The Language of Anatomy

- Anatomical position
- Axial
- Appendicular part

Body Planes and Sections

- Sagittal:mid, para
- Frontal/Coronal
- Transverse/Horizontal

Directional Terminology

- ***Posterior/Dorsal***
- ***Anterior/Ventral***
- ***Superior/Cranial***
- ***Inferior/Caudal***
- ***Lateral***
- ***Medial***
- ***Proximal***
- ***Distal***
- ***Superficial***
- ***Deep***

Body Cavities

- Dorsal-cranial,vertebral
- Ventral-thoracic (pleural, pericardial), abdominopelvic

Membranes in Ventral Body Cavity

- Visceral serosa
- Parietal serosa
- Serous fluid
- Organ association

  Pericardium

  Pleura

  Peritoneum

Abdominopelvic Regions

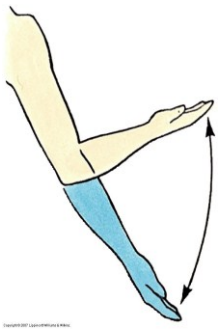
- ***Umbilical region***
- ***Epigastric region***
- ***Hypogastric region***
- ***Inguinal regions (right/left)***
- ***Lumbar regions (right/left)***
- ***Hypochondriac regions (right/left***)

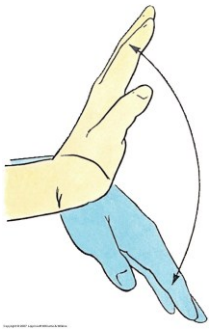
Abdominopelvic Regions

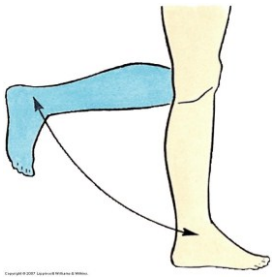
- ***Right Upper***
- ***Left Upper***
- ***Right Lower***
- ***Left Lower***

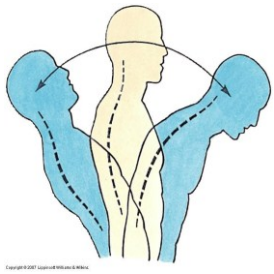
Movement Terminology

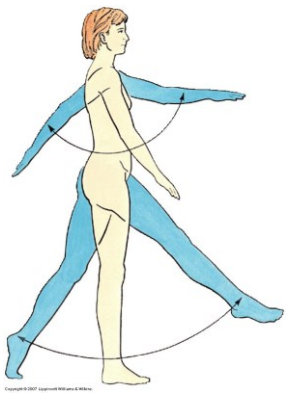
- Flexion, extension
- Abduction, adduction
- Rotation: lateral, medial
- Circumduction
- Pronation, supination
- Eversion, inversion
- Protraction/protrusion; retraction/retrusion
- Elevation, depression

