

Melrose Public Schools
Science Course Syllabus

Course Titles: Anatomy & Physiology
Structure & Function of the Body

Department: Science, Business, and Technology

Course Description:

Human Anatomy & Physiology is a laboratory-based course that investigates the structure and function of the human body. The course is designed to give all students an understanding of the body and how it functions as well as to educate, stimulate, and motivate students interested in pursuing a career in medicine or another health-related field. Topics covered will include the basic organization of the body; biochemical composition, and major body systems along with the impact of diseases on certain systems.

Primary Course Materials:

Martini/Ober: Visual Anatomy and Physiology

Essential Questions:

How does structure determine function?

How do body systems work together to maintain homeostasis and a healthy individual?

How are cells responsible for carrying out necessary life functions?

How can the dysfunction of body parts (systems, organs., tissues, or cells) lead to homeostatic imbalance?

Course Objectives:

Common Goals:

Thinking and Communicating

1. Read information critically to develop understanding of concepts, topics and issues.
2. Write clearly, factually, persuasively and creatively in Standard English.
3. Speak clearly, factually, persuasively and creatively in Standard English.
4. Use computers and other technologies to obtain, organize and communicate information to solve problems.
5. Conduct research to interpret issues or solve complex problems using a variety of data and information sources.

Course Objectives:

1. The Chemistry of Life

Central Concept: Chemical elements form organic molecules that interact to perform the basic functions of life.

- 1.1 Recognize that biological organisms are composed primarily of very few elements. The six most common are C, H, N, O, P and S.
- 1.2 Describe the basic molecular structures and primary functions of the four major categories of organic molecules (carbohydrates, lipids, proteins, proteins, nucleic acids).

- 1.3 Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify factors such as pH and temperature, that have an effect on enzymes.

2. Cell Biology

Central Concepts: Cells have specific structures and functions that make them distinctive. Processes in a cell can be classified broadly as growth, maintenance and reproduction.

- 2.1 Relate cell parts/organelles (plasma membrane, nuclear envelope, nucleus, nucleolus, cytoplasm, mitochondrion, endoplasmic reticulum, Golgi apparatus, lysosome, ribosome, vacuole, cytoskeleton, centriole, cilium, flagellum) to their functions. Explain the role of cell membranes as a highly selective barrier (diffusion, osmosis, facilitated diffusion, active transport).
- 2.5 Explain the important role that ATP serves in metabolism.
- 2.6 Describe the cell cycle and the process of mitosis. Explain the role of mitosis in the formation of new cells, and its importance in maintaining chromosome number during asexual reproduction.
- 2.7 Describe how the process of meiosis results in the formation of haploid cells. Explain the importance of this process in sexual reproduction, and how gametes form diploid zygotes in the process of fertilization.

4. Anatomy and Physiology

Central Concepts: There is a relationship between the organization of cells into tissues and the organization of tissues into organs. The structures and functions of organs, determine their relationships with body systems of an organism. Homeostasis allows the body to perform its normal functions.

- 4.1 Explain generally how the digestive system (mouth, esophagus, stomach, small and large intestines, rectum) converts macromolecules from food into smaller molecules that can be used by cells for energy and for repair and growth.
- 4.2 Explain how the circulatory system (heart, arteries, veins, capillaries, red blood corpuscles) transports nutrients and oxygen to cells and removes cell wastes. Describe how the kidneys and the liver are closely associated with the circulatory system as they perform excretory function of removing waste from the blood. Recognize that kidneys remove nitrogenous wastes, and the liver removes many toxic compounds from the blood.
- 4.3 Explain how the respiratory system (nose, pharynx, larynx, trachea, lungs, alveoli) provides exchange of oxygen and carbon dioxide.
- 4.4 Explain how the nervous system (brain, spinal cord, sensory neurons, motor neurons) mediates communication among different parts of the body and mediates the body's interactions with the environment. Identify the basic unit of the nervous system, the neuron, and explain generally how it works.
- 4.5 Explain how the muscular/skeletal system (skeletal, smooth and cardiac muscles, bones, cartilage, ligaments, tendons) works with other systems to support the body and allow for movement. Recognize that bones produce bone cells.
- 4.6 Recognize that the sexual reproductive system allows organisms to produce offspring that receive half of their genetic information from their mother and half from their father, and that sexually produced offspring resemble, but are not identical to, either of their parents.
- 4.7 Recognize that communication among cells is required for coordination of body functions. The nerves communicate with electrochemical signals, hormones circulate through blood, and some cells produce signals to communicate only with nearby cells.

