BIO-2341: ANATOMY AND PHYSIOLOGY II

Cuyahoga Community College

Viewing: BIO-2341 : Anatomy and Physiology II

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Fall 2023

Subject Code
BIO - Biology

Course Number:
2341

Title:
Anatomy and Physiology II

Catalog Description:
Study the structure and function of cells, tissues, and organs of the human cardiovascular, lymphatic/immune, respiratory, urinary, digestive, and reproductive systems. Includes the study of cellular division, embryological and fetal development, and classical genetics. Laboratory may include demonstrations, dissections, microscopic observations, anatomical models, and videos pertaining to the topic.

Credit Hour(s):
4

Lecture Hour(s):
3

Lab Hour(s):
3

Requisites

Prerequisite and Corequisite
BIO-2331 Anatomy and Physiology I.

Outcomes

Course Outcome(s):
1. Apply fundamental knowledge of the cardiovascular system to explain homeostasis and to predict outcomes of disrupted structure and/or function.

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):
a. Describe the major functions of each component of the cardiovascular system (i.e., blood, heart, blood vessels).
b. Describe the composition of whole blood.
c. Describe the chemical composition and biological function of plasma.
d. Compare and contrast the structural features and general functions of the formed elements.
e. List the five types of leukocytes in order of their relative prevalence in normal blood and describe their major functions.
f. Describe the structure and function of hemoglobin, including its breakdown products.
g. Define hematopoiesis, describe the origin and production of the different formed elements, and explain factors that influence formed element production.
h. Define hemostasis and describe the mechanisms of action for vascular spasm, platelet plug formation, coagulation, and clot resolution.
i. Explain the basis of the ABO and Rh blood grouping systems and the clinical significance.

j. Predict which blood types are compatible and what happens when the incorrect ABO or Rh blood type is transfused.
k. Describe the location of the heart within the thoracic cavity.
l. Identify and describe the location, structure and function of the pericardium, heart wall, chambers, primary internal and external structures of the heart, apex and base.
m. Outline the flow of blood through the heart and systemic and pulmonary circulation, identifying the chambers, valves, and vessels and indicate the oxygenation level of the blood.
n. Identify the coronary arteries, cardiac veins and coronary sinus and describe their function.
o. Compare and contrast action potentials of cardiac contractile cells, cardiac autorhythmic cells and skeletal muscle cells.
p. List the parts of the electrical conduction system of the heart in the correct sequence for one contraction and explain their function.
q. Explain the electrical events that occur during the waves and intervals of a normal electrocardiogram.
r. Define cardiac cycle and relate the electrical and mechanical events that occur to heart anatomy.
s. Describe the pressure and volume changes that occur during a cardiac cycle.
t. Explain common heart sounds and relate their timing to electrical events and changes in pressure during a cardiac cycle.
u. Define cardiac output, stroke volume, and heart rate, and describe extrinsic and intrinsic factors that affect these values.
v. Define the terms artery, capillary, and vein and compare their tunic thickness, composition, and lumen diameter.
w. Compare and contrast the structure and function of muscular arteries, elastic arteries, arterioles, veins, venules, and capillaries.
x. List types of capillaries, state where in the body each type is located, and correlate their anatomical structures with their functions.
y. Identify major arteries and veins of the pulmonary and systemic circuits.
z. Define blood flow, blood pressure and peripheral resistance and interpret the equation that explains their relationship.
aa. List the local hormonal and neural factors that affect peripheral resistance and explain the importance of each.
bb. Define mean arterial pressure, cardiac output and total peripheral resistance and interpret the equation that explains their relationship.
cc. Describe the exchange of materials in capillary beds and the forces that cause capillary filtration and reabsorption.
dd. Explain the control mechanisms that affect mean arterial blood pressure and blood flow to tissues, including the autonomic nervous system, baroreceptors, chemoreceptors, hormones, and autoregulation.
ee. Predict changes that could occur in the cardiovascular system and the consequences of those changes.

Course Outcome(s):

2. Apply fundamental knowledge of the respiratory system to explain homeostasis and to predict outcomes of disrupted structure and/or function.

