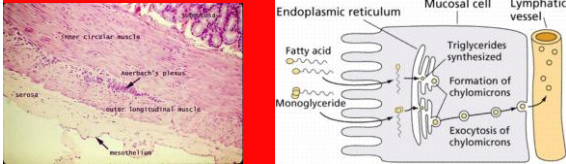


# Human Physiology

## 6.1- Digestion and Absorption



### Essential idea:

- The structure of the wall of the small intestine allows it to move, digest and absorb food. (7 meters)

### Nature of science:

- Use models as representations of the real world
  - dialysis tubing can be used to model absorption in the intestine. (1.10)

### Applications and Skills

- Application: Use of dialysis tubing to model absorption of digested food in the intestine. (pg. 287-288)
  - Investigate diffusion of Starch with Amylase
  - Investigate the diffusion of Cola

Digestion of the polysaccharide Amylose / Starch

inside starch / Amylose

The reaction is a hydrolysis

The enzyme is called Amylase

soluble maltose

Cola, left to go flat before being put in a tube

Bag made of dialysis tubing

Water

### Understandings

- The contraction of circular and longitudinal muscle of the small intestine mixes the food with enzymes and moves it along the gut.
  - Mixing movements: inner circular muscles contract rhythmically
  - Propelling movements: outer long muscles produce a wavelike motion called peristalsis

### Understandings

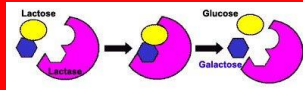
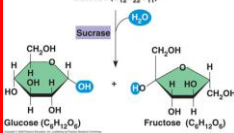
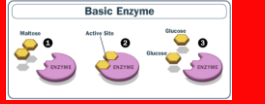
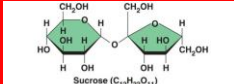
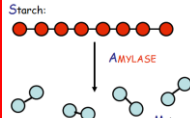
- The pancreas secretes enzymes into the lumen of the small intestine.
  - Acinar cells: Main pancreatic cell
  - Produce pancreatic juice
    - Amylase for starch
    - Lipase for triglycerides and phospholipids
    - Proteases for proteins and peptides
  - Empties into the small intestine

## Understandings

- Enzymes digest most macromolecules in food into monomers in the small intestine.

– Carbohydrates

- Starch into maltose (amylase)
- Maltose into glucose (maltase)
- Lactose into glucose and galactose (lactase)
- Sucrose into glucose and fructose (sucrase)

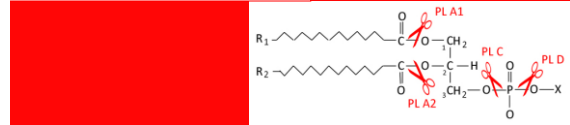
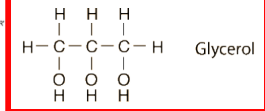
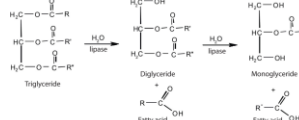


## Understandings

- Enzymes digest most macromolecules in food into monomers in the small intestine.

– Lipids

- Triglycerides into fatty acids and glycerol, or monoglycerides (lipase)
- Phospholipids into fatty acids, glycerol, and phosphates (phospholipase)



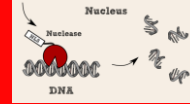
## Understandings

- Enzymes digest most macromolecules in food into monomers in the small intestine.

– Proteins

- Large protein and peptides into shorter peptides (proteases)
- Dipeptides into amino acids (dipeptidases)
- Single amino acids from polypeptides (exopeptidases)

– DNA and RNA into nucleotides (nucleases)



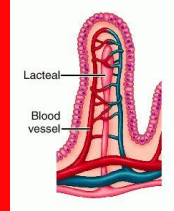
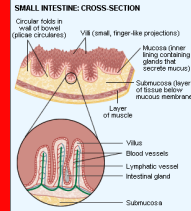
Enzyme	Substrate	Product
Endopeptidases	Protein	Small Peptides
Exopeptidases	Small Peptides	Basic amino acids
Dipeptidases	Dipeptides	Amino acids
Maltase	Maltose	2 glucose
Lactase	Lactose	glucose + galactose
Sucrase	Sucrose	glucose + fructose
Nucleotidase	Nucleotides	nucleosides
Nucleosidase	Nucleosides	sugars + bases
Lipase	Diglycerides, monoglycerides	fatty acid + glycerol

## Understandings

- Villi increase the surface area of epithelium over which absorption is carried out.

