

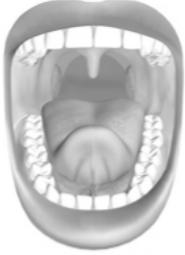
Questions

- Which macromolecule has the highest energy content?
- How have herbivores adapted to the demands of a largely cellulose diet?

Questions

- Describe the action of the carnassial teeth in carnivores.
- How are the digestive systems of humans and *Paramecium* similar?

The mouth



- amylase to breakdown carbohydrates (starch)
- The tongue secretes lipase enzymes which begin to breakdown lipids

http://www.3dscience.com/3D_images/Human_Anatomy/Digestive/Open_Mouth.php

Stomach

- Highly muscular organ
 - Creates a uniform consistency
- Releases Hydrochloric acid (HCl) and pepsinogen





Fig. 43.8 pg 966

Stomach



How does the acid get into the stomach?


$$H_2O + CO_2 \xrightarrow[2]{3} \xrightarrow{3} H^+ + HCO_3^-$$

Carbonic acid bicarbonate

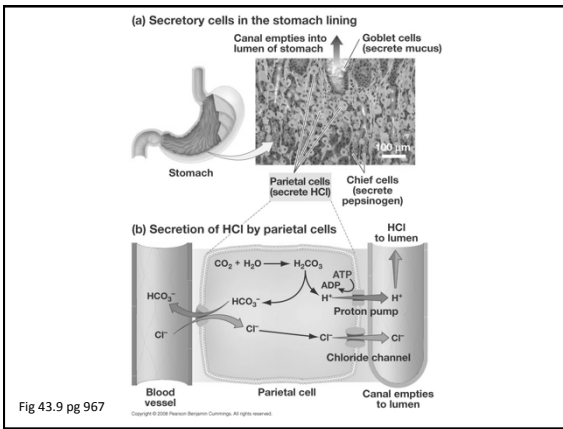
H⁺ actively pumped into lumen by ATPase (requires energy)

Concentration gradient ~3 mill to 1

Stomach



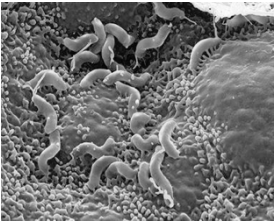
- Acid digestion (pH 2-3) of proteins (denaturing)
 - Unfolding proteins (loss of 2^o and 3^o structure)
 - Pepsin = enzyme that further denatures proteins
 - Why doesn't pepsin dissolve our own cells?
 -
 -



Stomach acid

Why aren't we digesting ourselves?

- because of mucous
- Stomach acids do not cause most ulcers
 - *Helicobacter pylori* (published 1983, Nobel Prize 2005)
 - Self inflicted research!
 - Who wants yogurt?

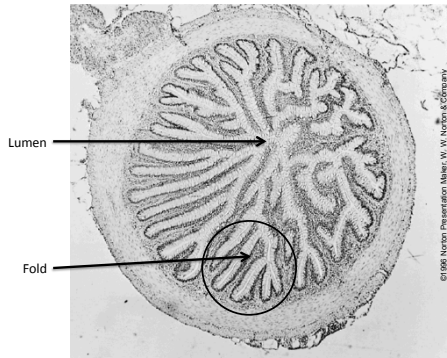


<http://www.humanhealth.com/helicobacter-pylori-2>

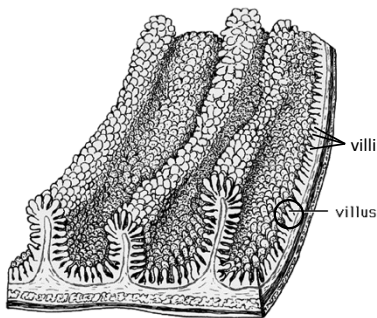
Small Intestine

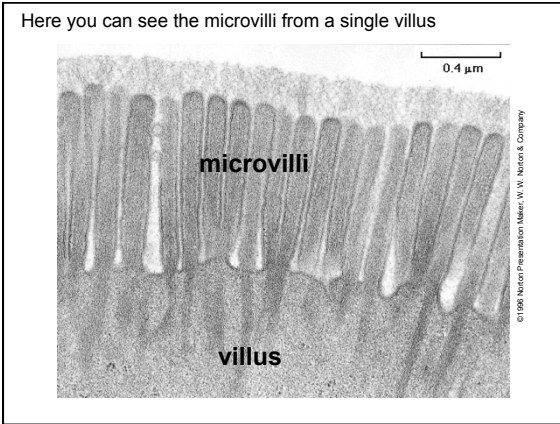
- Enzymes added to the slurry (chyme)
 - Enzymes provided by the pancreas and liver
- Nutrients absorbed selectively and actively
- Keyword for small intestine: surface area!

An intestinal cross section reveals the increased surface area:



Villi line the folds to increase the surface area of the absorptive regions of the intestine.





Surface area

~20 m long + Folds + Villi + Microvilli =
2 million cm² =Tennis court!