4.8. Recognize that the body's systems interact to maintain homeostasis.
Describe the basic function of a physiological feedback loop.

Content Outline:

Unit 1 – The Human Body: An Orientation - Students receive an introduction to the human body including body systems, anatomical terminology, and importance of homeostasis.

Mastery Objectives:

- Explain how anatomy and physiology are related.
- Name the organ systems of the body and briefly state the major functions of each system.
- Identify the organs shown on a diagram or a dissectible torso.
- List functions that humans must perform to maintain life.
- Define *homeostasis* and explain its importance.
- Define *negative feedback* and describe its role in maintaining homeostasis and normal body function.
- Use proper anatomical terminology to describe body directions, surfaces, and body planes.

Essential questions:

- How are structure and function related in the human body?
- Generally, how is feedback used to maintain homeostasis in the human body?

Learning Activities:

- Homeostatic Control Mechanism Modeling
- Clay Man Autopsy
- Labeling/diagrams

Unit 2 – Basic Chemistry – A review of basic chemistry concepts and overview of organic molecules necessary for life.

Mastery Objectives:

- Differentiate between ionic, polar covalent, and nonpolar covalent bonds, and describe the importance of hydrogen bonds.
- Distinguish between organic and inorganic compounds.
- Identify and describe the function of the four major classes of macromolecules (carbohydrates, proteins, lipids, and nucleic acids)

Essential Questions:

- What are the differences between organic and inorganic compounds?
- How are the different types of organic molecules used by the human body?

Learning Activities:

- Organic Chemistry Jigsaw Activity
- Bonding Modeling mini-posters

- Articles- Link between Diabetes and Alzheimer's disease

Unit 3- Cell and Tissues- A review of cell biology as well as a description of the four tissue types (connective, muscular, nervous and epithelial) that comprise the human body

Mastery Objectives:

- Identify the organelles on a cell model or describe them, and discuss the major function of each.
- Describe the structure of the plasma membrane, and explain how various transport processes account for the directional movements of specific substances across the plasma membrane.
- In relation to protein synthesis, describe the roles of DNA and of the three varieties of RNA. +
- Name some cell types and relate their overall shape and internal structure to their special functions.
- Name the four major tissue types and their chief subcategories. Explain how the four major tissue types differ structurally and functionally.
- Give the chief locations of the various tissue types in the body.
- Describe the process of tissue repair (wound healing).

Essential Questions:

- How can organelle distribution in different cells account for the specialization of cells?
- How can a plasma membrane allow passage of some materials and prohibit passage of others?
- How can the four major tissue types be organized to form different organs in the human body?
- How is tissue repaired?
- Why are some tissues/organs irreparable?

Learning Activities

- Cell Parts Graphic Organizer and diagrams
- Membrane Transport Animations
- Membrane Transport Graphic Organizer
- Tissue Slides- diagramming and identification

Unit 4- Skin and Body Membranes – An in depth look at the structures and functions of skin and other body membranes

Mastery Objectives:

- List the general functions of each membrane type-cutaneous, mucous, serous, and synovial-and give its location in the body.
- Compare the structure (tissue makeup) of the major membrane types.
- List several important functions of the integumentary system and explain how these functions are accomplished.

- Recognize, name, and describe functions of the following skin structures: epidermis, dermis (papillary and reticular layers), hair and hair follicle, sebaceous gland, and sweat gland.
- Name the factors that determine skin color and describe the function of melanin.
- Differentiate between first-, second-, and third-degree burns. +
- Summarize the characteristics of basal cell carcinoma, squamous cell carcinoma, and malignant melanoma. +
- List several examples of integumentary system aging.

Essential Questions:

- How does the structure of the each membrane type (tissue types) relate to its function?
- How does the skin function in thermoregulation?
- What are some factors (internal and external) related to skin pigmentation.

