Biology Lecture 6 – The Digestive and Excretory Systems

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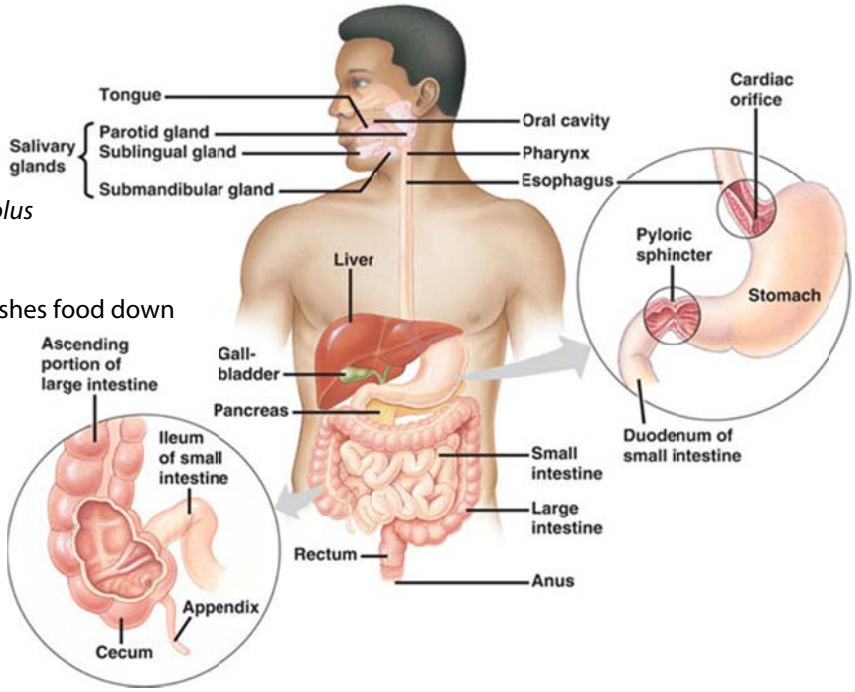
DIGESTIVE SYSTEM



Mouth

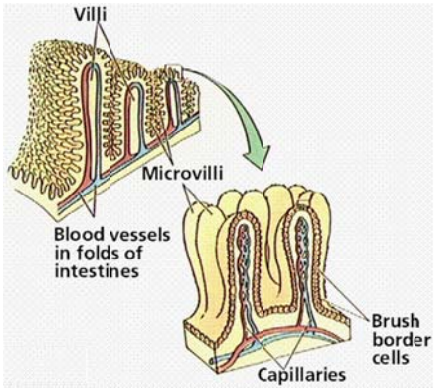
- *Salivary amylase* digests starch
- Saliva lubricates food for esophagus
- Chewing increases food surface area, creates *bolus*

Esophagus

- *Peristalsis* (wave-like contraction of muscles) pushes food down towards stomach

Stomach

- Converts & mixes food into chyme
- Cell types:
  - *Mucous cells*: secretes mucus for lubrication, protection
  - *Chief cells*: secrete *pepsinogen* which is converted to pepsin by low pH
  - *Parietal cells*: secrete *hydrochloric* acid
  - *G cells*: secrete gastrin which stimulates parietal cells to secrete HCl
- *Pepsinogen* begins protein digestion in the stomach



Small Intestine

- Enzymes secreted by the pancreas do most of the digestion (macro→oligo) here
- Wall has finger-like projections called *villi*; these in turn have projections called *microvilli*
- Each villus is associated with a capillary network and a lymph vessel called a *lacteal*
- Microvilli form the *brush border* in which final digestion (oligo→mono) takes place
- *Goblet cells* secrete mucus to lubricate the small intestine
- Chyme moved through small intestine via peristalsis

Pancreas

- Secretes bicarbonate ion to change pH from 2 to 6
- Secretes enzymes:
  - *Trypsin/chymotrypsin*: *digests* proteins
  - *Pancreatic amylase*: digests carbohydrates
  - *Lipase*: digests fat. Requires *action* of *bile* (created in the liver, stored in the gall bladder) to increase fat surface area (*emulsification*)
  - *Ribonuclease/deoxyribonuclease*: *digests* nucleic acids

