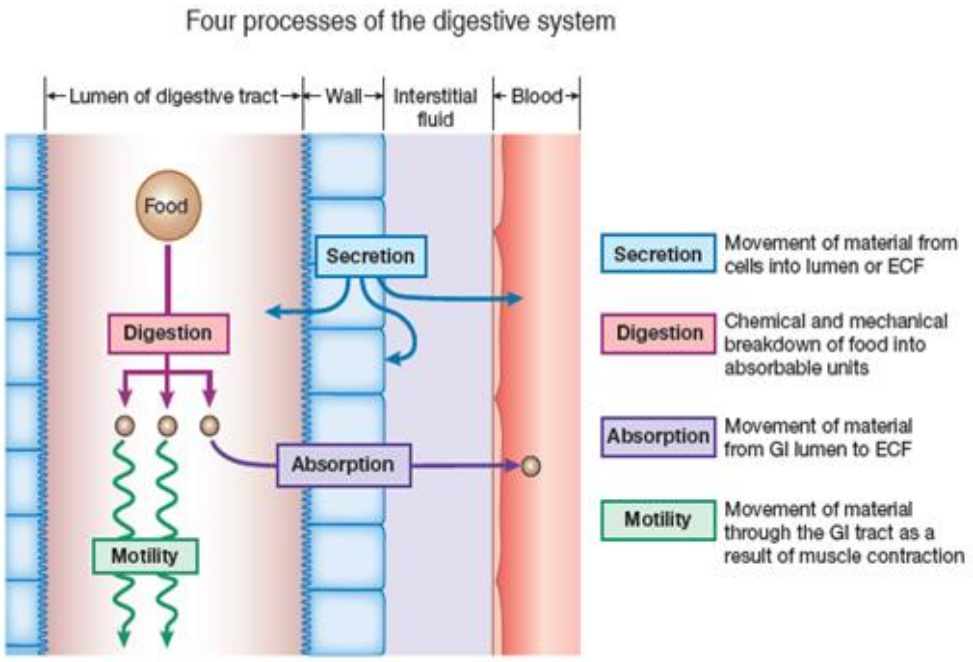
Diagrams & Flowcharts -- GIT –Renal System 25/01/2024

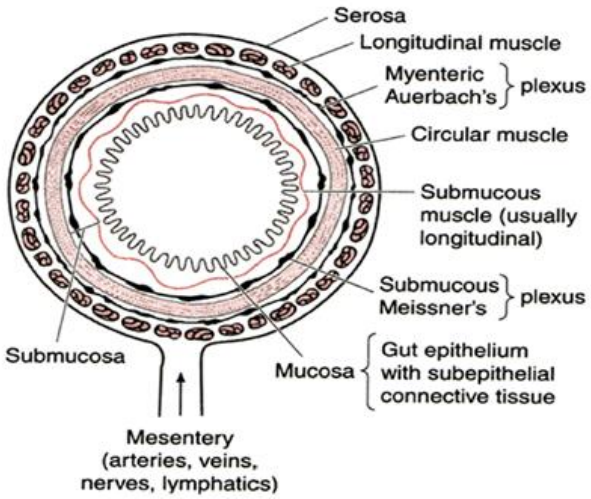
Instructions:

1. Write the diagrams/flow charts neatly with proper Labeling in 100page unruled notebook
2. Submit your assignment to the respective Table Teacher on time
3. Clarify your doubts with teacher concerned.
4. Submit the assignment by 16th February 2024

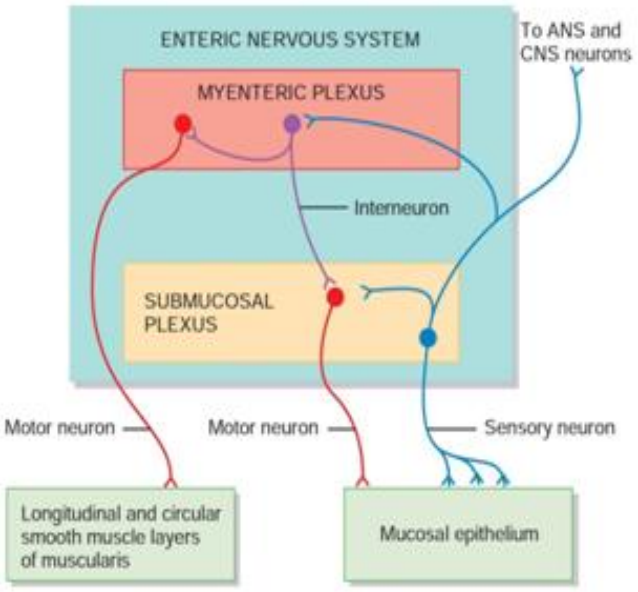
1. Summary of process of Digestive system



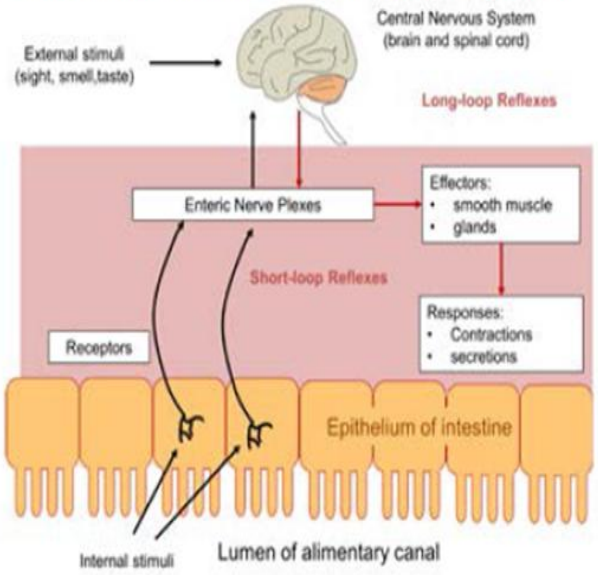
2. The layers of the alimentary canal



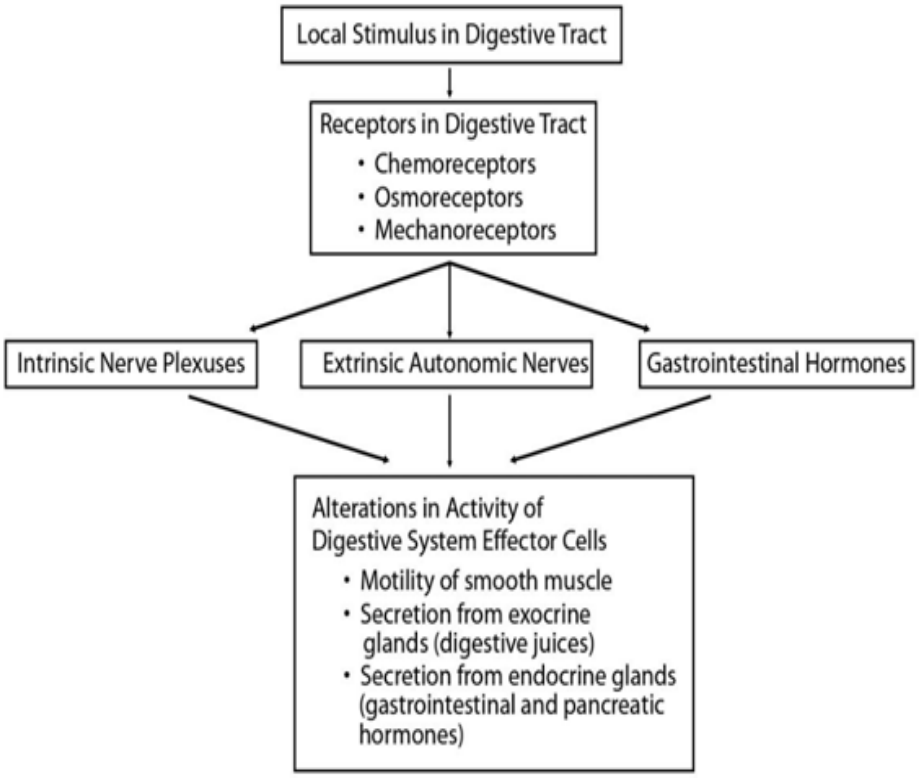
3. Organization of Enteric Nervous system



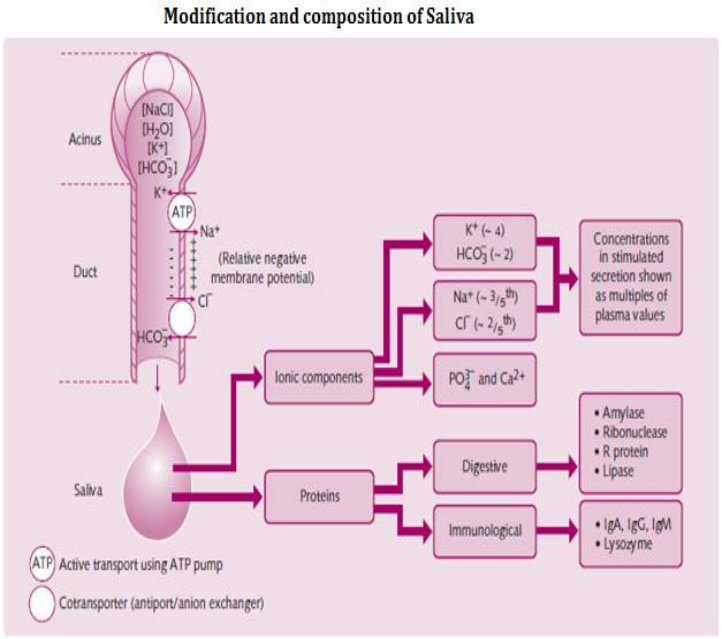
Schematic drawing of the major types of neural reflexes controlling gut activity

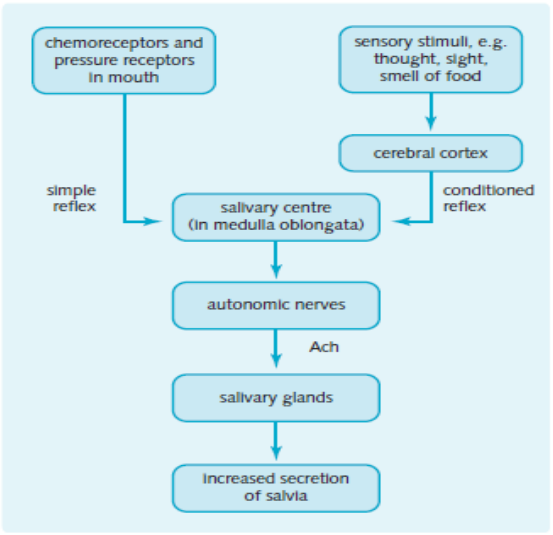


Summary of the regulatory mechanisms influencing gastrointestinal function.