Objective(s):

a. Describe the major functions of the respiratory system.
b. Define pulmonary ventilation, external respiration, and internal respiration and describe events involved in each process.
c. Describe the location, structure, and function of the components of the respiratory system, beginning at the nose and ending at the alveoli.
d. Describe the gross and microscopic anatomy of the lungs, including their blood and lymphatic supply.
e. Explain the different histological components of the respiratory membrane.
f. Apply gas laws (Boyle's, Henry's, Charles,' and Dalton's) to inspiration, expiration and movement of gases.
g. Explain the relationship of intrapleural pressure, transpulmonary pressure, and intrapulmonary pressure relative to atmospheric pressure during ventilation.
h. Compare and contrast the different pulmonary volumes and capacities and describe how they are measured.
i. Describe oxygen and carbon dioxide concentration gradients and net gas movements in the lungs and tissues.
j. Interpret the hemoglobin dissociation curve and explain factors that affect hemoglobin loading and unloading in the lungs and tissues.
k. Explain the Bohr effect and the Haldane effect as they relate to gas transport.
l. Describe mechanisms and factors that control ventilation.

Course Outcome(s):

3. Apply fundamental knowledge of the urinary system to explain homeostasis and to predict outcomes of disrupted structure and/or function.

Essential Learning Outcome Mapping:

Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

a. Describe the major functions of the urinary system and which organs are responsible for those functions.
b. Describe the location, structure, and functions of the components of the urinary system, beginning at the kidney and ending at the urethra.
c. Explain the location, structure, and functions of each structure of a nephron.
d. Explain the blood flow through the kidney, from the renal artery to the renal vein.
e. Describe the three processes that take place in the nephron (i.e., filtration, reabsorption, and secretion) and explain how the integration of these three processes determines the volume and composition of urine.
f. Explain the hormones and mechanisms that affect urine concentration and volume.
g. Define plasma clearance, glomerular filtration rate, tubular load, and tubular maximum, and relate these values to kidney function.
h. Explain the micturition reflex.
i. List the physical characteristics and normal chemical composition of urine and compare it to the normal chemical composition of plasma and filtrate.

Course Outcome(s):

4. Apply fundamental knowledge of fluid/electrolyte and acid-base balance to explain homeostatic mechanisms and predict consequences of system imbalances.

Objective(s):

a. Compare and contrast relative volumes and osmolarities of intracellular fluid and extracellular fluid and its subdivisions.
b. Describe the boundary walls that separate different body fluid compartments and list transport mechanisms by which water and other substances move between compartments.
c. Describe the normal routes of body water entry and loss, and explain how changes in water intake/loss can disrupt osmolarity homeostasis.
d. Describe the mechanisms that regulate imbalances in body fluid osmolarity.
e. Define electrolyte and explain the importance of maintaining electrolyte homeostasis.
f. Describe the mechanisms that regulate electrolyte homeostasis.
g. State the normal pH range for arterial blood and explain how changes in pH outside the normal range adversely affect body functions.
h. Describe the major buffer systems of the body and their locations.
i. Explain the mechanisms that regulate pH involving the respiratory and urinary systems.
j. Define acidosis and alkalosis.
k. Compare and contrast metabolic and respiratory causes of pH imbalances.

Course Outcome(s):

5. Apply fundamental knowledge of the lymphatic and immune systems to explain homeostasis and to predict outcomes of disrupted structure and/or function.

Objective(s):

a. Describe the major functions of the lymphatic system.
b. Compare and contrast lymphatic vessels and blood vessels in terms of structure and function.
c. Identify and describe lymphatic capillaries, lymphatic vessels, trunks, and ducts and trace the path of lymph circulation through them.
d. Describe the mechanisms of lymph formation and circulation.
e. Describe the location, structure, and function of lymphatic tissues, nodules, and organs.
f. Compare and contrast innate (non-specific) and adaptive (specific) immune responses.
g. Describe the immunological memory response.
h. Describe mechanisms of innate (non-specific) immunity including barriers, chemical mediators, and cells.
i. Describe the classes of the major histocompatibility complex and compare their locations and functions.
j. Describe mechanisms of cell-mediated adaptive immunity, including the cells and molecules necessary.
k. Describe mechanisms of antibody-mediated adaptive immunity, including the general structure of antibodies and the functions of the five classes of antibodies.

l. Explain the four ways to acquire antibody-mediated adaptive immunity.
m. Analyze the causes and symptoms of immune disorders and their effect on immunity.

