

Musculoskeletal System

Skeletal System

Functions of skeletal system

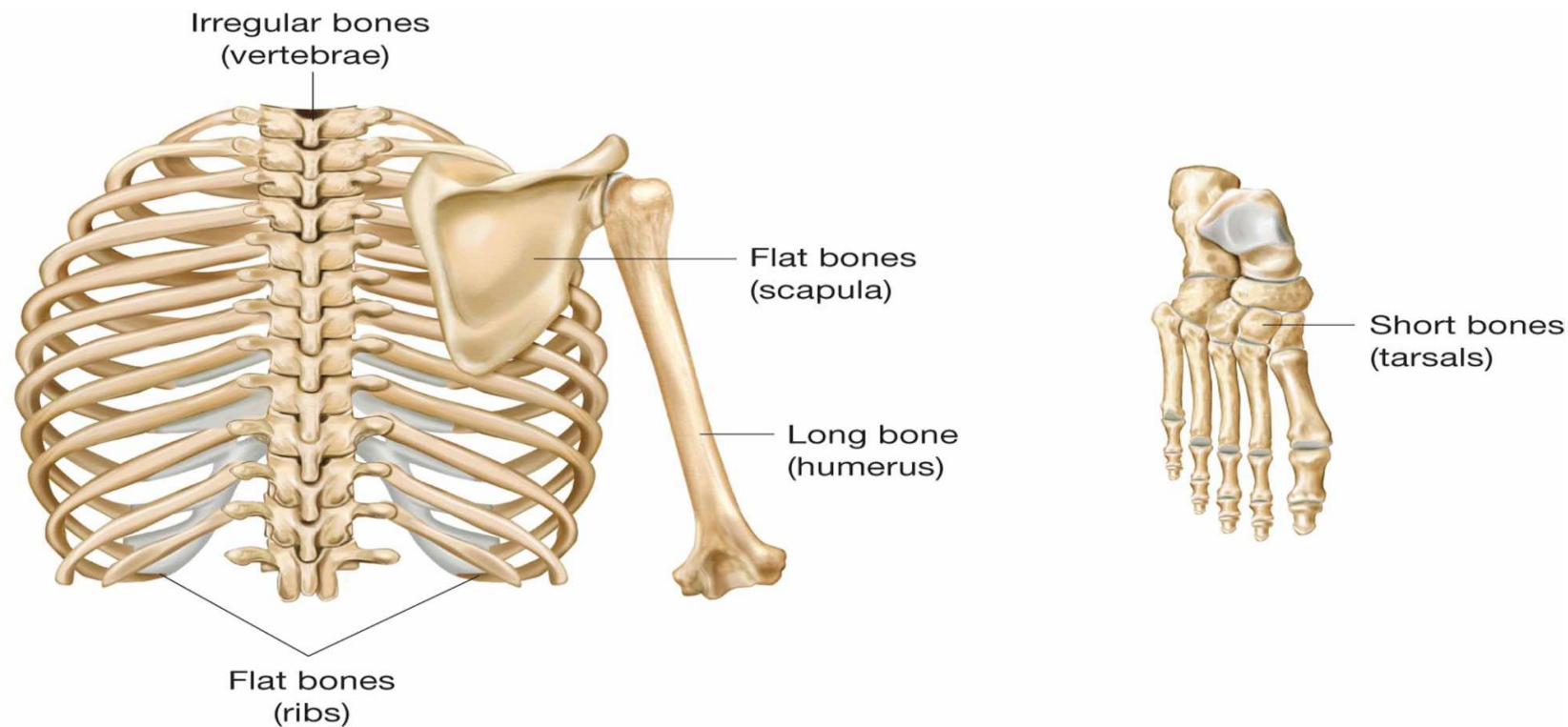
- Internal framework of body
- Supports body
- Protects internal organs
- Point of attachment for muscles
- Produces blood cells
- Stores minerals

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

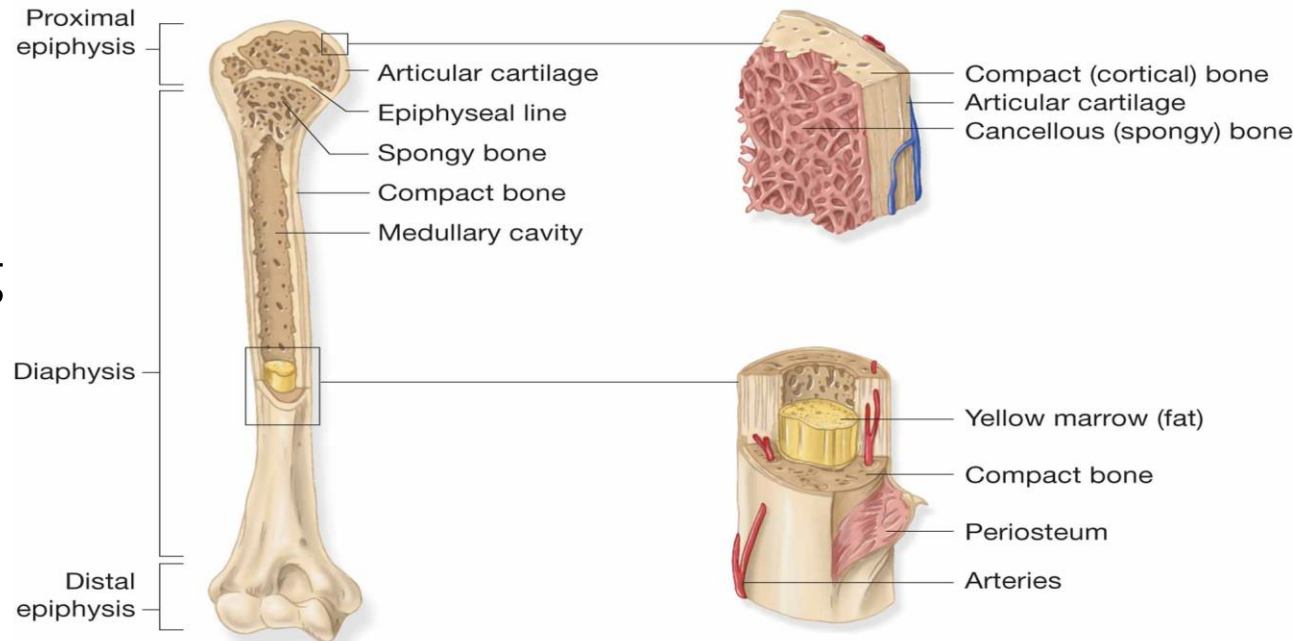
| Long bones | Short bones | Flat bones | Irregular bones |
|--|--|---|--|
| Longer than wide | Roughly as long as wide | Plate- shaped | Shape very irregular |
| <u>Example:</u> - femur - humerus | <u>Example:</u> - carpals - tarsals | <u>Example:</u> - sternum - scapula - pelvis | <u>Example:</u> -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