4. Salivation





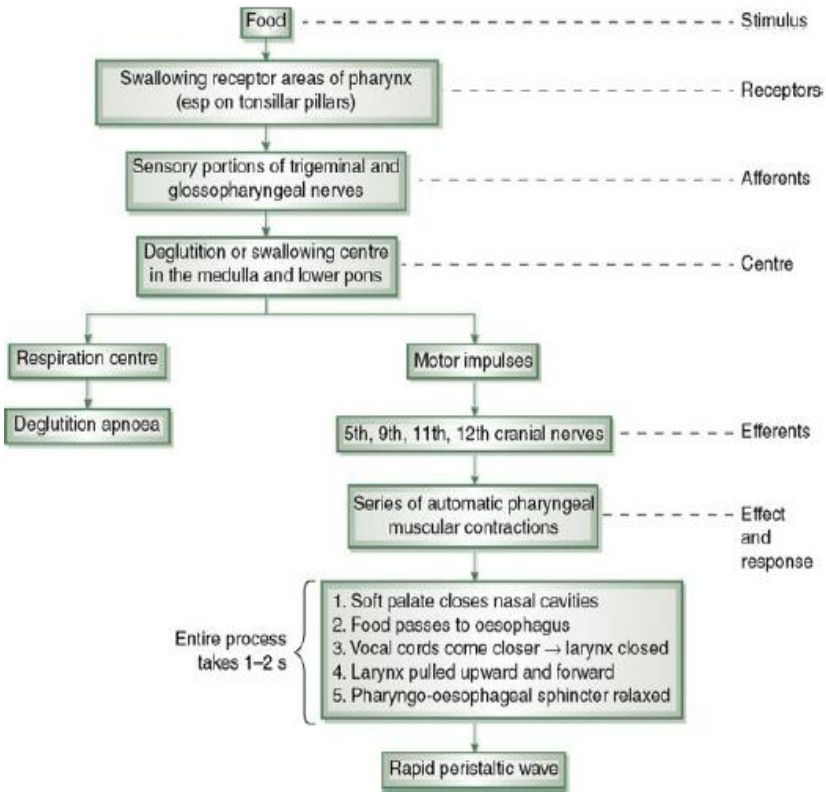
Control of salivation. Two reflexes, the simple reflex and the conditioned (acquired) reflex, increase salivation above the baseline level of around 0.5 mL/min.

Regulation of Salivary Flow

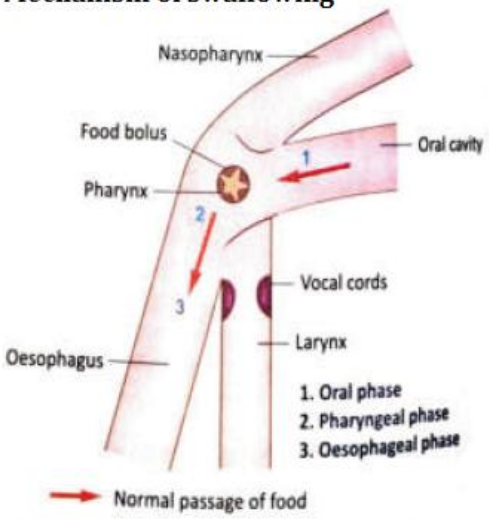
Increase Salivary Flow	Reduce Salivary Flow
• Parasympathetics (CN VII & IX), ACh, VIP • CNS (in cephalic, "sensory" phase) • Nausea • Esophageal distension • Chewy, flavorful foods • Dry, acidic foods • Meats, sweets, and bitter foods	• Sympathetics, NE • Hormones (ADH, aldosterone) conserve water and salt when volume depleted • Sleep • Dehydration (activates hormones) • Drugs, chemotherapy • Aging (decreases ANS tone; glands can atrophy)

ACh, acetylcholine; ADH, antidiuretic hormone; ANS, autonomic nervous system; CN, cranial nerve; CNS, central nervous system; NE, norepinephrine; VIP, vasoactive intestinal peptide.

5. Swallowing reflex/ deglutition reflex



Mechanism of swallowing



Stages of Deglutition

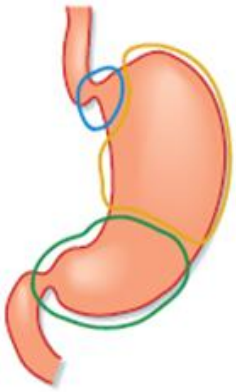
1. **Buccal/ Oral Phase - voluntary**
2. **Pharyngeal Phase – reflex mechanism**
3. **Esophageal phase – involuntary**

Swallowing Reflex arc:

- **Stimulus:** bolus in the oropharynx.
- **Receptors:** touch & pressure receptors of fauces, tonsils, posterior pharyngeal wall,soft palate.
- **Afferents:** V, IX, X cranial nerves.
- **Centre:** Nucleus Tractus Solitarious (NTS)
- **Efferents:** V, VII, IX, X, XII cranial nerves.
- **Effector organs:** muscles of soft palate, pharynx, neck muscles & esophagus.

6. Stomach

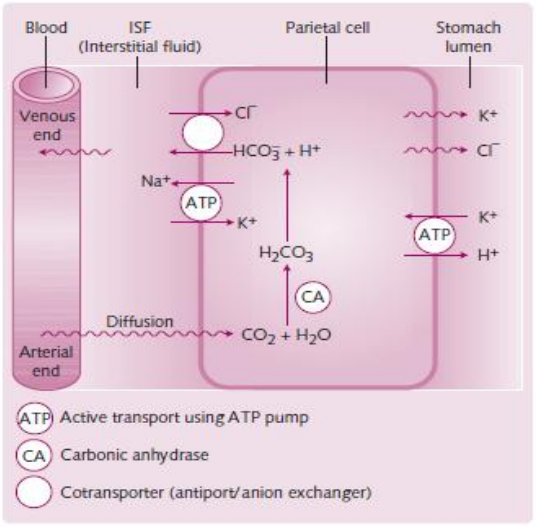
Functional regions of the stomach



Region	Luminal secretion	Motility
LES* and cardia	Mucus HCO_3^-	Prevention of reflux Entry of food Regulation of belching
Fundus and body	H^+ Intrinsic factor Mucus HCO_3^- Pepsinogens Lipase	Reservoir Tonic force during emptying
Antrum and pylorus	Mucus HCO_3^-	Mixing Grinding Sieving Regulation of emptying

*LES is part of the esophagus

Mechanism of secretion of HCL



Regulation of Gastric secretion

- CEPHALIC PHASE (NEURONAL)
  - Conditioned reflex
  - UnConditioned reflex
- GASTRIC PHASE (NEURONAL & HORMONAL)
- INTESTINAL PHASE (HORMONAL)

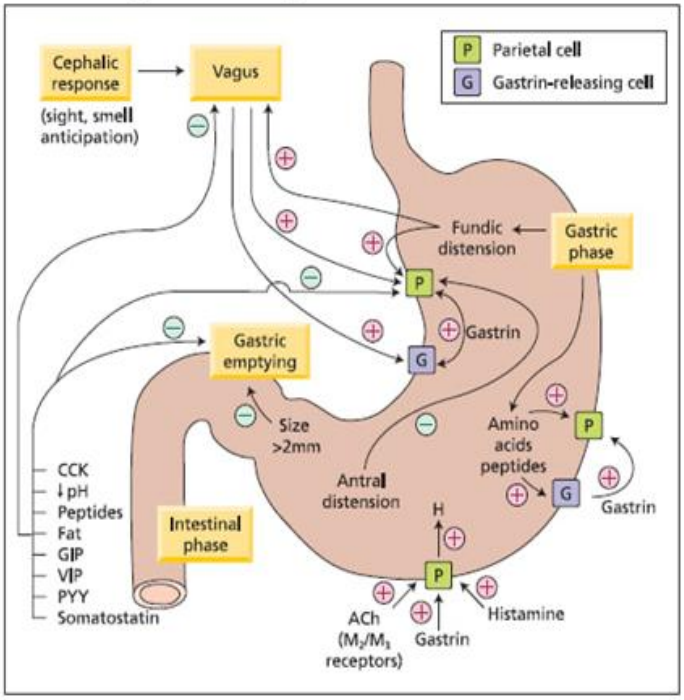
Regulation of each Phase of Gastric secretion

phase	stimuli	mechanism
cephalic	sight, smell and taste of food	vagus nerve → intrinsic nerves → ACh → parietal and chief cells → secretion vagus nerve → G cells → gastrin → parietal and chief cells → secretion
gastric	distension of stomach, amino acids and peptides (products of protein digestion); also alcohol and caffeine	local reflexes → intrinsic nerves → ACh → parietal and chief cells → secretion vagal reflexes → intrinsic nerves → ACh → parietal and chief cells → secretion local reflexes → G cells → gastrin → parietal and chief cells → secretion
intestinal	amino acids and peptides (products of protein digestion)	intestinal G cells → gastrin → parietal and chief cells → secretion
all phases	gastrin, ACh	enterochromaffin-like cell → histamine → parietal cells → acid secretion

Factors affecting gastric emptying

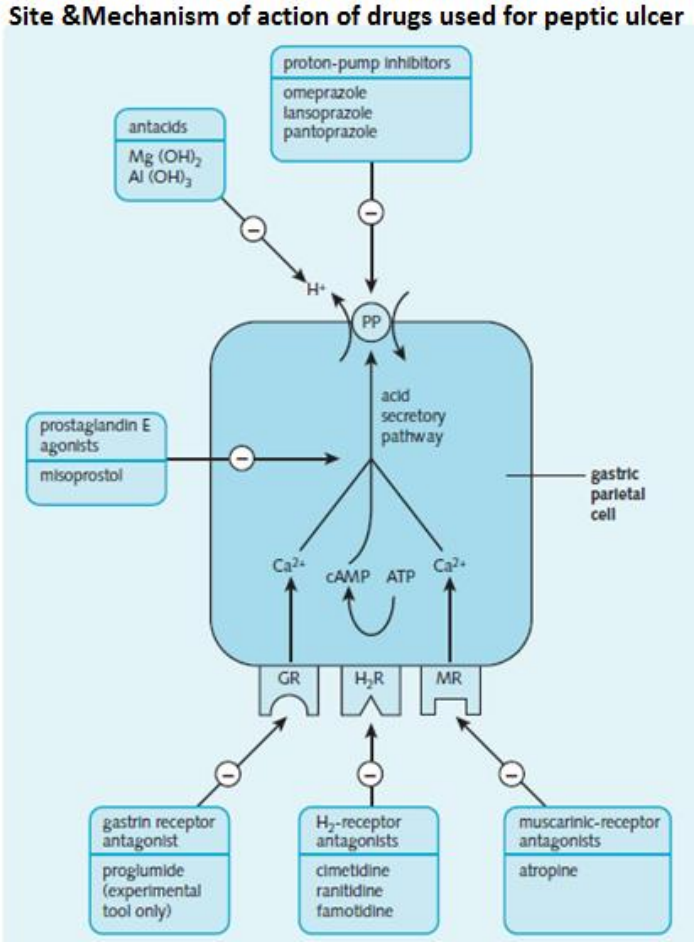
	Factor	
	Stomach content	***Duodenal chyme***
Energy content	Carbohydrates empty quickest Proteins empty slower Fats empty slowest	Fats
Bulk	Solid and coarse foods	Distension (duodenum)
Osmolality	Isosmolar ↑ in variation from isosmolar values further ↓ emptying	High osmolality
Temperature	Body temperature Cold or hot substances	
pH		<3.5

