Standard anatomical position:
Body erect, feet slightly apart, palms forward, thumbs away from body. Remember that “right” and “left” refer to the patient or the cadaver, NOT THE OBSERVER.

2 Fundamental divisions of body:
Axial part = head, body and trunk
Appendicular part = appendages or limbs attached to axis
There are also regional terms that is used to designate specific areas within axial and appendicular part of body

Planes / Sections: There are 3 planes
1. Sagittal plane: vertical plane that divide body into left & right parts. NOT RIGHT AND LEFT HALVES: This is because some planes are parasagittal plane. Where the cut off is not exactly in the middle. In order to have equal halves, midsagittal or median plane.
2. Frontal plane (Coronal): vertical plane that divide body into anterior and posterior parts.
3. Transverse (Horizontal) plane: horizontal plane that divides body into superior and inferior parts. (Traverse section = cross-section)
1 more section: Oblique section – plane is cut at an angle.

Definitions:
Superior: above
Inferior: below
Anterior (ventral): in front
Posterior (dorsal): behind
Medial: towards middle
Lateral: away from middle
Intermediate: between medial and lateral
Proximal: closer
Distal: further
Superficial: towards body surface
Deep: away from body surface

Body cavities:
Dorsal (posterior):
Cranial and vertebral cavity. Cranial cavity unclosed by skull and houses the brain. Vertebral cavity enclosed by the vertebrae and houses the spinal cord. Both cavities are very well-protected. (Very strong and bony)

Ventral (anterior):
Thoracic cavity (superior) and abdominopelvic cavity (inferior)
Thoracic cavity contains 2 lateral pleural cavities (lungs) and central pericardial cavity (heart).
Thoracic cavity is surrounded by ribs and muscles of chest – decent protection.
Abdominopelvic cavity (two parts)
Superior – abdominal (stomach, intestine, spleen, liver) – nothing covering them – no protection
Inferior – pelvic (in bony pelvis, contain urinary bladder, some reproductive organs and rectum)
Bony pelvis sort of protects – protection is basic

Diaphragm separates the thoracic and abdominopelvic cavities, nothing separates the abdominal and pelvic cavity
Skin + derivatives (sweat & oil glands, hair, nails) = integumentary system

Structure of skin:
2 distinct regions:
Epidermis (superficial part of skin) – epithelial layer (thick, keratinized stratified squamous epithelium)
Dermis (deep part of skin) – Connective tissues
There is also the hypodermis, known as superficial fascia because it is superficial to the tough connective tissue wrapping of skeletal muscles, it consists mostly of adipose tissue– not really skin, but shares the skins protective functions. Contains areolar CT+ blood vessels, adipose tissue (store fat)
Act as shock absorber, insulator. It thickens when weight is gained. It anchors skin to underlying structures with ability to slide.
Epidermis isn't vascularized, dermis and hypodermis is. Epidermis gets nutrition from diffusion.

4 types of epidermal cells:
Keratinocytes: majority of epidermal cells. Main function is to produce keratin – fibrous protein that helps give the epidermis its protective properties. The lifespan of keratinocyte is 25-45 days.

Melanocytes: spider shaped, creates the pigment melanin. Found in the deepest layer of the epidermis. As melanin is made, it is accumulated in the membrane bound granules called melanosomes and brought to the numerous branching processes, they are then taken to the nearby keratinocytes, and they accumulate on the superficial side of keratinocyte nucleus, forming a shield protecting UV rays.
*Tanning – tanning produce melanin at a faster rate, this is to protect the nucleus from UV rays. Melanin is a dark colour. Number of melanocytes is the same between people; the difference is half-life, production rate of melanin etc.

Langerhans cells, also called epidermal dendritic cells: star shaped: They are macrophages: ingest foreign substances, activate immune system. Migrate to epidermis from bone marrow.

Merkel cells, also called tactile cells: at epidermis/dermis boundary, have disc-like sensory nerve ending – like touch receptors.

The layers of epidermis (from deep to superficial)
Stratum Basle: attached to dermis, consists of single row of stem cells – youngest keratinocytes. It has high mitotic index. 10-25% of the cells are melanocytes; also some Merkel cells are present.

Stratum Spinosum: several cell layers thick. Contain web of keratin filaments attached to desmosomes. Name reflects when the cell is dried and dead – looks like tiny spiked iron balls. Contain keratinocytes and melanin granules. Also contain Langerhans cells – most abundant in this layer.

Stratum Granulosum: three to five cell layers. Keratinization of cells begins – these cells flatten, their nuclei/organelles begin to disintegrate, they accumulate two types of granules. The keratohyalin and lamellated granules. Keratohyaline granules help to form keratin in the upper layers. The lamellated granules contain water-resistant glycolipids that are a major factor in slowing water loss. Cells are now struggling to be viable. They are too far from the capillaries, and are cut off from the nutrients by the glycolipids.

Stratum Lucidum: two or three rows of clear, flat, dead keratinocytes – translucent. The Keratohyaline granules are in parallel arrays. Only found in thick skin. No more nourishment from capillaries.

Stratum Corneum: 20 – 30 cell layers thick. They account for ¾ of the epidermal thickness. They are thickest on palm of hand & soles. They are dead cells filled with keratin fibrils – they are strong, protective and waterproof.

Thick skins refers to skin that contain all 5 layers, thin skins to skin that contain only 4 layers – no stratum lucidum. Most of our body are soft skin other than the palm, fingertips, and soles of feet.

Dermis: Strong, flexible connective tissue, the cells are fibroblasts, macrophages, some mast cells and white blood cells. It is semifluid matrix, embedded with collagen, elastin & reticular fibers – binds entire body together.
Dermis is richly supplied with nerve fibers, blood and lymphatic vessels. Also contain hair follicles, oil & sweat glands.
The dermis contains two layers, the thin superficial papillary layer, and the deep thick reticular layer. The top 20% of dermis is papillary, and the bottom 80% is reticular.
Papillary layer:
Fine interlacing collagen and elastic fibers form a loosely woven mat interspersed with small blood vessels. The looseness of this CT allows phagocytes and other defensive cells to wander freely as they patrol the area for bacteria. The superior surface is thrown into peg like projections called dermal papillae that indent the overlying epidermis. On palms of the hands and soles of feet, these papillae lie atop larger mounds called dermal ridges. Collectively, these skin ridges are called friction ridges, increase friction and enhance gripping ability of fingers and feet. These create finger prints.
Reticular layer:
Dense irregular fibrous CT. Network of blood vessels that nourish this layer lies between this layer and hypodermis – they are called Cutaneous plexus. The bundles of collagen fibers are parallel to the skin. Separations or less dense regions between these bundles form cleavage or tension lines in the skin. These externally invisible lines tend to run longitudinally in the skin of the head and limbs and in circular patterns around the neck and trunk.
*When an incision is made parallel to these lines, the skin gapes less and heals more readily than when the incision is made across the tension line.
Collagen fibers of the dermis give skin strength and resiliency that prevent most jabs and scrapes from penetrating the dermis. Collagen also binds to water, helping keep skin hydrated. Elastic fibers provide the stretch-recoil properties of skin.

In addition to the epidermal ridges and tension lines, a third type of skin marking is flexure lines. They are dermal folds hat occur at or near joints, where dermis is tightly secured to deeper structures. Since skin cannot slide easily to accommodate joint movement, the dermis folds and deep skin creases form.

Extreme stretching of stretching such as pregnancy can tear the dermis. This tearing is indicated by silvery white scars called striae. They are commonly called “stretch marks”.