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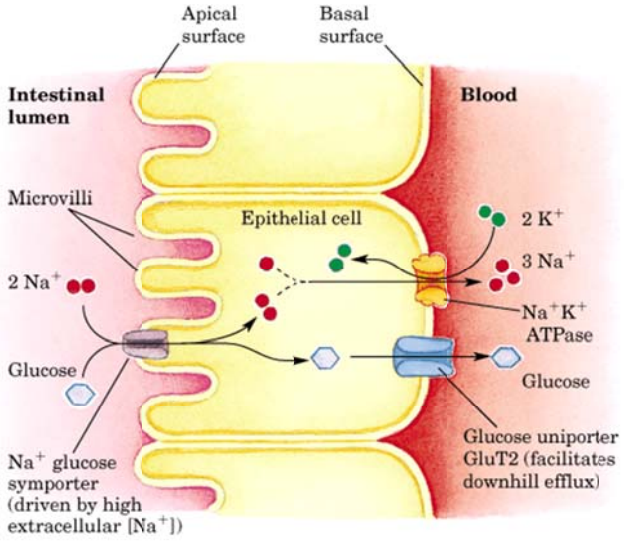
Large Intestine

- Absorbs water; absorbs electrolytes
- Contains E. coli bacteria which have a *mutualistic* relationship with us - they help us produce several vitamins; we give them nutrition



Digestion of Carbohydrates

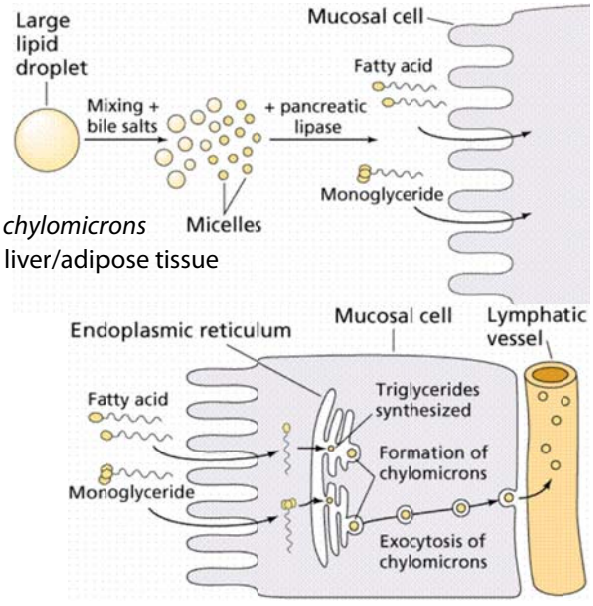
- Begins in mouth (*salivary amylase*); ends in small intestine (*pancreatic amylase*)
- Broken down to monosaccharides by brush border enzymes
- Transported into enterocytes by cotransport with sodium
- Enters capillaries; transported to liver
- Liver can form glycogen (*glycogenesis*); break down glycogen (*glycogenolysis*) or make glucose from other molecules (*gluconeogenesis*)

Digestion of Proteins

- Begins in stomach (*pepsin*); ends in small intestine (*trypsin/chymotrypsin*)
- Broken down into amino acids by the brush border enzymes
- Transported into enterocytes by facilitated diffusion or cotransport
- Enters capillaries; transported to liver
- If converted to glucose in liver, urea results

Digestion of Fats

- Begins and ends in small intestine (*lipase*)
- Emulsified by *bile*
- Broken down into fatty acids/cholesterol/etc by brush border enzymes
- Diffuse through enterocyte membrane; converted by triglycerides
- Triglycerides combine with phospholipids/cholesterol/proteins to form *chylomicrons*
- Chylomicrons enter lacteal; enters bloodstream in *thoracic duct*, then to liver/adipose tissue
- Free fatty acids are transported in blood by *albumin*
- Usually fats in blood are lipoproteins