Control of gastric motility & secretion

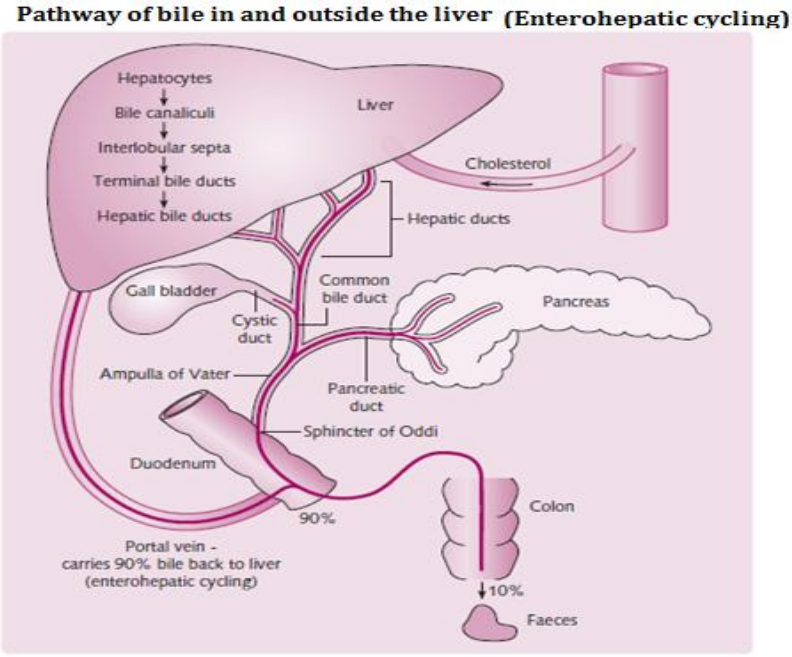


ACh, acetylcholine; CCK, cholecystokinin; GIP, gastric inhibitory polypeptide; M_2/M_3, muscarinic receptors; PYY, peptide YY; VIP, vasoactive intestinal polypeptide.

Site &Mechanism of action of drugs used for peptic ulcer



7. Enterohepatic circulation



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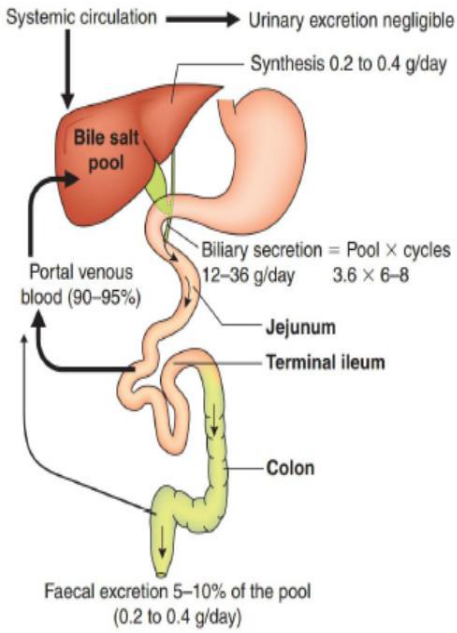
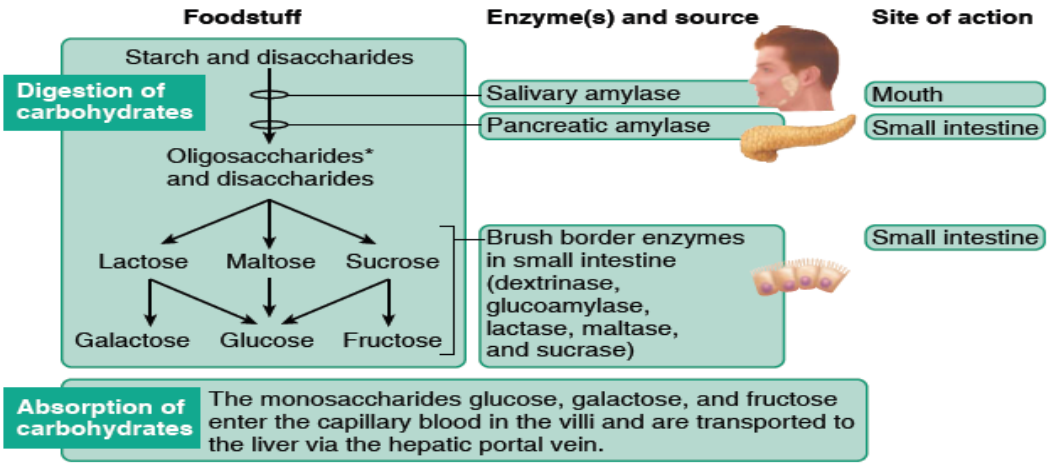
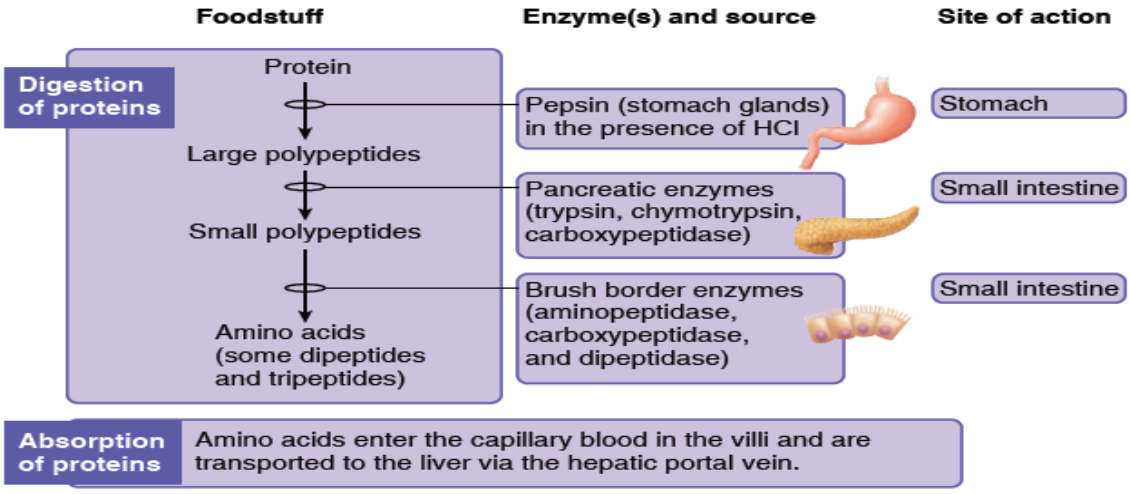
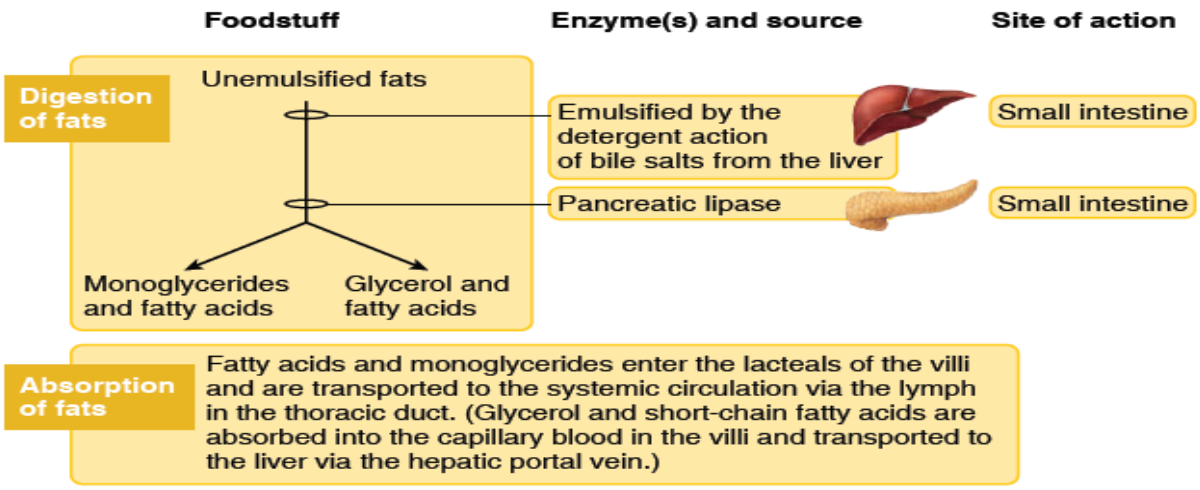
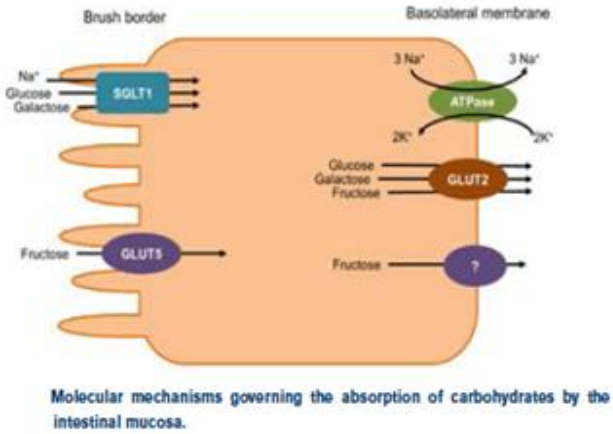