Short-term but acute trauma (such as burn, or wielding a hoe) can cause a blister, the separation of the epidermal and dermal layers by fluid-filled pocket.

The pigments that contribute to skin colour:
Melanin: Only pigment made in the skin, its two forms range in color from yellow to tan to reddish brown to black. Skin colour dependent on type, relative amount and keratinocyte retention of the pigment (how long keratinocyte can hold them).
Carotene: yellow to orange pigment found in plant products (carrot). It accumulates in keratinocytes (mostly stratum corneum) and in fatty the fatty tissue of the hypodermis. Carotene can be converted to vitamin A, which is essential for normal vision, as well as for epidermal health.
Hemoglobin: red blood cells circulating through the dermal capillaries, give the pinkish hue to skin. Cyanosis – decreased oxygen level in hemoglobin, give skin bluish colour. Caucasians have little melanin, the epidermis is nearly transparent, this allow for the hemoglobin colour to really show.

Hair & Hair follicles
Sense insects, guard head (physical trauma, heat loss, sun), shield eyes, and filter particles from inhaled air.
Hard keratin (more durable, doesn’t flake)
Hair shaft – Keratization is complete. Hair root – Keratization ongoing
Hair shaft – the shape determines if the hair is straight or curly.
If the shaft is flat, the hair/ribbon like in cross section, the hair is kinky
If the shaft is oval, the hair is silky and wavy
If the shaft is round, the hair is straight and course.

The shaft has three layers
Medulla - consists of large cells and air spaces. Medulla is the only part of the hair that contains soft keratin. Absent in fine hairs
Cortex – bulky layer surrounding medulla, consists of several layers of flattened keratinocytes, melanin pigment is here
Cuticle – single layer of overlapping cells (like singles on a roof). It helps to keep neighboring hairs apart. Most heavily keratinized part of the hair, provides strength and helps keep inner layers compacted.

Split ends occur when the cuticles wear away at the tip of the hair shaft due to abrasion, the keratin fibrils in the cortex and medulla frizz out. Hair turn gray or white is result of rate of melanin pigment production is slowing down, and from the replacement of melanin by air bubbles in the hair shaft.
Hair structures:
Shaft: Part that projects from skin
Root: part embedded in skin (in hair follicle)
Bulb: deep end of follicle, expanded. Has papilla (contains knot of capillaries that supplies nutrients, and signals to grow) & root hair plexus (wraps around each bulb, bending the hair stimulates these endings, contribute to the ability of touch receptors)
Follicle wall: contains outer CT root sheath, derived from dermis. Contains inner CT root sheath, derived mainly from an invagination of the epidermis. The sheath thins as they reach to the hair bulb.
Hair matrix: fraction of a millimeter above bulb, dividing area of the hair bulb that produces the hair.
Arrector pili muscle: bundle of smooth muscles associated with each hair follicle. Most hair follicles approach the skin surface at a slight angle. Arrector pili muscle is attached so that its contraction pulls the hair follicle into an upright position. It dimples skin- cause Goosebumps.
Sebaceous glands: Holocrine (burst) gland that secretes sebum (oily – lubrication & waterproofing; bactericidal)

Whitehead – When sebum keeps producing oil and gets clogged up in follicle
Blackhead – When the oil in whitehead oxidizes and turns black
Acne – Inflammation of the sebaceous glands, usually caused by bacterial infection.

Clinical notes on hair:
Vellus hair – Body of children and adult females – fine hair
Terminal hair – coarser, longer hair of the eyebrows and scalp. Can be darker. At puberty terminal hair appear in the axillary and public region of both sexes and on the face and chest of males.
Hair growth is affected by hormones such as androgen (male sex hormone, terminal hair). Hair growth is also affected by nutrition. Conditions that increase local dermal flow may enhance local hair growth (brick layers who carried their hod on one shoulder all the time developed one hairy shoulder)

Hirsuitism – when adrenal gland or ovarian tumor secretes abnormally large amount of androgens. Excessive hair in women.

Average rate of hair growth is 2.5mm per week – children grow faster
Each follicle goes through growth cycles. In each cycle there is active phase ranging from weeks to years, then there is resting phase – during this phase the hair matrix cells die and the follicle base and bulb shrivel. After the resting phase, the matrix proliferates again and form new hair to replace the old one that has fallen out or will be pushed out by new hair. Head hair has longer active phase (can grow longer without falling out) eyebrow hair has shorter active phase (hair can’t grow very long)

Alopecia is a natural process. A hair follicle only has a limited number of cycles, hair are not replaced as fast – begin balding.
Male pattern baldness – genetically determined, sex influenced condition. Growth cycle becomes so short that many hairs never emerge from their follicles. This gene “switches on” in adulthood, this cause the testosterone to turn into DHT. No hormones to help hair growth.

Nails: Also hard keratin like hair, it is a scale-like modification of epidermis - protective and useful tool
Each nail contain free edge, body (visible attached portion) and root (embedded in the skin)
The deeper layers of the epidermis extend beneath the nail as the nail bed, the nail is like the superficial keratinized layer
Nails appear pink because of rich bed of capillaries in the dermis, but the lunula contain more tissues/cells therefore you can’t see the capillaries and therefore they appear white.
The proximal and lateral borders of the nails are overlapped by skin folds they are called nail folds.
The proximal nail fold is called cuticle or eponychium
The region beneath the free edge of the nail where dirt accumulate is called hyponychium
The proximal portion of the nail bed is called matrix and this makes new nails.

Sweat glands: they are also called sudoriferous glands
They are distributed over skin surface except for the nipples & part of external genitalia. There is 2.5million/person.
Two types of sweat glands merocrine and apocrine
Merocrine: More common; in palms, soles and forehead. Each is a simple, coiled, tubular gland. The secretory part lies coiled in the dermis, and the duct extends to open in a funnel-shaped pore at the skin surface. They secrete sweat – hypotonic solution, 99% water, some salts, and some other solutes. Normally swear is acidic with pH between 4 and 6. Sweating is regulated by sympathetic division; its major role is to prevent overheating. Sweating first begin on the forehead and then spreads inferiorly over the remainder of the body. Emotionally induced sweating begins on the palms, soles and axillae (armpits) and then spreads to other body parts.

Apocrine – 2000/person, in the axillary and the anogential area. They are larger than merocrine; tend to lie deeper in dermis and even the hypodermis, their ducts empty into hair follicles. Their secretion contains the same components as sweat, plus fatty substances and proteins. It is more viscous and sometimes milky or yellowish. The secretion is odorless, but when the organic molecules are decomposed by bacteria on skin, it develops odor – body odor.
Begin functioning at puberty under the influence of androgens. Not for thermoregulation, are activated sympathetic nerve fibers during pain and stress. Activity is increased during sexual foreplay, enlarge and recede with the phases of woman’s menstrual cycle, they might be sexual scent glands.

They are both merocrine glands because they release through exocytosis (exocrine), they use vesicles to empty into ducts.

Modified apocrine glands:

Cerminous: found in lining of external ear canal, their secretion mixes with sebum to form cerumen or earwax.
Mammary: secretes milk

Functions of the skin:

1. Protection: a) chemical (secretions, melanin) b) physical (waterproof, barrier to trauma/bacterial invasion) c) biological (Langerhans cells in epidermis, macrophage in dermis). Note* not impermeable to gases, fat soluble vitamins & steroids, plant oleoresins, organic solvents, salts of heavy metals, penetration enhancers for drug admiration.
2. Excretion: Some N-containing wastes (urea); NaCl & H2O via sweat
3. Body temperature: sweating (0.5-12 L/day), vasoconstriction
4. Cutaneous sensation: feel on skin, pressure on skin, hair follicle receptor on wind, free nerve ending sense pain, temperature
5. Metabolic: production of vitamin D
6. Blood reservoir: Muscles need blood, can take this blood to muscle. Skin can hold a lot of blood (5% of body entire volume), it doesn't need as much blood supply as other body parts.