Learning Activities:

- Skin diagram
- Comparison of Skin Types (microscopic view)
- Skin Disease Project

Unit 5 – The Skeletal System - An in depth look at the structures and functions of bones and the skeletal system

Mastery Objectives:

- List functions of the skeletal system and how they relate to its structures.
- Describe briefly the process of bone formation in the fetus and summarize the events of bone remodeling throughout life.
- On a skull or diagram, identify and name the bones of the skull. +
- Discuss differences in skeletal structure between sexes and individuals of different ages
- Identify on a skeleton or diagram the bones of the shoulder and pelvic girdles and their attached limbs.
- Name the three major categories of joints and compare the amount of movement allowed by each.
- Identify some examples of homeostatic imbalance in the skeletal system.

Essential Questions:

- How does the skeleton change from embryonic development through old age?
- How is it possible to identify sex, age, and other characteristics based on skeletal structure?
- Why are joints a major structure connecting the functions of the skeletal and muscular systems?

Learning Activities:

- Joint Modeling Project
- Labeling/diagrams
- Bone identification
- Skull and Pelvis comparison charts
- Bone/Skeletal Disease Project

Unit 6 – The Muscular System - An in depth look at the structures and functions of muscles and the muscular system

Mastery Objective:

- Describe the macroscopic and microscopic structure of skeletal muscle and explain the role of actin- and myosin-containing myofilaments.
- Describe how an action potential is initiated in a muscle cell.
- Describe the events of muscle cell contraction.
- Describe three ways in which ATP is regenerated during muscle activity.
- Describe the effects of aerobic and resistance exercise on skeletal muscles and other body organs.
- Demonstrate or identify the different types of body movements.
- Name and locate the major superficial muscles of the human body (on a torso model, muscle chart, or diagram) and state the action of each.
- Explain the importance of a nerve supply and exercise in keeping muscles healthy.
- Describe the changes that occur in aging muscles.

Essential Questions:

- How do the microscopic elements of skeletal muscle interact to cause muscle contraction?
- Why is a healthy nervous system crucial to muscular function?
- How are a variety of body movements allowed by the interaction of the muscular and skeletal systems?
- What is the importance of different types of exercise in maintaining a healthy musculature/body?

Learning Activities:

- Skeletal Muscle Model
- Muscle Fatigues Lab
- Building a Functional Hand
- Labeling/diagrams

Unit 7 – The Nervous System - An in depth look at the structures and functions of the nervous system

Mastery Objectives:

- List the general functions of the nervous system.
- Explain the structural and functional classifications of the nervous system.
- Describe the general structure and function of a neuron, including generation of a nerve impulse and its conduction from one neuron to another.
- Define *reflex arc* and list its elements.
- Distinguish between the central and peripheral nervous system.
- Distinguish between the somatic and autonomic nervous system.
- Compare the of a contusion with those of a concussion.
- Describe the general structure of a nerve.
- Contrast the effect of the parasympathetic and sympathetic divisions on the following organs: heart, lungs, digestive system, blood vessels.
- List several factors that may have harmful effects on brain development.
- Describe the changes that occur in an aging brain.

Essential Questions:

- How does the nervous system function to control and coordinate body physiology?
- How does the somatic nervous system differ from the autonomic nervous system?

Learning Activities:

- Reflex lab
- Effects of Drugs on Nervous System
- Special Senses Jigsaw
- Diagrams and labeling

Unit 8 – The Endocrine System

Mastery Objectives:

- Describe how hormones bring about their effects in the body.
- Explain how various endocrine glands are stimulated to release their hormonal products.
- Define *negative feedback* and describe its role in regulating blood levels of the various hormones.
- On an appropriate diagram, identify the major endocrine glands and tissues.
- List hormones produced by the endocrine glands and discuss their general functions and consequences of dysfunction.
- Discuss other organs with endocrine functions
- Describe the effect of aging on the endocrine system and body homeostasis.

Essential Questions:

- How does the endocrine system work independently and collectively to maintain homeostasis?