8. Flowchart of Digestion and Absorption of Foodstuffs

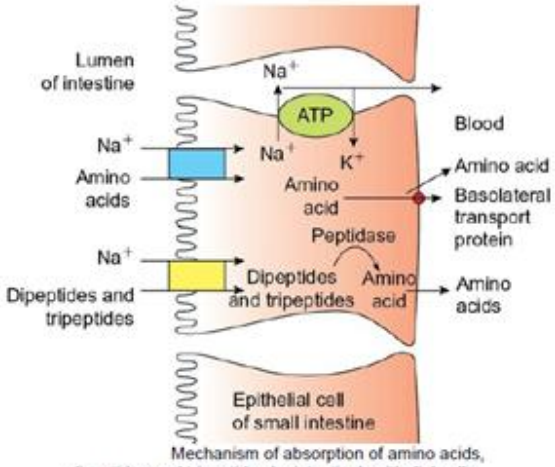






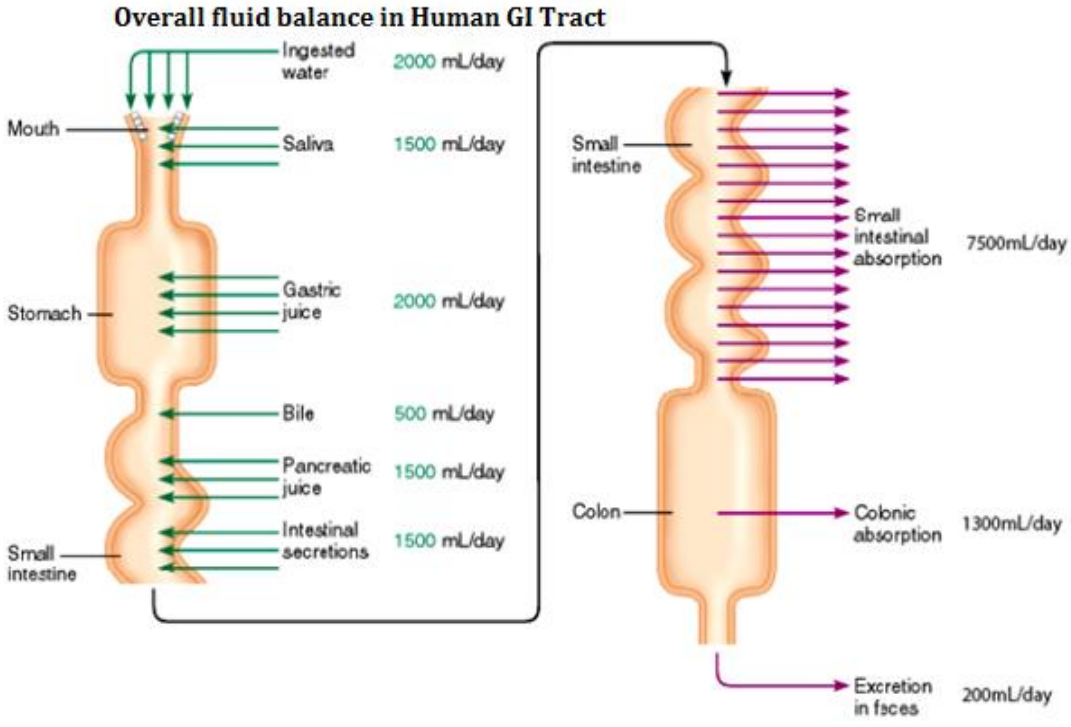


Molecular mechanisms governing the absorption of carbohydrates by the intestinal mucosa.



Mechanism of absorption of amino acids, dipeptides and tripeptides by intestinal epithelial cells.

9. Fluid balance in GIT

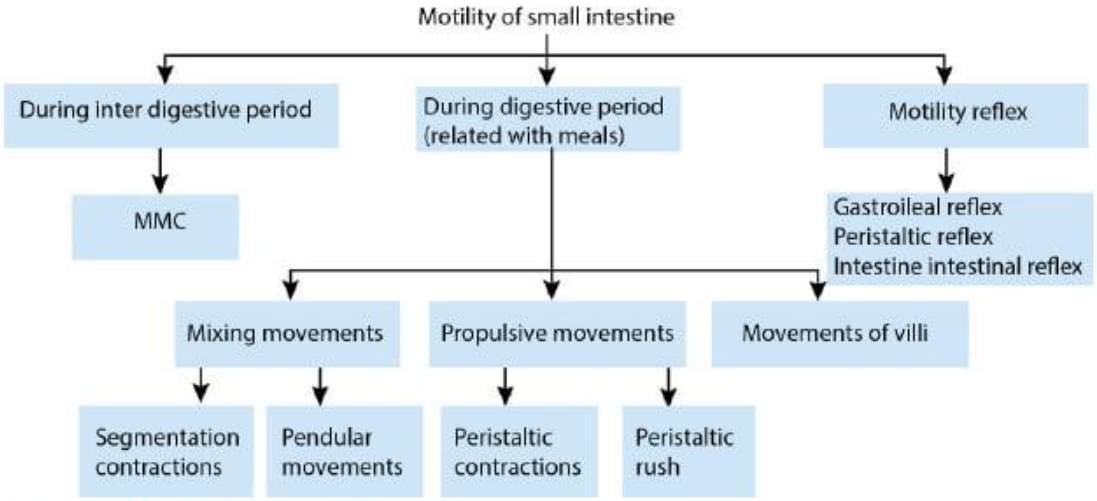


10. Gastro intestinal hormones

Paracrine hormone	DNES cell	Site of secretion	Function
Cholecystokinin (CCK)	I	Small intestine	Stimulates contraction of gall bladder (with release of bile) and facilitates the release of pancreatic enzymes
Gastric inhibitory peptide (GIP)	K	Small intestine	Inhibits secretion of gastric HCl
Gastrin	G	Pylorus and duodenum	Stimulates gastric secretion of HCl and pepsinogen
Glicentin	GL	Stomach through colon	Stimulates hepatic glycogenolysis
Glucagon	A	Stomach and duodenum	Stimulates hepatic glycogenolysis
Motilin	Mo	Small intestine	Increases gut motility
Neurotensin	N	Small intestine	Inhibits gut motility; stimulates blood flow to the ileum
Secretin	S	Small intestine	Stimulates bicarbonate secretion by the pancreas and biliary tract
Serotonin and substance P	EC	Stomach through colon	Increase gut motility
Somatostatin	D	Pylorus and duodenum	Inhibits nearby DNES cells
Vasoactive intestinal peptide (VIP)	VIP	Stomach through colon	Increases gut motility; stimulates intestinal ion and water secretion

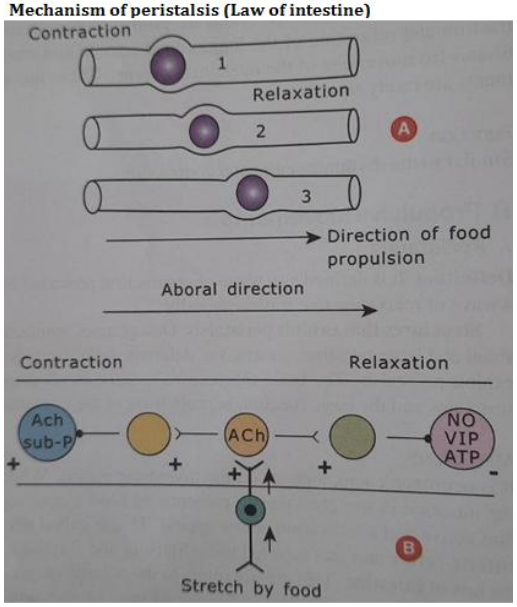
HCl, hydrochloric acid.

11. Small Intestinal Motility

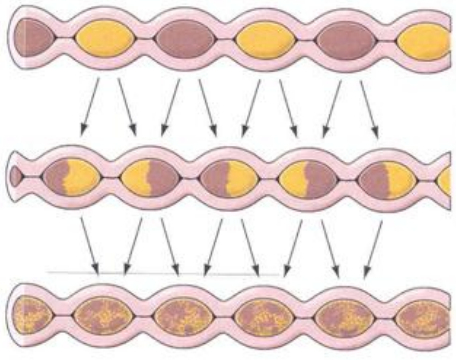


Summary of motility of small intestine.

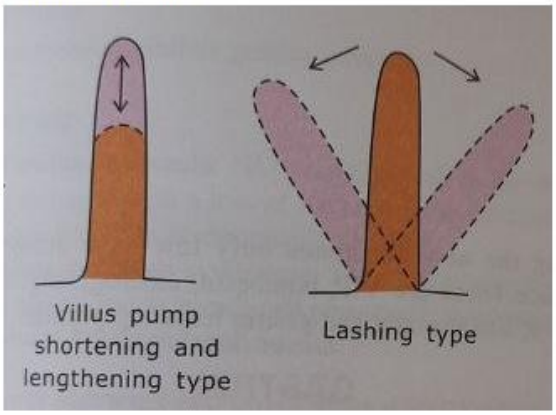
Mechanism of peristalsis (Law of intestine)