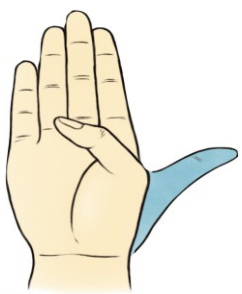


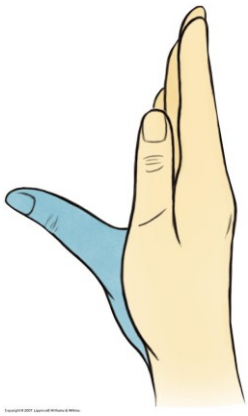


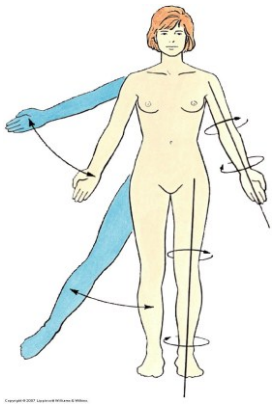


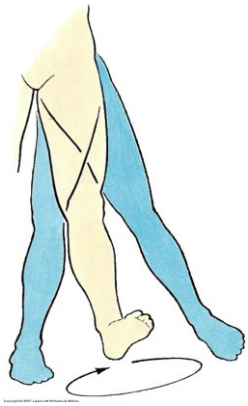


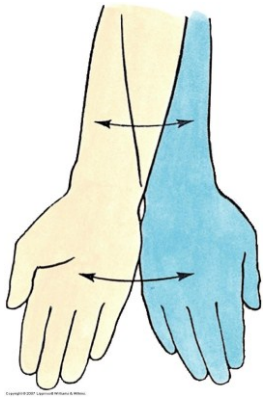


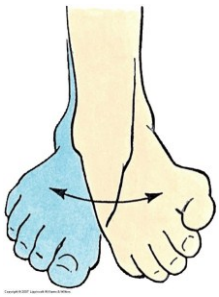


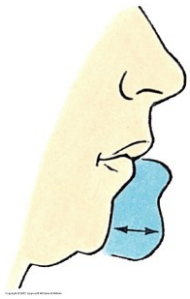


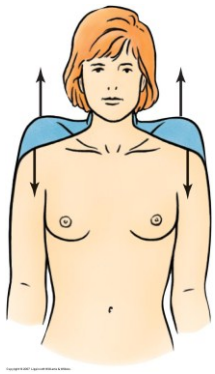












Body Planes and Sections

- Sagittal:mid, para
- Frontal/Coronal
- Transverse/Horizontal

Histology

- *Complements study of gross anatomy*
- *Tissues are groups of cells w/common and related functions.*
- Primary tissue types:
  Epithelial(covering),Connective(support), Muscle(movement), Neural(control).

Epithelial Tissue

- Occurs in the body as***:***
  Covering, lining, glandular epithelium
- Functions include***:***
  Protection, absorption, filtration,secretion.

Epithelial Classification

- **Number of layers:** *Simple(single cell)* layer for absorption, filtration, & thin barrier. *Stratified (two or more)*layers common in high abrasion areas.
- **Shape**: *Squamous, Cuboidal, Columnar* (nuclear shape conforms to cell shape)

Simple Epithelia

- ***Simple Squamous***- Cells laterally flattened; located in areas of filtration/rapid diffusion.
  Endothelial lining-provides frictionless lining; blood vessels/heart chambers.
  Mesothelial-epithelium found lining organs.

Simple Epithelia

- ***Simple Cuboidal***-Spherical nuclei; absorption & secretion; kidney tubules and secretory ducts.
- ***Simple Columnar***-Single layer of tall cells aligned in rows;some have cilia;absorption & secretion.
- ***Pseudostratified Columnar***- Cells vary in height; absorption & secretion; trachea.

Stratified Epithelia

- ***Stratified Squamous***- Most widespread (in areas of wear and tear);superficial cells less viable than deep cells>epidermis is keratinized, other areas non-keratinized
- ***Transitional***- Basal cells are cuboidal/colum., apical cells vary in shape according to distension of organ; urinary bladder

Stratified Epithelia

Stratified Columnar- Rare tissue; forms large gland ducts and male urethra

Stratified cuboidal

Connective Tissue

- ***Found throughout entire body but never exposed.***
- ***Classes : (1)Connective tissue proper (2)cartilage (3)bone (4) blood.***
- ***Functions: (1)binding/support (2) protection (3) insulation (4) transportation.***

CT Proper

- ***Loose Connective Tissue***

Areolar- Most widely distributed CT; supports and binds other tissues,reinforces organs, stores nutrients.

Adipose- Adipocytes predominate(90%), oil droplet occupies cell volume displacing nuclei; tissue vascularized; insulation & shock absorber.

CT Proper

- **DENSE CONNECTIVE TISSUE**

Dense regular-Parallel collagen fibers/ poorly vascularized; enormous tensile strength; found in tendons, ligaments.

Dense irregular:Irregularly arranged collagen fibers, found in dermis, fibrous coverings of kidneys, bones, cartilages, muscles, and nerves.