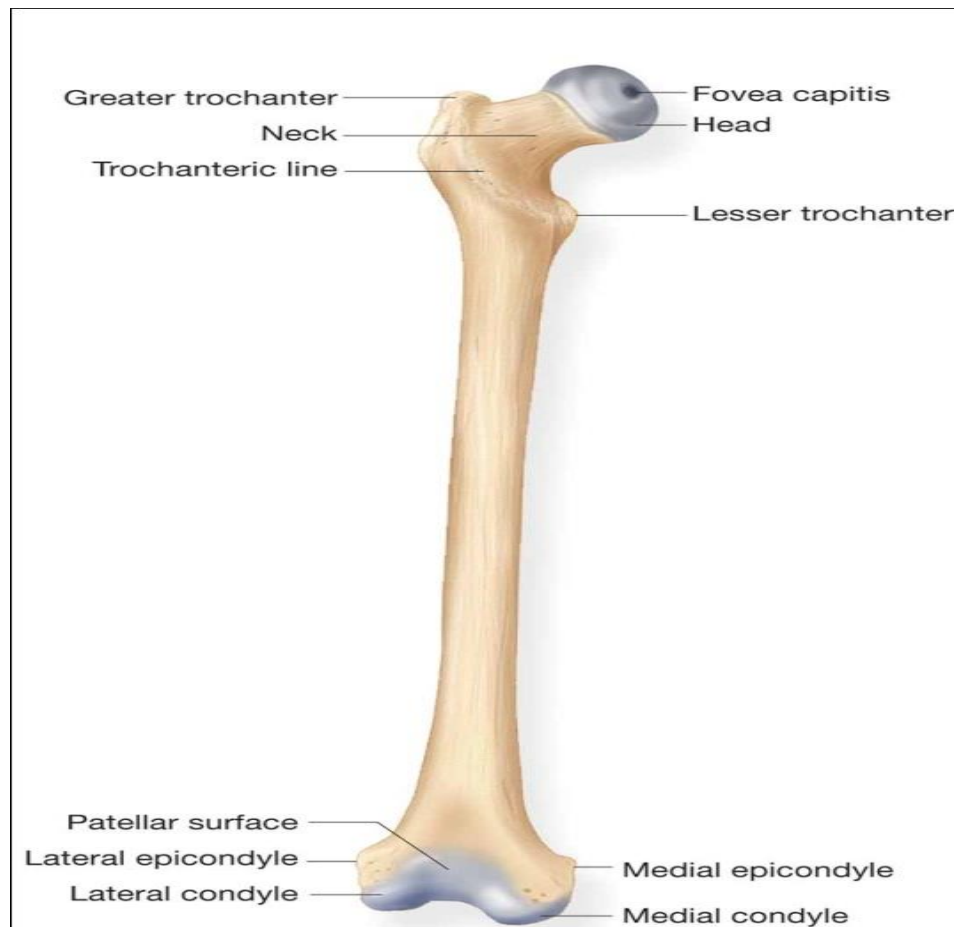
Components of a long bone



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

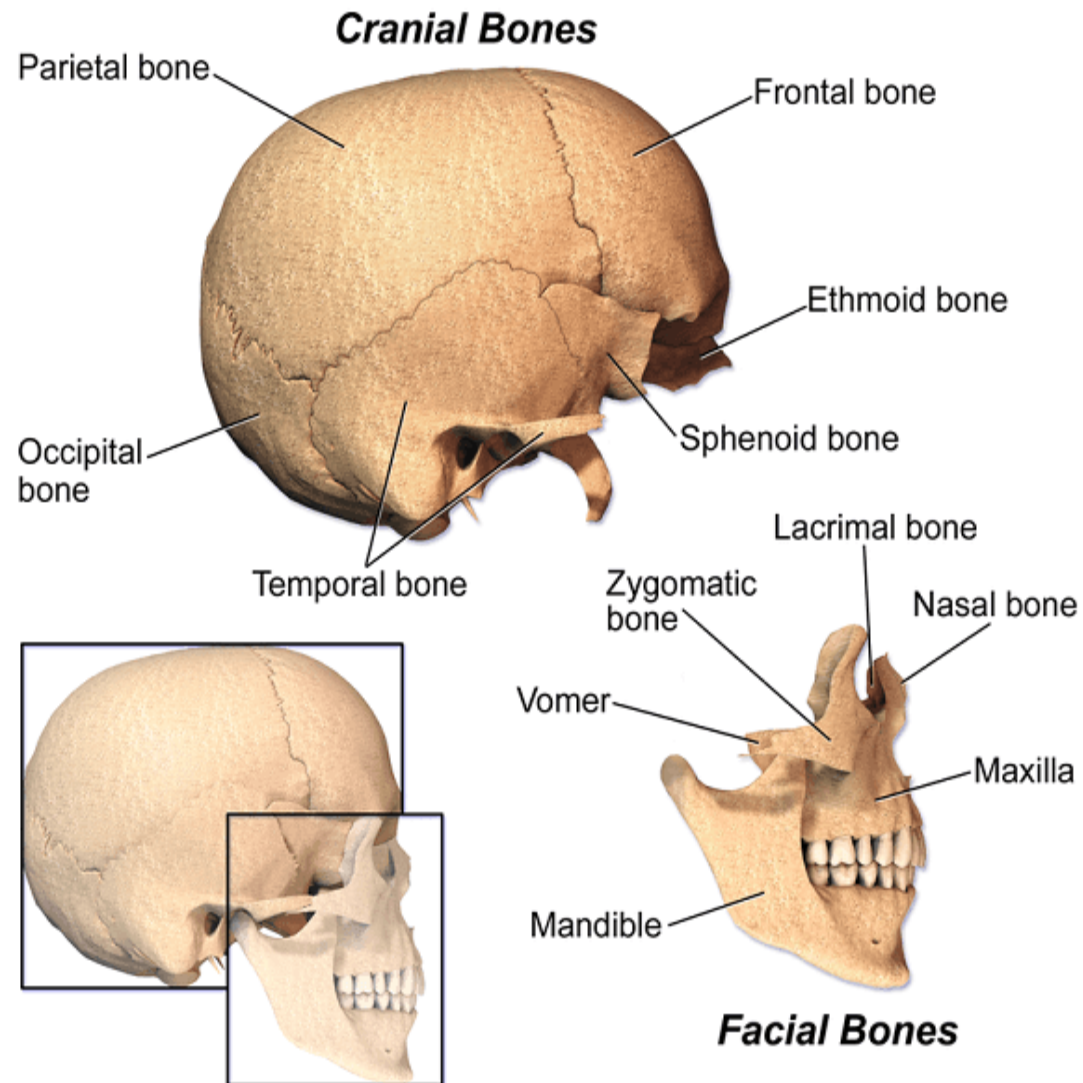
- Is divided into two parts: cranium and facial bones