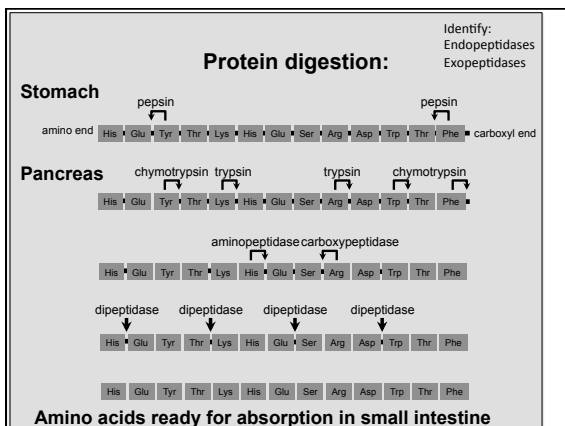
Fig 43.11 pg 969

Small Intestine

Protein digestion

- Protein digestion completed via proteases
 - Trypsinogen changed to trypsin (by protein, not H⁺)
 - Trypsin activates many other proteases

Fig 43.12 pg 970



Small Intestine
Lipid digestion

- Pancreas secretes enzymes to breakdown fats
- Brought into the cells and transported to storage in multiple forms
 - Triglycerides, fatty acids, glycerols
- Fats insoluble in water, tend to form large globules
 - Bile salts (actually lipids) emulsify* the lipids
 - *To combine by making the lipid globs smaller

Bile

What is Bile?

- containing water, electrolytes and a battery of organic molecules including bile acids, cholesterol, phospholipids and bilirubin
- “Bile Salt”

What is the function of Bile?

- Bile “salts” aid in digestion of fats by emulsifying them.

Cholic acid (hydrophobic)

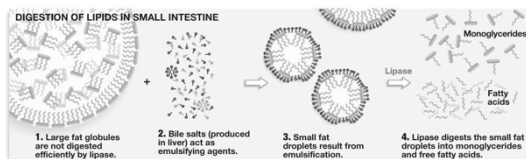
Glycine (hydrophilic)

Glycocholic acid (amphipathic)

Think oil, water, and soap
fat, food, and bile

<http://www.vivo.colostate.edu/hbooks/pathophys/digestion/liver/bile.html>

Emulsification



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Figure 43.13 pg 971

Emulsification



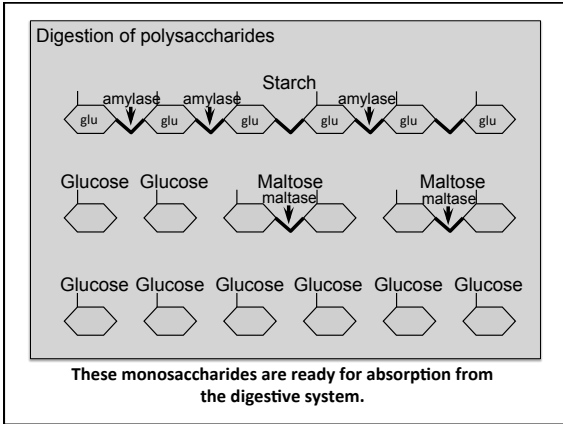
Emulsification: Separating large globs of fat into smaller globs in order to increase the available surface area.

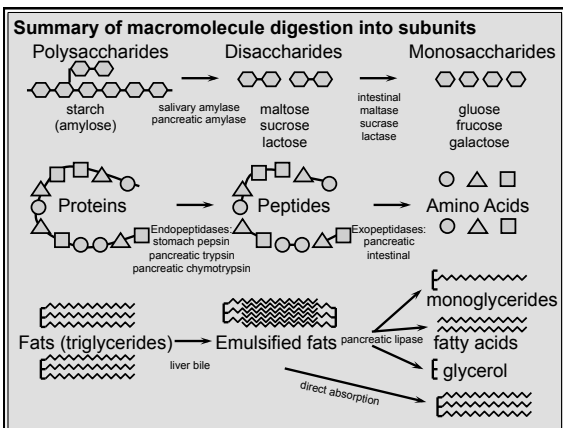
Increased surface area leads to faster digestion by enzymes

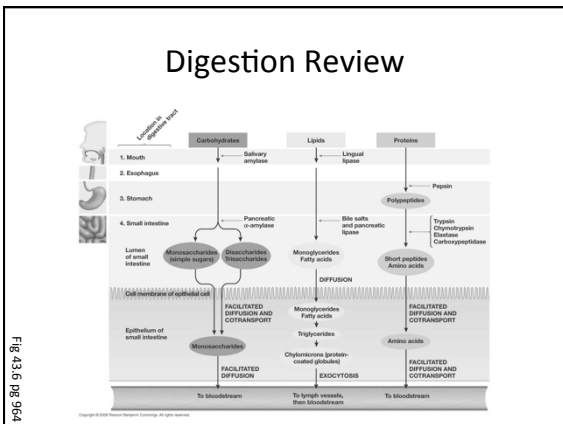
http://www.youtube.com/watch?v=fJCVL63YNU&feature=related

Small Intestine *Carbohydrate digestion*

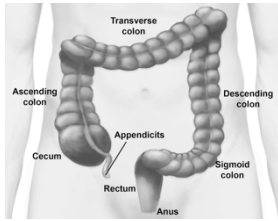
- Polysaccharides broken down further into disaccharides and monosaccharides by amylase
- Unique enzymes break down disaccharides into monosaccharides
 - Examples: lactase, maltase



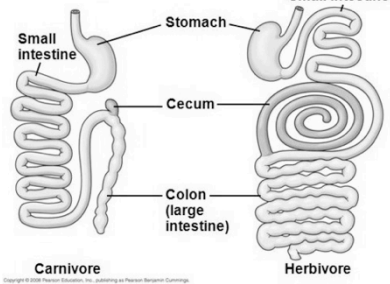




Large Intestine



- Purpose:
 - To compact waste and absorb water
 - How?
 - Aquaporins!



Small Intestine

Carnivore

Herbivore

Questions

- Which enzymes are responsible for the breakdown of starch?
- What is the purpose of bile salts?
- What enzyme is activated in the stomach?