Burns: can be from heat, electricity, radiation, and chemical (acid)
First concern is dehydration, second concern is infection
First degree – only epidermis
Second degree – epidermis and upper dermis
Third degree – epidermis and dermis
The deeper you go, the more danger you are – you are damaging the cells that cause the repair.
Potential for repair is take skin from other part of the body, and then put it on the damaged skin. Called skin crafting. Skin might reject this though
Rule of nines: volume of blood lost can be estimated by computing the percent of body surface burned. Dividing body into 11 areas worth 9% each. 1% for the genitals.

Bone: is a living dynamic tissue which responds to its environment.

1. Bone reacts to amount of force applied by increasing the density & amount of roughening on bone or decreasing density when fore is reduced or eliminated. Deposition (body > bone) vs. reabsorption (bone > body)
2. Bone stores calcium – resorbed & transferred to bloodstream when needed.

Functions of bone:

1. Support: Supports body when standing, cradles organ
2. Protection: Protects brain, spinal cord, vital organs of thorax
3. Movement: Muscles attach to bones by tendons, use bones as levers to move the body
4. Mineral Storage: Calcium and phosphate
5. Blood Cell Formation: Hematopoiesis occurs in marrow cavities of certain bone
6. Triglyceride (fat) storage: Fat is stored in bone cavities and represents a source of stored energy for the body.

Compare structure of bony tissues and cartilages:
Cartilage: features between dense CT & bone – it's tough, but flexible

1. Avascular, no nerve fibers. This is why cartilage take long time to repair – relies on diffusion
2. Ground substance contains of GAG (glucose amino glycan – hold a lot of water) chondroitin sulfate & hyaluronic acid – also chondronectin (adhesive protein)
3. Collagen fibers – give strength (can have some elastic fibers)
4. Up to 80% H2O, gives it cushioning properties, can spring back to its original shape

Some terms relating to cartilage:
Perichondrium – membranous wrapping around cartilages, act like a girdle to resist outward expansion when cartilage is compressed. Perichondrium contains the blood vessels from which the nutrients diffuse to cartilage. In damaged areas, perichondrium can form scar tissues because poorly vascularized cartilage repairs, badly.
Ossification of cartilage with aging is gradually replacing cartilage with bone (old person's ribcage is not flexible, result is not as easy to breathe)
Chondroblasts – high MR, immature cartilage cells – actively form cartilage
Chondrocytes- Low MR: mature cartilage cells – maintain cartilage
Lacunae: localized clusters of chondrocytes in cartilage – in cluster because they get trapped by the cartilage around them (like wiping a floor)

Types of Cartilage

1. Hyaline cartilage: most abundant, the only fiber found in their matrix is collagen fibers; firm support + pliability; appear glassy blue-white; chondrocytes only 1-10% of volume.
   Location: embryonic skeleton, ends of long bones (epiphyseal plates in growing children), costal cartilages of ribs, cartilages of nose, trachea, larynx
   Function: support & reinforces; resilient cushioning & resists compressive stress.
2. Elastic cartilage: like hyaline cartilage but more elastic fibers in it.
   Location: external ear, epiglottis – (in these places because they need the cartilages to be bendy (for food to go down))
   Function: Maintains shape while giving lots of flexibility
3. Fibrocartilage: Rows of chondrocytes alternating rows with thick collagen fibers; structural intermediate between hyaline cartilage & dense regular CT
   Location: intervertebral disks, pubic symphysis, discs of knee joints
   Function: tensile strength with ability to absorb compressive shock

Bone: calcium salts give hardness & strength for support/protection of softer tissues; cavities for fat storage & synthesis of blood cells.
Two types: axial and appendicular
Axial: Skull, vertebral column, ribcage – most involved in protecting, supporting, or carrying other body parts.
Appendicular: upper/lower limbs, girdles (attach limbs to axial skeleton) – used for locomotion
Osteoblast – growing bone
Osteocyte – maintain bone
Osteoclast – digesting bone to remove calcium from bone (multi nucleus)

Classification of bones
Bones vary in size and shape, unique shape of each bone fulfills a particular need. Bone is classified by their SHAPE not their SIZE.

All bones have:
Compact bone provides the external surface
Spongy (trabecular) bone – honeycomb of trabeculae
Types of bones:

1. Long bone – much longer than wide, has a shaft + 2 round ends, mostly compact bone with hollow centre (marrow cavity); spongy bone is found in the two ends. All limb bones except for the kneecap, wrist/ankle bones are long bones.
2. Short bone – cube-shaped, primarily spongy bone, with thin outer layer of compact bone. Wrist, ankle, sesamoid bones are short bones.
3. Flat bone – thin, flattened, sometimes curved. Skull bones, ribs, breastbone are flat bones
4. Irregular bone – Complicated shapes, primarily spongy bone + thin covering layer of compact bone. Leftover bones – vertebrae & hip bones are irregular bones.

Long bone:

1. Diaphysis – Tubular shaft of long bone = long axis of the bone. Collar of compact bone surrounding marrow cavity (medullary cavity). In adults, medullary cavity contains fat (yellow marrow or yellow bone marrow cavity) in babies, medullary cavity contains red blood marrow instead – as they grow the red blood marrow gets concentrated to epiphyses.
2. Epiphyses – extremities of a long bone; expanded for articulation with other bones. Compact bones forms thin outer layer; inferior filled with spongy bone. Have a thin layer of hyaline (articular) cartilage for forming joints.
3. Epiphyseal line – line between diaphysis & each epiphysis – it's the remnant of epiphyseal plate. Epiphyseal plate – a disc of hyaline cartilage that grows during childhood – lengthens bone. When epiphyseal plate becomes line, growth ends.

Membranes cover outer & inner surfaces of long bones.
Periosteum covers the outer surface, contains osteoblasts and osteoclasts.
Endosteum covers the inner surface (lines marrow cavity), and covers each trabeculae; delicate layer of CT that also contains osteoblasts & osteoclasts

Structure of other bone types:
All 3 other types have similar structure
With Compact bone on the outside, spongy bone on the inside
Compact covered with Periosteum & spongy lined with Endosteum.
They are not cylindrical so no shaft, marrow cavity or epiphyses. They do contain bone marrow between trabeculae.

COMPACT BONE:
Osteon (Haversian) system: The structural unit of compact bone. Osteon: elongated cylinder orientated parallel to the long axis of bone.

A single osteon is a group of hollow tubes of bone matrix – like the rings of a tree. Each of the matrix tube is called lamellar bone. The collagen fiber have a 90*change of orientation with each layer. This pattern is designed to withstand tension stress; adjacent lamellae reinforce one another to resist twisting.
In each core is central canal or Haversian canal, contain small blood vessels and nerve fibers that serve the needs of osteon cells.
There are also perforating or Volkmann's canal, perpendicular to long axis bone & Haversian canals that connect the blood and nerve supply of Periosteum to those in the central canals and medullary cavity.
Osteocytes: mature bone cells; sit within the lacunae within bony matrix in areas where adjacent lamellae meet.
Canaliculi: like small version of Volkmann's canal, connect the lacunae with each other, also connected to Haversian canal.
Interstitial Lamellae: fill the gaps between osteons or are leftovers of osteons that were partially destroyed by bone remodelling.
Circumferential lamellae: sheets of bone located just deep to Periosteum; extend around entire circumference of shaft – resist twisting of long bone.