- Protects brain, eyes, ears, nasal cavity, and oral cavity
- Attachment for muscles of chewing and turning the head

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)

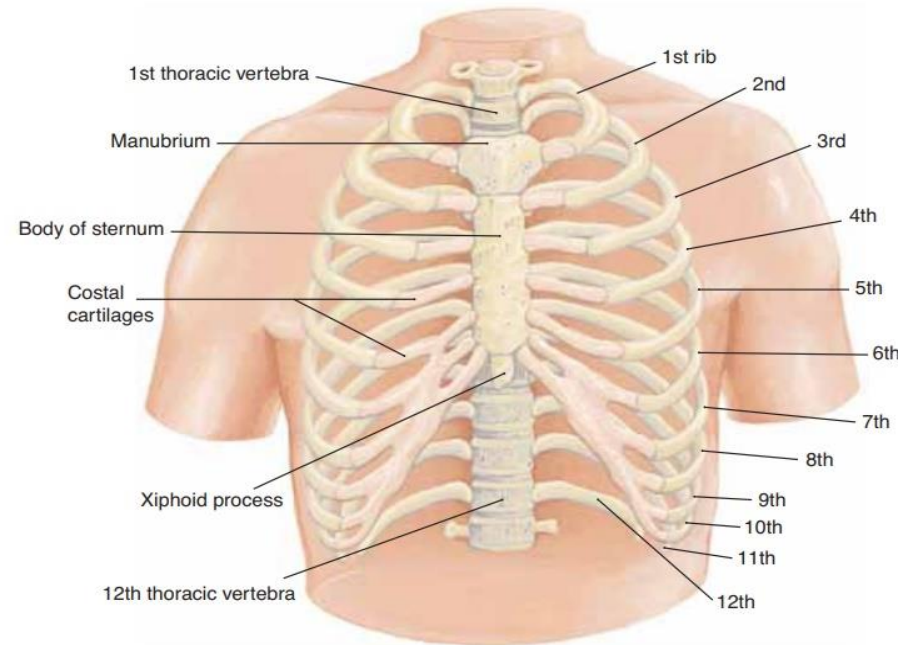
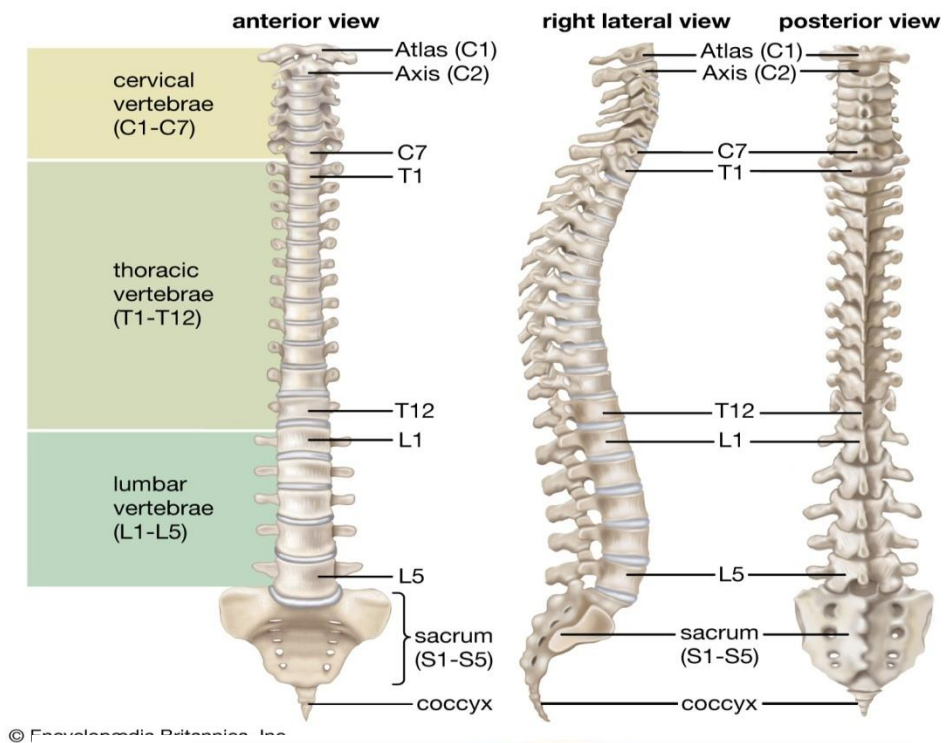


