Study Guide for Exam 2  
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I. Nutrition  
A. General Considerations  
1. Autotrophic organisms make their own food.  
2. Heterotrophic organisms must obtain food from other sources.  
B. Plant Nutrition  
1. Roots  
   a. anchorage for the plant  
   b. absorption of water and minerals  
2. Nutrients Required  
   a. CHOPKNS CaFe Mg  
   b. CO₂ is the raw material for glucose—it comes from the air  
   c. H₂O is used for photosynthesis and water balance and contains minerals  
3. Fungi are not plants. They are heterotrophic.  
   a. Saprophytic fungi use dead organic material.  
   b. Parasitic fungi use living organic material.  
C. Animal Nutrition  
1. Herbivores eat plants.  
2. Carnivores eat animals.  
3. Omnivores eat both plants and animals.  
D. Human Nutrition  
1. Carbohydrates  
   a. Provide energy and roughage  
   b. Examples are sugars and starch  
2. Proteins  
   a. Used for body structures  
   b. Examples are meat and eggs  
   c. Vegetarians can obtain protein from vegetables  
   d. Amino acids  
      i. "Essential" ones must be provided in the diet  
      ii. "Non-essential" ones can be made by the body  
3. Lipids  
   a. Provide energy  
   b. Examples are fats and oils  
   c. Also include phospholipids and steroids  
4. Vitamins  
   a. Organic molecules used by enzymes  
   b. Must be provided in the diet  
   c. Cannot be made by the body  
5. Minerals  
   a. Inorganic ions of various metals  
   b. Used by enzymes for proper function
II. Digestion

A. General Considerations

1. Organisms that can absorb food do not need to digest it.
2. An incomplete digestive tract has one opening; a complete system has two openings.
3. Large food particles require two phases.
   a. Mechanical digestion increases the surface area of the particles by making them smaller
   b. Chemical digestion is used to hydrolyze polymers such as starch, disaccharides, proteins, lipids and nucleic acids.

B. Human Nutrition

1. General Considerations
   a. The digestive tract is a series of glands and organs separated by sphincters.
   b. Only the mouth, stomach and small intestine have digestion.
   c. There is an enzyme for each nutrient that can be digested.

2. Mouth
   a. Contains the teeth, tongue and salivary glands
   b. Functions
      i. Chewing food which is mechanical digestion
      ii. Digestion of starch by salivary amylase (ptyalin)

3. Esophagus
   a. Passageway to stomach
   b. No digestion occurs here
   c. Ends at the cardiac sphincter

4. Stomach
   a. Closed off by cardiac and pyloric sphincters
   b. Stimulated by gastrin; regulated by enterogastrone
   c. Produces pepsin and lipase
   d. Performs digestion of proteins and lipids (fats—triglycerides)
   e. Contains strong acid conditions

5. Duodenum
   a. First 10-12 inches of the small intestine
   b. Secretes the hormones enterogastrone, secretin and pancreozymin into the bloodstream
   c. Receives secretions from the liver and the pancreas

6. Small Intestine
   a. Site of digestion of proteins, lipids, disaccharides, and nucleic acids
   b. Secretes the hormones cholecystokinin and enterocrinin into the bloodstream
   c. Has villi to increase surface area for absorption
      i. Capillaries absorb amino acids, simple sugars and nucleotides
      ii. Lacteals absorb fatty acids and glycerol

7. Liver
   a. Storage of glycogen and control of metabolism
   b. Production of bile which emulsifies fats
   c. Excretory function for protein and nucleic acid metabolic waste products

8. Gall Bladder
   a. Storage of bile
   b. Bile emulsifies fats
   c. Bile is released when cholecystokinin is detected in the bloodstream

9. Large Intestine
   a. Absorption of water and storage of digestive wastes
   b. Absorption of minerals
   c. Bounded by the ileocaecal sphincter and the anal sphincter
III. Respiration
A. Anatomy
1. Trachea, bronchi, bronchioles, lungs.
2. Lungs contain alveoli
B. Gas Exchange
1. Oxygen from the atmosphere is inhaled and enters the circulatory system.
2. CO₂ and H₂O from the circulatory system enter the alveoli and are exhaled.

IV. Circulation
A. General Considerations
1. Transport systems for respiratory gases, nutrients and wastes from cells
2. Closed series of blood vessels and the heart
3. Two divisions
   a. Pulmonary circulation - right side of heart sends blood to the lungs
   b. Systemic circulation - left side of heart sends blood to the body
B. Heart
1. Specialized pumping organ
2. Made of cardiac muscle
3. Controlled by pacemaker cells and the autonomic nervous system
4. Atherosclerosis can cause blockage of coronary arteries
C. Arteries
1. Carry blood away from the heart
2. Pulmonary arteries carry deoxygenated blood to the lungs
3. Systemic arteries branch off from the aorta
4. Arteries send blood through arterioles to the capillaries
D. Capillaries
1. Near to all body cells
2. Oxygen diffuses from the capillaries across the moist cell membranes into the cells.
3. CO₂ and H₂O diffuse from the cells across the moist cell membranes into the capillaries.
4. Blood from capillaries enters the venules in order to return to the heart.
5. Excess fluid is forced out into tissues by blood pressure. It is collected via the lymphatic system.
E. Veins
1. Veins return blood to the heart.
2. Pulmonary veins return oxygenated blood to the heart.
3. Systemic veins return blood to the inferior and superior venae cavae.
4. The hepatic portal vein transports blood from the intestines to the liver.
F. Blood components
1. Red blood cells contain hemoglobin which carries oxygen.
2. White blood cells have various functions.
3. Antibodies are produced by lymphocytes which are attacked by the AIDS virus.
4. Platelets are part of the system for blood clotting.