Supportive CT

Hyaline Cartilage

- Most abundant cartilage.
- Chondrocytes (1-10%) of cartilage vol.
- Located in nose, costal cartilages, tracheal rings,larynx, embryonic skeleton, and epiphyseal plates.

Elastic Cartilage

- Similar to hyaline; elastin fibers
- External ear and epiglottis

Supportive CT

Fibrocartilage

- Matrix dominated by densely interwoven collagen fibers
- Compressible & tension resistant.
- Intervertebral discs,pubic symphysis, meniscus.

Integumentary System

Skin

3 regions

- Epidermis
- Dermis
- Subcutaneal

Epidermis

- Keratinized stratified squamous
- 4-5 layers

Cell types

- Keratinocytes
- Melanocytes
- Merkel cells
- Langerhans' cells

Epidermal layers

- Stratum basale
- Stratum spinosum
- Stratum granulosum
- Stratum lucidum
- Stratum corneum

Dermis

- “Second” skin
- Fibroblasts, macrophages, mast cells,WBCs
- 2 layers:papillary, reticular
- Hypodermis
- Striae

Nail structure

- Scalelike modification of epidermis
- Eponychium
- Hyponychium

Sweat/sebaceous glands

- Eccrine
- Apocrine
- Ceruminous
- Mammary
- Sebaceous

Hair

- Filamentous strands of dead keratinized cells
- Produced by follicles
- Shaft projects from skin
- Root in skin
- Melanocytes
- Arrector pili

Hair (cont'd)

- Distribution: entire body except palms, soles, lips, nipples, genital regions
- Hair types: vellus, intermediate, terminal

Bone Classification

- 206 named bones
- Axial skeleton
- Appendicular skeleton
- Shape classification: long, short, flat, irregular, sesamoid

Bone Classification(cont'd)

- *Long bones*: length exceeds width;shaft & 2 ends;primarily compact w/spongy interior; ex. humerus, femur
- *Short bones*: cubelike;spongy bone; ex. carpals, tarsals
- *Flat bones*: thin,flattened, w/slight curvature;compact bone surfaces w/spongy layer; ex. sternum, ribs

Bone Classification(cont'd)

- *Irregular bone*: complicated shapes & mostly spongy bone; ex. vertebra, pelvis
- Sesamoid:short bone,forms within tendon;patella

Bone Functions

- Support-hard framework;supports body wall (limbs, rib cage)
- Protection-braincase, vert.foramina
- Movement-levers
- Storage
- Blood cell formation

Bone Structure

- Bones are organs-osseous tissue, along with nervous,cartilaginous,fibrous CT
- Osteocytes, osteoblasts, osteoclasts

Textures: Compact vs Spongy

- Compact-dense, smooth, solid outer layer, osteons
- Spongy bone-honeycomblike; trabeculae

Structure of Typical Long Bone

- Diaphysis-compact bone surrounds cavity;yellow marrow evident in adults
- Epiphyses-compact exterior,spongy interior;hyaline cartilage on joint surface

Structure of Typical Long Bone (cont'd)

- Periosteum-double layered (outer & inner);fibrous outer, inner has osteoblasts & osteoclasts;Sharpey's fibers
- Endosteum-lines marrow; osteoblasts & osteoclasts

Structure of short, irregular & flat bones

- Non-cylindrical
- No marrow cavity
- Diplöe-internal layer of spongy bone in flat bones

Hematopoietic Tissue

- **Red marrow**
- In newborns, red marrow predominate cavities
- Adults: RBC produced in femoral& humeral head, diploe of sternum, & irregular bones (pelvic)

Microscopic Structure of Bone

- Compact bone-has osteons
- Osteon-has Haversian system
- Haversion system-central canal, Volkmann's canal, lacunar osteocytes, & canaliculi
- Spongy bone

Bone Markings

Muscle & ligament attachment projections

- Tuberosity-rounded elevation
- Crest-ridge
- Line-linear elevation
- Tubercle-small eminence
- Trochanter-blunt elevation
- Epicondyle-eminence sup. to condyle
- Spine- "thorn" like process

