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Human Anatomy & Physiology Curriculum Overview

The Anatomy & Physiology course at Pen Argyl Area High School is an elective open to juniors and seniors that have demonstrated the ability to succeed in the sophomore, Lab Biology, course. This course will build off of established content knowledge to develop the abilities to synthesize large amounts of anatomical information and analyze physiological processes. Students will be exposed to the study of human and comparative anatomy, with specific emphasis placed on preparing students for careers in health care. Students will apply information acquired through text, web, simulation, and lecture sources to lengthy dissections and laboratory experiments. All material presented in Anatomy & Physiology is aligned with established Pennsylvania state standards and assessment anchors. Since ready access to anatomical knowledge is required for all health care professionals, students will be required to pass cumulative exams given regularly throughout the year that will assess the ability to learn and retain information in a meaningful manner.
Unit 1: Foundational Knowledge

Part A: Organization of the Human Body & Medical Terminology
Part B: Systems and Subsystems

Unit Outcomes:
Students will be able to discuss human anatomy with correct terminology, specifically referring to regions of the body, planes, and anatomical directions.

A. Define and explain how anatomy and physiology are related.
B. Name and explain the relationship between levels of structural organization that make up the human body.
C. Identify and state the major functions of the organ systems of the body.
D. Properly use the terms that describe relative positions, body sections, and body regions.
E. Describe the functions of the human body and explain how these functions aid in the maintenance of life.
F. Develop an understanding of homeostasis and its role in normal body function.

Eligible Content and Related Standards:
State Standards:
3.1.12.A5: Analyze how structure is related to function at all levels of biological organization from molecules to organisms.
3.1.12.A1: Relate changes in the environment to various organisms’ ability to compensate using homeostatic mechanisms.

Assessment Anchors:
BIO.A.1.2.2: Describe relationships between structure and function at various levels of biological organization.
BIO.A.4.2.1: Explain how organisms maintain homeostasis

Applicable Writing Standards

Applicable Math Standards
State Standards: 2.3.11.E, 2.6.11.A, 2.6.11.C, 2.6.11.E, 2.7.11.A, 2.7.11.E
Content:
A. Definitions and relationship between anatomy and physiology
B. Levels of organization and relationships
C. Organ system overview: names, functions, organs/identification of organs
D. Necessary life functions; survival needs
E. Homeostasis
   1. Feedback loops: positive vs. negative
   2. Identification of stimulus, receptor, control center, effector, response
F. Language of anatomy and physiology
   1. Anatomical positions
   2. Directional terms
   3. Regional terms
   4. Body planes and sections
   5. Body cavities and quadrants

Instructional Strategies:
PowerPoint-based lecture
Group activities and projects
Laboratory investigations
Daily questions
Text reading/questions
Online interactives, games, review activities
Smartboard quizzes, games, activities
Online practice tests
Quizlet, Socrative, EdPuzzle, kahoot
Workbook activities
Use of models
Graphic organizers
Interpreting data tables and graphs

Remediation:
Adapted Reading
Vocabulary Review (flash cards: physical and on quizlet)
Re-teaching Activities (small-group, one-on-one instruction)
**Enrichment:**
Lab Research
Case Studies
Science journal articles

**Assessment Criteria:**
Text-based assessment questions
Oral questions and answers
Class discussions
Teacher created quizzes, tests, essays

**Resources and Materials:**
Text resources (print and digital)
PowerPoint slide shows
Lab packets, as appropriate
Website resources: HASPI, Biology corner, HHMI, learn.genetics.utah.edu
Internet materials, as appropriate Current newspaper/ magazine articles, as appropriate
Unit 2: Biochemistry and Metabolism

Part A: Biochemistry
Part B: Digestive & Excretory systems

Unit Outcomes:

Students will be able to compare and contrast the four groups of biochemicals with specific reference to their roles in physiological activities. Students will investigate the interactions of biochemical molecules during digestion and excretion, and how these molecules support life functions.

A. Describe the relationships among matter, atoms, and molecules.
B. Identify three major types of chemical reactions that occur in the body
C. Explain the importance of water and salts to body homeostasis
D. Differentiate among a salt, an acid, and a base
E. Explain the concept of pH, and its affect on body functions
F. Compare the structures and functions of carbohydrates, lipids, proteins, and nucleic acids
G. Describe where and how each major macromolecule group is used by the body (i.e. digestion, homeostasis)
H. Describe how and where enzymes work in the body

Eligible Content and Related Standards:

State Standards:
3.1.12.A5: Analyze how structure is related to function at all levels of biological organization from molecules to organisms.
3.1.12 B5: Relate the monomer structure of biomacromolecules to their functional roles.
3.1.12.A2: Evaluate how organisms must derive energy from their environment or their food in order to survive.
3.2.12.A1: Compare and contrast the unique properties of water to other liquids.
3.2.12.A4: Describe the interactions between acids and bases.