Figure Rib cage. Anterior view.

B. Appendicular skeleton

- Includes bones of:

1- Pectoral girdle

- Attaches upper extremity to axial skeleton

- Articulates with:

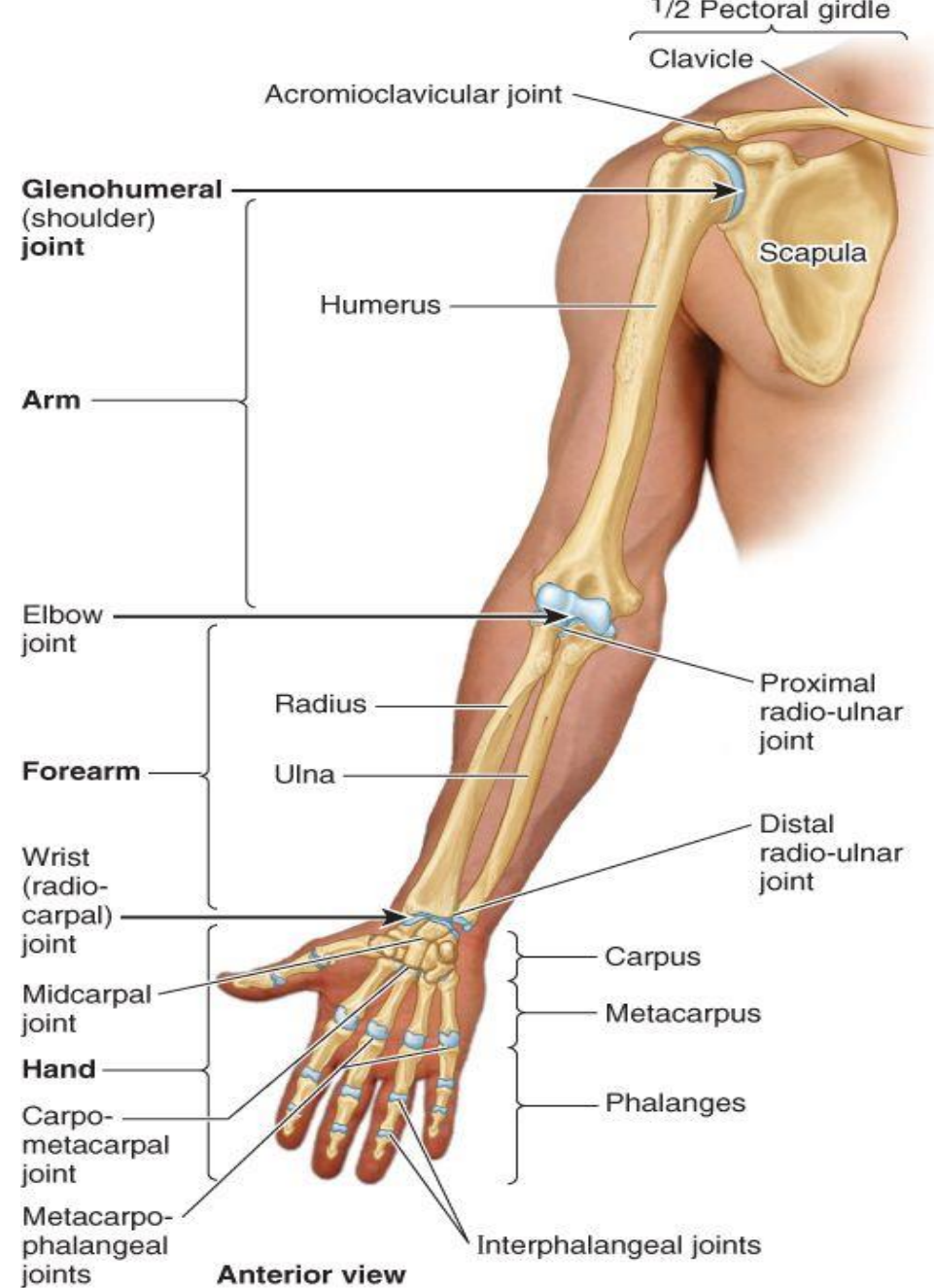
- Sternum anteriorly
- Vertebral column posteriorly