Bone Markings

Joint forming projections

- Head
- Facet-smooth flat area
- Condyle-rounded articulation

Bone Markings

Depressions/openings for blood vessels & nerves

- Meatus
- Groove
- Fossa-hollowed or depressed area
- Foramen-passage through bone

Joint Classification

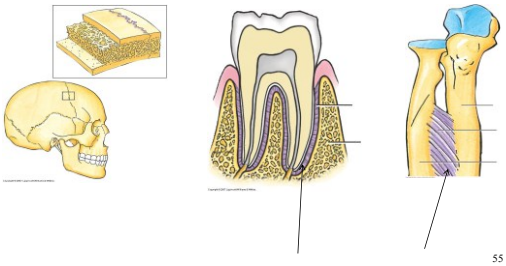
Fibrous joint

Suture: cranial sutures
Gomphosis: tooth socket
Syndesmosis (ligamentous): interosseus membrane

Cartilaginous joint

Hyaline (synchondrosis): epiphyseal plate
Fibrocartilaginous: intervertebral disc & symphysis

Fibrous joints



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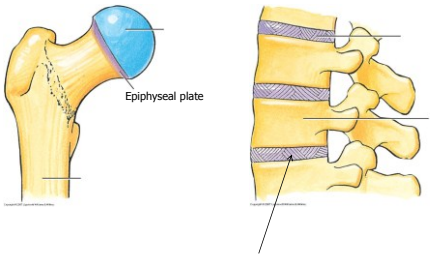
Cartilaginous joints



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Joint Classification

Synovial joints

- Planar (gliding)

Uniaxial (flexion & extension; axial rotation)

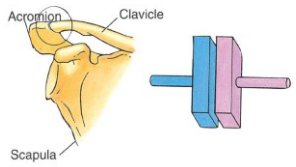
Hinge

Pivot

Biaxial (flexion & extension; abduction & adduction; circumduction)

Condyloid=Ellipsoid

Planar



Plane joints permit gliding or sliding movements (e.g., the acromioclavicular joint).

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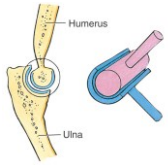
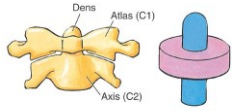
Uniaxial



Hinge joints (uniaxial) permit flexion and extension only (e.g., the elbow joint).



Pivot joints (uniaxial) allow rotation. A round process of bone fits into a bony ligamentous socket (e.g., the atlantoaxial joint between the atlas [C1] and axis [C2]).

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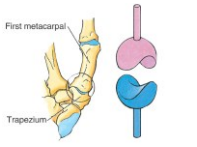
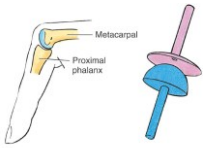
Biaxial



Saddle joints (biaxial) are shaped like a saddle—that is, they are concave and convex where the bones articulate (e.g., the joint between the metacarpal and the trapezium).



Condyloid joints (biaxial) permit flexion and extension, abduction and adduction, and circumduction (e.g., the metacarpophalangeal [knuckle] joints of fingers).

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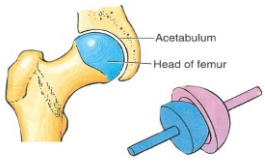
Joint Classification

Multiaxial (flexion & extension; abduction & adduction; medial rotation & lateral rotation)

Ball and socket



Ball and socket joints (multiaxial) permit movement in several axes (e.g., flexion-extension, abduction-adduction, medial and lateral rotation, and circumduction). A rounded head fits into a concavity (e.g., the hip joint).

Overview of Muscle Tissue

- ***Skeletal***-Muscle fibers are the longest of muscle types;striations; voluntary;somatic movement;adaptable.
- ***Cardiac***-Constitutes bulk of heart walls; striated;involuntary;pacemaker sets contractions.
- ***Smooth muscle***-Found in walls of visceral organs, forces fluids/substances through internal body channels; nonstriated; involuntary.