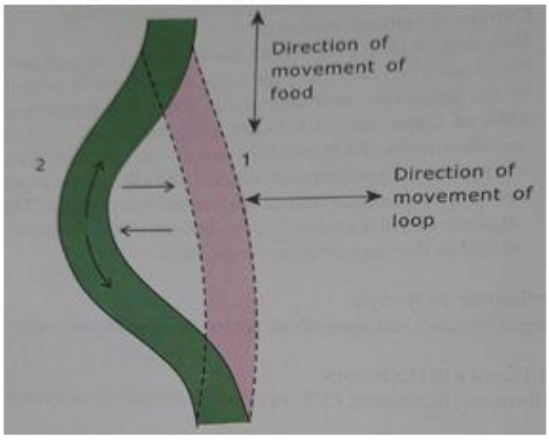
Segmentation contraction



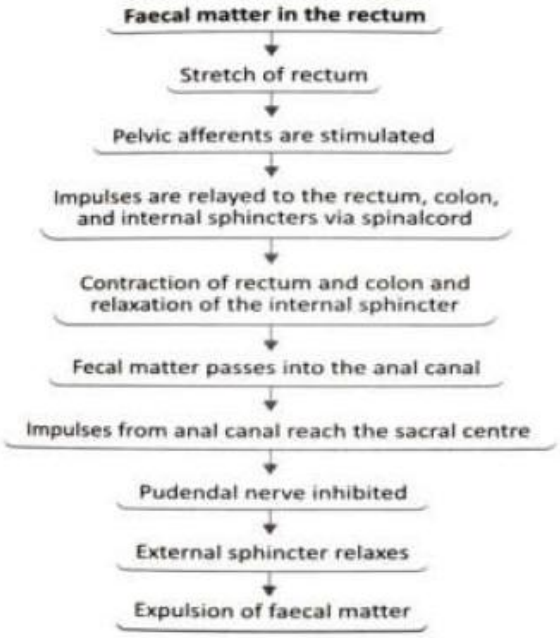
Villi movements



Pendular movements



12. Defecation Reflex

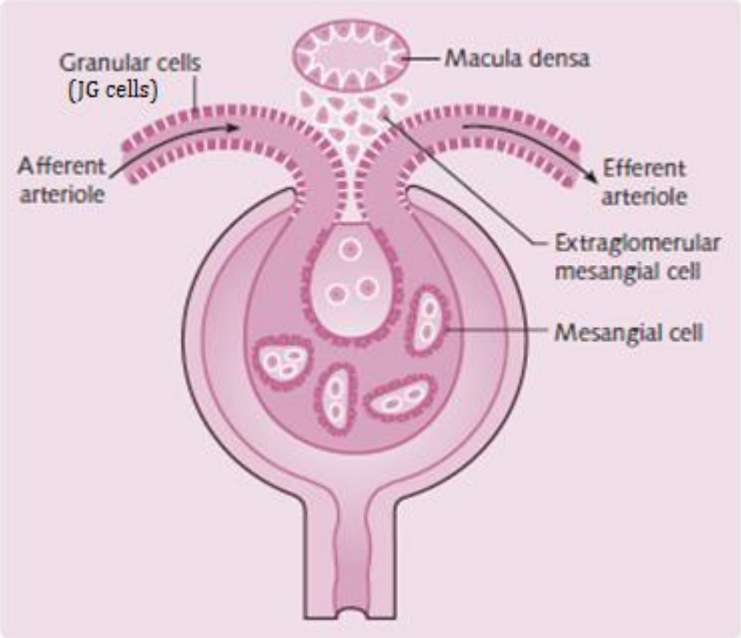


Defecation Reflex Pathway

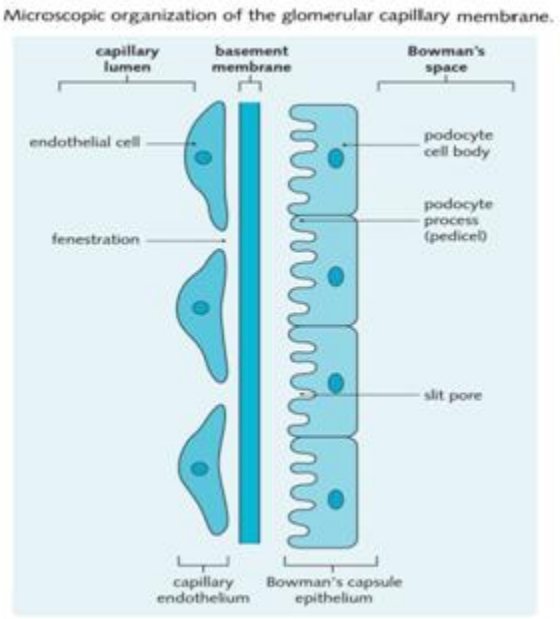
- Stimulus – distension of rectum
- Afferent – parasympathetic
- Center – S2, S3, S4
- Efferent – Sympathetic – inferior hypogastric plexus
  – Parasympathetic – nerve of erigenti (S2,S3,S4)
  – Spinal – Pudendal nerve (S2,S3,S4)
- Result – Voiding of feces

RENAL SYSTEM

1. Juxta glomerular Apparatus



2. Glomerular- capillary membrane



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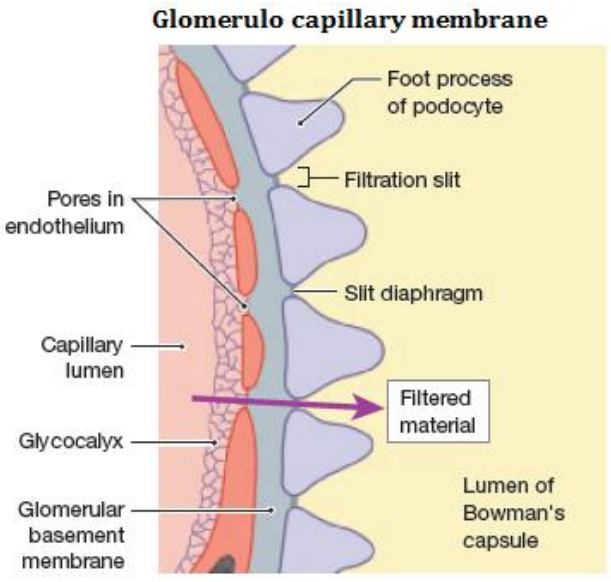
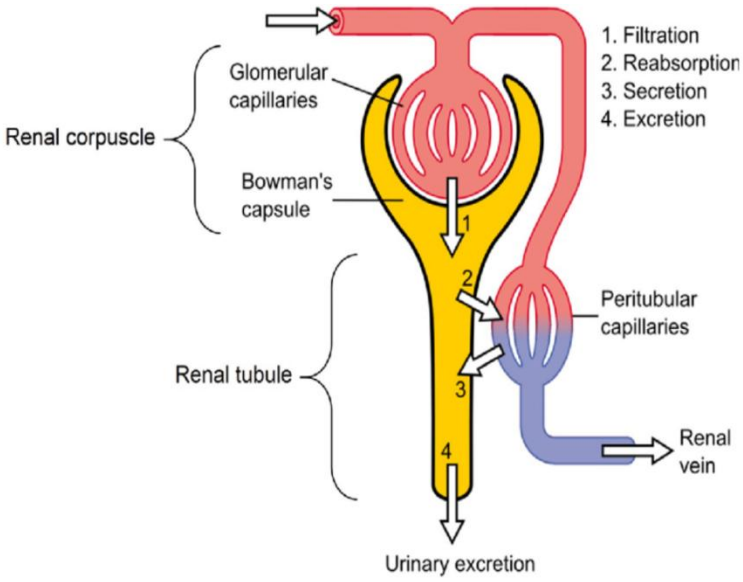
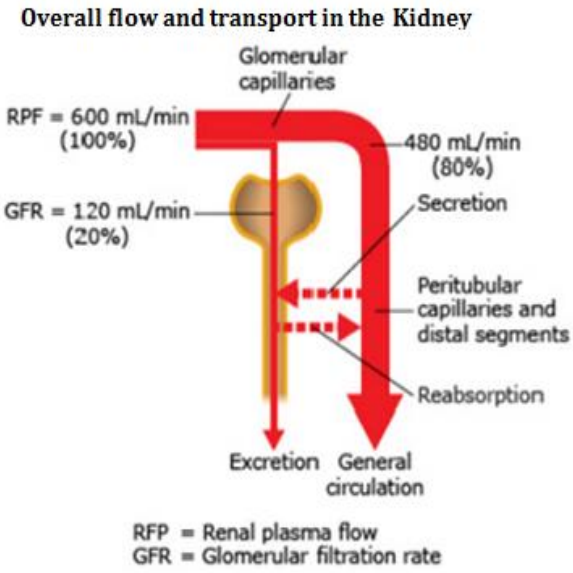
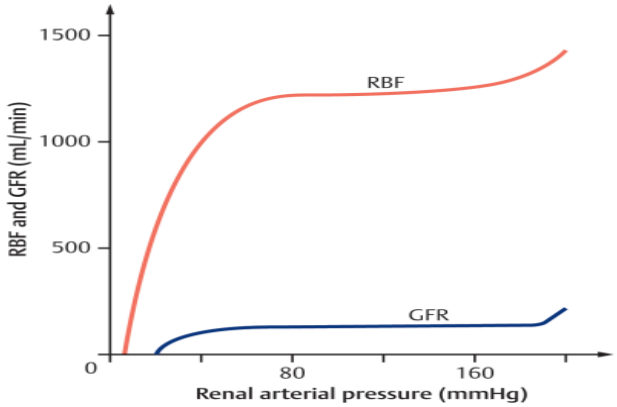


3. Functions of Nephron

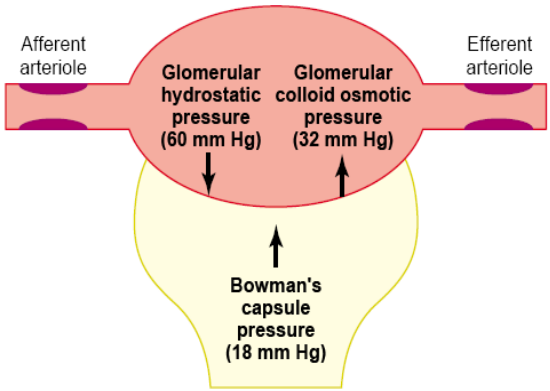




4. Autoregulation



5. Glomerular Filtration (GFR)



Net filtration pressure (10 mm Hg) = Glomerular hydrostatic pressure (60 mm Hg) − Bowman's capsule pressure (18 mm Hg) − Glomerular oncotic pressure (32 mm Hg)

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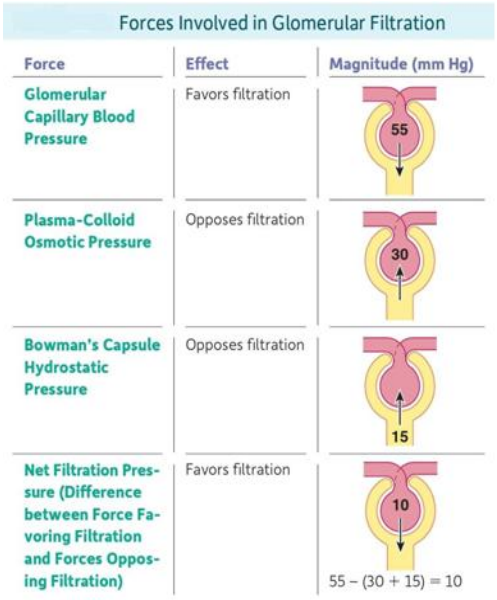
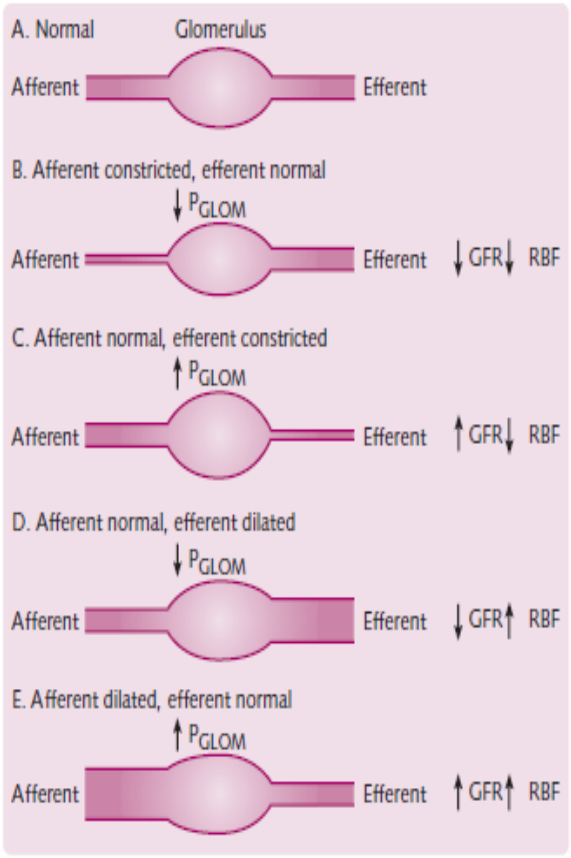


Effects of afferent and efferent arteriolar constriction and dilatation on RBF & GFR



Tubuloglomerular feedback helps GFR autoregulation

1. GFR increases.
2. Flow through tubule increases.
3. Flow past macula densa increases.
4. Paracrine signal from macula densa to afferent arteriole
5. Afferent arteriole constricts.