Spongy bone:
Contains trabeculae (align precisely along lines of stress and help the bone resist stress), few cells thick, contain irregularly arranged lamellae and osteocytes interconnected by Canaliculi. No osteons
Nutrients diffuse through Canaliculi from the marrow spaces between the trabeculae to reach the osteocytes.

Bone formation and remodeling:
Osteogenesis or Ossification means making something to become bone. This includes formation of bony skeleton in embryos, growth of bones during childhood & adolescence & remodelling/repair of bones in adults.

1. Intramembranous Ossification: bone develops from fibrous CT membrane containing mesenchymal (stem) cells. Cranial bones of the skull and clavicles – flat bones. Begins at about 8 weeks of embryonic development.
2. Endochondral Ossification: more common, bone develops via the replacement of hyaline cartilage. All bones below the skull (other than clavicle). Begins in second month of embryonic development. More complex because it require the cartilage to break down first before building bone.

*In short bones, only the primary ossification centre are formed; most irregular bones are formed using several distinct ossification centres.

When ossification is complete, hyaline cartilage remains:

1. On the epiphyseal surfaces as the articular cartilage.
2. At the junctions of diaphysis and epiphyses where it forms epiphyseal plates – where long bones continue to grow.

Mechanisms of bone growth:

During infancy & youth, long bones lengthen entirely by interstitial growth of the epiphyseal plates, and the bone grows in thickness by appositional growth.
Most bones stop growing during adolescence or early adulthood – some facial bones (jaw, nose) continues to grow throughout life.

As the long bone lengthens, the shape of the ends must be altered (remodel). As the length increases, external surface of ends made slimmer while internal surface is thickened.
In summary, bone is destroyed by osteoclasts and laid down by osteoblasts on both the inner and outer surfaces of growing long bone.
Epiphyseal plate stays roughly the same size throughout childhood & adolescence.
Epiphyseal plate then becomes thinner; the cells multiply more and more slowly.
Longitudinal growth ends when bone of the epiphysis & diaphysis fuses = epiphyseal plate closure (18 in females, 21 in males). Some hormones cause the epiphyseal plate to close quicker.

Growth in width:
Growth in width = appositional growth.
Layers of bone are laid on top of one another

1. Osteoblasts on periosteal side secrete bone matrix
2. Osteoclasts on the endosteal side remove bone matrix

Osteoblast is quicker than osteoclast, more deposition occurring, bone get thicker slowly.

Parathyroid hormone control:
PTH produced by parathyroid glands, PTH is released when blood is losing calcium. Increased PTH level stimulate osteoclasts to absorb bone, releasing calcium to blood. Parathyroid glad is posterior to thyroid gland (4 glands).
Calcitonin is produced by parafollicular cells (in thyroid) – is opposite of PTH.

Osteoporosis
When bone resorption outpaces bone formation – bone become porous
Some areas of skeleton especially vulnerable: spine, neck of femur.
Estrogen and testosterone promote bone health by restraining osteoclast activity and promoting deposition of new bone (less of these hormones in adults)
Other factors include: insufficient exercise, poor diet in calcium & protein, abnormal vitamin D receptors, smoking (reduce estrogen levels)

Skeleton: There are 206 bones in skeleton, making up 20% of body weight.
Axial skeleton: segregated into 3 major regions: the skull, vertebral column, and thoracic cage. 80 bones

Skull: most complex. Contain 2 set of bones: cranial + facial = 22 bones.
Most skull bones are flat bones (other than mandible); they are united by sutures ("stiches" – immovable joints)
Facial bone form anterior part of skull & cranial bone form the rest
Skull has eye orbits & paranasal sinuses, houses organs of hearing, 85 openings for nerve, blood vessel, and spinal cord.

Cranium: Can be divided into vault and base
Vault: forms superior, lateral, & posterior aspects of the skull + forehead
Base: inferior aspect of skull, internally the base is divided into 3 areas: anterior fossa (highest), middle fossa, posterior fossa (lowest). The brain sits snugly in the cranial fossas.
Cranium surrounds & protects brain and organs of hearing, balance.

Cranium: 8 bones: Paired parietal & temporal bones, unpaired frontal, occipital, sphenoid and ethmoid bones. The bones are curved, allow them to be self-bracing, can be strong and quite thin (like eggshell)

Frontal bone:
Dome shaped bone; also forms the roof of the orbits & anterior cranial fossa. It articulates posteriorly with the parietal bones via the coronal suture.
Supraorbital margins: thickened superior margins of the orbits that lie under the eyebrows – for shading
Supraorbital foramen – Each supraorbital margin is pierced by his, which allows the supraorbital artery and nerve to pass to the forehead
Glabella: The smooth portion of the frontal bone between the orbits. The areas lateral to the glabella is riddled internally with sinuses, called frontal sinuses.

Parietal bone:
Paired, form the superior & lateral aspects of the skull.
Form bulk of the cranial vault.
The 4 largest sutures occur where the parietal bones articulate with other bones.
Parietal – parietal = sagittal suture
2 Parietal – frontal = coronal suture
2 parietal – occipital = lambdoid suture
Parietal – temporal = squamous suture

Occipital bone:
Single bone at base of skull; helps form posterior aspect of skull, also form walls of the posterior cranial fossa – supports the cerebellum.
Attaches to 2 parietal & 2 temporal, also attached to sphenoid bone
Foramen magnum –hole at the base of skull – for passage of brain stem – spinal cord.
Occipital condyle – on each side of foramen magnum is the site or articulation with first cervical vertebra. This permits the nodding motion
External occipital protuberance – it is superior to foramen magnum; knob projection at the back of skull – more prominent in males.

Temporal bone:
Paired, form inferior & lateral aspects of skull and parts of the cranial floor.
Located below the 2 parietal bones – have 4 different areas of region.

1. Squamous region: flattened, touches the squamous suture
   Zygomatic process meets zygomatic bone (cheekbone)
   Mandibular fossa – small oval – on the inferior surface of the zygomatic process, receives the condyle of the mandible (lower jawbone). This forms a freely movable joint.
2. Tympanic region: surrounds the external acoustic meatus (external ear canal).
   Below the external acoustic meatus is the needle-like styloid process – an attachment site for many tongue and neck muscles.
3. Mastoid region: contain mastoid process, an anchoring site for some neck muscles.
4. Petrous region – internal aspect of temporal bone (can't easily be seen)
   Contributes to cranial base & houses middle and inner ear cavities.
   Jugular foramen – junction of the occipital and temporal bone allows the passage of the internal jugular vein and 3 cranial nerves.
   Carotid canal – Anterior to the jugular foramen, transmits the internal carotid artery into cranial cavity, The arteries are close to internal ear cavities – explain why we can hear our rapid pulse as thundering sound when excited.
   Internal acoustic meatus – positioned superolateral (top and side) to the jugular foramen, transmits cranial nerves.

Sphenoid bone: bat-shaped
Complex bone, difficult to visualize; articulates with all other cranial bones. (Keystone bone of the cranial sksleton)
Forms base of middle cranial fossa, contributes to base of anterior cranial fossa.
Consists of a central body and 3 pairs of processes: greater wings, lesser wings, pterygoid processes
Within the body of the sphenoid are the paired sphenoid sinuses.
Greater wing: project laterally from the sphenoid body, forming parts of the middle cranial fossa, and the dorsal walls of the orbit.
Lesser wing: horn-like, form part of the floor of the anterior cranial fossa, and part of the medial walls of the orbits.
Pterygoid process – project inferiorly from the junction of the body and greater wings, they anchor the pterygoid muscles (for chewing)
Optic foramen (canal) – for optic nerves to pass to the eyes
Superior orbital fissure – opening on the side of sphenoid body – long slit between the greater and lesser wings, allows cranial nerves that control eye movements to enter the orbit.