– Intestinal villi

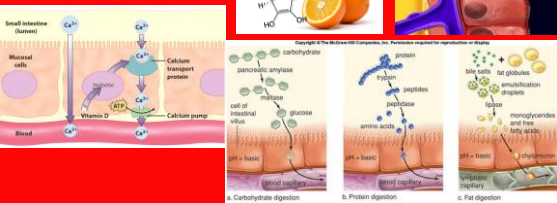
- Increases surface area available for absorption
- Aid in mixing actions
- Contains capillaries and a lymphatic capillary (lacteal).



## Understandings

- Villi absorb monomers formed by digestion as well as mineral ions and vitamins.

- Monosaccharides, amino acids, fatty acids, glycerol, nitrogen bases are absorbed by the villi cell membranes.
- Mineral ions (calcium, potassium, sodium)
- Vitamins (ascorbic acid)

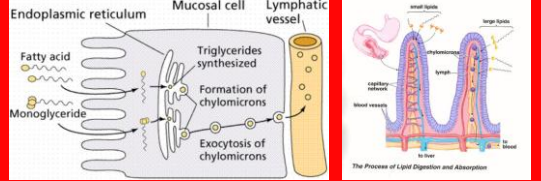


## Understandings

- Different methods of membrane transport are required to absorb different nutrients.

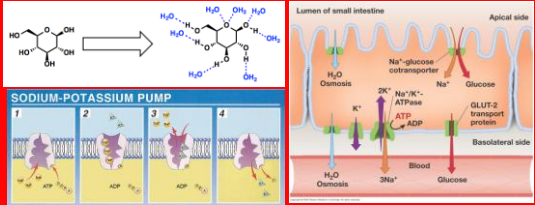
– Fatty acids and monoglycerides

- Diffuse into the cell membranes of the villi.
- The endoplasmic reticulum reconstructs the triglyceride.
- Cholesterol is added.
- Lipids are encased in protein (chylomicrons).
- Chylomicrons are carried away in lymphatic lacteals



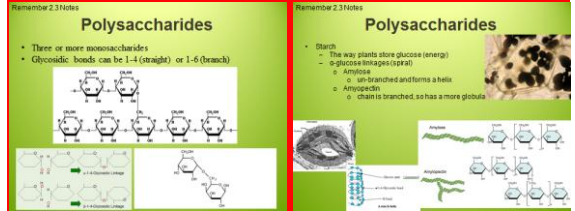
## Understandings

- Different methods of membrane transport are required to absorb different nutrients.
  - Glucose
    - Polar molecule (hydrophilic)
    - Sodium potassium pump (3 Na<sup>+</sup> out for 2 P<sup>+</sup> in)
    - Sodium-glucose co-transporters move glucose into intestinal cells.
    - Glucose channel proteins move it to blood vessels.



## Applications and Skills

- Application: Processes occurring in the small intestine that result in the digestion of starch and transport of the products of digestion to the liver.
  - Two type of starch: amylose and amylopectin
  - Amylase breaks only 1-4 chains (at least 4 glucoses long)
  - Fragments with 1-6 bonds are dextrans.
  - Maltase (maltose), glucosidase (maltotriose), and dextrinase (dextrans) in membranes of microvilli.



## Applications and Skills

- Skill: Production of an annotated diagram of the digestive system. (pg 280)
  - Include:
    - Mouth
    - Esophagus
    - Stomach
    - Small Intestine
    - Pancreas
    - Liver
    - Gall Bladder
    - Large Intestine



Annotate: Add brief notes to a diagram or graph.

## Applications and Skills

- Skill: Identification of tissue layers in transverse sections of the small intestine viewed with a microscope or in a micrograph. (pg 281)
  - Also draw the longitudinal section to contrast

Identify in both:

- Serosa
- Muscle Layers
- Sub-mucosa
- Mucosa

