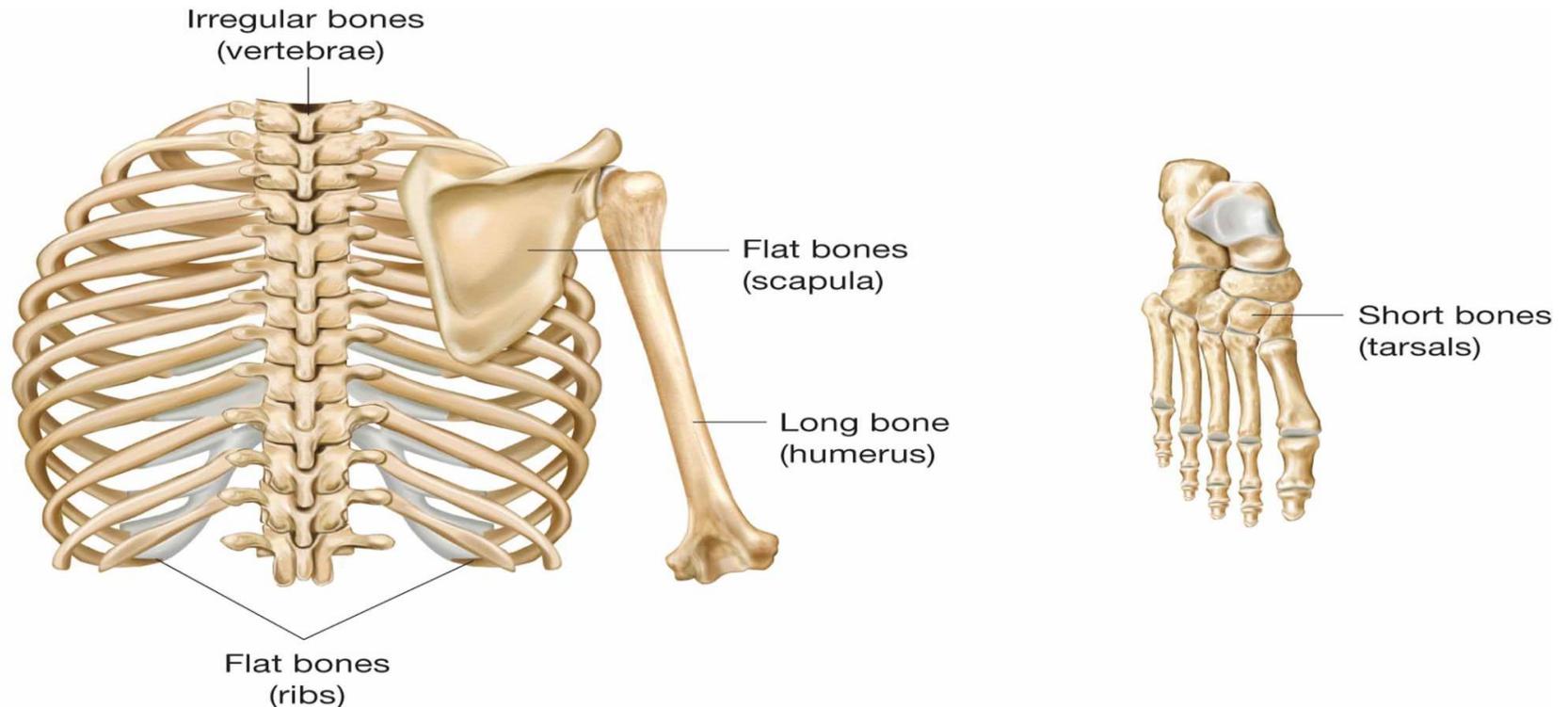
- Internal framework of body
- Supports body
- Protects internal organs
- Point of attachment for muscles
- Produces blood cells
- Stores minerals

## Organs of skeletal system

- **Bones of the skeleton (206):** are body organs with blood supply, nerves, and lymphatic vessels, connected to each other to form skeleton.
- Red bone marrow within bones produces blood cells
- **Joints:** place where two bones meet and held together by ligaments to give flexibility to skeleton

# Four shapes of bones

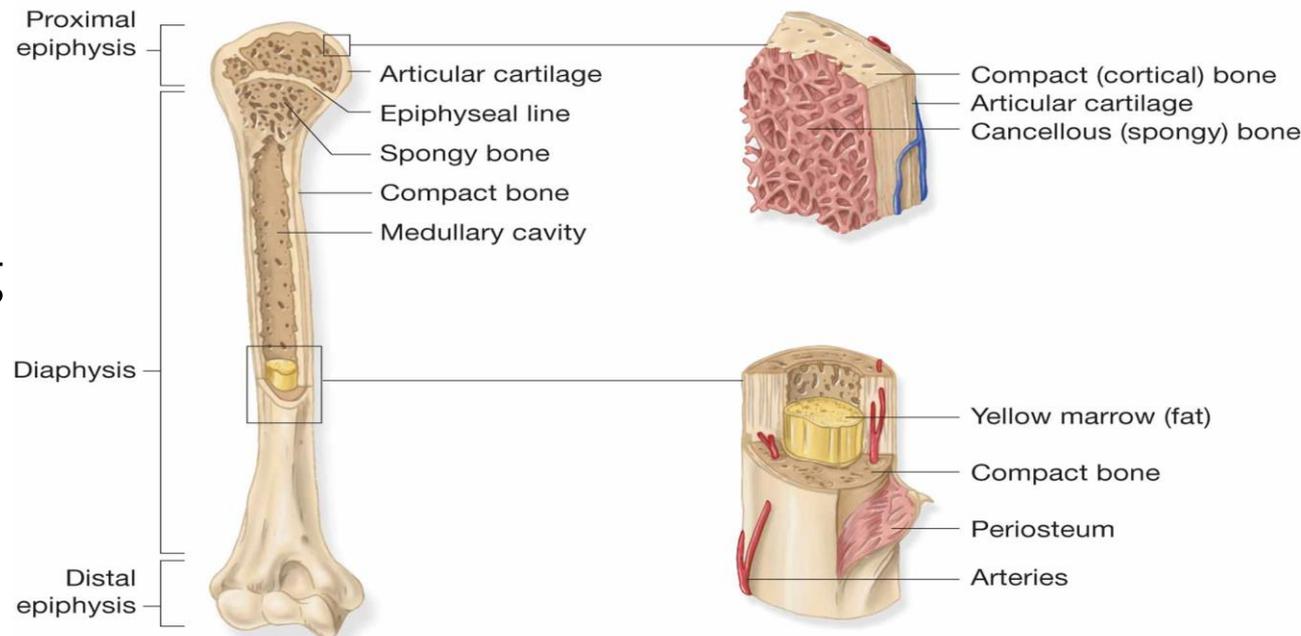
<b>Long bones</b>	<b>Short bones</b>	<b>Flat bones</b>	<b>Irregular bones</b>
Longer than wide  <b><u>Example:</u></b> - femur - humerus	Roughly as long as wide  <b><u>Example:</u></b> - carpals - tarsals	Plate- shaped  <b><u>Example:</u></b> - sternum - scapula - pelvis	Shape very irregular  <b><u>Example:</u></b> - vertebrae