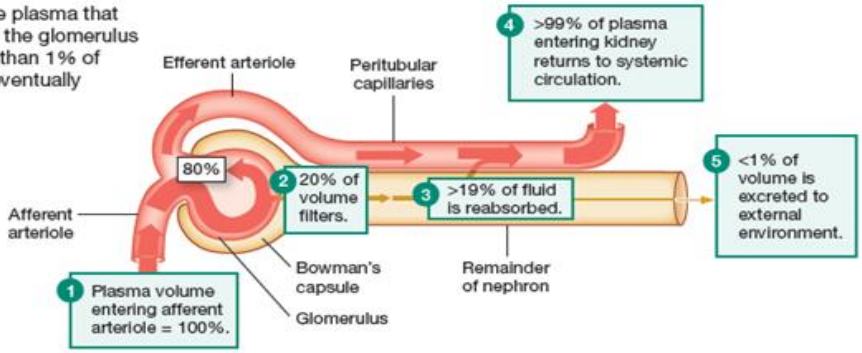
Resistance in afferent arteriole increases.

Hydrostatic pressure in glomerulus decreases.

GFR decreases.

The Filtration Fraction = GFR/RPF

Only 20% of the plasma that passes through the glomerulus is filtered. Less than 1% of filtered fluid is eventually excreted.



Useful Equations in Renal Physiology

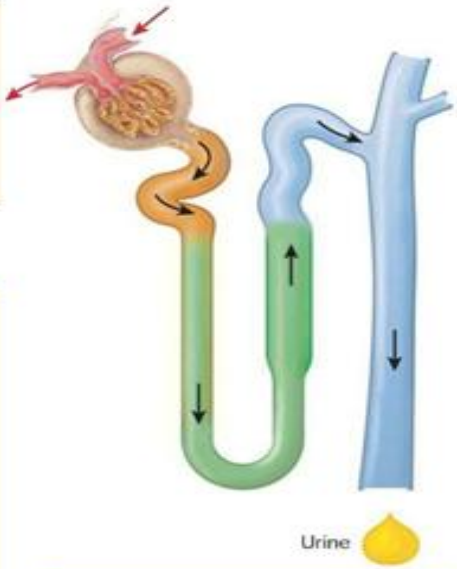
- Excretion = Filtration − Reabsorption + Secretion
- Filtration rate of $X = [X]_{plasma} \times GFR$
- Excretion rate of X = urine flow $\times [X]_{urine}$
- Clearance of $X = \dfrac{\text{excretion rate of } X \text{ (mg/min)}}{[X]_{plasma} \text{ (mg/mL plasma)}}$ **(UV/P)**
- When $[X]_{plasma}$ = renal threshold for X, then reabsorption of X = transport maximum for X.

6. Summary of filtration, reabsorption and secretion in the Nephron and collecting duct

RENAL CORPUSCLE

Glomerular filtration rate: 105–125 mL/min of fluid that is isotonic to blood

Filtered substances: water and all solutes present in blood (except proteins) including ions, glucose, amino acids, creatinine, uric acid



Urine

PROXIMAL CONVOLUTED TUBULE

Reabsorption (into blood) of:

Water	65% (osmosis)
Na^+	65% (sodium–potassium pumps, symporters, antiporters)
K^+	65% (diffusion)
Glucose	100% (symporters and facilitated diffusion)
Amino acids	100% (symporters and facilitated diffusion)
Cl^-	50% (diffusion)
HCO_3^-	80–90% (facilitated diffusion)
Urea	50% (diffusion)
Ca^{2+}, Mg^{2+}	variable (diffusion)

Secretion (into urine) of:

H^+	variable (antiporters)
NH_4^+	variable, increases in acidosis (antiporters)
Urea	variable (diffusion)
Creatinine	small amount

At end of PCT, tubular fluid is still isotonic to blood (300 mOsm/liter).

NEPHRON LOOP

Reabsorption (into blood) of:

Water	15% (osmosis in descending limb)
Na^+	20–30% (symporters in ascending limb)
K^+	20–30% (symporters in ascending limb)
Cl^-	35% (symporters in ascending limb)
HCO_3^-	10–20% (facilitated diffusion)
Ca^{2+}, Mg^{2+}	variable (diffusion)

Secretion (into urine) of:

Urea	variable (recycling from collecting duct)

At end of nephron loop, tubular fluid is hypotonic (100–150 mOsm/liter).

NORMAL CHARACTERISTICS OF URINE

Volume	one to two liters per 24 hours; considerable variation in normal volume
Color	yellow or amber color; color is darker in concentrated urine
Turbidity	transparent in freshly voided urine; microbes, pus, epithelial cells, or crystals may cause cloudiness
Odor	aromatic when fresh; ammonia-like after standing because of breakdown of urea to ammonia by bacteria
pH	normal range is 4.6–8.0; high protein diets produce an acidic urine; vegetarian diets produce an alkaline urine
Specific gravity	normal range is 1.001–1.035; low specific gravity represents dilute urine, higher values represent a concentrated urine

DISTAL CONVOLUTED TUBULE AND COLLECTING DUCT

Reabsorption (into blood) of:

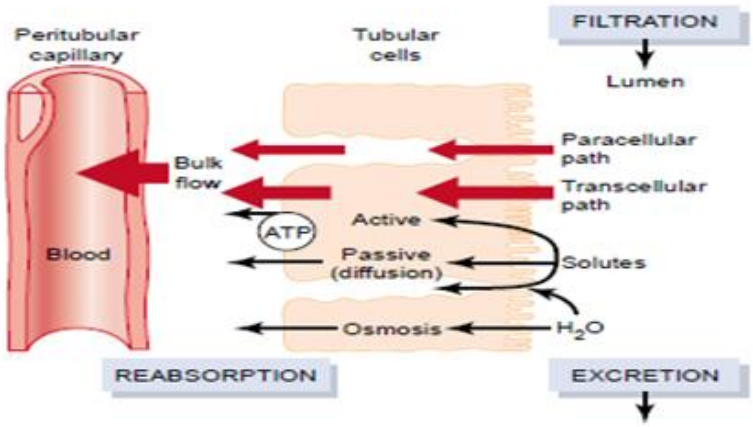
Water	20% (osmosis, water channels stimulated by ADH)
Na^+	5–15% (symporters, sodium–potassium pumps, sodium channels stimulated by aldosterone)
Cl^-	5% (symporters)
HCO_3^-	variable, depends on H^+ secretion (antiporters)
Urea	variable (recycling of nephron loop)
Ca^{2+}	variable (stimulated by parathyroid hormone)

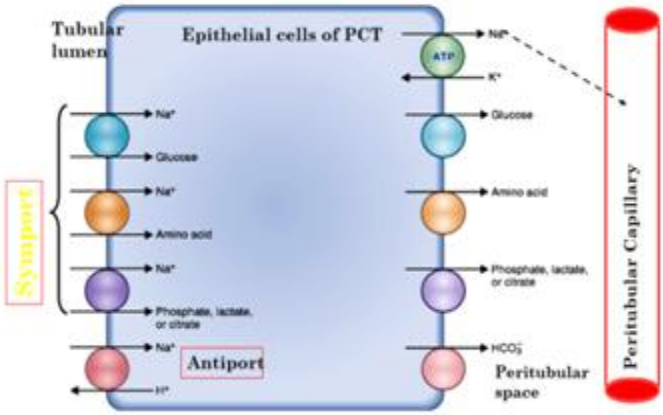
Secretion (into urine) of:

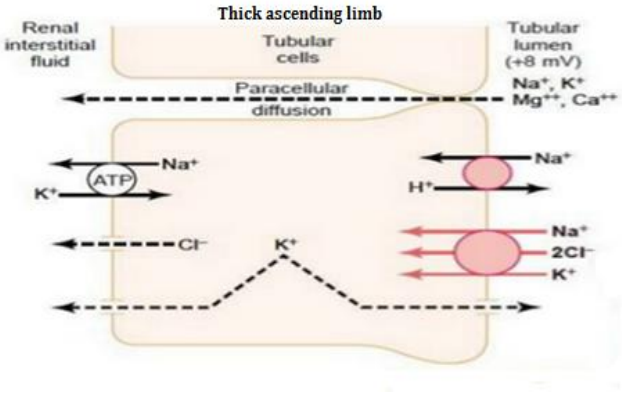
K^+	variable, adjusts to dietary intake (leakage channels)
H^+	variable, adjusts to maintain acid–base homeostasis (H^+ pumps)

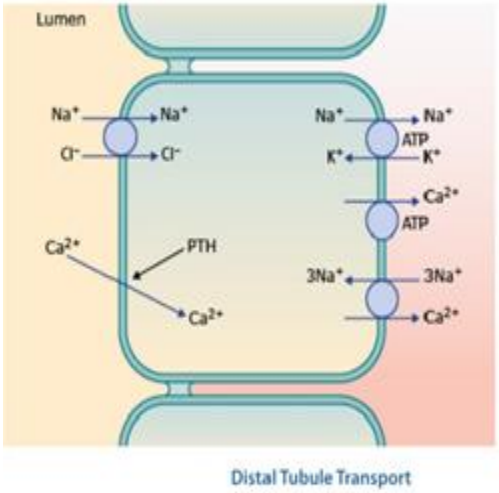
Tubular fluid leaving the collecting duct is dilute when ADH level is low and concentrated when ADH level is high.

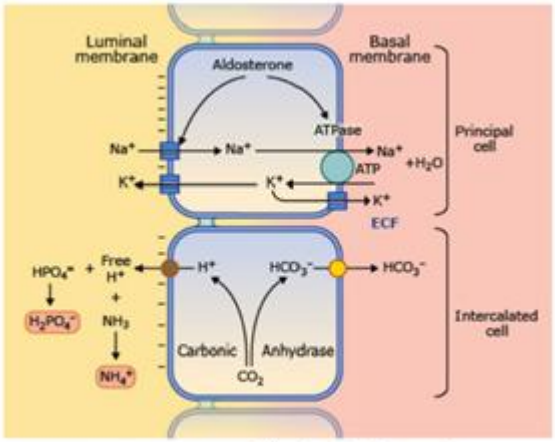
7. Mechanism of reasorption and secretion in renal tubules