- 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

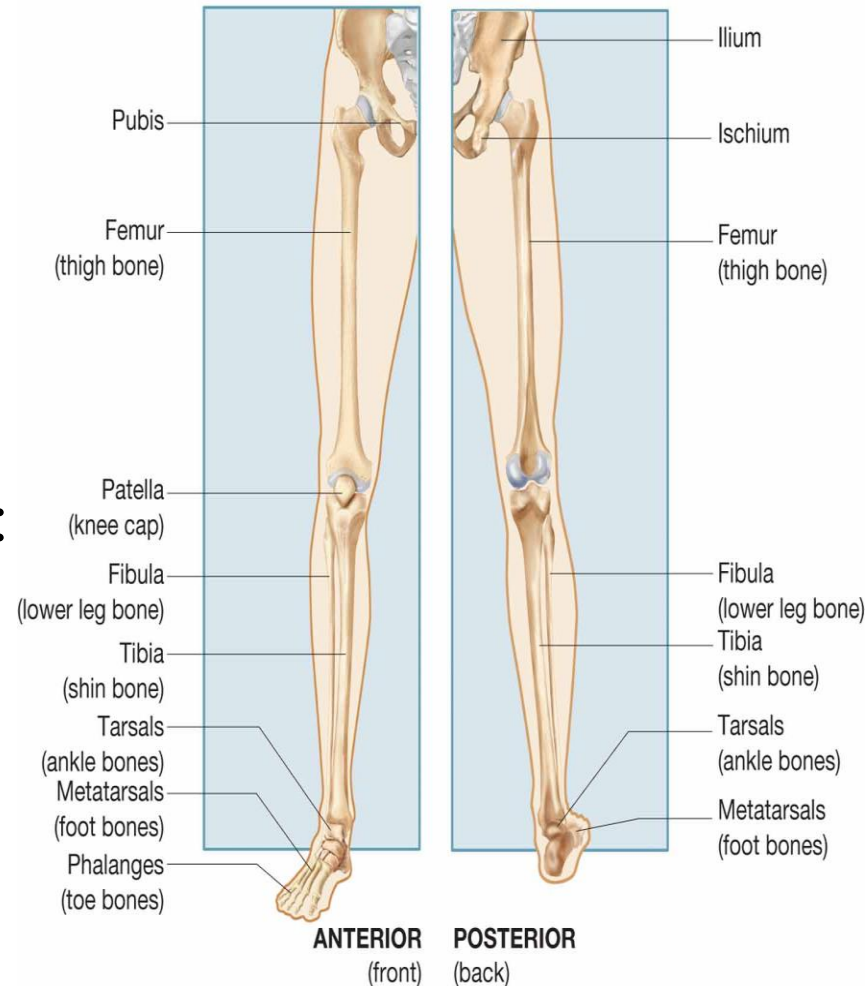


3- **Pelvic girdle** (hipbone)

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

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

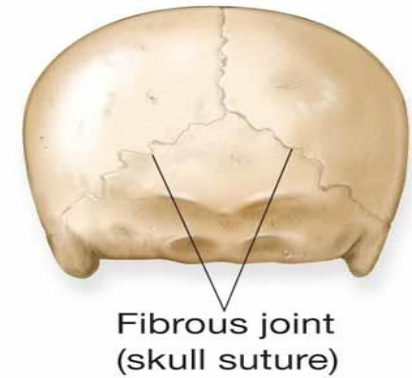
- Femur – thigh bone
- Patella – knee cap
- Fibula – lower leg bone
- Tibia – shin bone
- Tarsals – ankle bones
- Metatarsals – foot bones
- Phalanges – toe bones



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)

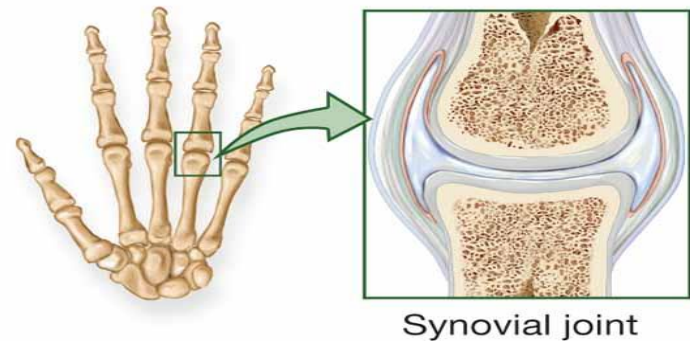
Skull



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

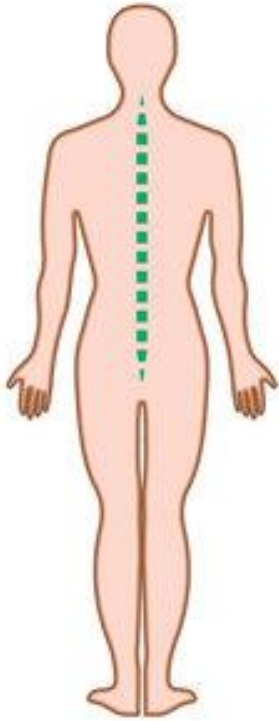
| | | |
|--------------|----------------|-----------------------------------|
| –algia | ostealgia | bone pain |
| chondr/o oma | osteochondroma | bone and cartilage tumor |
| –clasia | osteoclasia | surgically break a bone |
| myel/o –itis | osteomyelitis | bone and bone marrow inflammation |
| –otomy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

Word building with synov/o & vertebr/o

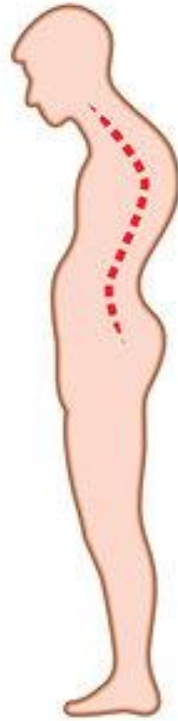
| | | |
|------------|----------------|---------------------------------------|
| –itis | synovitis | inflammation of synovial membrane |
| –ectomy | synovectomy | surgical removal of synovial membrane |
| inter– –al | intervertebral | pertaining to between vertebrae |