# Long bones

- Majority of bones in body
- Divided into:
  - 1- Diaphysis (Central shaft)
    - Medullary cavity, an open canal within diaphysis that contains yellow bone marrow and mostly fat
  - 2- Epiphysis (wide ends of long bone) of two types:
    - a- Distal epiphysis
    - b- Proximal epiphysis
- Articular cartilage covers epiphysis to prevent bone rubbing on bone

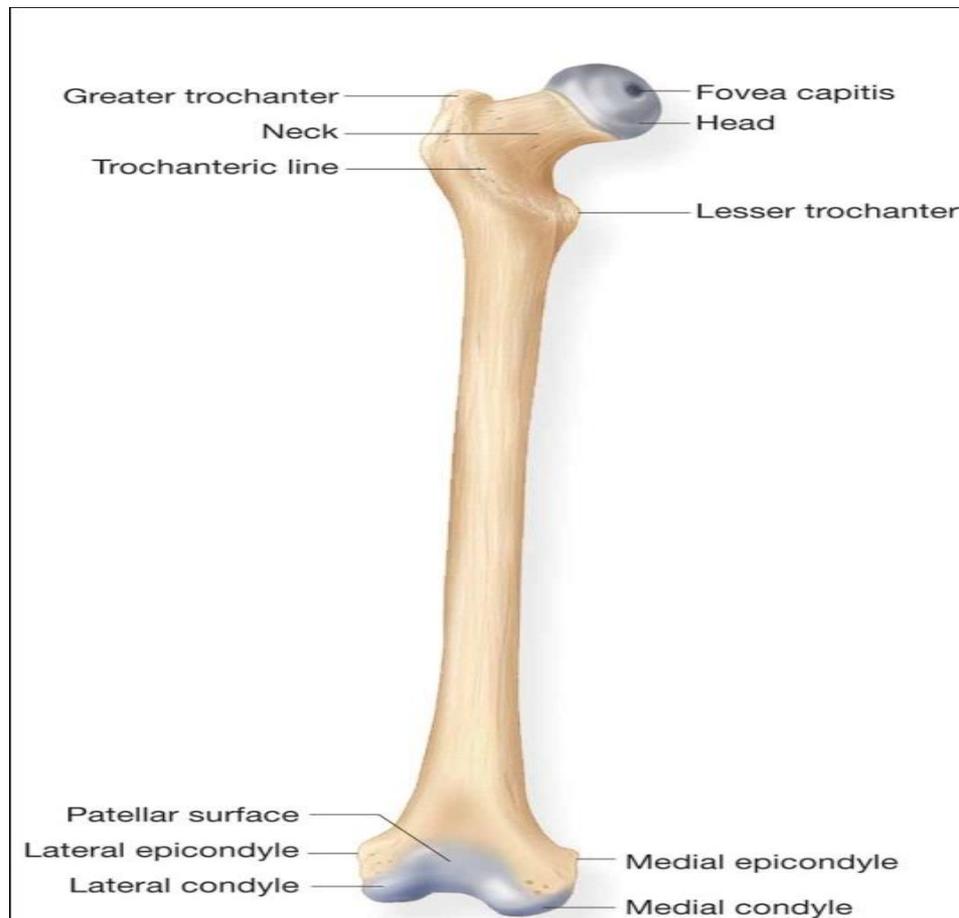
## Components of a long bone



# Bony processes

- Projection from the surface of a bone
- Rough processes provide place for muscle attachment
- Smooth rounded processes articulate with another bone in a joint.
- As head of the bones, condyle, epicondyle, trochanter, tubercle and tuberosity.
- Some of them are smooth and others are rough.

## **Bony processes of femur**



## **Bony depressions**

- Sinus (hollow cavity within bone)
- Foramen (smooth opening for nerves and blood vessels)
- Fossa (shallow cavity or depression within a bone)
- Fissure (deep groove or slit-like opening)

## **The Skeleton**

Skeleton has two divisions:

A- Axial skeleton

B- Appendicular skeleton

**A. Axial skeleton**: includes:

- Head
- Neck
- Spine
- Chest
- Trunk

# Skull

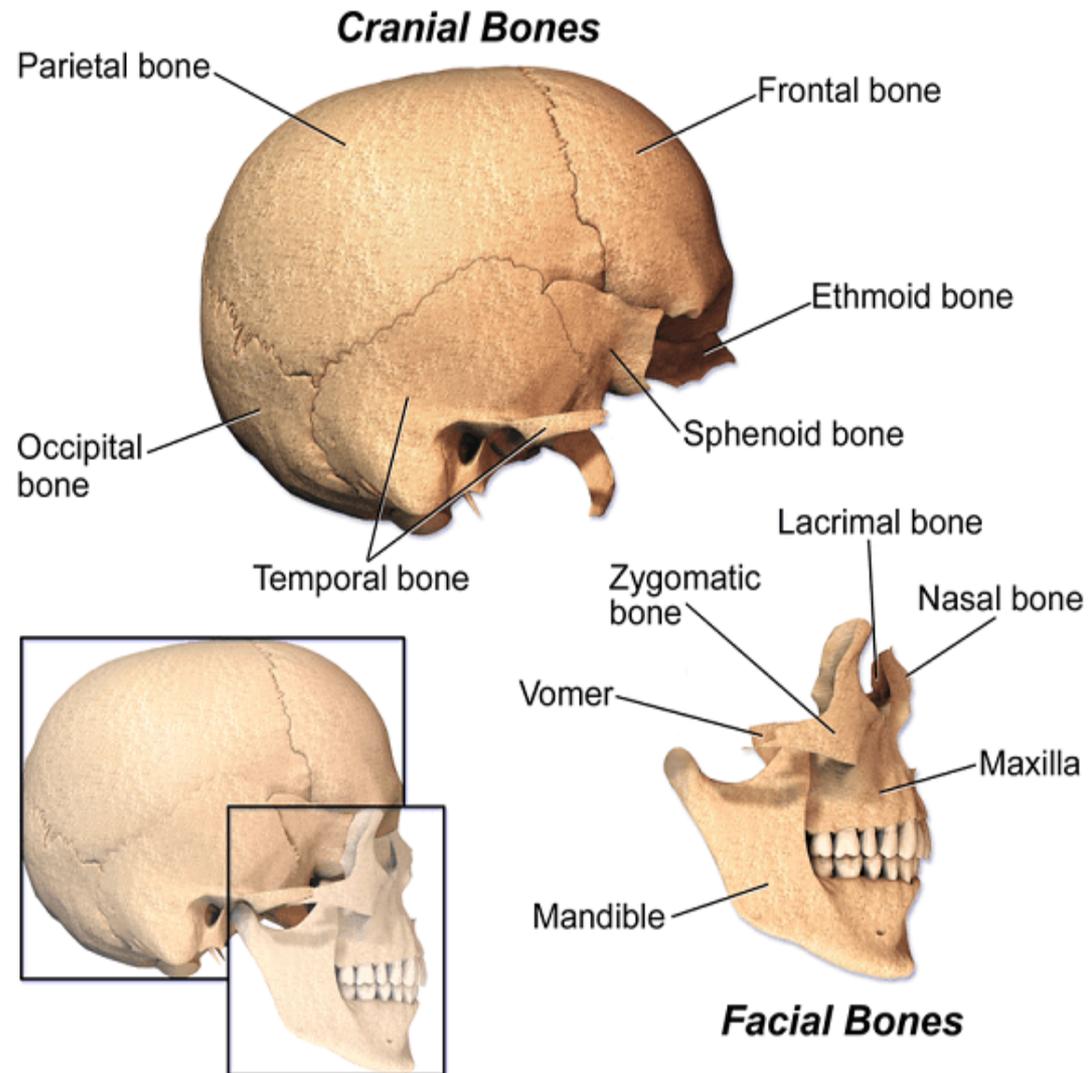
- Is divided into two parts: cranium and facial bones
- Protects brain, eyes, ears, nasal cavity, and oral cavity
- Attachment for muscles of chewing and turning the head

