

Homeostasis

- A dynamic state of equilibrium in which internal conditions vary, but always within relatively narrow limits.
- Homeostatic control:
 - Receptor = sensor that monitors environment & responds to changes (stimuli) by sending information (input) to control centre.
 - Input flows along afferent pathway
 - Control Centre = sets point/range a variable is maintained
 - Output flows along efferent pathway to the effector.
 - Effector = provides means for response to stimulus
 - Results of response feed back to influence effect of the stimulus:
 - Reducing it (negative feedback)
 - Enhancing it (positive feedback)

The Cell

- The Cell Theory:
 1. A cell is a basic structural & functional unit of living organisms
 2. Activity of an organism depends on individual & collective activities of its cells.
 3. Principle of complementarity structure & function = biochemical activities of cells are dictated by their shapes or forms, & by the relative number of their specific subcellular structures.
 4. Continuity of life from one generation to the next has a cellular basis = new cells are produced from existing cells.
- General cells (all cells have the same basic parts and some common functions).
 - Plasma membrane
 - Fluid mosaic model = phospholipid bilayer in which proteins are dispersed.
 - Phospholipid bilayer = polar, charged, hydrophilic head & uncharged, nonpolar, hydrophobic tail
 - Cytoplasm = cytosol & organelles.
 - Cytosol = viscous, semitransparent fluid
 - Organelles = metabolic machinery
 - Mitochondria: supply ATP via aerobic cellular respiration
 - Ribosomes: synthesize proteins.
 - Golgi apparatus: modify, concentrate, & package proteins & lipids made.
 - Inclusions = chemical substances – e.g. stored nutrients.
 - The Nucleus = an organelle that controls cellular activities.
 - Contains genes & dictates the kinds & amounts of proteins to be synthesized in response to signals acting on the cell.
 - 3 regions
 - Nuclear envelope = double-membrane
 - Outer: continuous with ER, studded with ribosomes externally.

- Inner: lined by nuclear lamina (protein network that maintain nucleus shape).
- Nucleoli = make ribosomes
- Chromatin = material that makes up chromosomes

Bones:

- Function of bones:
 - Support – framework to support body & cradle its soft organs.
 - Protection – of vital organs.
 - Movement – used by skeletal muscles as levers to move the body
 - Mineral and growth factor storage –reservoir for Ca^{2+} & phosphate.
 - Blood cell formation – occurs in red marrow cavities
 - Fat storage – triglyceride = energy source stored in bone cavities.
 - Hormone production – osteocalcin = regulate bone formation & protect against obesity, glucose intolerance and diabetes mellitus.
- Classification of bones:
 - Skeleton divided in 2:
 - Axial skeleton = long axis: skull, vertebral column & rib cage
 - Act to support, protect and carry other body parts.
 - Appendicular skeleton = upper & lower limbs & girdles
 - Allow the body to move freely.
 - Long bones = longer than they are wide – e.g. limb bones
 - Short bones = roughly cubed shaped – e.g. wrist and ankle bones.
 - Sesamoid bones = short bone that forms a tendon: e.g. the patella.
 - Flat bones = Thin plates of spongy bone covered by compact bone
 - Irregular bones = complicated shapes – e.g. vertebrae & hipbones.
 - Sutural bone = extra bone pieces within suture in cranium. Occur only in some people.
- Bone Structure:
 - Spongy Bone (trabecular/cancellous bone):
 - honeycomb of small needle-like pieces called trabeculae.
 - Lie precisely along lines of stress to help bone resist stress.
 - Contain irregularly arranged lamellae & osteocytes interconnected by canaliculi.
 - Open spaces between trabeculae filled with red or yellow bone marrow.
 - Function:
 - High surface area to mass ratio = less dense than compact bone = softer, weaker and more flexible.
 - Found at end of long bones, within vertebrae & cranial bones.
 - Compact bone (cortical bone):
 - Structure of a typical long bone:
 - Diaphysis = shaft
 - Epiphyses = broad bone ends – outer shell of compact bone & inner spongy bone.
 - Lined by articular (hyaline) cartilage = cushion opposing bone ends & absorb stress.

- Epiphyseal line = remnant of epiphyseal plate, a disc of hyaline cartilage that grows during childhood to lengthen the bone.
- Metaphysis = flared portion of bone where diaphysis and epiphysis meet, contains epiphyseal line
- Membranes:
 - Periosteum = covers bone external surface, except at joint surfaces.
 - Outer fibrous layer: dense, irregular connective tissue.
 - Inner osteogenic layer: osteogenic cells that give rise to all bone cells except bone-destroying cells (osteoclasts).
 - Endosteum = covers internal bone surfaces: the trabeculae of spongy bone and lines the canals that pass through compact bone.
 - Also contains osteogenic cells.
- Structural unit: osteon.
 - A group of hollow tubes of bone matrix, one placed outside the next
 - Each matrix tube is a lamellae = collagen fibres in adjacent lamellae run in different directions to resist twisting stress.
 - Central canal: runs through osteon core, contains small blood vessels & nerve fibres.
 - Perforating (Volkmann's) canals lie at right angles to the central canal & connect the blood & nerve supply of periosteum to those in the central canal and medullary cavity.
 - Osteocytes: occupy lacunae at junctions of lamellae.
 - Canaliculi connect lacunae to each other & to the central canal.
 - Allows communication & relay of nutrients & wastes.