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 |



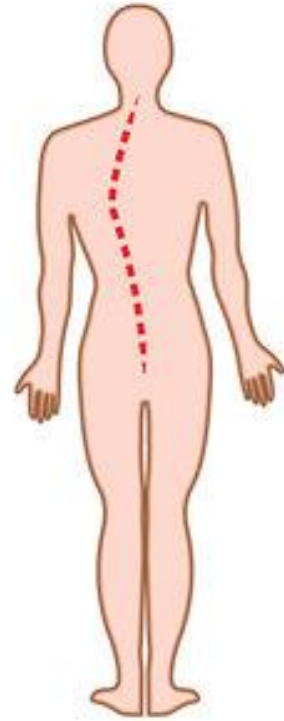
Healthy



Kyphosis



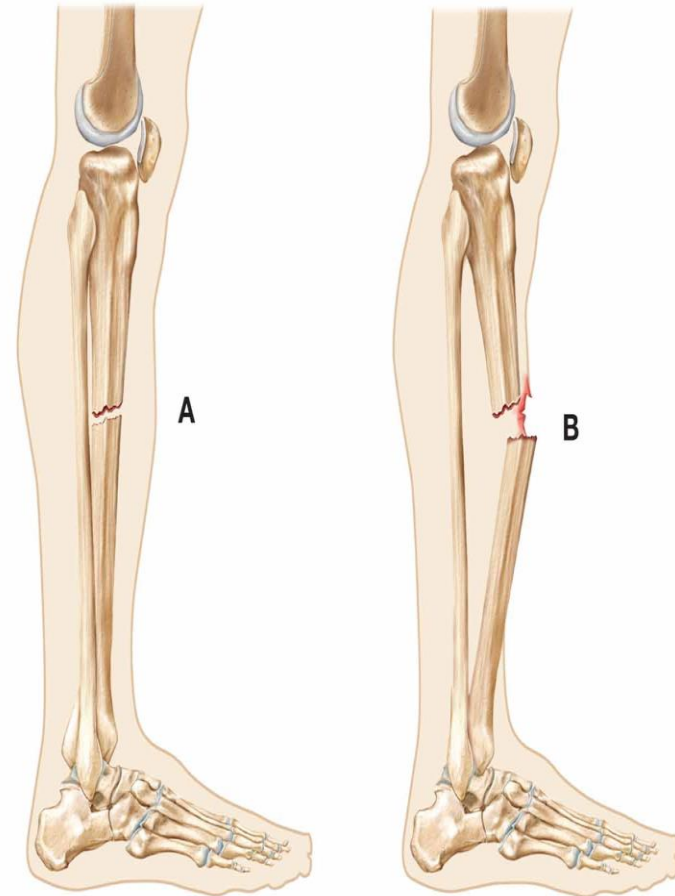
Lordosis



Scoliosis

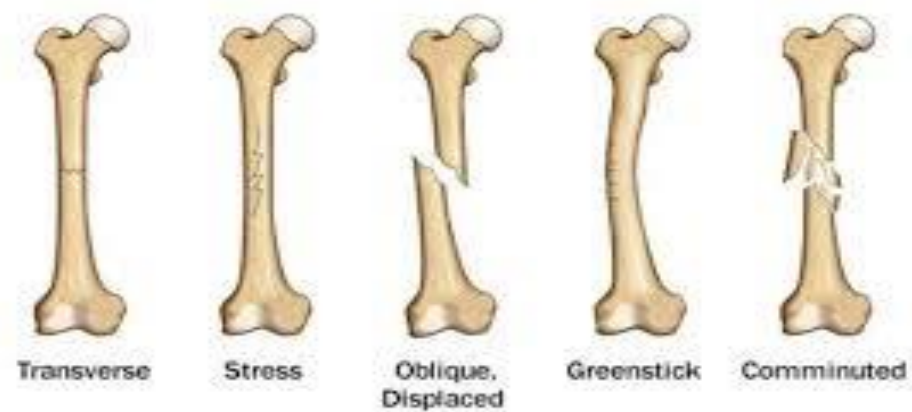
Fractures

| | |
|----------------------|---|
| 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 |
|-------------|--|

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

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



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)

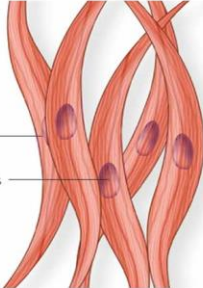

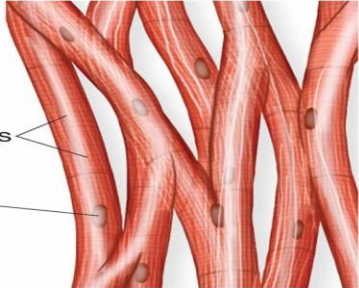
- Attached to bones to produce voluntary movement of skeleton
- Stimulated by motor neurons

Smooth muscles (visceral muscles)