# Cranium

- Frontal – 1 (forehead)
- Parietal – 2 (upper sides and roof of skull)
- Temporal – 2 (sides & base of skull)
- Ethmoid – 1 (part of eye orbit, nose, & floor of skull)
- Sphenoid – 1 (part of floor of skull)
- Occipital – 1 (back & base of skull)

# Facial bones

- Mandible – 1 (lower jawbone)
- Maxilla – 1 (upper jawbone)
- Zygomatic – 2 (cheek bones)
- Vomer – 1 (part of nasal septum)
- Palatine – 1 (hard palate and floor of nose)
- Nasal – 2 (part of nasal septum and bridge of nose)
- Lacrimal – 2 (inner corner of eye)



# The Trunk

## 1- Vertebral column divided into:

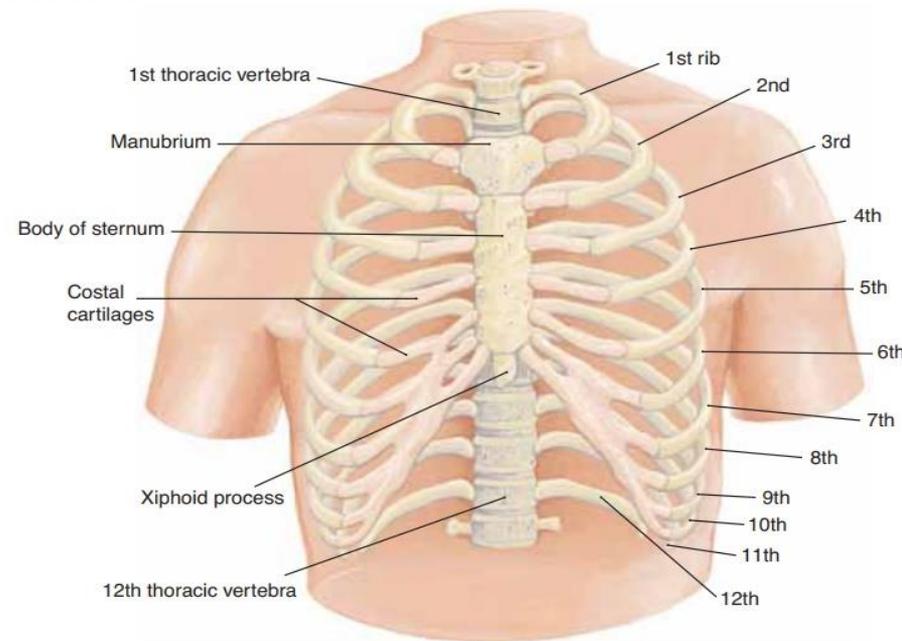
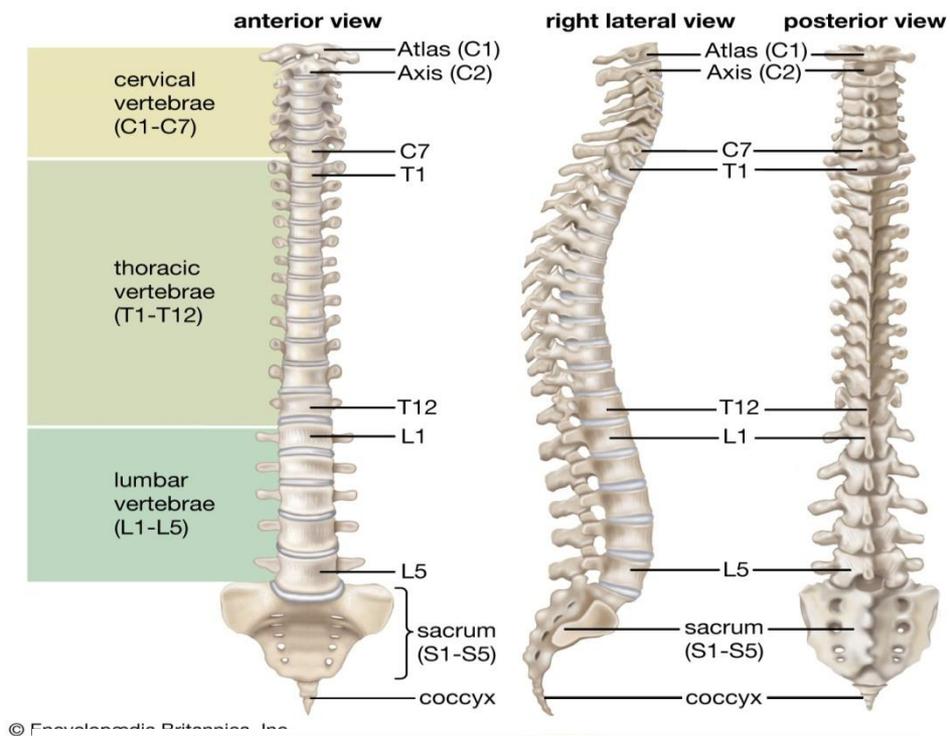
five sections:

- Cervical (7) - Thoracic (12) –
- Lumbar (5) - Sacrum (fused 5)
- Coccyx (3-5)

## 2- Sternum

## 3- Rib cage

- 12 pairs of ribs
- Attached to vertebral column at back
- Provides support for organs, such as heart and lungs
- True ribs (10 pairs attached to sternum in front)
- Floating ribs (inferior 2 pairs and no attachment in front)