Course Outcome(s):

6. Apply fundamental knowledge of the digestive system to explain homeostasis and to predict outcomes of disrupted structure and/or function.

Objective(s):

a. Describe the major functions of the digestive system.
b. Describe the location, structure, and function of the components of the gastrointestinal tract, beginning at the mouth and ending at the anus.
c. Describe the location, structure, and function of each of the gastrointestinal tract tunics.
d. Describe the location, structure, and function of the accessory organs of the digestive system.
e. Describe the location, structure, and function of the peritoneum and associated mesenteries.
f. Compare and contrast chemical and mechanical digestion.
g. Define the various movements of the gastrointestinal tract and describe their regulation.
h. List the enzymes, their sources, their substrates, and the products of chemical digestion.
i. Describe the production and function of the major secretions of the gastrointestinal tract and accessory organs.
j. List the organs and specific structures that facilitate the absorption of nutrients.
k. Discuss the neurological and hormonal mechanisms that regulate activity of the gastrointestinal tract and its accessory organs.

Course Outcome(s):

7. Apply fundamental knowledge of nutrition and metabolism to explain energy balance and to predict outcomes of disrupted structure and/or function.

Objective(s):

a. Define nutrient and essential nutrient.
b. List the five major nutrient categories, their sources, and main cellular uses.
c. Categorize the major nutrients as either macronutrients or micronutrients.
d. Define metabolism and explain how catabolism and anabolism differ.
e. Explain how enzymes as biological catalysts are essential for metabolism.
f. Describe oxidation-reduction reactions and explain their role in metabolism.
g. Identify the molecular structure of ATP, its synthesis and its metabolic role.
h. List the steps of cellular respiration.
i. Compare and contrast the catabolic pathways of carbohydrates, proteins, and fats.
j. Define the terms fed and fasted and explain the important events that occur during these states.
k. Explain what is meant by body energy balance.
l. Describe the neural and hormonal factors that regulate food intake.
m. Describe how body temperature is regulated; indicating the major mechanisms for heat production and loss.

Course Outcome(s):

8. Compare and contrast the eukaryotic cell division strategies of mitosis and meiosis.

Objective(s):

a. Describe the general phases of the cell cycle.
b. Discuss the stages, events, and significance of mitosis and meiosis.
c. Describe the role of mitotic cell division in tissue repair, growth and development.
d. Describe the role of meiosis in gametogenesis.

Course Outcome(s):

9. Discuss the principles of classical and contemporary genetics.

Objective(s):

a. Describe the central dogma of molecular biology, the structure of DNA, RNA, and protein molecules, and the processes of transcription and translation.
b. Explain monohybrid and dihybrid crosses and simple variations including dominant/recessive inheritance, incomplete dominance, co-dominance, sex-linked inheritance and mutant alleles and their role in genetic disease.
c. Create and interpret simple pedigrees illustrating dominant/recessive inheritance, incomplete dominance, co-dominance, sex-linked traits, and diseases.
d. Explain variations in embryonic chromosome number (aneuploidy) as a result of non-disjunction by comparing normal and atypical human karyotypes, including Down syndrome, triple X, Klinefelter syndrome, Turner syndrome and XYY.

Course Outcome(s):

10. Apply fundamental knowledge of the reproductive system to explain normal reproductive function and to predict outcomes of disrupted structure and/or function.

Objective(s):

a. Describe the major functions of the male and female reproductive systems.
b. Compare and contrast the location, structure, and function of the components of the male and female reproductive systems.
c. Compare and contrast the process and hormonal regulation of spermatogenesis and oogenesis.
d. Describe the sex hormones secreted by cells of the male and female reproductive systems, including the source, target cells, and the major effects on the body.
e. Describe age related changes in endocrine regulation of the male and female reproductive systems, including infancy, adolescence, puberty, adulthood, and the elderly.
f. Describe the events of the uterine cycle and ovarian cycle, including follicular development, and correlate with hormone levels.
g. Describe the structure of sperm and trace the path from its production to ejaculation.
h. Describe the structure of an oocyte and its development from oogonia to ovulation.
i. Describe the events leading to fertilization; beginning at ovulation/ejaculation and ending in the formation of a zygote.
j. Describe the anatomical and physiological basis of male and female birth control methods.

