NOTES
BLOOD BRAIN BARRIER & CSF

BLOOD BRAIN BARRIER (BBB)

osms.it/blood-brain_barrier

- Selective barrier separating blood, interstitial liquid in central nervous system (CNS)
- Molecular transport keeps harmful substances out, allows metabolic waste products to diffuse from brain → plasma
- Formed by
  - Tight junctions between endothelial cells of brain capillaries
  - Astrocyte projection ("feet") supporting, maintaining structure
  - Basal (basement) membrane
- *Passive transport:* no energy needed (e.g. passive diffusion of lipid-soluble molecules)
- *Active transport:* energy needed (e.g. facilitated diffusion of glucose, amino acids)
- *Primary function:* CNS homeostasis
  - Providing selective nutrient passage
  - Controlling fluid movement
  - Protecting from toxins, microbes

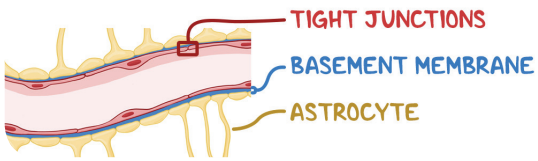

Figure 52.1 Components of the blood brain barrier.

BBB PERMEABILITY

- May change due to inflammation, irradiation, tumors
- Permeant molecules (lipid-soluble molecules)
  - Steroid hormones; oxygen; carbon dioxide; water; glucose, essential amino acids; certain electrolytes
- Impermeant molecules
  - Non-essential amino acids; waste products; microbes, toxins; proteins; certain electrolytes (e.g. potassium); water-soluble drugs

BBB IN CIRCUMVENTRICULAR ORGANS

- Absent in circumventricular organs → connection between CNS, blood
- Includes sensory, secretory organs

Sensory organs

- Sense plasma molecules, coordinate response to them
  - Area postrema/vomiting center (senses harmful substances in blood → vomiting reflex)
  - Subfornical organ
  - Vascular organ of lamina terminalis

Secretory organs

- Receive stimuli, secrete substances directly in plasma
  - Posterior pituitary gland
  - Median eminence of hypothalamus
  - Pineal gland

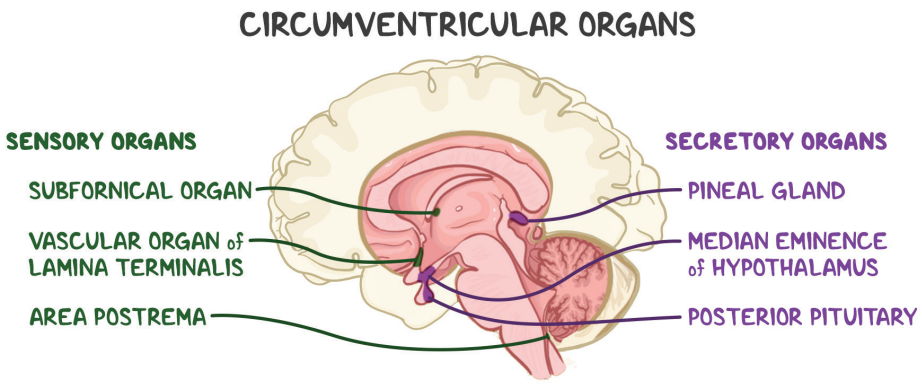

Figure 52.2 Sensory and secretory circumventricular organs.

CEREBROSPINAL FLUID (CSF)

osms.it/cerebrospinal-fluid

- Body fluid found within CNS
- Fills, circulates through
  - Ventricular system (lateral ventricles, third ventricle, fourth ventricle, central canal of spinal cord)
  - Subarachnoid space surrounding brain, spinal cord

CIRCULATION

- Lateral ventricles → interventricular foramina → third ventricle → cerebral aqueduct → fourth ventricle → lateral, median apertures → subarachnoid space, cisterns (some enters spinal column) → arachnoid granulations (arachnoid mater outpouching) → venous system circulation
- Kept in motion by cilia of ependymal cells lining ventricle system

PRODUCTION

- Mostly produced by choroid plexuses
  - Network of capillaries, modified ependymal cells in ventricles
  - Also functions as blood-CSF barrier
- Rate
  - 500mL/day
- Regulated by
  - Hormones, blood pressure, autonomic nervous system