**Figure** Rib cage. Anterior view.

## **B. Appendicular skeleton**

- Includes bones of:

### **1- Pectoral girdle**

- Attaches upper extremity to axial skeleton

- Articulates with:

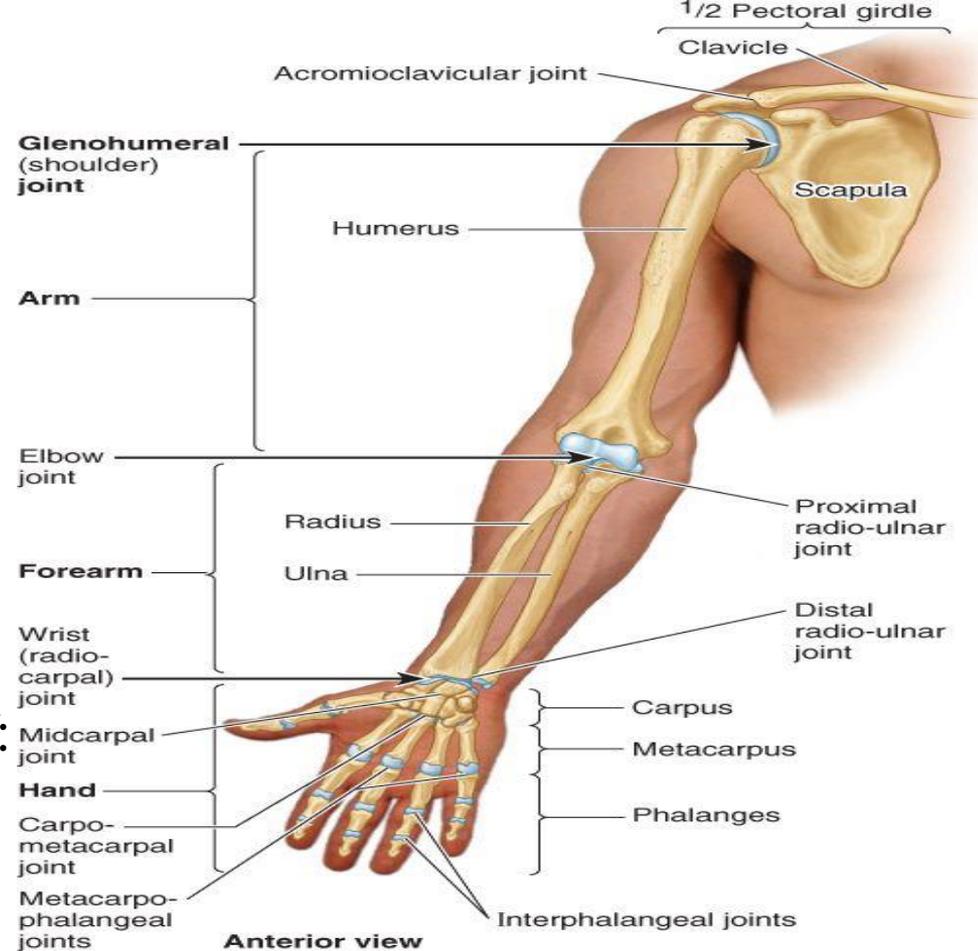
- Sternum anteriorly
- Vertebral column posteriorly

- Consists of:

- Clavicle – collar bone
- Scapula – shoulder blade

### **2- Upper extremity (arm) consists of:**

- Humerus – upper arm
- Ulna – part of forearm
- Radius – part of forearm
- Carpals – wrist bones
- Metacarpals – hand bones
- Phalanges – finger bones

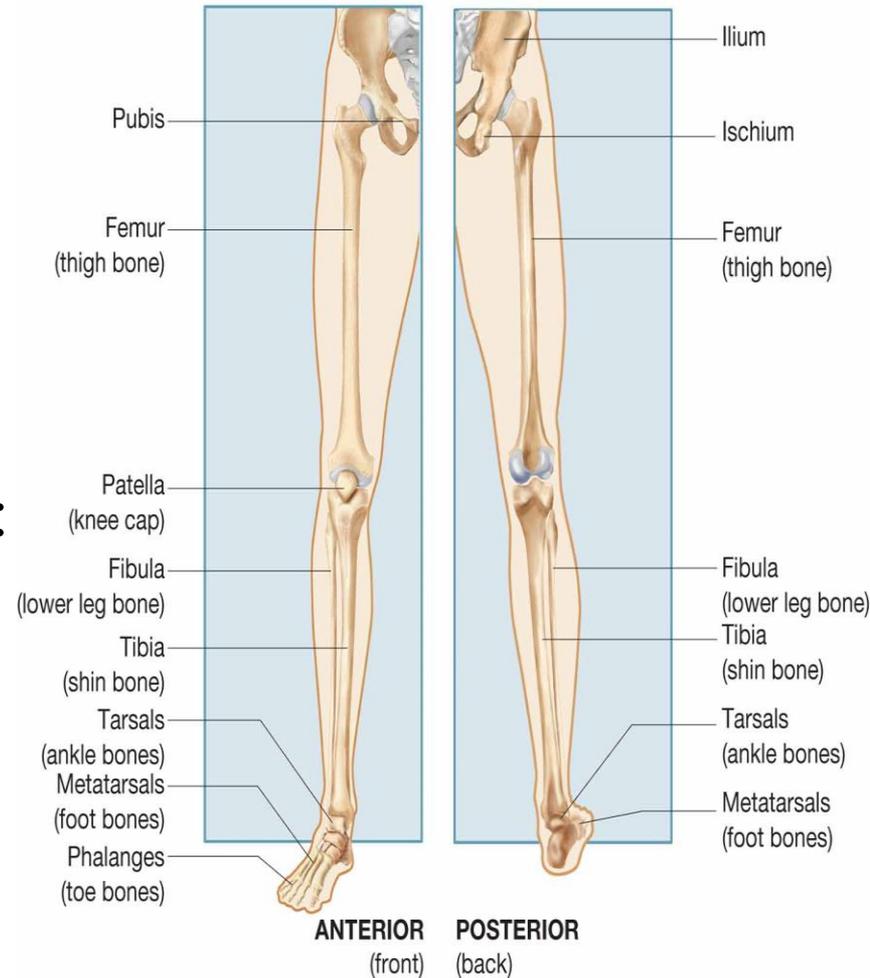


### 3- Pelvic girdle (hipbone)

- Attaches lower extremity to axial skeleton
- Articulates with sacrum posteriorly
- Consists of:
  - Ilium
  - Ischium
  - Pubis