Assessment Anchors:
BIO.A.1.2.2: Describe relationships between structure and function at various levels of biological organization.
BIO.A.2.1.1: Describe the unique properties of water and how these properties support life.
BIO.A.2.2.3: Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.
BIO.A.2.3.2: Explain how factors such as pH, temperature, and concentration levels can affect enzyme function.

**Applicable Writing Standards**

**Applicable Math Standards**
State Standards: 2.3.11.E, 2.6.11.A, 2.6.11.C, 2.6.11.E, 2.7.11.A, 2.7.11.E

**Content:**
A. Atomic structure, bond types, organic and inorganic molecules
B. Special properties of water; function in human body
C. Biochemical reactions
D. Acids, bases, salts, buffers, and electrolytes
E. Acid-base balance and osmoregulation (kidney, lung function)
F. Structure and function of carbohydrates, lipids, proteins, nucleic acids; activity in body
G. Explain the role of ATP in cell metabolism
H. Properties and importance of enzymes to body
I. Major organs involved in digestion and excretion; interaction of these organs within and between body systems

**Instructional Strategies:**
PowerPoint-based lecture
Group activities and projects
Laboratory investigations
Daily questions
Text reading/questions
Online interactives, games, review activities
Smartboard quizzes, games, activities
Online practice tests
Quizlet, Socrative, EdPuzzle, kahoot
Workbook activities
Use of models
Graphic organizers
Interpreting data tables and graphs

**Remediation:**
Adapted Reading
Vocabulary Review (flash cards: physical and on quizlet)
Re-teaching Activities (small-group, one-on-one instruction)

**Enrichment:**
Lab Research
Case Studies
Science journal articles

**Assessment Criteria:**
Text-based assessment questions
Oral questions and answers
Class discussions
Teacher created quizzes, tests, essays

**Resources and Materials:**
Text resources (print and digital)
PowerPoint slide shows
Lab packets, as appropriate
Website resources: HASPI, Biology corner, HHMI, learn.genetics.utah.edu
Internet materials, as appropriate Current newspaper/ magazine articles, as appropriate
Unit 3: Cytology & Histology

Part A: Cells and Tissues
Part B: Integumentary & Endocrine systems

Unit Outcomes:

Students will be able to compare various cell types and discuss their ability to form complex tissues (histology), glands, and organs found in the human body.

A. Identify on a cell model or diagram the cell organelles and be able to explain their functions
B. Describe the structure of the plasma membrane, and explain how the various transport processes account for the directional movements of specific substances across the plasma membrane
C. Name the four primary classes of human tissues and explain how they differ structurally and functionally
D. Identify different tissue types when given a diagram
E. Describe the structure, function, and location of different tissue types
F. Recognize and identify the major skin structures when provided a diagram or model
G. Compare tissue structure and function among integumentary epithelia and endocrine glandular tissue
H. Describe ways the body repairs damaged tissue
I. Identify the various forms of cancer and describe how it affects the body
J. Have an understanding of stem cells and how they are used in modern medical procedures and research

Eligible Content and Related Standards:

State Standards:

3.1.12.A4: Explain how the cell cycle is regulated.

3.1.12.A6: Analyze how cells in different tissues/organs are specialized to perform specific functions.

3.1.12.A7: Describe the potential impact of stem cell research on the biochemistry and physiology of life.

Assessment Anchors:

BIO.A.4.1.1 Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell.

BIO.A.4.1.2 Compare the mechanisms that transport materials across the plasma membrane
Applicable Writing Standards

Applicable Math Standards
State Standards: 2.3.11.E, 2.6.11.A, 2.6.11.C, 2.6.11.E, 2.7.11.A, 2.7.11.E

Content:
A. Cell organelle structure and function
B. Plasma membrane and membrane transport
C. Cell specializations: locations in body; function
   1. Microvilli (absorption), cilia (movement of debris), flagella (movement of cell)
   2. Cell-to cell junctions: tight junctions, gap junctions, desmosomes
D. Cell cycle, cancer, MHC proteins; Stem cell research
E. Tissue types: identification, structure, function, and location of each
   1. Epithelial tissue:
      a. Simple vs. stratified
      b. Squamous, cuboidal, columnar, transitional, pseudostratified
   2. Connective tissue:
      a. Bone, blood, cartilage (elastic, hyaline, fibrocartilage)
      b. Loose connective: adipose, areolar, reticular
      c. Dense connective: regular, irregular
   3. Muscle tissue: skeletal, smooth, cardiac
   4. Nervous tissue: neuronal, neuroglia
F. Anatomy and physiology of selected features of the integumentary system
G. Endocrine glandular tissue function; relationship to homeostasis
H. Tissue repair process

