

Cells to systems

Organisation of the Human body:

1. Chemical level
2. Cellular level
3. Tissue level
4. Organ level
5. Body system level
6. Organism level

1) Chemical Level

All matter is a combination of atoms:

- Oxygen
 - Carbon
 - Nitrogen
 - Hydrogen
- Make up 96% of total body chemistry

These atoms then combine to make molecules:

- Fatty acids
 - Amino acids
 - Nucleotides
 - Sugars
- (FANS)

2) Cellular level

- Atoms and molecules need to be packed and arranged in precise ways to form cells
- Cells are the fundamental structural and functional units of a living organism
- Cell is smallest unit for carrying out processes associated with life
- Exist alone (e.g. bacteria is single cell that carries out all functions for living) or in a group in multicellular organism (e.g. red blood cells exist in groups with other types of cells to form human body)

Basic Function:

- Obtaining oxygen and nutrients from the environment and converting it to energy
- Eliminating wastes or bi-products (e.g. CO₂)
- Synthesise proteins and other components for cells structure/growth/function

- Cells have specialised functions in multicellular organisms
- Kidney cells: selectively retain the substances needed by the body while eliminating unwanted substances
- Muscle cells: produce intracellular movement
- Morphology: study of gross structure of an organism

Cell to Cell Adhesions:

- Plasma membrane encloses the contents of each cell and acts as the outer boundary
- Plasma membrane also involved in cell adhesions
- 3 types of cell to cell adhesions:
 - 1) Cell adhesion molecules
 - 2) Extracellular matrix
 - 3) Specialised cell junctions
 - Desmosomes (adhering junctions)
 - Tight junctions (impermeable junctions)
 - Gap junctions (communicating junctions)

1) Cell adhesion molecules

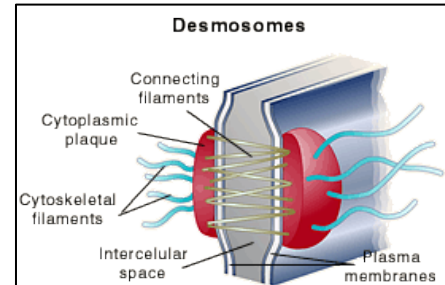
- Proteins that protrude from outer membrane surface to form loops and hoops
- Binds to other cells or forms extracellular matrix

2) Extracellular matrix (ECM)

- Molecules are secreted by the cell creating a complex meshwork of proteins and carbohydrates called the extracellular matrix (ECM)
- The extracellular matrix is directly connected to the cells it surrounds
- Gives structural and biochemical support

3) Specialised cell junctions – Desmosomes (adhering Junctions)

- Attachment between 2 non-touching cells (physical cells don't touch but the filaments link)
- Strongest attachment
- Plaques located in the inner surface, filaments link adjacent cells

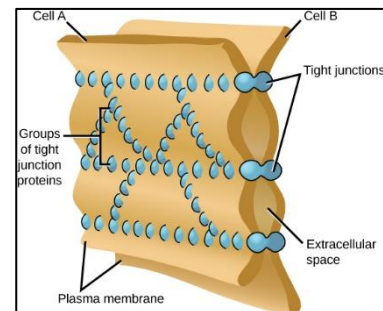


*intercellular space: space occurring between cells

**extracellular space: space outside cells

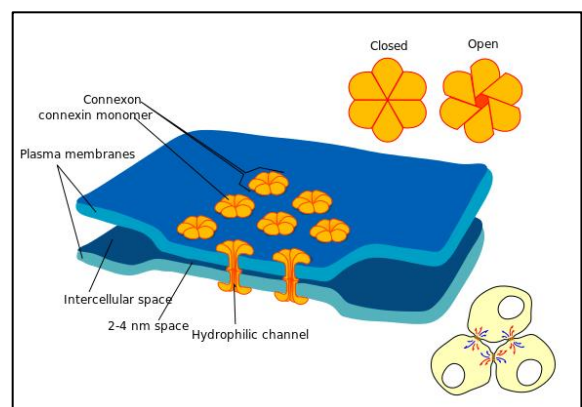
3) Specialised cell junctions – Tight junctions (impermeable junctions)