Muscle Functions

- ***Producing movement***-Skeletal muscle is responsible for all somatic movements & manipulation;cardiac muscle courses blood through vessels;smooth muscle-peristaltic actions
- ***Maintaining posture***-Continuously defying gravity via constant adjustments
- ***Stabilizing/strengthen joints***
- ***Generation of heat***-Skeletal muscle contractions responsible for heat production.

Skeletal muscle functions

- Produce somatic movements
- Maintain body posture/position
- Reinforce soft tissue-anterior/posterior walls/pelvic floor
- Guard entrances/exits-orifices of alimentary/urinary tracts
- Regulation of body temperature-heat loss by muscle contractions

Gross Anatomy of Skeletal Muscles

- ***Epimysium***-dense CT surrounds entire muscle;blends with deep fascia.
- ***Perimysium and fascicles***-fibrous CT surrounding bundles of fibers.
- ***Endomysium***-sheath of CT surrounding muscle fiber.
- *CT coverings contributes to muscle tissue elasticity*

Attachments

- Movable ***insertion*** moves towards immovable ***origin.***
- ***Direct attachment-***epimysium fused to periosteum/perichondrium.
- ***Indirect attachment***-epimysium extends beyond muscles as sheet like aponeurosis; anchors muscle to bone, cartilage or fasciae of other muscles.

Tendons and Aponeuroses

- Tendon-fusion point of collagen fibers of endo-, peri-, and epimysium that attach muscle to bone, skin, or another muscle; resemble thick cords or cables
- Aponeuroses-Formation of thick, flattened sheets.

Naming Skeletal Muscles

- **Location**-temporalis, intercostals
- **Shape**-deltoid, trapezius
- **Relative size**-maximus, minimus, longus, brevis
- **Direction**-rectus, oblique
- **Number of origins**-biceps, triceps
- **Location of attachments**-origin first/sternocleidomastoid
- **Action**-flexor, extensor,adductor.

Arrangement of Skeletal Muscle Fibers

- **Circular**-orbicularis oris
- **Convergent**-pectoralis major
- **Parallel**-sartorius
- **Unipennate**-extensor digitorum longus
- **Multipennate**-deltoid
- **Fusiform**-biceps
- **Bipennate**-rectus femoris

The Cardiovascular System:
Blood Vessels

- ***Blood vessels***-closed delivery system that begins and ends at the heart
- ***Heart>arteries>arterioles>capillary bed> venules>veins>heart***

Structure of Blood Vessel Walls

- All blood vessels (except capillaries), are composed of three *tunics* surrounding a central blood-containing *lumen*.
- ***Tunica intima (interna)-***endothelium (continuum of endocardium)
- ***Tunica media***-Circular smooth muscle & elastin; regulated by vasomotor nerve fibers of ANS; vasoconstriction/vasodilation;thickest layer

Structure of Blood Vessel Walls (cont'd)

- ***Tunica externa (adventitia)-***loose collagen fibers that protect/reinforce blood vessel;infiltrated with nerve fibers, lymphatic vessels, elastin fibers; vasa vasorum.

Lymphatic System

- Assists CV system by transporting excess interstitial fluid through lymphatic vessels
- Lymph is sieved for foreign or pathologic material
- Lymphatic structures contain certain cells that initiate an immune response to abnormal materials and perform other functions essential to homeostasis and survival

Lymphatic system functions

Fluid and nutrient transport, lymphocyte development, and the immune response

Reabsorbs interstitial fluid and returns it to the venous circulation in order to maintain blood volume levels and prevent interstitial fluid levels from rising out of control

Transports dietary lipids which are transported through tiny lymphatic vessels called lacteals

Lymphatic Capillaries

– Tend to be larger in diameter, lack a basement membrane, and have overlapping endothelial cells

– Anchoring filaments help hold these endothelial cells to the nearby tissues

Lymphatic Capillaries

- Act as one way valves
  - when interstitial fluid pressure rises, the margins of the endothelial cell walls push into the lymphatic capillary lumen and allow fluid to enter
  - when the pressure increases in the lymphatic capillary, the cell wall margin pushes back into place next to the adjacent endothelial cell
  - fluid "trapped" in the lymph capillary cannot be released back into the tissues