### 4- Lower extremity (leg) consists of:

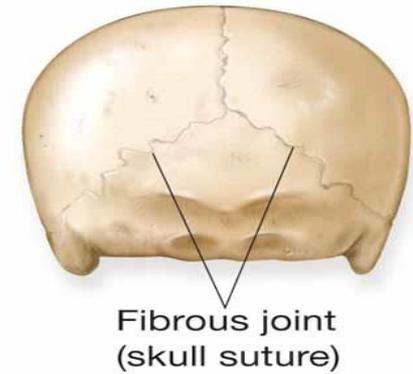
- Femur – thigh bone
- Patella – knee cap
- Fibula – lower leg bone
- Tibia – shin bone
- Tarsals – ankle bones
- Metatarsals – foot bones
- Phalanges – toe bones



# Joints

- Formed where two bones meet
- Also called an articulation
- Three types based on movement allowed between the 2 bones:
  - Synovial (elbow, hip and knee)
  - Cartilaginous (pubic symphysis)
  - Fibrous (sutures of the skull)

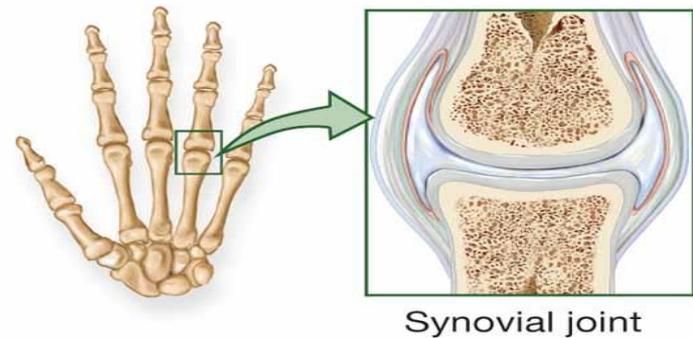
**Skull**



**Pelvis**



**Hand**



# **Skeletal system combining forms**

ankyl/o	stiff joint	crani/o	skull
arthr/o	joint	chondr/o	cartilage
articul/o	joint	clavicul/o	clavicle
burs/o	sac	coccyg/o	coccyx
carp/o	wrist	cortic/o	outer portion
cervic/o	neck	cost/o	rib
lamin/o	lamina	lord/o	bent backwards
mandibul/o	mandible	lumb/o	loin
fibul/o	fibula	ischi/o	ischium
humer/o	humerus	kyph/o	hump
ili/o	ilium	maxill/o	maxilla
femor/o	femur	medull/o	inner portion
metacarp/o	metacarpals	metatars/o	metatarsals
myel/o	bone marrow	orth/o	straight
oste/o	bone	patell/o	patella
ped/o	foot	pelv/o	pelvis
pod/o	foot	pub/o	pubis

phalang/o	phalanges	radi/o	radius
sacr/o	sacrum	synov/o	synovial membrane
–blast	immature, embryonic	scapul/o	scapula
scoli/o	crooked, bent	spondyl/o	vertebrae
stern/o	sternum	synovi/o	synovial membrane
tars/o	ankle	thorac/o	chest
tibi/o	tibia	uln/o	ulna
vertebr/o	vertebra	–clasia	to break surgically
–desis	stabilize, fuse	–listhesis	slipping
–porosis	porous		

## Word building with arthr/o

–algia	arthralgia	joint pain
–centesis	arthrocentesis	puncture to withdraw fluid from joint
–clasia	arthroclasia	surgically break a joint
–desis	arthrodesis	fusion of a joint
–gram	arthrogram	record of a joint
–itis	arthritis	joint inflammation
–otomy	arthrotomy	incision into a joint
–scope	arthroscope	instrument to view joint

## Word building with cortic/o and crani/o

–al	cortical	pertaining to the outer portion
intra– –al	intracranial	pertaining to inside the skull
–otomy	craniotomy	incision into the skull

## Word building with burs/o & chondr/o

–ectomy	bursectomy	surgical removal of bursa
–itis	bursitis	inflammation of bursa
–ectomy	chondrectomy	surgical removal of cartilage
–malacia	chondromalacia	softening of cartilage
–oma	chondroma	cartilage tumor
–plasty	chondroplasty	surgical repair of cartilage

## Word building with medull/o & myel/o

–ary	medullary	pertaining to the inner portion
–oma	myeloma	red bone marrow tumor

## Word building with oste/o

–algia	ostealgia	bone pain
chondr/o – oma	osteochondroma	bone and cartilage tumor
–clasia	osteoclasia	surgically break a bone
myel/o –itis	osteomyelitis	bone and bone marrow inflammation
–otomy	osteotomy	incision into bone
–pathy	osteopathy	bone disease
–tome	osteotome	instrument to cut bone

## Word building with synov/o & vertebr/o

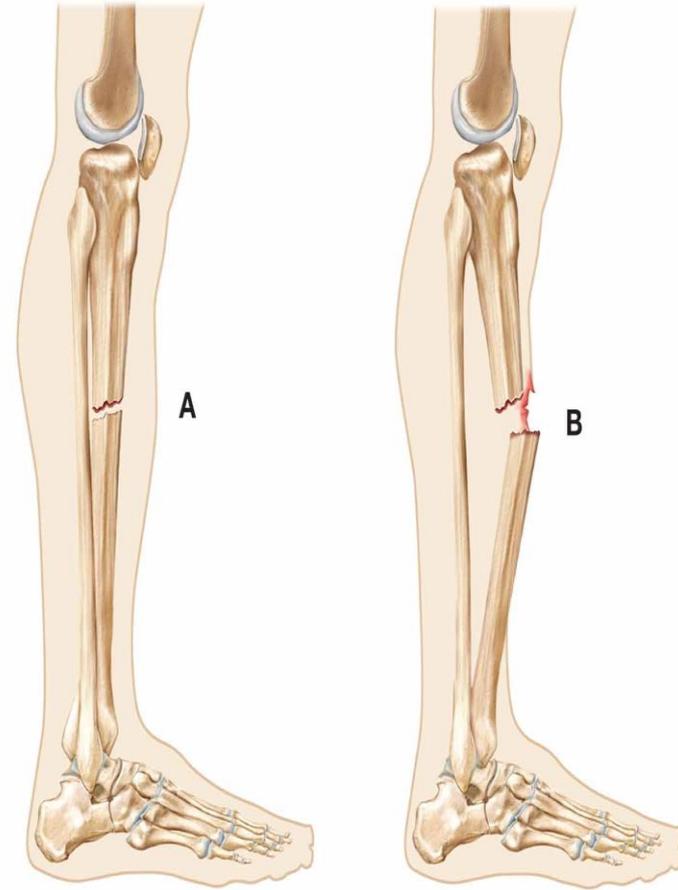
–itis	synovitis	inflammation of synovial membrane
–ectomy	synovectomy	surgical removal of synovial membrane
inter– –al	intervertebral	pertaining to between vertebrae

