Food, Macromolecules and Digestion

Many small molecules connect to form Macromolecules

Carbohydrates

- Primary source of energy for living organisms
- Simple sugars
  - Table sugar, soft drinks
- Polysaccharides
  - Long starch molecules

Most carbs are polysaccharides

- Polymers – long chains of simple sugars

Carbohydrate Monomers: simple sugars

Simple sugars connect to make disaccharides and polysaccharides
Protein Monomers

Amino acids come in 20 Different Flavors!
(Lysine, Valine, Tryptophan, Proline, etc.)

Protein Shape

Polypeptides fold to become functional proteins

Functions of proteins

- Body structures
- Regulate body functions
- Enzymes
- Hormones
- Seldom used for energy

Enzymes: proteins that speed up chemical reactions

Nucleic Acids: DNA and RNA

- Information storage and retrieval
  - They provide the directions for building proteins.
- There are 2 types of nucleic acids:
  - DNA, deoxyribonucleic acid
  - RNA, ribonucleic acid

Nucleic Acid Monomers

Nucleotides
"bases"
A, C, G, T/U
Nucleic Acid Polymers
- Nucleotide monomers are linked into long chains
  - A sugar-phosphate backbone
  - Bases: A, C, G, T/U

Structural differences – DNA and RNA
- RNA
  - Single stranded
  - Sugar is ribose
  - Bases: A, U, C and G
- DNA
  - Double stranded
  - Sugar is deoxyribose
  - Bases: A, T, C and G

Lipids (or fats)
- Macromolecules that are not soluble in water
  - Hydrophobic or "water-fearing"
  - Triglycerides
  - Steroids

Lipid Monomers
- Fatty acids (Building Blocks)
  - Unsaturated fatty acid
  - Glycerol

Steroids
- Lipids
- Structure
  - four fused carbon rings
- Examples
  - cholesterol
  - sex hormones

How we process Food
- Ingestion – another word for eating
- Digestion – the breakdown of food to small nutrient molecules.
- Absorption – the uptake of small nutrient molecules by cells lining the digestive tract.
- Elimination – the disposal of undigested materials from the food we eat.
Digestion: A Closer Look

- **Mechanical digestion**
  - Involves physical processes like chewing
- **Chemical digestion**
  - the breakdown of food by digestive enzymes.

Why is digestion important?

- Digestion breaks down food to create:
  - Molecules small enough for cells to absorb
  - Monomers that can be recombined into new molecules

Foods are digested by hydrolysis

A Tour of the Human Digestive System

The digestive tube (alimentary canal)

Accessory organs

The Mouth

- The mouth functions in:
  - Eating and chewing (ingestion)
  - The initial steps of digestion

Salivary glands secrete saliva

Contains an enzyme that begins starch digestion
Swallowing

- Why doesn't food go down the wind pipe?
- During swallowing,
  - a reflex tips the epiglottis
  - Closes the entrance to the windpipe

Esophagus

- The esophagus:
  - a muscular tube
  - Connects the mouth to the stomach
  - Moves food down by peristalsis, alternating waves of muscular contraction and relaxation

Functions of the Stomach

- The stomach:
  - Stores food
  - Churns food into a thick soup called chyme
  - Starts protein digestion
  - Controls movement of food into the small intestine

The small intestine

- The longest part of the alimentary canal
- Function: digestion and absorption of nutrients
- 3 regions – duodenum, jejunum, and ileum

The duodenum

- The first part of the small intestine
- Most digestion occurs here
- The pancreas secretes digestive enzymes
- The liver secretes bile which helps digest fats

Nutrients are absorbed in the small intestine

- Most nutrients (~90%) are absorbed in the small intestine
- The rest?
  - Stomach & large intestine
Nutrients are absorbed in the small intestine

- Sugars and amino acids move into the bloodstream
- Fatty acids and glycerol join with proteins to form lipoprotein droplets and enter lacteals

Blood goes from the intestine to the liver

- Blood rich in amino acids and glucose travels from the digestive tract to the liver
- The liver
  - Stores the glucose as glycogen
  - Synthesizes proteins

What does the liver do?

- 500 VITAL FUNCTIONS
- Immunity against infection
- Factory for proteins and cholesterol
- Excretes wastes via bile
- Regulates blood clotting
- Clears blood of drugs, Chemicals, alcohol
- Converts excess glucose to starch for storage
- Excretes bile for fat digestion

The Large Intestine

- The colon
  - the main part of the large intestine
  - Absorbs water
  - Produces feces, the waste product of food
- The rectum stores feces

Gut hormones control digestion

- Gastrin
  - ↑ output of gastric juice
- CCK
- Secretin
  - ↑ output of bile and pancreatic juice

Figure 22.14a

Food into mouth

Digestion

Mechanical digestion
- Chewing in mouth
- Churning in stomach
Chemical digestion
- Saliva in mouth
- Acid and pepsin in stomach
- Enzymes in small intestine

Absorption
- Nutrients and water in small intestine
- Water in large intestine

Elimination
- Feces formed in large intestine
- Elimination from anus

Figure 22.15-4