Ethmoid bone:
Approximates a cube that lies deep between orbits & nasal cavities
Most deeply situated bone of the skull
Superior surface of the ethmoid bone is formed by the paired horizontal cribriform plate – help form roof of nasal cavity and floor of anterior cranial fossa.
Cribriform plates are punctured by tiny holes called olfactory foramina that allow the filament of the olfactory nerves to pass from the smell receptors in the nasal cavities to the brain.

Crista galli – projects superiorly between the cribriform plates (triangular process) attach to dura mater of brain (outer layer of brain)
Perpendicular plate – projects inferiorly in the median plane and forms the superior part of the nasal septum, which divides the nasal cavity into right and left halves.
Lateral mass – each side of the perpendicular plate, riddled with ethmoid sinuses
Superior and middle nasal conchae – extending medially from the lateral masses
Orbital plates – lateral surfaces of the ethmoid lateral masses – contribute to the medial wall of the orbits.

Sutures; only 4 needs to be known
Coronal – frontal & 2 parietal bones
Squamous- parietal & temporal bone
Lambdoid – occipital & 2 parietal bones
Sagittal – 2 parietal bones
Suture bones – tiny irregular bones, occur within cranial suture, additional ossification centres that appeared during fetal development.

Facial bones: 14 bones: unpaired mandible & vomer, paired maxillae, zygomatic, nasal, lacrimal, palatine & inferior conchae.

Mandible: movable, lower jaw bone, biggest and strongest bone of the face
It has a body, which forms the chin, and two upright rami (branches). Each rami join the posteriorly at mandibular angle.
Mandibular notch – separate the two processes at the superior margin of each ramus.
Coronoid process – anterior process of the 2, an insertion point for the large temporalis muscle (elevates the lower jaw during chewing)
Mandibular condyle – posterior process of the 2, articulates with the mandibular fossa of the temporal bone, forming a joint.
Alveolar margin – contain the sockets in which teeth are embedded
Mandibular foramina – large – one the medial surface of each ramus, permit the nerves responsible for tooth sensation to pass to the teeth in the lower jaw. While working on lower teeth, dentists inject here.
Mental foramina – openings on the lateral aspects of the mandibular body, allow blood vessels and nerves to pass to skin of chin and lower lip.

Maxillary bones:
Fused medially, form the upper jaw and the central portion of the facial skeleton. All facial bones except the mandible articulate with the maxillae. (Keystone bones of the facial skeleton)
Alveolar margin – carry the upper teeth
Palatine process – project posteriorly from the alveolar margins and fuse medially, forming the anterior 2/3 of the hard palate (bony roof of the mouth)
Incisive fossa – posterior to the teeth; serve as passageway for blood vessels and nerves.
Frontal processes – extend superiorly to the frontal bone, forming the lateral aspects of the bridge of the nose
Zygomatic process – laterally, the maxillae articulate with the zygomatic bones.

Maxillary sinuses – each side of the bone; these are the largest paranasal sinuses – gets infected.

Zygomatic bones: (cheekbones)
Articulate with zygomatic process of temporal bones posteriorly, the zygomatic process of the maxillary bone anteriorly.
Contribute to inferolateral margins of orbit.

Nasal bones:
2 tiny rectangular bones that fuse medially forming the bridge of the nose
Articulate with the frontal bone superiorly, the maxillary bone laterally
Inferiorly they attach to the cartilage that form most of the skeleton of the external nose

Lacrimal bones:
Fingernail-shaped, contribute to the medial walls of each orbit
Articulate with frontal bone superiorly, ethmoid bone posteriorly, and the maxillae anteriorly.
Each lacrimal bone contains a deep groove that help form a lacrimal fossa, the lacrimal fossa houses the lacrimal sac, part of the passageway that allows tears to drain from eye surface into nasal cavity.

Palatine bones:
2-L shaped bones fashioned from two bony plates, the horizontal and vertical plates
Horizontal plates complete the posterior portion of the hard palate
Vertical plates form part of the posterolateral walls of the nasal cavity and small part of the orbit

Vomer:
Single thin bone, lies in nasal cavity, where it forms the nasal septum

Orbits: cone-shaped bony cavities; the eyes are firmly encased and cushioned by fatty tissue.
The walls of each orbit are formed by parts of seven bones – frontal, sphenoid, zygomatic, maxilla, palatine, lacrimal, and ethmoid bones.

Paranasal sinuses:
Frontal
Maxillary
Sphenoid
Ethmoid
Mucosa-lined, air-filled sinuses
Lighten skull and enhance resonance of voice, connect to nasal cavity to help to warm & humidify incoming air

Hyroid bone:
Not really part of the skull, just inferior to the mandible, in the anterior neck, looks like miniature mandible
The only bone of the body that does not articulate with any other bone – does not form joints, just surrounded by muscles

Supports the tongue (movable base for the tongue), gives attachment to muscles for swallowing & speech
Horseshoe shaped with a body + 2 horns

Vertebral Column
33 bones of which 24 remain separate (flexible) and the remaining 9 fuse to form 2 composite bones (sacrum & coccyx) it is 60 cm long
7 cervical, 12 thoracic, 5 lumbar, (remember this with the meal time, 7am, 12pm, 5pm) 5 sacral, 3-4 coccyx
Sacrum articulates with the hip bones of the pelvis
3 functions:

1. Weight-bearing
2. Anchor for muscles & ligaments
3. Protection of spinal cord

The vertebrae become progressively larger from the cervical to the lumbar region, as they must support greater and greater weight.
All of us have same amount of cervical vertebrae. Variations in numbers of vertebrae occur in about 5% of people
You can see four curvatures that give the vertebrae its S shape, the cervical and lumbar are concave, the thoracic and sacral are convex.
Curvatures increase the resilience and flexibility of the spine, allowing it to function like a spring rather than a rod.

Supporting elements of vertebral column

1. Ligament
   Strap-like, support column of bones to stay upright
   Major supporting ligaments are the anterior and posterior longitudinal ligaments; these run as continuous bands down the front and back surfaces of the vertebrae from the neck to the sacrum.
   Broad anterior ligament is strongly attached to both the bony vertebrae and the discs, along with its supporting role; it prevents hyperextension of the spine (bending too much backwards)
   Posterior ligament resists hyperflexion of the spine (bending too forward), is narrow and relatively weak, it attaches only to the discs

2. Intervertebral discs
   Cushion-like pad between bony vertebral bodies – shock absorbers, 25% length of vertebral column – flatten somewhat during the course of the day (night time always shorter)

Composed of 2 parts; inner gelatinous nucleus puposus (pulp) acts like a rubber ball, giving the disc its elasticity and compressibility.
Surrounding the nucleus puposus is anulus fibrosus (ring of fibers), this limits the expansion of the nucleus pulpous when the spine is compressed, bind successive vertebrae together, resists tension in spine
Disc is thickest in lumbar/cervical regions – for flexibility

A typical vertebra:
Vertebra gets larger as one descends column
Each vertebra contains a body anteriorly, and vertebral arch posteriorly, body is the weight bearing region
Together, the arch and body enclose an opening called the vertebral foramen. Successive vertebral foramina form the long vertebral canal, through which the spinal cord passes.