Course Outcome(s):

11. Describe the stages in the development of the zygote, embryo, and fetus. Describe the events of parturition and the control of lactation.

Objective(s):

a. Describe major developmental events and timing of the germinal, embryonic, fetal, and neonatal stages of development.
b. Describe major events that occur during fertilization.
c. Describe developmental changes between the zygote and blastocyst stages.
d. Describe the process of implantation.
e. Describe events of early embryogenesis, including the formation of the trophoblast, embryoblast, and embryonic disc.
f. Describe the formation and function of the extraembryonic membranes.
g. Explain the process and timing of placentation, including maternal and fetal contributions.
h. Explain the formation of the embryo including gastrulation and germ layer cellular fates.
i. Describe neurulation, including neural plate formation and neural tube formation.
j. Compare and contrast the fates of neural crest cells and the neural tube.
k. Describe major anatomical and physiological maternal adaptations to pregnancy.
l. Define organogenesis and highlight major milestones in fetal body system development.
m. Describe major events that occur during the three stages of parturition.
n. Describe respiratory, cardiovascular, and digestive changes that occur in the newborn.
o. Describe the physiological events of lactation and the role of hormones in milk production and release.

Methods of Evaluation:

a. Quizzes
b. Examinations
c. Laboratory practicals

d. Reviews of scientific journal articles
e. Case study analysis
f. Online activities
g. Class participation

Course Content Outline:

a. Cardiovascular system
    i. Blood
        1. Functions
        2. Composition of whole blood
            a. Formed elements
                i. Erythrocytes (red blood cells - RBCs)
                    1. General characteristics
                    2. Function
                    3. Hemoglobin
                    4. Life span
                    5. Laboratory values
                    6. Disorders
                ii. Leukocytes (white blood cells -WBCs)
                    1. General characteristics
                    2. Functions
                    3. Granular leukocytes
                        a. Neutrophils
                        b. Eosinophils
                        c. Basophils
                    4. Agranular leukocytes
                        a. Lymphocytes
                        b. Monocytes
                    5. Laboratory values
                    6. Disorders
                iii. Thrombocytes (platelets)
                    1. General characteristics
                    2. Function
                    3. Laboratory values
                    4. Disorders
            b. Plasma
                i. Composition
                ii. Function
        3. Hematopoiesis
            a. Hormonal control
            b. Colony stimulating factors
        4. Hemostasis
            a. Vascular spasm
            b. Platelet plug formation
            c. Coagulation
            d. Clot resolution
        5. Blood types
            a. A, B, O groups
            b. Rh factor
            c. Agglutination
            d. Compatibility
            e. Clinical significance
    ii. Heart
        1. Gross anatomy
            a. Anatomical relationships
            b. Pericardium
            c. Walls
            d. Chambers
            e. Valves

f. Great vessels
g. Coronary circulation

2. Physiology
   a. Conduction system
   b. Electrocardiogram (ECG)
   c. Cardiac cycle
      i. Atrial diastole
      ii. Atrial systole
      iii. Ventricular diastole
      iv. Ventricular systole
      v. Timing
      vi. Sounds
   d. Cardiac output
      i. Formula
      ii. End diastolic volume
      iii. End systolic volume
      iv. Frank-Starling's law
      v. Regulation of the cardiac cycle
         1. Autonomic nervous system (ANS)
         2. Baroreceptors
         3. Chemoreceptors
         4. Chemicals
         5. Temperature

iii. Blood vessels
1. Arteries
   a. Function
   b. Histology
   c. Properties
   d. Types
   e. Anastomoses
2. Capillaries
   a. Structure
   b. Function
   c. Types
3. Veins
   a. Histology
   b. Function
   c. Compare to arteries
4. Cardiovascular physiology
   a. Pressure values
      i. Arterial blood pressure
         1. Formula
         2. Factors which affect blood pressure
            a. Cardiac output
            b. Peripheral resistance
         3. Control of blood pressure
            a. Vasomotor center (medulla oblongata)
            b. Baroreceptors
            c. Chemoreceptors
            d. Chemicals
            e. Autoregulation
      ii. Capillary exchange of materials
         1. Starling’s Law of capillaries
            a. Hydrostatic pressures
            b. Colloid osmotic pressures
            c. Net filtration pressure
      iii. Circulatory routes