Learning Activities:

- Glands of the Endocrine System Presentations/Glands and Their Functions graphic organizer
- Negative Feedback Lab
- Endocrine Disorder Project and jigsaw
- Diagrams and labeling

Unit 10 – The Respiratory System- An in depth look at the structures and functions of the respiratory system

Mastery Objectives:

- Name the organs forming the respiratory system from the nasal cavity to the alveoli of the lungs (or identify them on a diagram or model) and describe the function of each.
- Distinguish between types of respiration (cellular, external, internal)
- Explain how the respiratory muscles cause volume changes that lead to air flow into and out of the lungs (breathing).
- Describe the process of gas exchanges in the lungs and tissues.
- Describe how oxygen and carbon dioxide are transported in the blood.
- Name several physical factors that influence respiratory rate.
- Describe normal changes that occur in respiratory system functioning from infancy to old age.

Essential Questions:

- How does the respiratory system maintain homeostatic levels of oxygen and carbon dioxide in the body?
- What connection exists between the respiratory and circulatory systems?

Learning Activities:

- Thoracic Cavity/Lung Model
- Respiratory Disorders Project
- Respiratory Rate Lab
- Diagrams and labeling

Unit 11 – The Urinary System - An in depth look at the structures and functions of the urinary system

Mastery Objectives:

- Recognize that the nephron is the structural and functional unit of the kidney and describe its anatomy.
- Describe the process of urine formation and the composition of normal urine.
- Describe the function of the kidneys in excretion of nitrogen-containing wastes.
- Describe the general structure and function of the ureters, bladder, and urethra.

- Discuss common urinary tract problems.
- Explain the role of antidiuretic hormone (ADH) in the regulation of water balance by the kidney.
- Explain the role of aldosterone in sodium and potassium balance of the blood.
- Describe three common congenital problems of the urinary system.
- Describe the effect of aging on urinary system functioning.

Essential Questions:

- How does the kidney work to maintaining homeostasis of blood?
- How does the structure of the nephron allow for its function (filtration, tubular reabsorption and tubule secretion)?
- What substances are typically found in urine? What are substances not typically found in urine and what might their presence indicate?

Learning Activities

- Urinalysis Lab
- Nephron coloring (movement of substances)
- Nephron animation
- Diagrams and labeling

Quarter	Content/Topic	Assessments	Standards
I	<p>Chapter 1 - The Human Body: An Orientation Overview of A & P Levels of Organization Maintaining Life Homeostasis Language of Anatomy</p> <p>Chapter 2 - Basic Chemistry Concepts of Matter & Energy Composition of Matter Molecules & Compounds Chemical Bonds & Reactions Biochemistry</p> <p>Chapter 3 - Cells and Tissues Cellular Basis of Life Anatomy - Generalized Cell Cell Physiology Body Tissues</p>	<p>Core Assignment Lab: Homeostasis Lab: Autopsy Open Response Homeostasis & Feedback Mechanisms Chapter 1 Test : Introduction : Body Orientation</p> <p>Lab: Chemistry of Carbohydrates Lab: Chemistry of Proteins & Lipids Lab: Enzyme – Structure & Function Chapter 2 Test : Basic Chemistry Lab : Mitosis Molecular Motion Review Cytology Test Lab : Histology Slides Lab Practical : Histology Tissue Test</p>	<p>4.8 1.1 1.2 1.3 2.1 2.5 2.6 2.7</p>
II	<p>Chapter 4 - Skin and Body Membranes Classification of Body Membranes Integumentary System</p> <p>Chapter 5 - The Skeletal System Bones: An Overview Axial Skeletal Appendicular Skeleton Joints & Body Movements</p> <p>Chapter 6 - The Muscular System Overview of Muscle Tissues Microscopic anatomy of Skeletal Muscle Skeletal Muscle Activity Muscle Types, Movements & Names Gross Anatomy of Skeletal Muscle</p>	<p>Project: Skin Maladies Lab: UV Light & Sunscreen Chapter 4 : Integumentary Test</p>	
III	<p>The Nervous System The Digestive System The Respiratory System The Lymphatic System and Body Defenses</p>		
IV	<p>The Urinary System</p>		

	The Endocrine System The Reproductive System		
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Major Evaluation Strategies:

Name of Assessment	<u>Type of Assessment</u> Test Performance Assessment	Common Goals Assessed	Standards Assessed	Other Objectives Assessed
Quizzes				
Lab Practical				
Chapter Tests				
Muscle Project				
Skin Project				
Mid-Year Exam				
Final Exam				