The vertebral arch is formed by two pedicles and two laminae
Pedicles (little feed), short bony pillars projecting posteriorly from the vertebral body, form the sides of the arch.
Laminae, flattened plates that fuse in the median plate, complete the arch posteriorly.
Pedicles have notches on their superior and inferior borders, providing lateral openings between adjacent vertebrae called intervertebral foramina. Spinal nerves from spinal cord pass through these foramina.

There are 7 processes from each vertebral arch;
1 spinous process – median posterior projection arising at the junction of the 2 laminae – muscle attachment
2 transverse processes – extends laterally from each side of the vertebral arch – 1 side per muscle attachment
For muscles move the vertebral column and for ligaments that stabilize it
Paired superior and inferior articular process protrudes superiorly and inferiorly, the smooth joint surface of the articular processes called facets are covered with hyaline cartilage. They are to link vertebrae above & below.

Cervical vertebrae
There are 7 cervical vertebrae and the first two (C1 and C2) are unusual and they don't have intervertebral disc.
C3-C7 has the following distinguishing features

1. Body is oval – wider from side to side than front to back
2. The spinous process is short & split at the end, (except for C7, sticks out/not split)
3. Vertebral foramen is large and generally triangular
4. Each transverse process contains a transverse foramen through which the vertebral arteries pass to service brain

The first two cervical vertebrae is called atlas and axis
Atlas: no body & no spinous process
It is a ring of bone consisting of anterior and posterior neural arches

And a lateral mass on each side, each lateral mass has articular facets on both its superior and inferior surfaces
Superior articular facets articulates with brain and C2 which allow the “nodding” movement

Axis: has a body and the other typical vertebral process, the only unusual feature is knoblike “dens” projecting superiorly from its body, the dens is the “missing” body from the atlas, which fuses with the axis during embryonic development, dens acts as a pivot for the rotation of the atlas, this joint allows the “no” movement

Thoracic vertebrae:
12 of them T1-T12, all articular with the ribs, T1 looks a lot like C7, the last four show a progression toward lumbar vertebral structure. The vertebrae increase in size from the first to last.

1. Body is heart-shaped & bears two small facets called demifacets (half-facets), on each side to receive the head of ribs. T10-T12 is different by only having a single facet to receive ribs
2. Vertebral foramen is circular
3. Spinous process is long and points sharply downwards
4. Transverse process have facets which articular with tubercles of the ribs, T11-T12 does not

Lumbar vertebrae
Is in the lower back – receives the most stress, their bodies are massive and kidney shaped in a superior view

1. Pedicle and laminae are shorter and thicker than other vertebrae
2. The spinous processes are short, flat and hatchet shaped, easily seen when person bends forward. These processes are robust and project directly backward
3. The vertebral foramen is triangular
4. Orientation of inferior & superior facet – curved, the superior part faces in, inferior part faces out. This allows for flexion and extension

Sacral vertebrae:
Is triangular – shapes the posterior wall of the pelvis, starts as 5 separate vertebrae – fuse in adolescents to become sacrum
Articulates with L5 superiorly and inferiorly with the coccyx, laterally, the sacrum articulates with the two hip bones to form the sacroiliac joint
Sacral promontory: the anterosuperior margin of the first sacral vertebra, bulges anteriorly into the pelvic cavity, the body’s center of gravity lies about 1cm posteriorly to this
Transverse lines/ridges – four ridges – marking the lines of fusion of sacral vertebrae
Anterior sacral foramina – lie at the lateral end of the transverse lines, transmit blood vessels and anterior rami (branches) of the sacral spinal nerve
Median sacral crest – fused spinous processes of the sacral vertebrae – roughens the sacral surface
Posterior sacral foramina – flanked laterally of median sacral crest, transmit the posterior rami of the sacral spinal nerves
Lateral sacral crest – remnants of the transverse processes of S1-S5
Sacral canal – vertebral canal continues inside the sacrum as sacral canal

Sacral hiatus – laminae of S5 or S4 fail to fuse medially, an enlarged exernal opening is obvious in the inferior end of the sacral canal

Coccyx (coccygeal vertebrae)
This is our tailbone - a small triangular bone
Consists of 3 -4 fused coccygeal vertebrae
Attachment area for some pelvic ligament – little support for pelvic organs, it is nearly useless

Thorax
It is the chest, includes the thoracic vertebrae dorsally, the ribs laterally, the sternum and costal cartilage anteriorly, the costal cartilage secure the ribs to the sternum
It is a protective cage around heart, lungs, and blood vessels
It supports the shoulder girdles and upper limbs
Provide attachment points for many muscles of neck, back, chest, and shoulders

Sternum – lies in the anterior midline of the thorax, it is a flat bone around 15cm long
It is the result from the fusion of three bones: the manubrium, body and xiphoid process
Manubrium articulates via its clavicular notches with the clavicles laterally, also articulates with the first pair of ribs
Body, or midportion, forms the bulk of sternum. The sides of the body are notched where it articulates with the costal cartilages of the second to seventh ribs
Xiphoid process forms the inferior end of the sternum, it is a plate of hyaline cartilage in youth, but it is usually ossified in adults, the process articulates only with the sternal body and serves as an attachment point for some abdominal muscles

3 important anatomical landmarks: the jugular notch, the sternal angle, and the xiphisternal joint
Jugular notch: central indentation in the superior border of the manubrium (you can feel)
Jugular notch is generally in line with the disc between the T2 and T3 vertebrae and the left common carotid artery from aorta
Sternal angle: felt as horizontal ridge across the front of sternum, where the manubrium joins the body, acts as cartilaginous hinge, allowing the sternal body to swing anteriorly when we inhale
Sternal angle is in line with the disc between T4 and T5, at the level of 2nd rib
Xiphisternal joint: the point where sternal body and xiphoid body fuse, in line with T9, the heart lies just deep to this joint

Ribs:
12 ribs all attached to the 12 thoracic vertebral column
They curve inferiorly & anteriorly
Superior 7 ribs attach directly to sternum by costal cartilages – true ribs
The remaining 5 ribs are false ribs because they attach indirectly to sternum or entirely lack a sternal attachment
Rib 8-10 attach to the sternum indirectly, via costal cartilage and rib 7
Ribs 11-12 are vertebral ribs – or floating ribs because they have no anterior attachments, instead their costal cartilage lie embedded in the muscles of lateral body wall
A typical rib is bowed flat bone, has four portions; shaft, head, neck and tubercle

Shaft: main portion of bone, its superior border is smooth, but the inferior border is sharp and shin and has costal groove on its inner face that lodges the nerves and blood vessels
Head: wedge shaped, the posterior end articulates with the vertebral bodies by two facets, one articulates with the demifacet on the body of the same-numbered thoracic vertebra. The other one articulates with the body of the vertebra immediately superior
Neck: Constricted portion of the rib just beyond the head.
Tubercle: lateral to neck, articulates with the costal facet of the transverse process of the same numbered thoracic vertebra

Appendicular skeleton: bones of limbs and their girdles
Pectoral girdle – attach the upper limbs to body trunk
Pelvic girdle – sturdier, secures the lower limbs

Pectoral (shoulder) girdle: paired clavicles anteriorly & scapulae posteriorly – almost a complete circle around upper trunk to make shoulders
Anteriorly – the medial end of each clavicle joins the sternum
Laterally – distal ends of each clavicle meet the scapulae
The bones are very light & very movable – attaches to muscle to move limb, this is because