1. Systemic circulation
2. Pulmonary circulation
3. Fetal circulation

b. Respiratory system
   i. Functions
      1. Respiration
      2. Olfaction
      3. Sound production
   ii. Gross anatomy
      1. External nose
         a. General characteristics
         b. Functions
      2. Nasal cavity
         a. General characteristics
         b. Functions
      3. Pharynx
         a. Nasopharynx
         b. Oropharynx
         c. Laryngopharynx
      4. Larynx
         a. General characteristics
         b. Functions
      5. Trachea
         a. General characteristics
         b. Histology
      6. Bronchi
         a. Main (primary)
         b. Lobar (secondary)
         c. Segmental (tertiary)
         d. Histological changes
      7. Lungs
         a. Pleural membrane
         b. Lobes
         c. Bronchioles
         d. Alveoli
         e. Respiratory membrane
         f. Blood supply
   iii. Physiology of respiration
      1. Respiratory pressures in the thoracic cavity
         a. Intrapleural pressure
         b. Transpulmonary pressure
         c. Intrapulmonary pressure
         d. Atmospheric pressure
      2. Pulmonary ventilation (breathing)
         a. Inspiration
         b. Expiration
         c. Compliance
         d. Airway resistance
         e. Modified respiratory movements
         f. Pulmonary air volumes and capacities
            i. Respiratory volumes
               1. Tidal volume
               2. Inspiratory reserve volume
               3. Expiratory reserve volume
               4. Residual volume
            ii. Respiratory capacities

1. Total lung capacity
2. Vital capacity
3. Inspiratory capacity

iii. Minute ventilation

3. Gas exchange
   a. Gas laws
      i. Charles' law
      ii. Dalton's law
      iii. Henry's law
      iv. Boyle’s law
   4. External respiration
   5. Internal respiration
   6. Transport of respiratory gases
      a. Oxygen
         i. Plasma
         ii. Hemoglobin dissociation curve
            1. Bohr effect
            2. Haldane effect
      b. Carbon dioxide
         i. Plasma
         ii. Hemoglobin
         iii. Bicarbonate ion
   7. Control of pulmonary ventilation
      a. Nervous system
         i. Medullary rhythmicity center
            1. Dorsal respiratory group
            2. Ventral respiratory group
         ii. Pontine respiratory centers
            1. Pneumotaxic center
            2. Apneustic center
      b. Factors that influence breathing rate and depth
         i. Higher brain centers
            1. Hypothalamus
            2. Cortical areas
         ii. Herring-Breuer (inflation) reflex
         iii. Chemical stimuli
            1. Central chemoreceptors
            2. Peripheral chemoreceptors
         iv. Exercise
         v. Temperature

c. Urinary system
   i. Functions
      1. Water balance
      2. Ion balance
      3. Acid-base balance
      4. Excretion of metabolic wastes and foreign substances
      5. Production of regulatory substances
      6. Vitamin D conversion
   ii. Gross anatomy
      1. Kidney
         a. Renal capsule
         b. Renal cortex
         c. Renal medulla
         d. Renal pelvis
         e. Nephron
            i. General characteristics
               1. Renal corpuscle
                  a. Bowman’s capsule
                  b. Glomerulus
               2. Renal tubules

a. Proximal convoluted tubule
b. Nephron loop
c. Distal convoluted tubule
3. Collecting duct
ii. Types
1. Cortical
2. Juxtamedullary
iii. Blood flow
iv. Juxtaglomerular apparatus
2. Ureters
a. Histology
b. Functions
3. Urinary bladder
a. General characteristics
b. Histology
c. Functions
4. Urethra
a. General characteristics
b. Functions
iii. Physiology of urine production and excretion
1. Glomerular filtration
a. Histology of filtration membrane
b. Net filtration pressure
c. Regulation of glomerular filtration rate (GFR)
i. Renal autoregulation
1. Myogenic mechanism
2. Tubuloglomerular feedback
ii. Extrinsic controls
1. Sympathetic nervous system
2. Renin-angiotensin-aldosterone mechanism
2. Tubular reabsorption
a. Tubular load
b. Tubular maximum
3. Tubular secretion
4. Regulation of urine concentration
a. Countercurrent mechanisms
b. Role of anti-diuretic hormone (ADH)
c. Urea recycling
5. Renal clearance
6. Micturition reflex
iv. Urine
1. Normal chemical composition
2. Urinalysis: tests for urinary function
d. Fluids/electrolytes acid-base balance
i. Fluids and electrolytes
1. Body fluid compartments
a. Intracellular fluid
b. Extracellular fluid
i. Plasma
ii. Interstitial fluid
c. Relative volumes
d. Fluid composition
2. Regulation of body osmolarity
a. Water intake mechanisms
b. Water loss mechanisms
c. Hypothalamic osmoreceptors
3. Electrolyte homeostasis