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

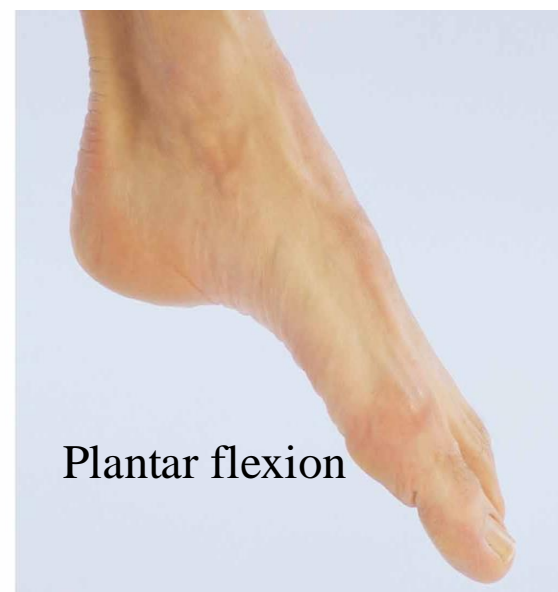
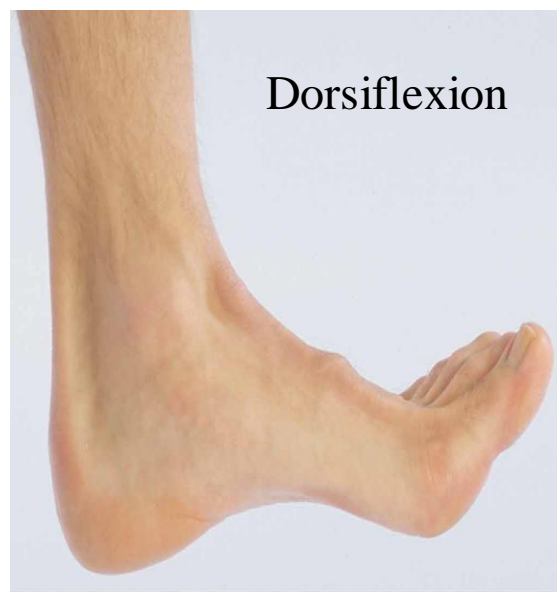
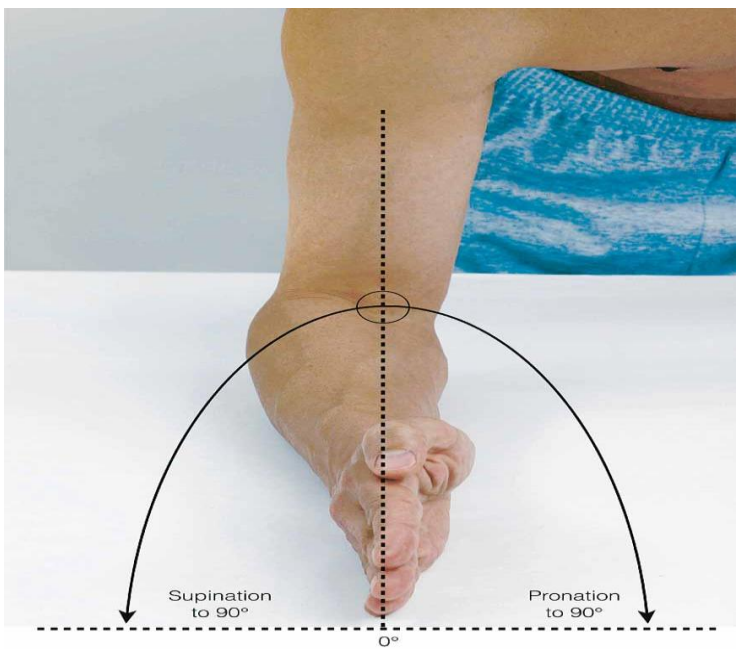
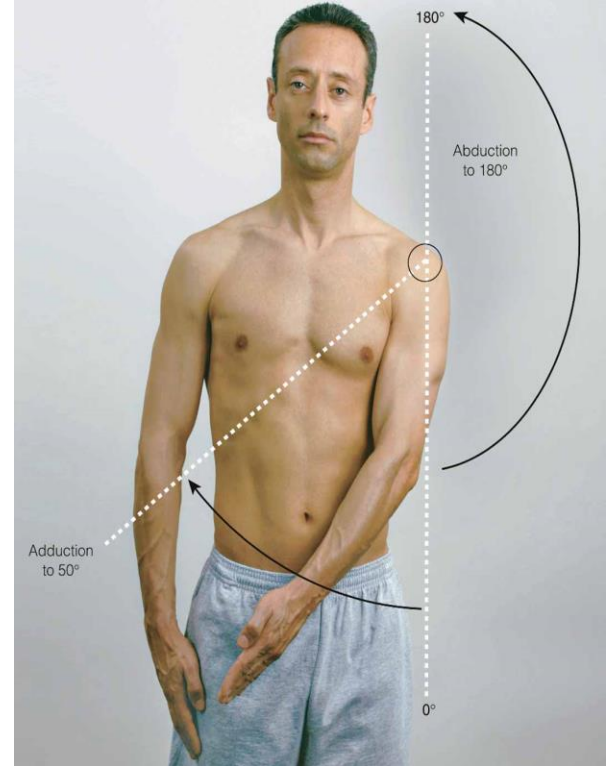
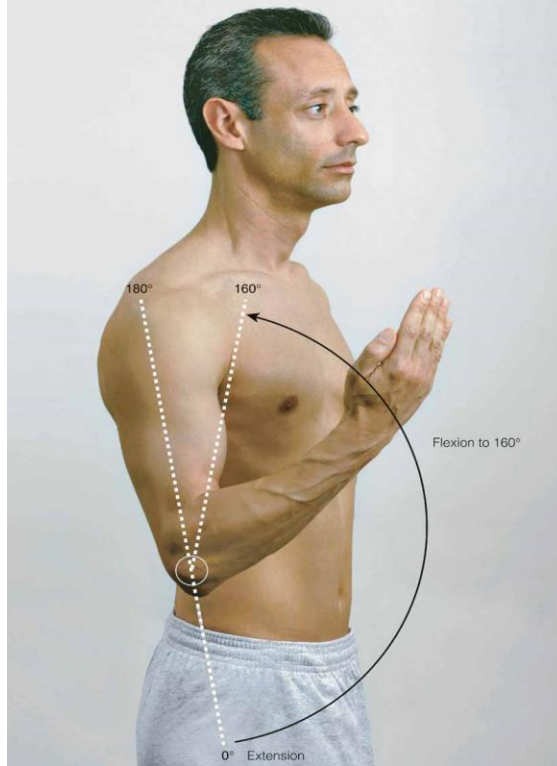
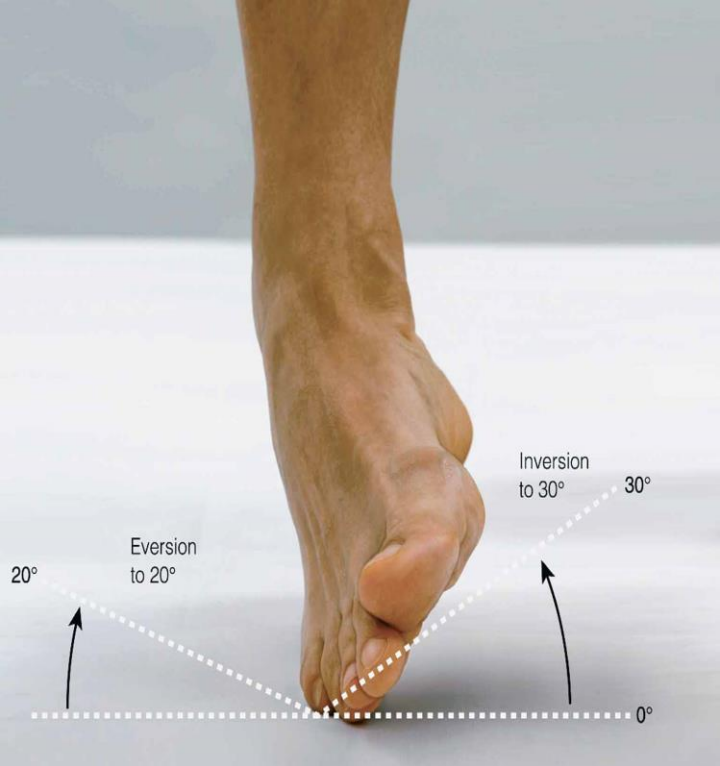
Cardiac muscle (myocardium)