- Adjacent cells bind at point of direct contact
- Seals off passageway between cells (prevents movement of materials between cells, hence the name impermeable)



3) Specialised cell junctions – Gap junctions (communicating junctions)

- Adjacent cells connect by small connecting tunnels (called connexions)
- Connexion: hollow tube like structure that extends through the plasma membrane
- Molecules, ions and electrical impulses can directly pass through a regulated gate between cells (hence the name communicating)



3) Tissue level

Cells combine to form tissues

Muscle tissue

- Consists of cells specialized for contracting, generating tension and producing movement
- Skeletal muscle: moves the skeleton
- Cardiac muscle: pumps blood out of the heart
- Smooth muscle: controls movement of contents through hollow tubes and organs (e.g. movement of food through digestive tract)

Nervous tissue

- Consists of cells specialized for initiating and transmitting electrical impulses to relay information
- Such signals are important in communication, coordination and control
- Found in brain, spinal cord, nerves and special sense organs

Epithelial tissue

- Consists of cells specialized for exchanging materials between the cell and environment
- Any substance that enters/leave body must cross epithelial layer (e.g. skin)
- 2 general structures:
 - Epithelial sheets: layer of tightly joined cells
 - secretory glands: specialized for secretion

Connective tissue

- Consists of cells specialized for connecting, supporting and anchoring various body parts
- E.g. tendons: attach skeletal muscles to underlying structures
- E.g. bone: gives the body shape, support and protection
- E.g. blood: transports materials from one part of the body to another

4) Organ level

- 2 or more types of primary tissue organised to perform a particular function
- E.g. the human eye

5) Body system level

- Groups of organs organised into body systems
- Circulatory, digestive, respiratory, urinary, skeletal, muscular, integumentary, immune, nervous, endocrine, reproductive

Homeostasis

- Maintenance of a relatively stable internal environment
- Aims to establish optimal condition, balanced and steady state
- Functions performed by each body system contribute to homeostasis
- Body detects deviations from normal internal environment, integrates this information and makes adjustments

Control systems

- 1) Intrinsically controlled:
 - Built into or inherent in an organ
 - E.g. skeletal muscle uses up O₂, chemical change causes the smooth muscle to relax so that the vessels dilate and bring more O₂
- 2) Extrinsically controlled:
 - Initiated outside an organ to alter organ activity
 - Extrinsic control permits coordinated regulation of several organs toward a common goal, intrinsic controls serve only the organ in which they occur
 - E.g. to restore blood pressure, nervous system acts on the heart and blood vessels throughout the body

More control systems:

- 1) Negative feedback control:
 - Change triggers a response that seeks to restore the factor to normal by moving the factor in the opposite direction to the initial change
 - E.g. when body temp decreases, sensors signal to the brain that generates responses such as shivering to generate heat
- 2) Positive feedback control:
 - Change triggers a response that seeks to restore the factor to normal by enhancing the change; moving the factor in the same direction to the initial change
 - Doesn't occur as often
 - E.g. during birth, oxytocin causes contractions, as baby pushes against the cervix, this causes the release of more oxytocin and even stronger contractions
- 3) Feed forward control:
 - Anticipate and prevent change
 - E.g. when food is in digestive tract, insulin is secreted to promote storage of nutrients after they have been absorbed by digestive tract