a. Electrolytes
i. Sodium
ii. Potassium
iii. Calcium
b. Hormonal regulation
c. Role of the urinary system
4. Fluid/electrolyte imbalances
a. Dehydration/Overhydration
b. Hyponatremia/hypernatremia
c. Hypokalemia/hyperkalemia
d. Hypocalcemia/hypercalcemia
ii. Acid/base balance
1. Buffers
a. Definition
b. Important buffer systems
i. Phosphate buffer system
ii. Bicarbonate buffer system
iii. Protein buffer system
2. Respiratory regulation of pH
a. Carbon dioxide
b. Hypoventilation
c. Hyperventilation
3. Urinary regulation of pH
a. Hydrogen ion
b. Bicarbonate ion
4. Acid/base imbalances
a. Respiratory acidosis
b. Respiratory alkalosis
c. Metabolic acidosis
d. Metabolic alkalosis

e. Lymphatic system
i. Function
ii. Gross anatomy
1. Lymph
a. Production
b. Mechanisms of circulation
2. Vessels
a. Compare to blood vessels
b. Histology
c. Types
i. Lymph capillaries
ii. Lymphatic vessels
iii. Lymphatic trunks
iv. Lymphatic ducts
1. Thoracic (left lymphatic) duct
2. Right lymphatic duct
3. Lymphatic organs and tissues
a. Location
b. General characteristics
c. Histology
d. Functions
e. Primary lymphatic organs
i. Red bone marrow
ii. Thymus
f. Secondary lymphatic organs and tissues
i. Lymph nodes
ii. Spleen
iii. Lymphatic nodules (follicles)
iv. Mucosa-associated lymphatic tissue (MALT)
iii. Immunity

1. Types of immunity
    a. Innate (non-specific) immunity
        i. Barriers
            1. Mechanical
            2. Chemical
            3. Genetic
        ii. Phagocytosis
        iii. Natural killer cells
        iv. Inflammation
        v. Antimicrobial proteins
            1. Interferon
            2. Complement
        vi. Fever
    b. Adaptive (specific) immunity
        i. Cell-mediated immunity
            1. Types of T cells
            2. Mechanism of selecting, activating, and cloning T cells
            3. Importance of helper T cells
        ii. Antibody-mediated immunity
            1. Antigens
                a. Self-antigens
                b. Nonself-antigens
                c. Antigen presenting cells
            2. Major histocompatibility complexes
                a. Types
                b. Locations
                c. Functions
            3. Antibodies
                a. Structure
                b. Functions of the five classes of antibodies
            4. Mechanism of selecting, activating, and cloning B cells
            5. Acquisition of the types of antibody-mediated immunity
                a. Active natural
                b. Active artificial
                c. Passive natural
                d. Passive artificial
    c. Immunologic memory
    d. Immune disorders
        i. Immuno-deficiency
        ii. Autoimmune diseases
        iii. Hypersensitivity (allergy)

f. Digestive system
    i. Digestive processes
        1. Ingestion
        2. Propulsion
        3. Mechanical digestion
        4. Chemical digestion
        5. Absorption
        6. Defecation
    ii. Control
        1. Nervous
            a. Enteric nervous system
            b. Autonomic nervous system
        2. Hormonal
    iii. Gross Anatomy
        1. Peritoneum
            a. Mesenteries
            b. Extensions
        2. Gastrointestinal (GI) tract