Instructional Strategies:
PowerPoint-based lecture
Group activities and projects
Laboratory investigations (microscope slides)
Daily questions
Text reading/questions
Online interactives, games, review activities
Smartboard quizzes, games, activities
Online practice tests
Quizlet, Socrative, EdPuzzle, kahoot
Workbook activities
Use of models
Graphic organizers
Interpreting data tables and graphs

Remediation:
Adapted Reading
Vocabulary Review (flash cards: physical and on quizlet)
Re-teaching Activities (small-group, one-on-one instruction)

Enrichment:
Lab Research
Case Studies
Science journal articles

Assessment Criteria:
Text-based assessment questions
Oral questions and answers
Class discussions
Teacher created quizzes, tests, essays

Resources and Materials:
Text resources (print and digital)
PowerPoint slide shows
Lab packets, as appropriate
Website resources: HASPI, Biology corner, HHMI, learn.genetics.utah.edu
Internet materials, as appropriate Current newspaper/ magazine articles, as appropriate
Unit 4: Information Processing

Part A: Nervous System
Part B: The Brain and Sensory Processing

Unit Outcomes:

Students will be able to describe the structure and functionality of the nervous system, including different divisions of the nervous system; how the brain receives, integrates, processes, and interprets information, and ultimately controls, regulates, and coordinates the other body systems, for homeostasis and survival.

A. Explain the structural and functional divisions of the nervous system
B. List the types of supporting cells and cite their functions
C. Distinguish between sensory, motor, and association neurons
D. Describe the important anatomical regions of a neuron and relate each to a physiological role
E. Describe the events that lead up to, happen during, and result after a nerve impulse and its conduction from one neuron to another
F. Identify and indicate the functions of the major regions of the cerebral hemispheres, diencephalon, brain stem, and cerebellum on a human brain model or diagram
G. Identify the three meningeal layers, and state their functions
H. Understand the formation and function of cerebrospinal fluid and the blood-brain barrier
I. Name 12 pairs of cranial nerves and describe their function
J. Compare and contrast the general functions of the parasympathetic and sympathetic divisions
K. Understand from an anatomical and physiological perspective, the functions of sight, hearing & balance, taste, and smell

Eligible Content and Related Standards:

State Standards:

3.1.12.A1: Relate changes in the environment to various organisms’ ability to compensate using homeostatic mechanisms.
3.1.12.A5: Analyze how structure is related to function at all levels of biological organization from molecules to organisms.
3.1.12.A6: Analyze how cells in different tissues/organs are specialized to perform specific functions.
Assessment Anchors:
BIO.A.1.2.2: Describe relationships between structure and function at various levels of biological organization.
BIO.A.4.2.1: Explain how organisms maintain homeostasis

Applicable Writing Standards

Applicable Math Standards
State Standards: 2.3.11.E, 2.6.11.A, 2.6.11.C, 2.6.11.E, 2.7.11.A, 2.7.11.E

Content:
A. Divisions of the nervous system
   1. Central NS: (interneurons/association) information processing, integration, and command control
   2. Peripheral NS:
      a. Afferent pathway (sensory neurons)
      b. Efferent pathway (motor neurons)
         i. Somatic NS v. Autonomic NS
            1. Sympathetic pathway v. Parasympathetic pathway
B. Types of neuroglia and their functions:
   a. astrocytes, oligodendrocytes, ependymal cells, microglia
C. Types of neurons and their location in the body
   a. Multipolar, bipolar, unipolar
D. Anatomy of a neuron
E. Physiology of a nervous impulse: stimulus, action potential propagation
F. Chemical synapse and neurotransmitters
G. Reflexes
H. Structure and function of brain regions
   a. Cerebrum, Cerebellum, Diencephalon and limbic system, Brain stem
I. Protection of the CNS
   a. Meninges, cerebrospinal fluid, blood-brain barrier
J. Disorders associated with damage to brain regions (concussion, stroke, traumatic brain injury, coma, aphasia, etc.)
K. Cranial nerves and regions they innervate
**Instructional Strategies:**

- PowerPoint-based lecture
- Group activities and projects
- Laboratory investigations
- Daily questions
- Text reading/questions
- Online interactives, games, review activities
- Smartboard quizzes, games, activities
- Online practice tests
- Quizlet, Socrative, EdPuzzle, kahoot
- Workbook activities
- Use of models
- Graphic organizers
- Interpreting data tables and graphs
- Dissection as appropriate (sheep brain)

**Remediation:**

- Adapted Reading
- Vocabulary Review (flash cards: physical and on quizlet)
- Re-teaching Activities (small-group, one-on-one instruction)