CHARACTERISTICS

- *Quantity:* 125mL in total
- *Color:* limpid
- *Pressure:* range from 8–15mmHg (supine) to 16–24mmHg (sitting)
- *pH:* 7.33
- *Protein content:* 35mg/dL (< serum)
- *Glucose:* 60mg/dL (< serum)
- Electrolytes (mEq/L)
  - *Sodium:* 138
  - *Potassium:* 2.8
  - *Calcium:* 2.1
  - *Magnesium:* 2.0
  - *Chloride:* 119 (> serum)
- Sampled by lumbar puncture
  - Lumbar cistern puncture at end of spinal cord; between second, third lumbar vertebrae (L2–L3)

FUNCTIONS

- CNS protection
  - Trauma → absorbs mechanical energy
  - Own weight → provides buoyancy
  - Ischemia → decreases quantity, relieves intracranial pressure
  - Toxic metabolites → clears them out
- Transportation medium for chemical signals, nutrients

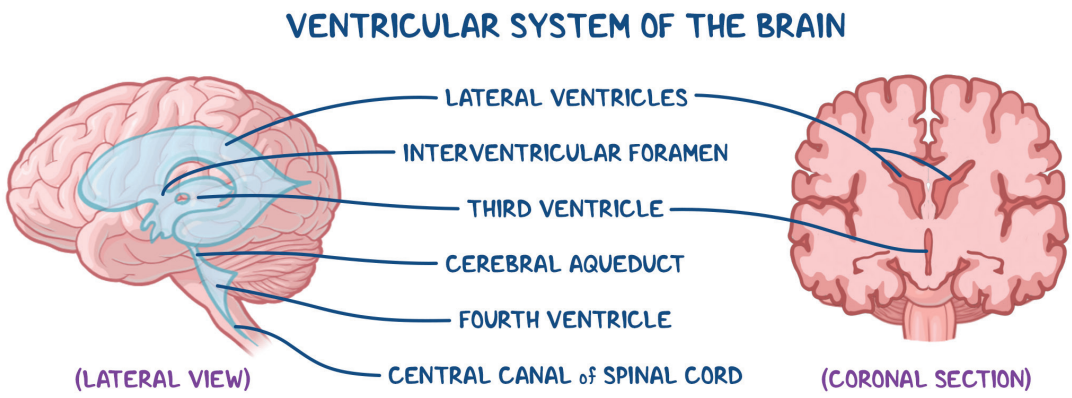

Figure 52.3 Ventricular system of the brain through which CSF flows.

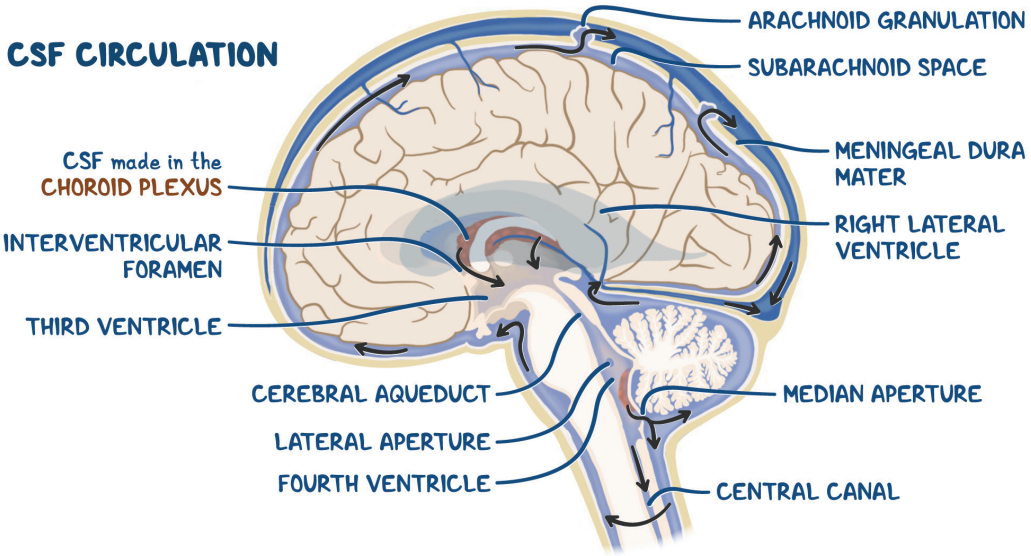

Figure 52.4 CSF circulation. CSF is produced by the choroid plexuses of the ventricles and is reabsorbed through the arachnoid granulations.