a. Histology of the four tunics
    i. Mucosa
    ii. Submucosa
    iii. Muscularis
    iv. Serosa/adventitia
b. Mouth
    i. Teeth
        1. General characteristics
        2. Functions of the four types
        3. Dentitions: deciduous versus permanent
    ii. Tongue
    iii. Digestion processes of the mouth
c. Esophagus
    i. General characteristics
    ii. Deglutition (swallowing)
d. Stomach
    i. General characteristics
    ii. Histology
    iii. Digestion processes of the stomach
    iv. Regulation of gastric secretion
        1. Neural control
        2. Hormonal control
    v. Regulation of gastric motility and emptying
        1. Neural control
        2. Hormonal control
e. Small intestine
    i. General characteristics
    ii. Histology
        1. Modifications for absorption
        2. MALT
        3. Intestinal crypts
            a. Intestinal juice
            b. Composition
            c. Control of secretion
    iii. Digestive processes of the small intestine
        1. Mechanical
        2. Chemical
        3. Propulsion
        4. Absorption
            a. Carbohydrates
            b. Amino acids
            c. Lipids
                i. Micelles
                ii. Lacteals
                iii. Chylomicrons
            d. Nucleic acids
            e. Water and electrolytes
            f. Vitamins
f. Large intestine
    i. General characteristics
    ii. Histology
    iii. Bacterial microbiota
    iv. Digestive processes of the large intestine
        1. Propulsion
        2. Absorption
        3. Defecation

3. Accessory organs

a. Salivary glands
    i. Locations
    ii. Composition of saliva
    iii. Functions of saliva
    iv. Control of salivation
b. Pancreas
    i. Acini cells
        1. Pancreatic juice
        2. Control of pancreatic juice secretion
    ii. Pancreatic islets (islets of Langerhans)
        1. Hormones
        2. Control of hormone secretion
c. Liver
    i. General characteristics
    ii. Histology
    iii. Blood supply
        1. Hepatic artery
        2. Hepatic vein
        3. Hepatic portal vein
    iv. Functions
        1. Metabolism
        2. Detoxification and purification
        3. Storage
        4. Phagocytosis
        5. Bile production
            a. Bile composition
            b. Function
            c. Regulation of production
d. Gallbladder
    i. General characteristics
    ii. Function

g. Nutrition, Metabolism and Energy Balance
    i. Nutrition
        1. Nutrients
            a. Macronutrients
                i. Carbohydrates
                ii. Lipids
                iii. Proteins
            b. Micronutrients
                i. Vitamins
                ii. Minerals
            c. Dietary sources
            d. Cellular uses
    ii. Metabolism
        1. Anabolism
        2. Catabolism
            a. Cellular Respiration
                i. Enzymes
                ii. Oxidation-reduction reactions
                iii. Glycolysis
                iv. Citric Acid Cycle
                v. Electron Transport Chain
                vi. ATP Synthesis
                    1. Substrate-level phosphorylation
                    2. Oxidative phosphorylation
            b. Carbohydrate metabolism
                i. Glycogenesis
                ii. Glycogenolysis
                iii. Gluconeogenesis
            c. Lipid metabolism

i. Lipogenesis
ii. Lipolysis
d. Protein metabolism
i. Protein synthesis
ii. Deamination
e. Amphibolism
i. Fed state
1. Energy storage
ii. Fasted state
1. Energy production/release
3. Energy balance
a. Food Intake
i. Neural regulation
ii. Hormonal regulation
b. Thermoregulation
i. Heat production mechanisms
ii. Heat loss mechanisms
iii. Role of the hypothalamus

h. Types of cell division
i. Cell cycle
1. Interphase
2. S-phase
3. M-phase
4. Checkpoints
5. Gap phases
6. Control mechanisms
ii. Mitosis
1. Phases of mitosis
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a. Growth
b. Development
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i. Spermatogenesis
ii. Oogenesis
b. Comparison of spermatogenesis and oogenesis
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1. General characteristics
2. Types