1. Only the clavicle attaches to axial skeleton, scapula can move freely across the thorax (only attached laterally with clavicle)
2. The socket of shoulder joint (scapula's glenoid cavity)is shallow and poorly reinforced, so it does not restrict the movement of humerus (arm bone). This is good for flexibility but bad for stability: shoulder dislocates easily

Clavicle (collarbone): S shaped, anchoring many muscles, also act as braces; they hold the scapulae and arm out laterally, (when clavicle is fractured, the entire shoulder region collapses medially)
The curvature ensures outward fracture, away from subclavian artery
Scapulae (shoulder blade): thin, triangular flat bones, lies on the dorsal surface of ribcage, between rib 2 and 7
Each scapula has 3 borders,
Superior is the shortest, sharpest border
Medial border parallels the vertebral column
Lateral border is thick, abuts the armpit and ends superiorly in a small, shallow fossa – the glenoid cavity. This cavity articulates with the humerus, forming shoulder joint
The posterior surface bears a prominent spine that is easily felt through the skin. The spine ends laterally in an enlarged, roughened triangular projection called the acromion – articulates with the acromial end of clavicle
Coracoid process – projects anteriorly from the superior scapular border, helps anchor the biceps muscle of arm

Upper limb:
30 separate bones: arm, forearm and hand

Humerus (arm)
Longest bone of upper limb, the only bone of the arm

Articulates with the scapular at the shoulder and the radius and ulna at the elbow
Head: proximal end of the humerus fits into the glenoid cavity of the scapula in a manner that allows the arm to hang freely at one's side
Anatomical neck: inferior to the head is a slight constriction
Greater tubercle: superior to the neck, more lateral
Lesser tubercle: superior to the neck, more medial: These tubercles are attachment sites of the rotator cuff muscles
Intertubercular groove separates the two tubercles
Surgical neck: distal to the tubercles, most frequently fractured part of the humerus
Distal end of the humerus are two condyles: a medial trochlea – articulates with ulna, and the lateral capitulum – articulates with radius
The condyle pair is flanked by the medial and lateral epicondyles – muscle attachment sites
Ulnar nerve: runs behind the medial epicondyle – responsible for the painful sensation of "funny bone"

Forearm
Two parallel long bones: radius & ulna
Their proximal ends articulate with humerus, distal ends form joints with bones of the wrist, they also articulate with each other both proximally and distally at small radialulnar joints
Interosseous membrane: flat, flexible ligament that connects the ulnar and radius along their entire length
In the anatomical position, radius lies laterally, and ulna medially

Ulna (elbow joint)
Slightly longer than radius, main purpose for forming the elbow joint with the humerus
The proximal end bears two processes the olecranon (elbow) and coronoid process, separated by trochlear notch, together these two processes grip the trochlea of humerus, forming a hinge joint that allows the forearm to be bend and straightened again.
When forearm is fully extended, the olecranon process "locks" into olecranon fossa, keeping the forearm from hyperextending
On the lateral side of coronoid process is a small depression, the radial notch where the ulna articulates with the head of the radius
Distally, the ulnar shaft narrows and ends in a knoblike head. Medial to the head is a styloid process, from which the ligament runs to the wrist

Radius (wrist joint)
Thin at its proximal end (head) and wide at the distal end
Distally, there is a ulnar notch with articulates with the ulna, laterally there is a styloid process – an anchoring site for ligaments that run to the wrist

Hand

27 bones, includes carpus (wrist), metacarpus (palm), phalanges (fingers)

Carpus (wrist)
Carpus consists of eight marble-size short bones, closely united by ligaments; gliding movements occur between these bones, the carpus as a whole is quite flexible
Carpals are arranged in two irregular rows of four bones each

Proximal row includes (lateral to medial): the scaphoid, lunate, triquetrum, and pisiform, only the scaphoid and lunate articulate with the radius to form the wrist joint.
So Long to Pittsburgh

Distal row includes (lateral to medial): the trapezium, trapezoid, capitate, hamate
Time to call home
“Sally left the party to Cathy home”

Metacarpus (Palm)
These small long bones are numbered 1 to 5, the distal end are the knuckles, from thumb to little finger
The base of the metacarpals articulate with carpals proximally and each other medially and laterally
The head articulates with the proximal phalanges

Phalanges (fingers)
Each finger has 3 phalanges, except for the thumb which has 2; distal, middle and proximal, the thumb has no middle phalange

Pelvic (hip) girdle
Attaches the lower limbs to the axial skeleton, transmits the weight of the upper body to the lower limbs, supports visceral organs of the pelvis
The pelvic girdle is secured to the axial skeleton by some of the strongest ligaments in the body
Sockets of the pelvic girdle are deep and cuplike and firmly secure the head of the femur – unlike the shallow glenoid cavity of the scapula
The pelvic girdle lacks the mobility of the pectoral girdle but is far more stable

The girdle is formed by pair of hip bones (also called os coxae or coxal bone); each coxal bone unites with its partner anteriorly and with the sacrum (vertebrae) posteriorly
Each hip bone consists of 3 separate bones during childhood; ilium, ischium, and pubis – fuse at puberty
At the point of fusing between the 3 bones, is a deep socket called acetabulum on the lateral surface of the pelvis; this receives the head of the femur, or thigh bone

False pelvis (greater pelvis, area above pelvic brim, really part of the abdomen and helps support the abdominal viscera)
True pelvis (lesser pelvis)

Ilium
Large flaring bone that forms the superior region of coxal bone, also forms the most of it
When you rest your hands on your hips, you are resting on iliac crest, which is the superior portion of the ilium
Iliac spines are the endings of iliac crest anteriorly and posteriorly – attachment site of muscles
Pelvic brim is the superior margin of the true pelvis
Anteriorly the body of the ilium joins the ischium and pubis

Ischium
Posterior – inferior part of the hip bone
Thicker superior body joins the ilium and a thinner, inferior ramus joins the pubis anteriorly
Ischial tuberosity – the inferior surface of the ischial body; rough and grossly thickened, when we sit our weight is entirely held by ischial tuberosities – the strongest part of the hip bones

Pubis –
Anterior part of ox cosa
In anatomical position, it lies horizontally and urinary bladder rests on it
It is made up of superior and inferior rami, unites at pubis symphysis
Anterior border of the pubis is thickened to form pubic crest – attachment for inguinal ligament
Obturator foramen, large opening in the hip bone – few blood vessels and nerves pass; although the foramen is large, it is nearly closed by fibrous membrane in life

Lower limb
Thigh:
Femur – single bone of the thigh; largest, strongest, longest bone in the body
The ball like head of the femur has a small central pit called fovea capitis; a ligament runs from this pit to the acetabulum, where it helps secure the femur
The neck angles laterally to join the shaft, this arrangement reflects that the femur articulates with the lateral aspect of the pelvis, the neck is the weakest part of the femur and is often fractured – commonly called broken hip
The junction of the neck and shaft are the greater and lesser trochanter – these projections serve as sites of attachment for thigh and buttock muscles
Linea aspera – long vertical ridge, site of muscle attachment

Distally, the femur broadens and the ends in a wheel-like lateral and medial condyles – articulates with tibia of the leg
The medial and lateral epicondyles flank the condyles superiorly – site of muscle attachment
Patellar surface – between condyles, articulate with the patella or kneecap

Leg: two parallel bones – tibia and fibula
The two bones are connected by interosseus membrane and articulate with each other both proximally and distally, unlike the joints between the ulna and radius, the tibiofibular joint allow no movement – less flexible but more stable
The medial tibia contributes to the knee joint, but the fibula doesn't – merely help stabilize the ankle joint