## Skeletal system vocabulary

callus	mass of bone tissue that forms at fracture site during healing
cast	solid material to immobilize a fracture; may be made of plaster of Paris or fiberglass
chiropractic	practice of treating patients using manipulations of vertebral column; practitioner is a chiropractor
crepitation	noise produced by bones or cartilage rubbing together
exostosis	bone spur
kyphosis	abnormal increase in curve of thoracic spine; humpback
lordosis	abnormal increase in forward curvature of lumbar spine; swayback
orthopedics	branch of medicine specializing in diagnosis and treatment of musculoskeletal system; physician is an orthopedist
orthotic	brace or splint used to prevent or correct deformities; specialist in making is an orthotist

# Fractures

closed fracture	fracture with no open skin wound; also called simple fracture
Colles' fracture	common wrist fracture
comminuted fracture	fracture where bone is shattered, splintered, or crushed
compound fracture	fracture with an open skin wound; also called open fracture
compression fracture	fracture with loss of height in vertebral body; often from osteoporosis
greenstick fracture	incomplete break; one side of bone is broken, the other is bent; common in children
impacted fracture	bone fragments are pushed into each other
oblique fracture	fracture at an angle to bone



A) closed fracture  
B) Open fracture

pathologic fracture	fracture caused by diseased or weakened bone
spiral fracture	fracture line spiral around shaft of bone; often slower to heal
stress fracture	slight fracture caused by repetitive low-impact forces like running
transverse fracture	fracture is straight across bone



## Bone pathologies

Ewing's sarcoma	cancerous tumor of shaft of long bones; spreads through periosteum; amputation is necessary to prevent metastasis
osteogenic sarcoma	most common type of bone cancer; begins in osteocytes
osteomalacia	softening of bones caused by calcium deficiency; caused in children with insufficient sunlight and vitamin D
osteoporosis	decrease in bone mass; results in thinning and weakening of bones; porous bone easily fractures
Paget's disease	metabolic disease of bone; unknown cause; results in bone destruction and deformity
rickets	caused by calcium and vitamin D deficiency; results in bone deformities like bowed legs

## Spinal column pathologies

ankylosing spondylitis	inflammatory condition resembles rheumatoid arthritis; gradual stiffening and fusion of vertebrae
herniated nucleus pulposus (HNP)	protrusion of an intervertebral disk; also called ruptured disk
scoliosis	lateral curve of spine
spina bifida	congenital anomaly; vertebra fails to fully form around spinal cord
spinal stenosis	narrowing of spinal canal; causes pressure on spinal cord and nerves
spondylolisthesis	forward sliding of lumbar vertebra over vertebra below it

## **Joint pathology**

dislocation	bones in joint are displaced from normal alignment
osteoarthritis (OA)	results in degeneration of bone and joints; bone rubs against bone
rheumatoid arthritis (RA)	autoimmune inflammation of joints with swelling, stiffness, pain; results in joint deformities

## **Skeletal system pathology**

sprain	damage to ligaments around joint due to overstretching; no dislocation or fracture
subluxation	incomplete dislocation; joint alignment is disrupted, but ends of bones remain in contact
systemic lupus erythematosus (SLE)	autoimmune disease of connective tissue affecting many systems including joints; looks like rheumatoid arthritis

## **Diagnostic imaging**

arthrography	visualizing joint by X-ray after injecting contrast medium into joint
bone scan	nuclear medicine procedure; radioactive dye is used to visualize bones; useful for identifying stress fractures and metastases
dual-energy absorptiometry (DXA)	measures bone density using low dose X-ray; detects osteoporosis
myelography	Study of spinal column after injecting opaque contrast medium; useful for identifying herniated nucleus pulposus
radiography	uses X-rays to study internal structure of body; especially useful for visualizing bones and joints

## **Endoscopic procedures**

arthroscopy	Examining interior of joint with an arthroscope, a fiberoptic camera; view of joint interior appears on monitor during procedure
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## Surgical procedures

amputation	removal of a limb for reasons like tumors, gangrene, or crushing injury
arthroscopic surgery	performing surgery while using an arthroscope to view inside joint
bone graft	bone from another source used to replace boney defect in another location
laminectomy	removal of posterior arch of vertebra to remove compression of a spinal nerve
percutaneous diskectomy	tube is inserted into intervertebral disk to suck out ruptured disk; may also be done with a laser
spinal fusion	surgical immobilization of adjacent vertebrae
total hip arthroplasty	implanting a prosthetic hip joint
total knee arthroplasty	implanting a prosthetic knee joint

## Fracture care

fixation	stabilizes fracture while it heals; external fixation includes casts and splints; internal fixation includes pins, plates, and screws
reduction	realigning bone fragments of fracture; closed reduction is manipulation without surgery; open reduction requires surgery
traction	applying a pulling force on fracture or dislocation to restore alignment

## Skeletal system pharmacology

bone reabsorption inhibitors	reduce the reabsorption of bone; treats osteoporosis and Paget's disease
calcium supplements & Vitamin D supplements	supplements that maintain bone density; treats osteomalacia, osteoporosis, & rickets
corticosteroids	have strong anti-inflammatory properties; treat rheumatoid arthritis
nonsteroidal anti-inflammatory drugs (NSAIDs)	provide mild pain relief and anti-inflammatory benefits; treat arthritis

# **Muscular system**

## - Function of Muscular System

- 1- Individual cells are able to contract or shorten in length
- 2- Shortening produces movement
- 3- Move bones closer together
- 4- Push food through digestive system
- 5- Pump blood through blood vessels

- Organs of muscular system are the muscles

## **Types of muscles:**

- Skeletal muscle            - Smooth muscle            - Cardiac muscle
- Voluntary muscles (skeletal muscles), consciously choose to contract the muscle
- Involuntary muscles (smooth muscles and cardiac muscle), under control of subconscious brain

## Skeletal muscles (striated muscles)

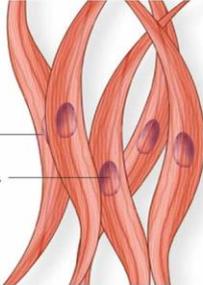
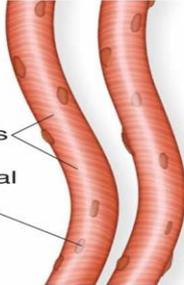
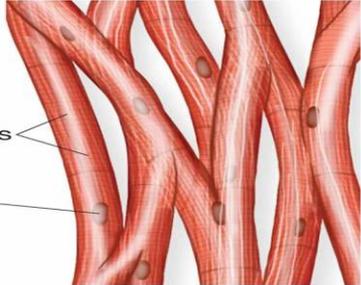
- Attached to bones to produce voluntary movement of skeleton
- Stimulated by motor neurons

## Smooth muscles (visceral muscles)

- Associated with internal organs (stomach, blood vessels and respiratory airways) to produce involuntary movements