Liver

- Stores/filters blood
- Metabolizes carbohydrates, fats, protein
- Detoxifies chemicals
- Destroys some red blood cells
- Stores vitamins, iron

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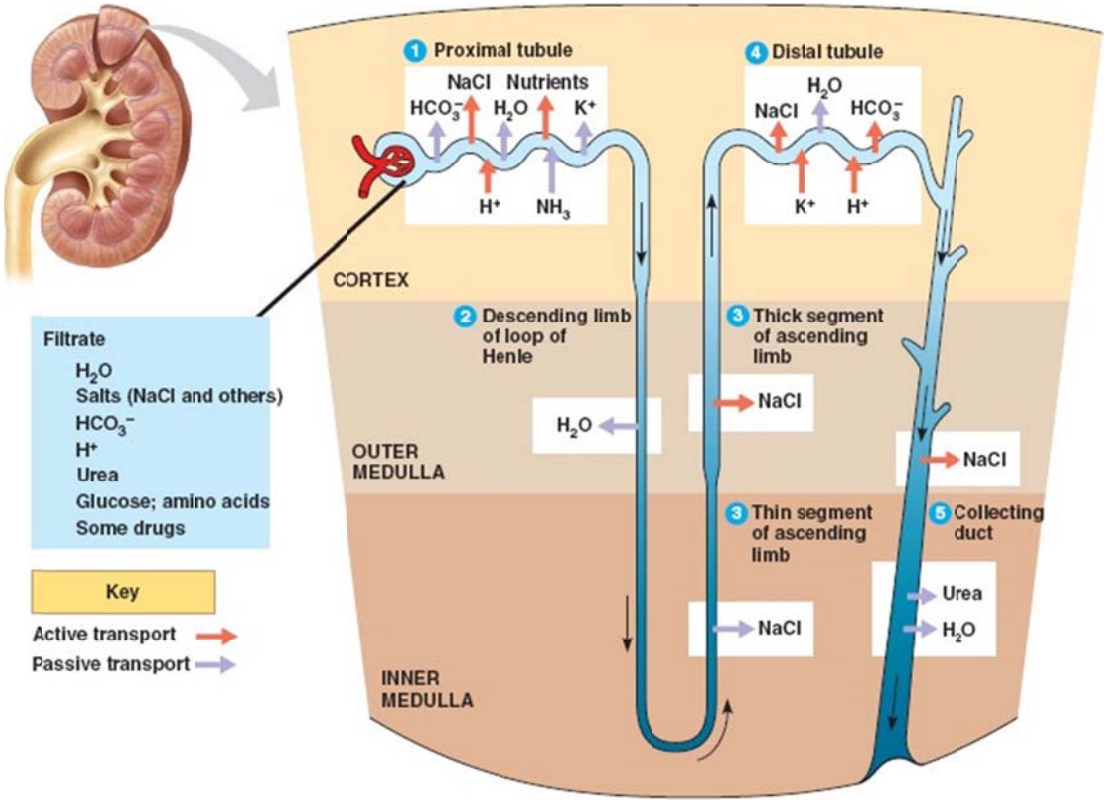
EXCRETORY SYSTEM

Kidney Structure

- *Cortex* on outside, *medulla* on inside
- Urine created in nephrons, enters renal pelvis → ureter → bladder → urethra



Nephron

- Filtration occurs at the *Glomerulus/Bowman's capsule* by hydrostatic pressure
- A lot of reabsorption occurs at the *proximal tubule*: all sugars, most proteins, salts, etc are reabsorbed. Some secretion also occurs: drugs, toxins, hydrogen ions
- *Loop of Henle* concentrates urine by only allowing water to exit on the way down and salts to exit on the way up
- Na^+/Ca^{2+} reabsorption and $K^+/H^+/HCO_3^-$ secretion occurs at the *distal tubule*
  Aldosterone increases Na^+ reabsorption/K^+ secretion
- Water reabsorption occurs in the *collecting duct* in the presence of *ADH*, further concentrating the urine

Juxtaglomerular Apparatus

- Detects when blood pressure is too low; secretes *renin*
- Renin starts a hormone cascade which eventually causes the secretion of aldosterone