Tibia – receives the weight of the body from the femur and transmits it to food, 2nd strongest bone
At the broad proximal end are the concave medial and lateral condyles, these condyles articulate with the corresponding condyles of the femur
Tibial tuberosity – inferior to the condyles, tibia's anterior surface is the rough tibial tuberosity, to which the patellar ligament attaches

Fibula – proximal end is its head, the distal end is the lateral malleolus – forms ankle bulge and articulates with the talus, does not bear weight, but does connect to muscles

Foot:
Contain tarsus, metatarsus, and phalanges (toes), total of 26 bones

Tarsus
7 bones called tarsals, forms the posterior half of the foot, body weight is primarily carried by the two largest; talus (part of ankle joint)- which articulates with the tibia and fibula, and the stronger calcaneus (heel), which forms the heel of the foot and carries the talus
The rest are the lateral cuboid, medial navicular, anterior medial, intermediate and lateral cuneiform bones

Metatarsus
5 small long bones named 1 -5, greater toe is 1

Phalanges
Smaller than their finger counterpart
Three phalanges in each digit, but the great toe- hallux has proximal and distal only

Joints
A joint is a site where 2 or more bones meet
Classified by structure and function
Structure – the material binding the bones together, whether if a joint cavity is present, there are fibrous, cartilaginous and synovial joints
Function – amount of movement allowed at the joint, there are synarthroses (immovable), amphiarthroses (slightly movable), diarthroses (freely movable)

Freely movable joints predominate in limbs
Immovable and slightly movable joints are largely in axial skeleton

Fibrous joints – joined by fibrous tissue, namely dense fibrous CT, no joint cavity is present. Amount of movement allowed depends on the length of the CT uniting the bones, although few are slightly movable, most are immovable
3 kinds are sutures, syndesmoses, and gomphoses

1. Suture (no movement)
   Occurs only between bones of skull
   Overlapping or interlocking 2 bones, junction filled with very short CT fibers
2. Syndesmoses (little movement)
   The bones are connected by ligaments, cords or bands of fibrous tissue
   Amount of movement allowed depends on the length of the connective fibers – longer = more movement
3. Gomphoses
   Peg-in-socket fibrous joint
   Only example is the articulation of tooth with its bony alveolar socket, comes from the Greek word “nail”, teeth are embedded in their sockets (as if hammered in) – fibrous connection is short

Cartilaginous joints – joined by cartilage, no joint cavity, not highly movable
2 kinds are synchondroses and symphyses

1. Synchondroses
   Bar or plate of hyaline cartilage unites the bones
   At areas of growth – ex. Epiphyseal plates, between the first 7 ribs and manubrium of sternum
2. Symphyses
   Articular surfaces of the bones are covered with hyaline cartilage, in turn fused to an intervening pad, or plate of fibrocartilage
   Fibrocartilage is compressible and resilient, acts as shock absorber and permits a limited amount of movement (intervertebral joints and the pubic symphysis of the pelvis)

Synovial joints – the articulating bones are separated by a fluid-containing joint cavity, permits freedom of movement, most joints of the body
5 characteristics

1. Articular cartilage
   Hyaline cartilage covers the opposing bone surface as articular cartilage, absorb compression placed on the joint, and keep the bone ends from being crushed

2. Joint cavity
   Synovial cavity – space that contains a small amount of synovial fluid
3. Articular capsule
   The joint cavity is enclosed by two-layered articular capsule
4. Synovial fluid
   Fills joint cavity, reduces friction
5. Reinforcing ligament
   Ligament that strengthen the joint, restrict movement – double joint means the reinforcing ligament is more stretchy and loose

Bursae and Tendon sheaths
Not strictly part of synovial joints, but found closely associated with them
Essentially bags of lubricant, reduce friction between bones during joint activity

1. Bursae – flattened fibrous sacs lined with synovial membrane, contain thin film of synovial fluid – occur where ligaments, muscles, skins, tendons, or bones rub together
2. Tendon – elongated bursa that wraps around a tendon subjected to friction, common where several tendons are crowded together within narrow canals

Factors that influence stability of synovial joints
Synovial joints allow lots of movement, therefore not as stable as fibrous/cartilaginous joints; the shape doesn't affect it though
3 factors:

1. Articular surfaces:
   Shape of articular surfaces of many joints don't affect stability
   When articular surface are large, and fit snugly together, or when socket is deep, stability is improved
2. Ligaments:
   More ligaments = more stable
   When other stabilizing factors are inadequate, more tension is placed on ligament and they stretch. Stretched ligaments stay stretched, ligaments can only stretch about 6% of their length before it snaps – when ligaments are the major means of bracing a joint, the joint is not stable
3. Muscle tone
   Most important stabilizing factor
   Tendons are kept are kept stretched at all times by the tone of their muscles
   Important in reinforcing the shoulder and knee joints and arches of foot

Common joint injuries
Sprains:
Partially torn ligament, repairs slowly (poor vascularization), completely torn ligament requires surgery
Cartilage injuries:
Usually the knee – cartilage has no blood supply, cannot repair itself, pieces break off and interfere with joint function – requires arthroscopic surgery
Dislocations:
Bones forced out of their normal positions at a point, need to be reduced
Repeat dislocations are common because ligaments get stretched

Movements allowed by synovial joints:
Flexion: decreasing the angle the moving bone is making with the stationary bone
Extension: increasing the angle
Hyperextension: more extension than what we normally do > 180*
(With neck, looking ahead is 180*)
Abduction: movement of a limb away from the midline
Adduction: movement of limb towards the midline
Circumduction: movement of limb so that it describes a cone in space (consists of flexion, abduction, extension, and adduction performed in succession)
Rotation: turning of a bone around its own axis (two cervical vertebrae, and the hip, and the shoulder joints) lateral rotation is rotation at the opposite direction

Special movements:
Supination and Pronation: movement of the radius around the ulna
In anatomical position, hand is supinated, and radius and ulna are parallel
In pronation, the forearm rotates; pronation moves the distal end of the radius across the ulna so the two bones form an x
Dorsiflexion and plantar flexion of the foot: lifting the foot so that its superior surface approaches the shin is dorsiflexion, depressing the foot is plantar flexion
Inversion and Eversion: in inversion, the sole of the foot turns medially, in eversion, the sole faces laterally
Protraction and retraction: non-angular anterior and posterior movement in a transverse plane (mandible is protracted when you put your jaw out, and retracted when you bring it back
Elevation and Depression: Elevation is lifting a body part superiorly, moving the elevated part down is depression
Opposition: saddle joint between metacarpal 1 and the trapezium allows for this movement, this is when you touch your thumb to the tips of the other fingers (opposable thumbs)
Types of synovial joints:

1. Plane joint:
   Articular surfaces are flat, only allow for short gliding movement (intercarpal joints)
2. Hinge joint:
   Cylindrical end of one bone conforms to a trough-shaped surface on another; motion is along a single plane that resembles hinge – flexion and extension (elbow)
3. Pivot joint
   Rounded end of one bone conforms to a ring or sleeve of bone of another, joint between the atlas and dens of axis (allows for movement of “no”)
4. Condyloid joint
   Oval articular surface of one bone fits into a complementary depression in another; both articulating surfaces are oval, all angular motions, wrist joint
5. Saddle joint
   Similar to Condyloid, but saddle joints offer greater freedom, shaped like a saddle, carpometacarpal joints of the thumb, this is shown by twiddling your thumb
6. Ball-and socket joint:
   Spherical head of one bone articulates with the cuplike socket of the other, most freely moving joint – shoulder and hip joints are the only examples