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

| | Visceral (smooth) | Skeletal (striated) | Cardiac |
|------------------|---|---|---|
| |  |  |  |
| Contracts | Slowly | Rapidly | Rapidly |
| Found | Viscera, blood vessels | Trunk, extremities, head and neck | Heart |
| Control | 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

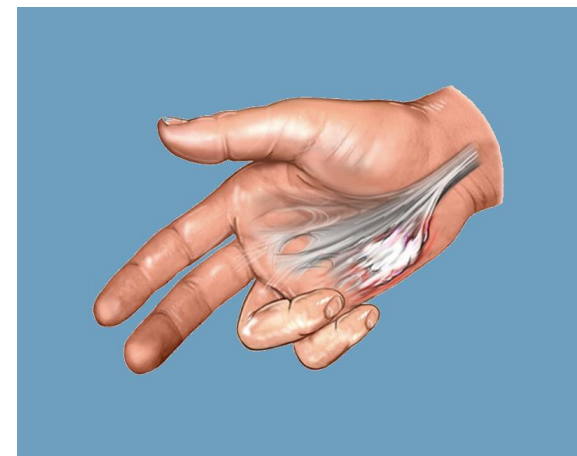
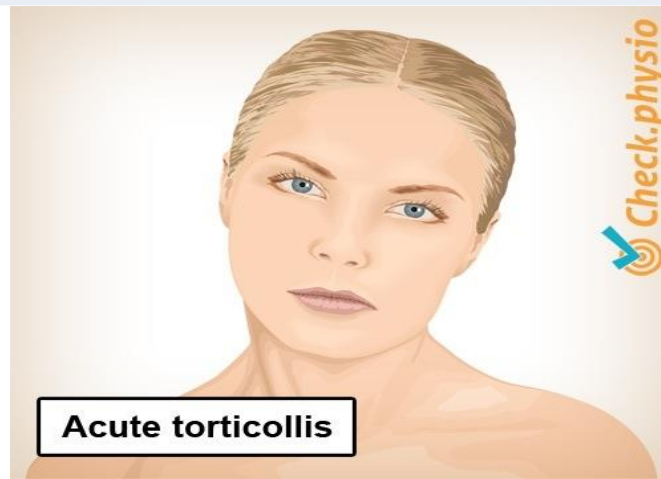
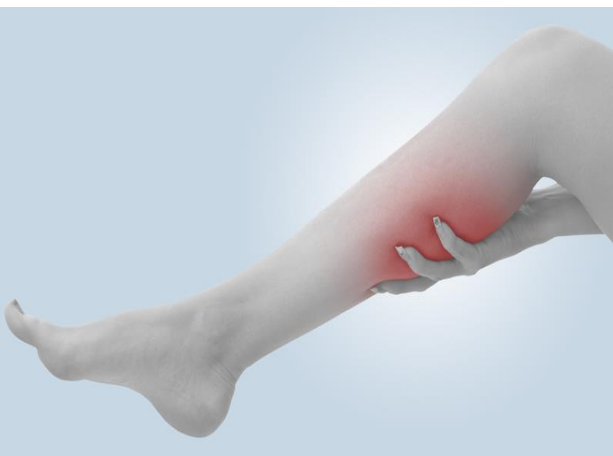
| | | |
|--------|--------------|-----------------------|
| brady– | bradykinesia | slow movement |
| dys– | dyskinesia | difficult movement |
| hyper– | hyperkinesia | excessive movement |
| hypo– | hypokinesia | insufficient movement |

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 |
|--------------------------|---|

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 |
|---------------------------|------------------------------|