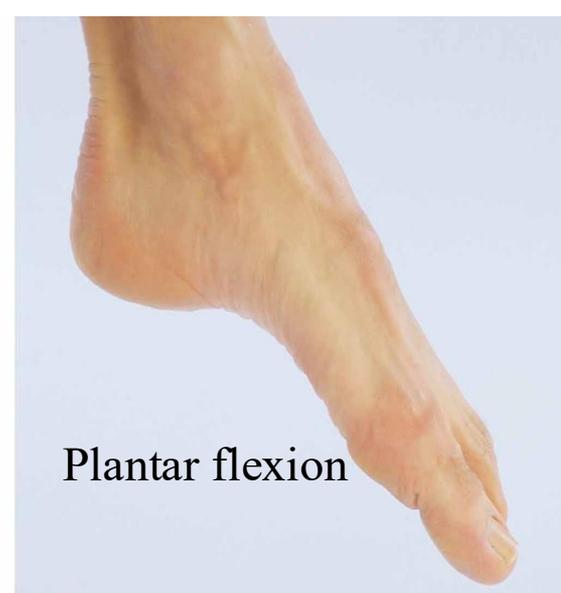
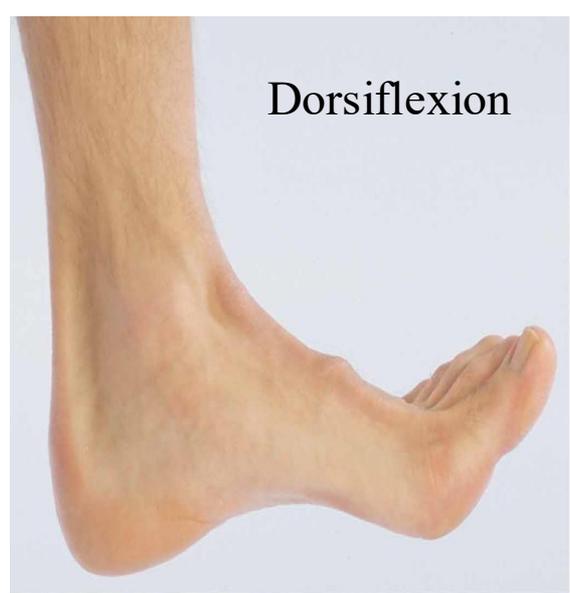
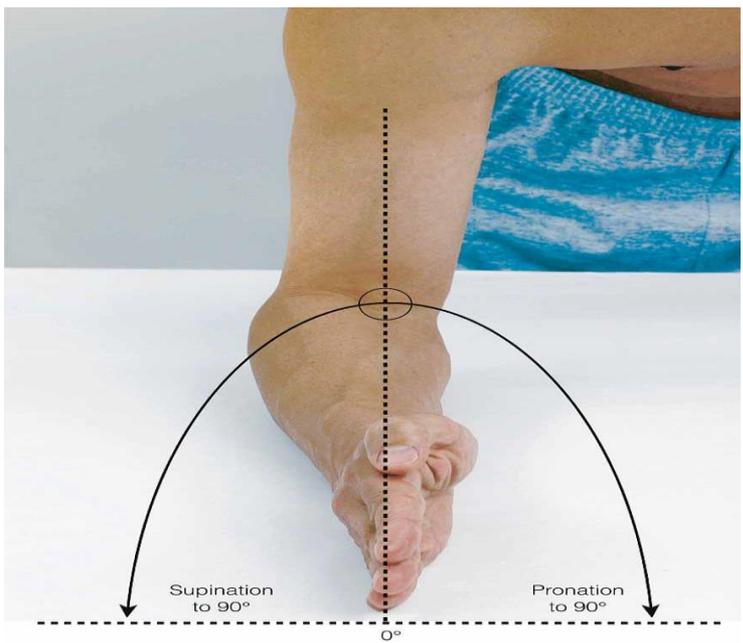
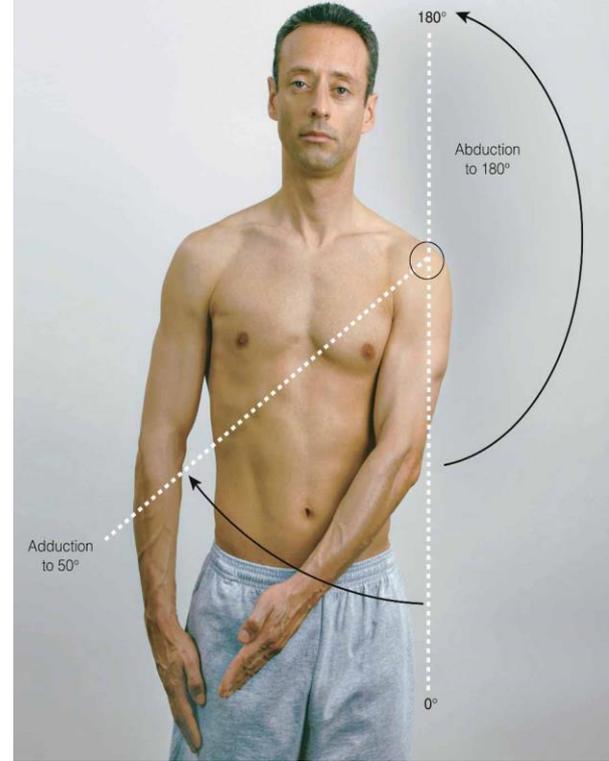
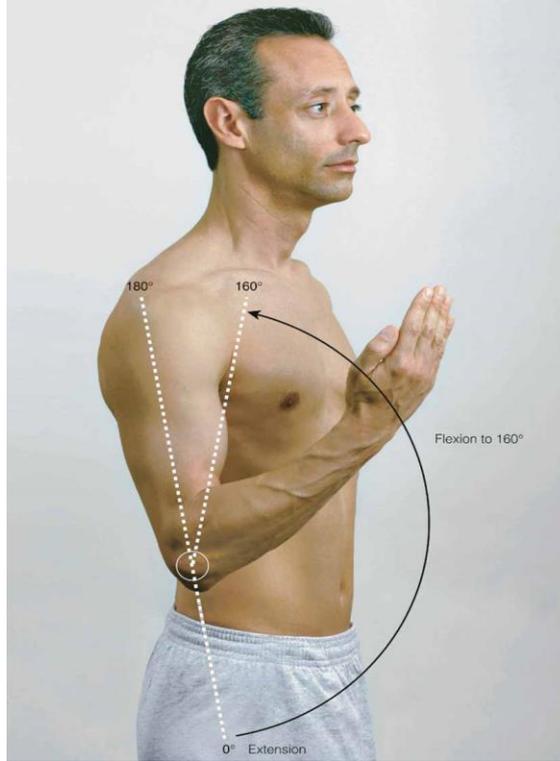
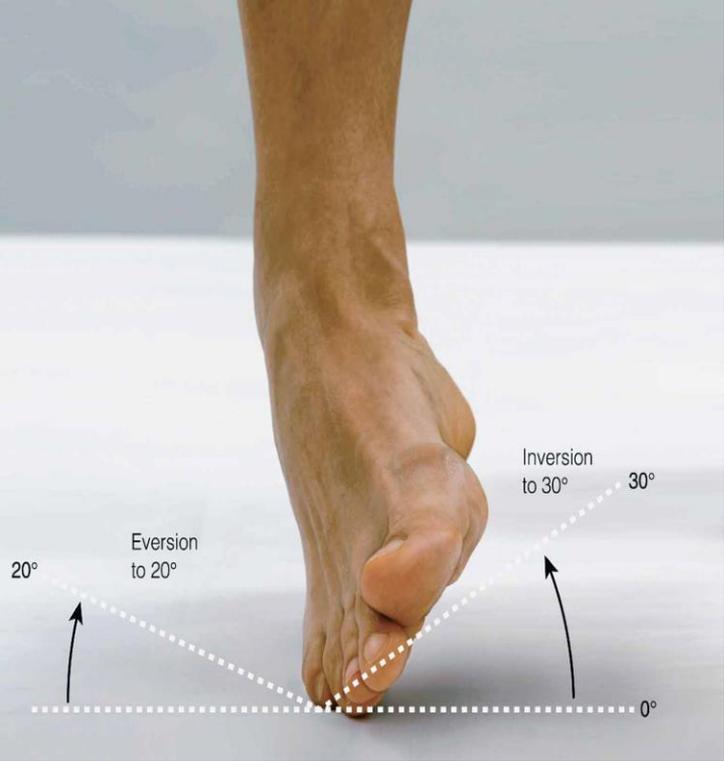
## Cardiac muscle (myocardium)