V. Excretion
A. Metabolic wastes are excreted by the kidneys.
B. The nephron is the functional unit of the kidney.
C. Urine is sent from the kidneys to the bladder for storage.
VI. Endocrine System
A. General Considerations
1. Endocrine glands secrete hormones (chemical signals) directly into the bloodstream.
2. Hormones are used for long-term control of the body.

B. Glands
1. Adrenal glands
   a. Located on top of the kidneys
   b. Adrenal medulla (inside layer) produces adrenaline (epinephrine) and noradrenaline
   c. Adrenal cortex (outside layer)
      i. Cortisone and hydrocortisone regulate carbohydrate and protein metabolism.
      ii. Aldosterone regulates mineral metabolism.
      iii. Androgens and estrogens regulate development of secondary sex characteristics.

2. Pituitary gland
   a. Posterior lobe
      i. ADH - antidiuretic hormone
      ii. Oxytocin - causes uterine contractions during labor and stimulates milk production
   b. Anterior lobe
      i. FSH - follicle stimulating hormone
         - stimulates follicle cells in females
         - stimulates production of sperm in males
      ii. LH - luteinizing hormone
         - stimulates the corpus luteum in females
         - stimulates interstitial cells in males
      iii. Prolactin - milk production in females after birth
      iv. ACTH - adrenocorticotropic hormone - controls the adrenal cortex
      v. Thyrotropic hormone - growth and function of the thyroid gland
      vi. Growth hormone - controls growth of the body - problems with this gland result in dwarfism

3. Gonads
   a. Ovaries (females)
      i. Contain follicle cells and produce eggs
      ii. Produce estrogens which regulate the uterine lining
      iii. The corpus luteum produces progesterone which prepares the uterine lining to receive a fertilized egg.
   b. Testes (males)
      i. Produce sperm cells
      ii. Influence development of secondary sex characteristics

4. Thyroid gland
   a. Located surrounding the trachea
   b. Largest gland which is purely endocrine in function
   c. Produces thyroxin which regulates metabolism

5. Parathyroid glands
   a. Smallest endocrine glands
   b. Found embedded in the thyroid
   c. Regulate calcium and phosphorus metabolism

6. Islets of Langerhans
   a. Groups of cells located inside the pancreas
   b. Produce insulin which regulates glucose metabolism and lowers blood glucose concentration
   c. Produce glucagon which balances insulin and raises the blood glucose concentration
7. Other glands
   a. Pineal
      i. Secretes melatonin
      ii. Associated with detection of the length of the day
   b. Thymus
      i. Immune system gland
      ii. Site where T-lymphocytes mature

VII. Nervous System
A. Central Nervous System
   1. Brain - thinking and control of body activities
      a. Two hemispheres which perform thinking and memory
      b. Hemispheres are connected by the corpus callosum
   2. Cerebellum - balance
   3. Medulla oblongata - controls autonomic nervous system
      a. Upper end of the spinal cord
      b. Spinal cord transmits information to the rest of the nervous system
   4. Thalamus - processes sensory information
   5. Hypothalamus - controls basic needs and emotions

B. Peripheral Nervous System
   1. The Neuron is the cell of the nervous system.
   2. Nerve fibers transmit impulses to various parts of the body.
   3. Impulses are propagated by changes in ions on the surface of the axon.
   4. Sensory neurons transmit information from sense organs to the central nervous system.
   5. Motor neurons transmit commands from the central nervous system to muscles and glands.
   6. A reflex arc is a nervous transmission that does not include the brain.

C. Autonomic Nervous System
   1. Ganglion cells are used in the Autonomic Nervous System.
   2. Sympathetic division
      a. Stimulated by noradrenalin
      b. Speeds up the internal organs
   3. Parasympathetic division
      a. Stimulated by acetylcholine
      b. Slows down the internal organs

VIII. Musculoskeletal system
A. The skeleton
   1. Axial skeleton - skull, spinal column and ribs
   2. Appendicular skeleton - bones of the arms and legs
B. Bone structure
   1. Bone cells in a matrix of calcium phosphate
   2. Haversian canal system provides blood supply
   3. Compact bone is dense - Spongy bone has spaces in it
C. Muscles
   1. Made of proteins actin and myosin
   2. Three types - striated, smooth, cardiac
   3. Provided in pairs - one muscle contracts while the other is relaxed
   4. Tendons connect muscles to bones - ligaments connect bones to each other