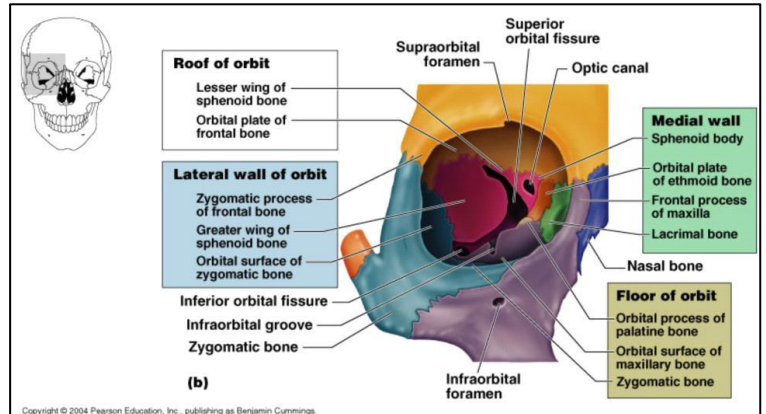
The human eye part 1

The Human Eye:

- A vital human sense organ
- Takes information from the environment (in the form of light) and converts to neural signals
- Path of the light must be distinct, light scatter results in blurry image
- Various intraocular structures – optical components must maintain transparency
- Eye sits within the orbit (bone and connective tissue framework) this includes:
 - extraocular muscles for movement
 - eyelids to cover and protect anterior ocular surface
 - blood vessels and nerves

**intraocular – inside the eye, extraocular – outside the eye

**anterior – front third of the eye, posterior – back two thirds of eye

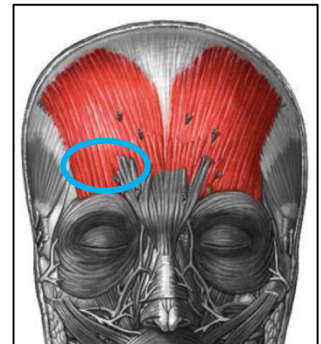


Eyebrows

Muscles that are located in the forehead produce eyebrow movements. All the muscles are innervated (supplied by) the facial nerve (CNVII)

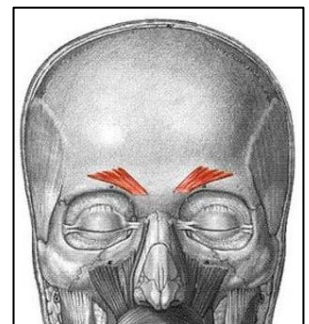
Frontalis muscle

- Starts high on the scalp and inserts into connective tissue near the superior orbital rim
- Vertically oriented fibres
- Allows for eyebrows to be raised



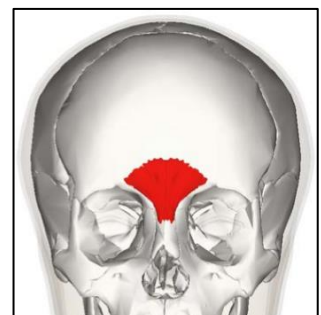
Corrugator muscle

- Originates from the frontal bone to skin superior to the medial brow
- Draws eyes medially (towards middle) and inferiorly (below)
- Creates vertical furrows between brows



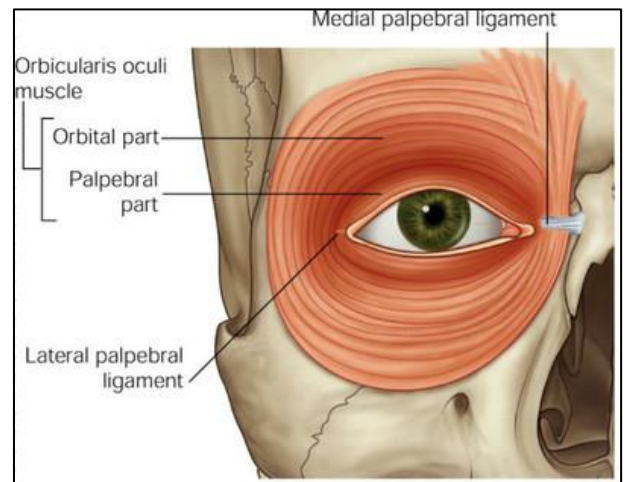
Procerus muscle

- Originates from nasal bone and inserts into medial side of frontalis
- pulls the medial (middle) portion of the eyebrow inferiorly (down)
- produces horizontal furrows over the bridge of the nose