Lymphatic Vessels

Lymphatic capillaries merge to form larger structures

Lymphatic vessels resemble small veins

Some vessels connect directly to lymphatic organs called lymph nodes

Afferent lymphatic vessels bring lymph to a lymph node where it is examined for foreign or pathogenic material

Once filtered, the lymph exits the lymph node via efferent lymphatic vessels

Lymph nodes are often found in clusters

The Nervous System: Neural Tissue

- Master controlling /communicating system of the body.
- 3 overlapping functions: (1) Sensory input; (2) Integration; (3) Motor output.
- Neuron

Organization of the Nervous System

- ***CNS***-integrating/command center of nervous system.
- ***PNS***-spinal,cranial nerves;functional subdivisions----afferent(sensory), efferent(motor)
- ***Fibers***-somatic(SA,SE)visceral(VA,VE)

Organization of Nervous System (cont'd)

- The motor division has 2 main parts:(1) ***Somatic nervous system*** (voluntary/involuntary);(2) ***Autonomic nervous system*** (visceral motor)—functional subdivisions are sympathetic/ parasympathetic (opposite effects on viscera-stimulaton/inhibition)

Histology of Nervous Tissue

- ***Neuron***-excitable nerve cells that transmit electrical signals
- ***Supporting cells***-surround and wrap neurons;both cell types (neurons/supportive) are bases for CNS/PNS

Histology of Nervous Tissue (Neuroglia)

- Nonnervous supporting cells
- Six types-4 in CNS, 2 in PNS, each has unique function
- Scaffold neurons
- Chemical production guides young neurons to proper connections; promote health/growth.

CNS Supportive Cells

- ***Astrocytes***- most numerous & versatile, radiating processes anchor neurons to capillaries (form BBB); chemical control (K, recycle neurotrans.)
- ***Microglia***- Ovoid cells, monitor neuron health, macrophage.
- ***Ependymal cells***- range in shape from squamous to columnar, line central cavities of CNS, circulate CSF.
- ***Oligodendrocytes***- producers of myelin sheaths.

PNS Supportive Cells

- ***Satellite cells (amphicytes)***-surround neuron soma within ganglia;regulate nutrient/waste product exchange between soma and ECF.
- ***Schwann cells (neurolemmocytes)***-surround and form myelin sheaths (functionally similar to oligodendrocytes);vital to peripheral nerve fiber regeneration.

Neurons

- Structural unit of nervous system
- Have extreme longevity
- Amitotic; exceptions are olfactory & hippocampal.
- High metabolic rate, require ample supply of glucose & oxygen.

Neurons (cont'd)

- Large, complex cells
- Soma, processes
- 3 functional components: input region, conducting component, & secretory component.

Cell Body

- Soma or perikaryon; transparent, spherical nucleus (biosynthetic center) with conspicuous nucleolus; lack centrioles.
- Free ribosomes, RER (Nissl bodies), Golgi apparatus arcs around nucleus; mitochondria, neurotubules, neurofibrils; CNS soma (nuclei), PNS soma (ganglia).

Processes

- CNS contain soma and processes
- PNS contain mostly processes
- Bundles of processes in CNS called *tracts;* nerves in PNS
- ***Dendrites***-short, tapering branching extensions; receptive regions; dendritic spine point of synapse

Processes

- Axon arises from hillock
- Long axon is a nerve fiber
- Each neuron possesses 1 axon; collaterals, telodendria (terminal branches); motor neuron impulse triggered at hillock, terminal represents secretory component; axolemma
- Axoplasmic transport is *anterograde* and *retrograde*

Myelin sheath and Neurilemma

- Myelin protects and electrically insulates fibers and hastens impulses (myelinated 150 m/s vs. unmyelinated ≤ 1m/s); neurilemma
- Nodes of Ranvier; white matter (myelinated fibers), gray matter(soma & unmyelinated fibers)