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ii. Gene expression/central dogma
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2. Translation
3. Protein synthesis

iii. Classical Mendelian genetics
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    b. Allele
    c. Locus
    d. Chromosomes
    e. Homologues
    f. Recombination
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    b. Monohybrid crosses
    c. Dihybrid crosses
    d. Mendelian ratios
        i. Genotypic ratios
        ii. Phenotypic ratios
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            2. Embryonic lethal
            3. Incomplete dominance
            4. Co-dominance
    e. Pedigree analysis of inheritance patterns
        i. Dominant trait
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        iii. Sex-linkage
    f. Karyotype analysis
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            1. Autosomes
            2. Sex chromosomes
        ii. Atypical karyotypes
            1. Non-disjunction during meiosis
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3. Sexual intercourse (copulation)
4. Reproduction
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    c. Parturition

ii. Male reproductive system
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2. Interstitial cells
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2. Spermatogenesis
3. Spermiogenesis
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c. Epididymis
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iv. Pampiniform venous plexus
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b. Follicle stimulating hormone (FSH)
c. Luteinizing hormone (LH)/Interstitial cell stimulating hormone (ICSH)
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a. Ovary
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1. Tunica albuginea
2. Germinal epithelium
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5. Stroma
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    a. Primordial
    b. Primary
    c. Secondary
    d. Tertiary/Graafian
    e. Corpus hemorrhagicum
7. Corpus albicans
8. Corpus luteum
9. Ligaments
10. Vasculature

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1. Hormone production
2. Follicular development
3. Oogenesis
4. Ovulation

b. Uterine tube/fallopian tube/oviduct
i. Fimbriae
ii. Infundibulum
iii. Ampulla
iv. Isthmus

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2. Body
3. Cervix
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    a. Perimetrium
    b. Myometrium
    c. Endometrium
        i. Stratum basalis
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1. Uterine cycle
    a. Menstrual phase
        i. Menarche
        ii. Menstrual irregularities
        iii. Menopause
    b. Proliferative phase
    c. Secretory phase
2. Implantation

d. Vagina
i. General characteristics
1. Rugae
2. Vaginal fornix
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1. Intercourse
2. Secretions
3. Parturition

e. External genitalia
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ii. Mons pubis
iii. Labia
iv. Clitoris
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viii. Greater vestibular/Bartholin's glands
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ii. Primary oocyte
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1. Nucleus
2. Plasma membrane receptors
3. Zona pellucida
4. Corona radiata
5. Granulosa cells/follicular cells
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a. Stages
i. Spermatogonia
ii. Primary spermatocyte
iii. Secondary spermatocyte
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1. Head
a. Acrosome
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1. Location of occurrence
2. Sperm penetration
3. Acrosomal reaction
4. Blocks to polyspermy
5. Meiotic events
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ii. Early cleavage
    1. Location of occurrence
    2. Timing of events
    3. Stages
        a. Early cell cleavage
            i. 2-cell stage
            ii. 4-cell stage
            iii. 8-cell stage
    4. Morula
    5. Blastocyst
        a. Inner cell mass
        b. Trophoblast
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    1. Timing of events
    2. Blastocyst hatching from zona pellucida
    3. Trophoblast differentiation
        a. Cytotrophoblast
        b. Syncytiotrophoblast
        c. Secretion of human chorionic gonadotropin
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    1. Timing of events
    2. Embryonic disc formation
        a. Epiblast
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        c. Primitive streak
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        a. Chorion
        b. Yolk sac
        c. Amnionic cavity
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        a. Ectoderm
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        c. Endoderm
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        a. Neural groove
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        a. Notochord formation
        b. Somites
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            ii. Dermatome
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        a. General characteristics
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ii. Estrogen/progesterone
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a. Attachments
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1. Anatomical and physiological adaptations
a. Skeletal
b. Cardiovascular
c. Gastrointestinal
d. Urinary
e. Respiratory
f. Body composition

2. Hormonal changes
a. Placental growth hormone
b. Human placental lactogen
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1. Initiation
a. Hormonal control
i. Prostaglandins
ii. Oxytocin
iii. Cortisol
iv. Positive feedback mechanism

b. Structural changes
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a. Dilation stage
b. Expulsion stage
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viii. Fetal cardiovascular adaptations
1. Umbilicus
a. Umbilical vein
i. Oxygenation
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b. Umbilical artery
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2. Vascular shunts of the heart
a. Foramen ovale
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1. Hormonal control
2. Milk production
a. Secretion
b. Let down
c. Ejection

3. Effects of breast feeding
a. Maternal
b. Neonatal

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