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⁺/Ca²⁺ reabsorption and K⁺/H⁺/HCO₃⁻ 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