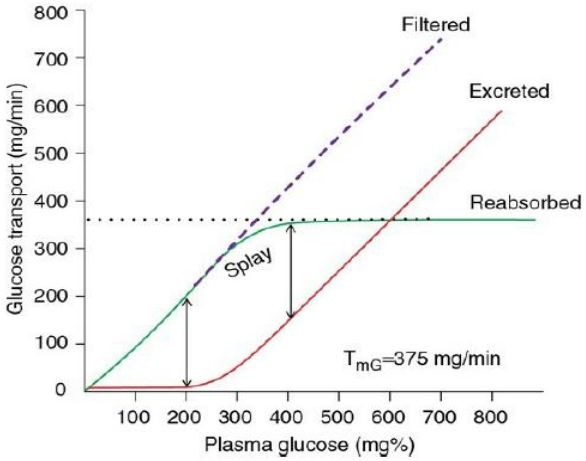




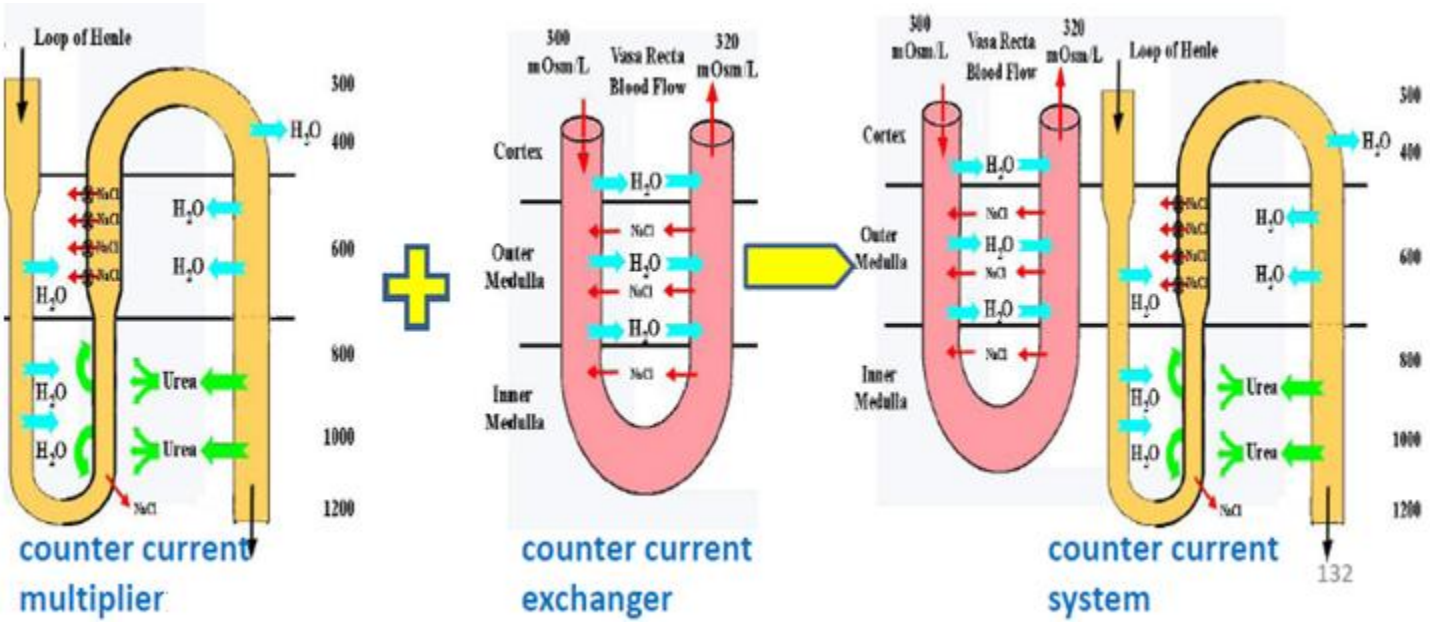


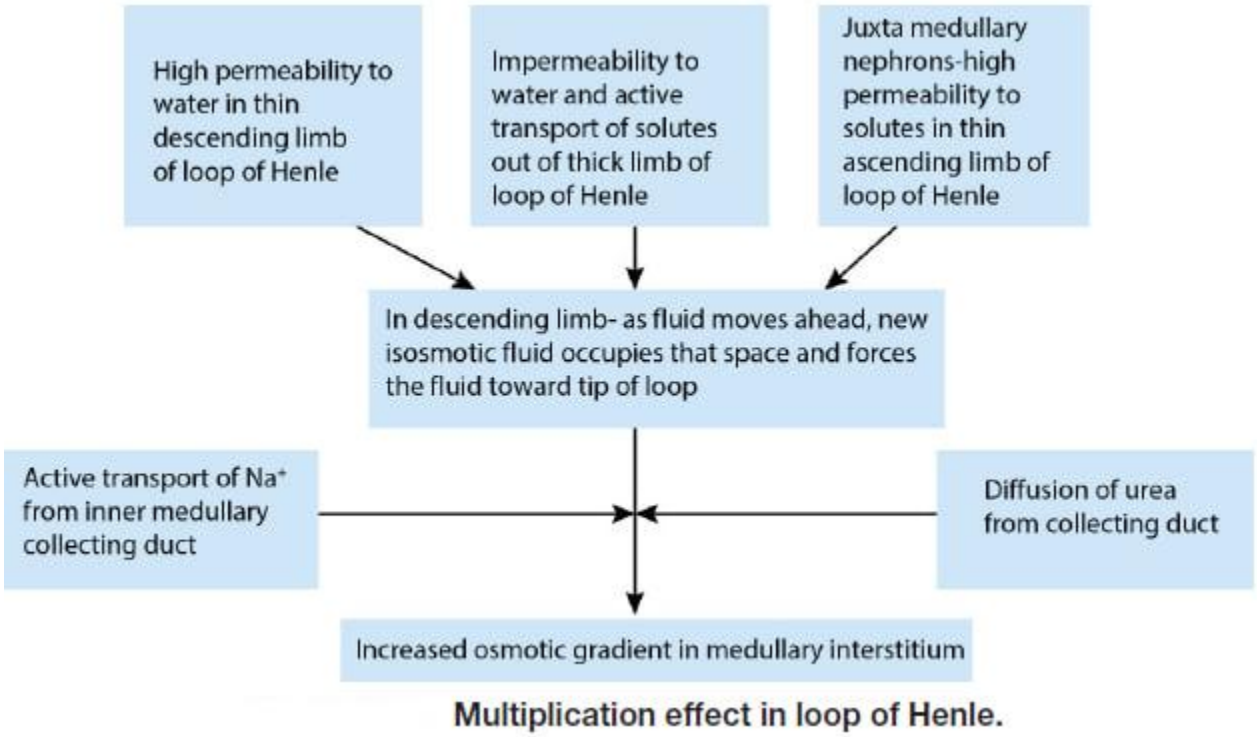


8. Renal Splay



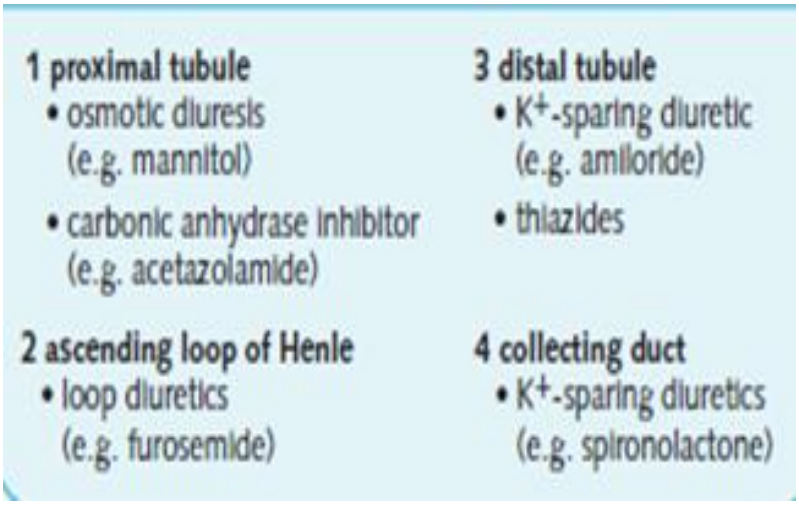
9. Counter current Mechanism



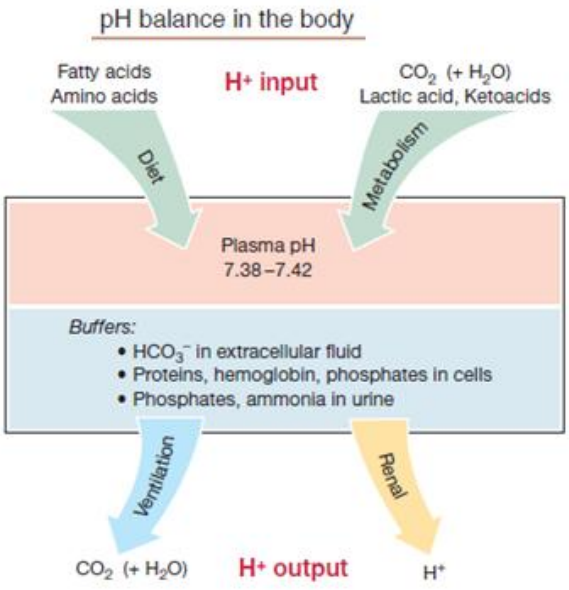


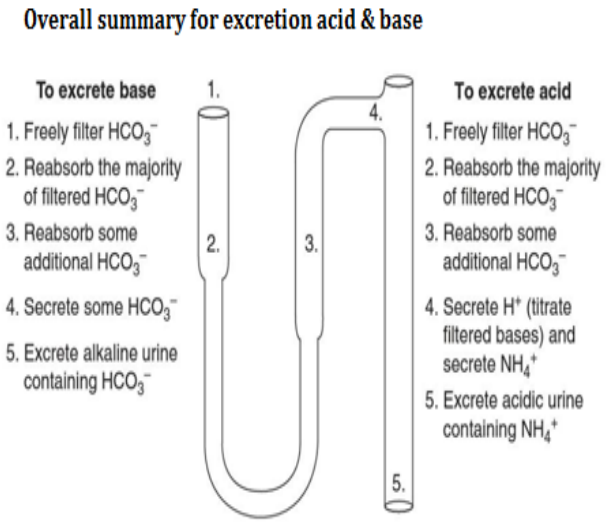
Multiplication effect in loop of Henle.