Orbicularis oculi

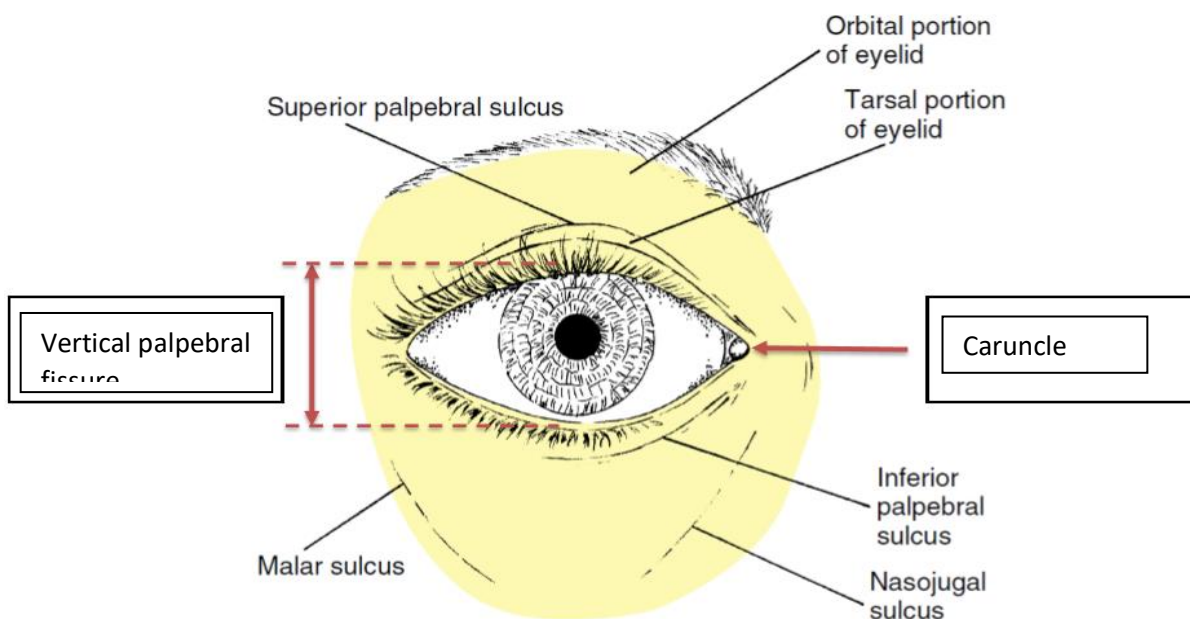
- ring-like band of muscle which lowers the entire eyebrows and closes eyelids. It can be divided into regions
- Orbital: closes eyelids controlled by voluntary action
- Palpebral: occupies area of eyelid and closes to the eyelid margin. Closes eyelid gently in involuntary or reflex blinking
- Lacrimal: facilitates emptying of lacrimal sac



Eyelids

Functions:

- Cover the eye for protection
- Spread tears across ocular surface
- Draining of tears
- Contains glands that produce parts of the tear film



- *Palpebral fissure*: area between open eyelids
- *Caruncle*: small pink mass of skin
- *Tarsal portion*: lies closest to the eyelid margin and rests on the globe (i.e. the eyeball)
- *Orbital portion*: extends from the tarsus to the eyebrow
- *Superior palpebral sulcus*: the furrow that separates the tarsal and orbital portions
- *Inferior palpebral sulcus*: lies in the lower eyelid and which separates the lower lid into tarsal and orbital portions (it is not as distinct)
- Medial canthus: inner eye
- Lateral canthus: outer eye

** note the medial canthus is just the inner part of the eye, the caruncle is the pink mass. They are different

** Medial rectus of right eye is on left side and medial rectus of left eye is on right side