- Makes up walls of heart
- Involuntary contraction of heart to pump blood

	<b>Visceral (smooth)</b>	<b>Skeletal (striated)</b>	<b>Cardiac</b>
			
<b>Contracts</b>	Slowly	Rapidly	Rapidly
<b>Found</b>	Viscera, blood vessels	Trunk, extremities, head and neck	Heart
<b>Control</b>	Involuntary	Voluntary	Involuntary

## **Muscles movement terminology**

abduction	movement away from midline of body
adduction	movement toward midline of body
flexion	act of bending or being bent
extension	brings limb into a straight condition
dorsiflexion	backward bending of foot
plantar flexion	bending sole of foot; pointing toes
eversion	turning outward
inversion	turning inward
pronation	turning palm downward
supination	turning palm upward
elevation	to raise
depression	to drop down
circumduction	movement in circular direction from a central point
opposition	moving thumb away from palm to contact tip of other fingers
rotation	moving around a central axis



# Muscular system combining forms

fasci/o	fibrous band	fibr/o	fibers
kinesi/o	movement	muscul/o	muscle
my/o	muscle	plant/o	sole of foot
myocardi/o	heart muscle	myos/o	muscle
ten/o	tendon	tend/o	tendon
tendin/o	tendon	ad-	towards
circum-	around	-asthenia	weakness
-kinesia	movement	-tonia	tone
ab-	away from		

## Word building with fasci/o and kinesi/o

–al	fascial	pertaining to fascia
–itis	fasciitis	inflammation of fascia
–otomy	fasciotomy	incision into fascia
–logy	kinesiology	study of movement

## Word building with muscul/o & myos/o

–ar	muscular	pertaining to muscles
poly– –itis	poliomyelitis	inflammation of many muscles

## Word building with my/o

–algia	myalgia	muscle pain
–asthenia	myasthenia	muscle weakness
electr/o –gram	electromyogram	record of muscle electricity
cardi/o –al	myocardial	pertaining to heart muscle
–pathy	myopathy	muscle disease
–plasty	myoplasty	surgical repair of muscle
–rrhaphy	myorrhaphy	suture a muscle
–rrhexis	myorrhexis	muscle rupture

## Word building with ten/o, tend/o, and tendin/o

–dynia	tenodynia	tendon pain
–plasty	tenoplasty	surgical repair of tendon
–rrhaphy	tenorrhaphy	suture a tendon
–plasty	tendoplasty	surgical repair of tendon
–otomy	tendotomy	incision into a tendon
–itis	tendinitis	tendon inflammation
–ous	tendinous	pertaining to a tendon

## Word building with –kinesia

brady–	bradykinesia	slow movement
dys–	dyskinesia	difficult movement
hyper–	hyperkinesia	excessive movement
hypo–	hypokinesia	insufficient movement

## Word building with –tonia

a–	atonia	lack of tone
dys–	dystonia	abnormal tone
hyper–	hypertonia	excessive tone
hypo–	hypotonia	insufficient tone
my/o	myotonia	muscle tone

## **Muscular system vocabulary**

adhesion	scar tissue in fascia; makes muscle movement difficult
atrophy	poor muscle development; result of muscle disease or lack of use; muscle wasting
contracture	abnormal shortening of muscle fibers, tendons, or fascia
hypertrophy	increase in muscle bulk from using it
intermittent claudication	attacks of severe pain and lameness caused by muscle ischemia; usually in calf muscles
spasm	sudden, involuntary, strong muscle contraction
torticollis	severe neck spasms pulling head to one side; wryneck or crick in the neck

## **Muscle pathology**

fibromyalgia	widespread aching and pain in muscles and soft tissue
lateral epicondylitis	inflammation of elbow muscles; caused by strong gripping; tennis elbow
muscular dystrophy	inherited disease with progressive muscle atrophy
pseudohypertrophic muscular dystrophy	one type of inherited muscular dystrophy; also called Duchenne's muscular dystrophy

## **Pathology of tendons, muscles, and/or ligaments**

carpal tunnel syndrome	repetitive motion disorder; compression of finger tendons and median nerve as they pass through carpal tunnel of the wrist
ganglion cyst	cyst on tendon sheath; usually on hand, wrist, or ankle
repetitive motion disorder	chronic disorders involving tendon, muscles, joints, and nerve damage; tissue is subjected to pressure, vibration, or repetitive movements
rotator cuff injury	joint capsule of shoulder joint is reinforced by tendons; high degree of flexibility puts rotator cuff at risk for strain and tearing
strain	damage to muscle, tendons, or ligaments due to overuse or overstretching

## **Clinical laboratory tests**

creatinine phosphokinase	muscle enzyme found in skeletal and cardiac muscle; elevated blood levels indicate muscle damage; seen in muscular dystrophy and heart attack
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## **Muscular system diagnostic procedures**

deep tendon reflexes	muscle contraction in response to stretch; used to determine if muscles are responding properly
electromyography	study of strength and quality of muscle contraction in response to electrical stimulation
muscle biopsy	removal of muscle tissue for examination

## **Surgical procedures**

carpal tunnel release	cutting of ligament in wrist to relieve pressure caused by carpal tunnel syndrome
tenodesis	surgical stabilization of a joint by anchoring down tendons of muscles that move the joint

## **Muscular system pharmacology**

skeletal muscle relaxants	relax skeletal muscle spasms
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