10. Sites of diuretic action



11. Role of kidney in Acid base balance



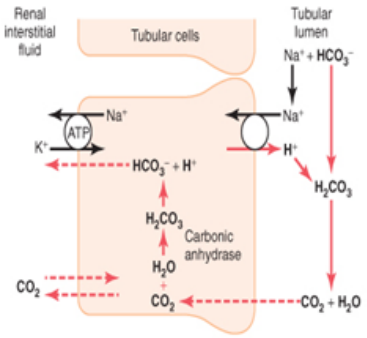


Reabsorption of HCO3

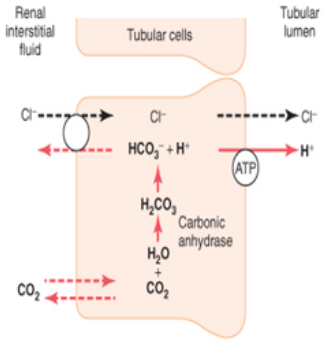
-PCT

-THICK ASCENDING LOH ,

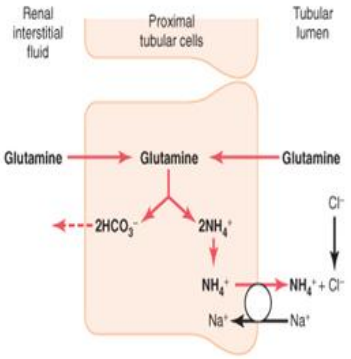
-EARLY PART OF DCT



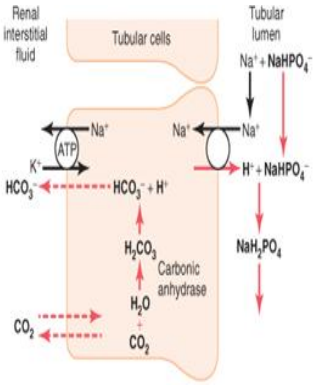
Secretion of H+ ion in the **intercalated cells of late DCT & CD**

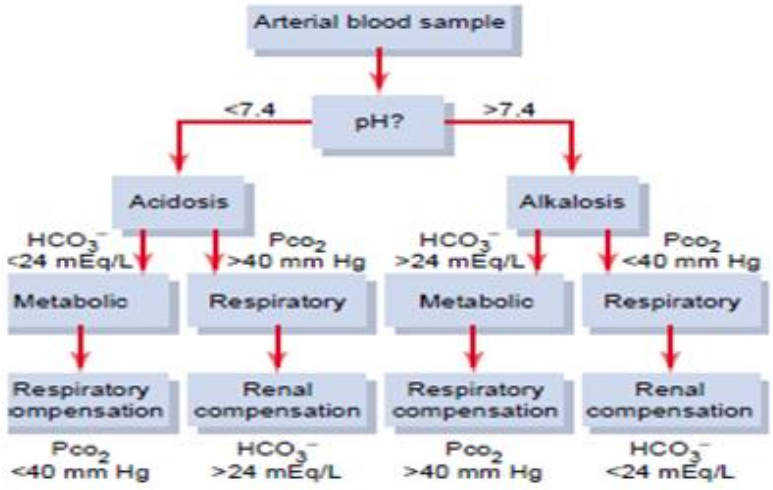


Excretion of Excess H+ ions & generation of new bicarbonate by the ammonia buffer system



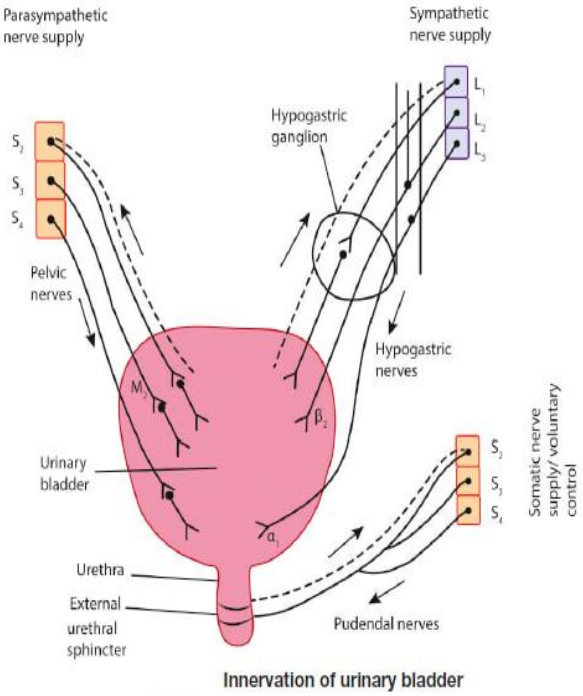
Phosphate buffer system carries excess H + ions into the urine & **generate new HCO3**



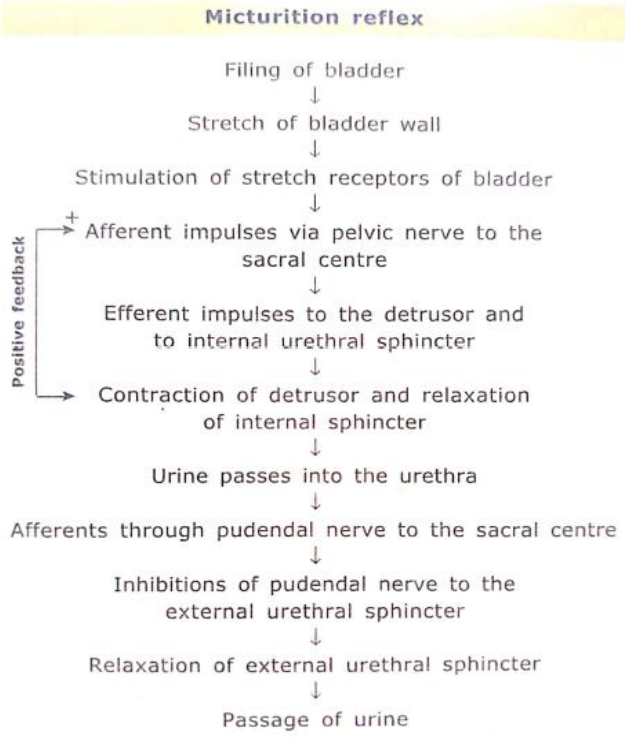


12. Nerve Supply to urinary bladder & micturition Reflex

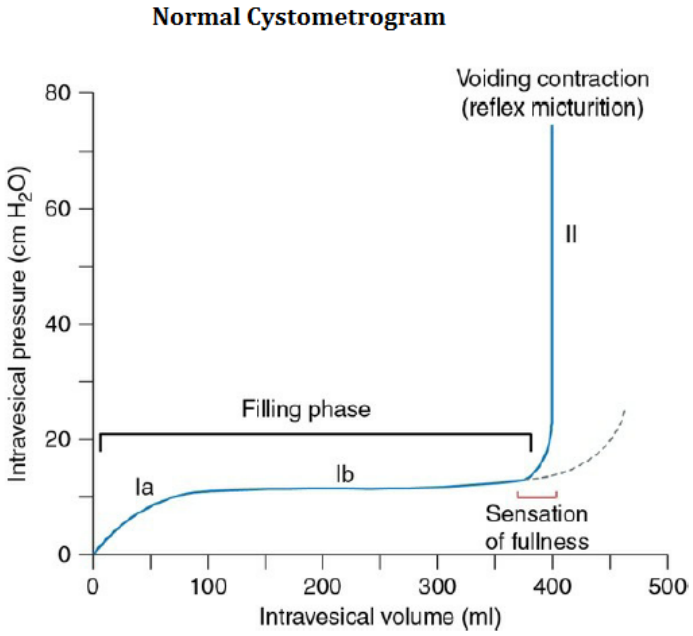
	a.Sympathetic nerve supply (nerve of filling)	b.Parasympathetic nerve supply(nerve of emptying)	c. Somatic nerve supply
1.origin	L1 and L2 segments of spinal cord.	S2,3,4 segments of spinal cord.	S2,3,4 segments of spinal cord.
2.pathway	Spinal cord(L1 &L2) ↓ sympathetic ganglion ↓ Hypogastric ganglion ↓ Hypogastric nerve ↓ Detrusor muscle relaxation and Internal sphincter contraction	Spinal cord(S2,3,4) ↓ Nerve of erigenti ↓ Hypogastric ganglion ↓ Hypogastric nerve ↓ Detrusor muscle contraction and Internal sphincter relaxation	Spinal cord(S2,3,4) ↓ pudendal nerve ↓ Contraction of external sphincter
3.function	➢Relaxation of detrusor muscle of the bladder ➢Constriction of the internal sphincter, results in filling of urinary bladder	➢contraction of detrusor muscle ➢relaxation of the internal sphincter ,results in emptying of urinary bladder.	➢relexation of external sphincter



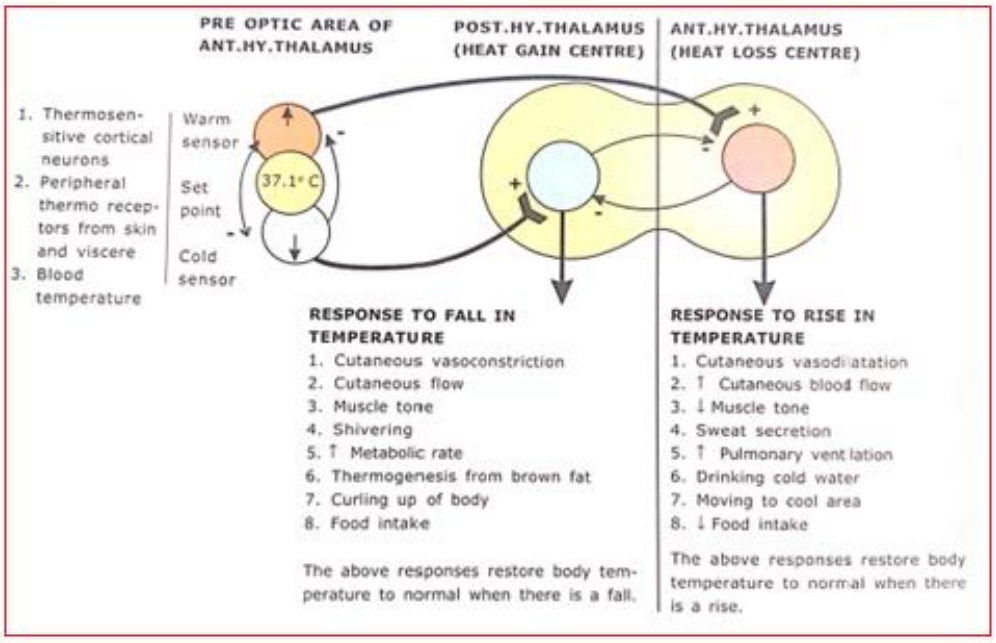
Innervation of urinary bladder



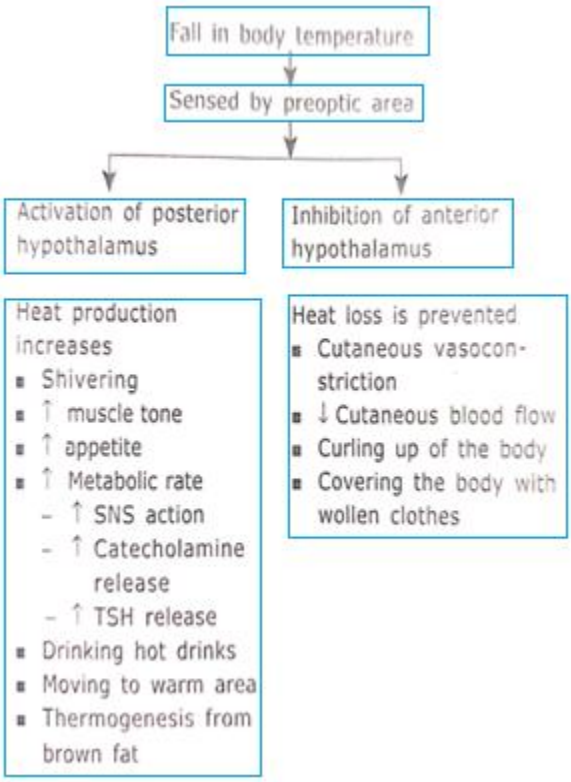
13. Normal cystometrogram



14. Role of Hypothalamus in body temperature



Regulation of body temperature in cold environment



Regulation of body temperature in hot environment