I. Nutrition

    -process of taking in and using food

    A. Animal

        1. heterotrophs

            a. obtain nutrients from organic molecules

            b. manufactured by other organisms

    B. Food processing

        1. Ingestion

            a. the taking in of food

        2. Digestion-

            a. mechanical-chewing, churning, no bonds broken

            b. chemical-digestive enzymes (hydrolysis), bonds broken

        3. Absorption

            a. passive and active transport from digestive lumen to
            circulatory and lymphatic systems

        4. Egestion (elimination)

            a. removal of undigested (indigestible) material

                -ex: cellulose (fiber, roughage)

    C. Body plan and lifestyle

        -adapted to mode of nutrition; type of food eaten; mechanism for
        obtaining food

        1. Herbivores

            a. feed directly on producers

        2. Carnivores

            a. adapted for capturing and killing prey

        3. Omnivores

            a. eat both plants and animals

    D. Different types of feeding

        1. Suspension-feeding

            a. trap or filter food from water or air surrounding them

        2. Substrate-feeding

            a. live in or on their food source, eating their way through the
            food

        3. Fluid-feeding

            a. suck fluids from other organisms

        4. Bulk-feeding

            a. eat large pieces of food

II. Digestive Systems

    A. Simple invertebrates-sponges

        1. digest intracellularly

    B. Cnidarians and Flatworms

        1. gastrovascular cavity

            a. one opening-mouth and anus

        2. digest intra and extracellularly

    C. Complex invertebrates and vertebrates

        1. complete tube-opening at each end

        2. digestion-mainly extracellularly

        3. parts perform specific functions

            a. sequence: mouth→pharynx→esophagus→stomach→small intestine→large intestine→anus

    D. Motility through alimentary canal

        1. accomplished by peristalsis

            a. waves of smooth muscular contractions

    E. Walls of digestive tract-4 layers

        1. mucosa

            a. layer of epithelial and connective tissues

            b. lines the lumen

        2. submucosa

            a. connective tissue rich in blood and lymph vessels and nerves

        3. muscle layer

            a. inner sublayer-circularly arranged muscle fibers

            b. outer longitudinal sublayer

        4. adventitia-outer connective tissue coat

            a. below diaphragm-visceral peritoneum

                i. connected by fold to parietal peritoneum

                    a. lines the walls of abdominal and pelvic cavities

            b. both enclose the peritoneal cavity

III. Digestion
- A. Mouth
  - 1. mechanical
    - a. teeth
      - i. incisors-biting
      - ii. canines-tearing
      - iii. premolar and molars-crushing and grinding
      - iv. covered by enamel
      - v. dentin
      - vi. pulp-contains nerves, blood, and lymph vessels
  - 2. chemical
    - a. salivary amylase
      - i. starch digestion
- B. Pharynx
  - 1. food is swallowed and propelled into
- C. E sophagus
  - 1. bolus moves by peristalsis
- D. S tomach
  - 1. mechanical
    - a. vigorous churning
  - 2. chemical
    - a. pepsin in gastric juice-protein digestion
    - b. hydrochloric acid and pepsinogen-precursor of pepsin
      - i. pH~1.5 to 2.5-kills bacteria-laden food
  - 3. rugae
    - a. folds-expand as stomach fills
  - 4. food stays here for 2-3 hours or more
    - a. mixture called acid chime
  - 5. cardiac and pyloric sphincters
    - a. "drawstrings" between esophagus and duodenum
- E . S mall intestine
  - 1. mechanical
    - a. peristalsis
    - b. bile-fat emulsification

2. chemical-secretions from liver, pancreas, and duodenum

    a. pancreatic enzymes

        i. protein, lipid, carbohydrate, RNA, DNA digestion

        ii. trypsin/Chemotrypsin

            a. polypeptides to dipeptides

        iii. pancreatic lipase

            a. degrades neutral fats

        iv. pancreatic amylase

            a. complex carbohydrates

3. parts

    a. duodenum, jejunum, ileum

4. digestive activities regulated by nerves and hormones

    a. both sympathetic and parasympathetic

    b. hormones secreted by digestive tract

        i. gastrin, secretin, cholecytstokinin (CCK), gastric inhibitory peptide (GIP)

F. Nutrient breakdown

    1. polysaccharides→maltose by salivary and pancreatic amylase

    2. maltose→glucose by maltase

    3. proteins→peptides and dipeptides by pepsin

    4. peptides and dipeptides→amino acids by dipeptidases

    5. large lipids→small lipids by bile salts

    6. small lipids→fatty acids and glycerol by pancreatic lipase

G. Nutrient Absorption

    1. into villi

        a. amino acids and glucose into hepatic portal vein to liver

        b. fatty acids and monoacylglycerol and bile salts form soluble micelles;

        c. f.a. and m. leave micelle and enter epithelial cells in intestinal lining; here reassembled into triacylglycerols; packaged into droplets

        d. droplets include cholesterol and phospholipids; covered with protein

        e. chylomicrons transported by lymphatic system to blood

H. Large Intestine

1. cecum with appendix, colon-ascending, transverse, descending, sigmoid; rectum; anus

2. Functions:

   a. reabsorption of water

   b. elimination of undigested wastes

   c. incubates bacteria

      i. produce vitamin K and certain B vitamins

IV. Diet

A. Carbohydrates

   1. complex-polysaccharides-starch and cellulose (fiber)

   2. used mainly as a fuel

   3. excess glucose stored as glycogen in liver or as fat

B. Lipids

   1. used as fuel, components of cell membranes, insulation, organ protection, steroid hormones

   2. ingested as triacylglycerols

   3. fatty acids to acetyl coenzyme A-used as fuel; excess stored as fat

C. Proteins

   1. enzymes; structural components; hormones

   2. essential amino acids-easiest to get from animal protein

   3. excess amino acids deaminated by liver; converted to urea, excreted in urine

   4. remaining keto acids converted to carbs, used as fuel or converted to lipid and stored in fat cells

D. Vitamins

   1. organic; required in small amounts

   2. serve as coenzymes

   3. Fat-soluble: A, D, E , K

   4. Water-soluble: B and C

E . Minerals

   1. inorganic

   2. ingested as salts

   3. trace-less than 100 mg per day

V. Metabolic rate

    A. Basal (BMR)-body's cost of metabolic living

    B. Total=BMR + energy used to carry on daily activities

    C. Input=Output..> body weight constant

    D. Obesity-serious nutritional problem

        1. excess fat accumulates in adipose tissue

    E. Malnutrition-deficiency in essential amino acids