**Enrichment:**

- Lab Research
- Case Studies
- Science journal articles

**Assessment Criteria:**

- Text-based assessment questions
- Oral questions and answers
- Class discussions
- Teacher created quizzes, tests, essays
Resources and Materials:

Text resources (print and digital)
PowerPoint slide shows
Lab packets, as appropriate
Brain model
Website resources: HASPI, Biology corner, HHMI, learn.genetics.utah.edu
Internet materials, as appropriate Current newspaper/ magazine articles, as appropriate
Unit 5: Support & Movement

Part A: Skeletal system
Part B: Muscular system

Unit Outcomes:

Students will be able to describe the structure and functionality of the skeletal and muscular systems. Students will identify bones, joints, and major muscles of the body and skull. Students will describe the process of bone growth, repair, and remodeling and the processes involved in muscle contraction.

A. Identify the subdivisions of the skeleton as axial or appendicular
B. State several functions of the skeletal system
C. Demonstrate knowledge, with the use of models or pictures, the major bones, their surface features, and basic functions
D. Identify the bones of the body and skull by name and location
E. Describe the developmental aspects of the skeleton from formation in the fetus throughout the lifetime of the bones
F. Describe the processes of bone growth, repair, and remodeling
G. Distinguish between and give the function of the four major classes of joints
H. Be able to identify and understand the function of tendons and ligaments
I. Understand the causes and current medical treatments of skeletal disorders and abnormalities
J. Distinguish between the three types of muscles, and tell where they are located in the body
K. Describe the structure of a skeletal muscle with respect to location and names of its connective tissue coverings and attachments
L. Explain how muscle fibers are stimulated to contract and what occurs during a muscle twitch with regard to each component’s function
M. Explain how skeletal muscle meets its energy demands during rest and exercise
N. Describe the effects of aerobic and resistance exercise on skeletal muscles and other body organs
O. Identify major muscles of the body by name and location
Eligible Content and Related Standards:
State Standards:

3.1.12.A6: Analyze how cells in different tissues/organs are specialized to perform specific functions.

3.1.12.A5: Analyze how structure is related to function at all levels of biological organization from molecules to organisms.

3.1.12.A1: Relate changes in the environment to various organisms’ ability to compensate using homeostatic mechanisms.

3.4.12.E1: Compare and contrast the emerging technologies of telemedicine, nanotechnology, prosthetics, and biochemistry as they relate to improving human health.

3.4.12.C. Apply the principles of motion and force.

Assessment Anchors:
BIO 3.1.B.A2: Explain the important role of ATP in cell metabolism

Applicable Writing Standards

Applicable Math Standards
State Standards: 2.3.11.E, 2.6.11.A, 2.6.11.C, 2.6.11.E, 2.7.11.A, 2.7.11.E

Content:
A. Anatomical divisions of the skeletal system
B. Names of bones and their location in the skeleton, including the skull
C. Processes involved in bone formation, growth, repair, and remodeling
D. Differences in skeletal structure throughout development
E. Types and locations of joints
F. Skeletal disorders
G. Types of muscle tissue and locations in body
H. Names of major muscles and their location
I. Structure of skeletal muscle including layers and subdivisions
J. Process of muscular contraction; innervation of a skeletal muscle by a motor neuron
K. Effect of different types of exercise upon muscle function and energy demand
L. Muscular disorders
**Instructional Strategies:**
- PowerPoint-based lecture
- Group activities and projects
- Laboratory investigations
- Daily questions
- Text reading/questions
- Online interactives, games, review activities
- Smartboard quizzes, games, activities
- Online practice tests
- Quizlet, Socrative, EdPuzzle, kahoot
- Workbook activities
- Use of models
- Graphic organizers
- Interpreting data tables and graphs
- Dissection as appropriate (cat: musculature)

**Remediation:**
- Adapted Reading
- Vocabulary Review (flash cards: physical and on quizlet)
- Re-teaching Activities (small-group, one-on-one instruction)

**Enrichment:**
- Lab Research
- Case Studies
- Science journal articles

**Assessment Criteria:**
- Text-based assessment questions
- Oral questions and answers
- Class discussions
- Teacher created quizzes, tests, essays
Resources and Materials:

Text resources (print and digital)
PowerPoint slide shows
Lab packets, as appropriate
Skeletal model (entire)
Bone models (separate)
Skull model (can disarticulate)
Website resources: HASPI, Biology corner, HHMI, learn.genetics.utah.edu
Internet materials, as appropriate Current newspaper/ magazine articles, as appropriate
Unit 6: Gas Exchange & Transport

Part A: Heart & Blood  
Part B: Cardiovascular & Respiratory Systems

Unit Outcomes:

Students will be able to describe salient features of blood chemistry, structure, and clotting mechanisms. Students will identify the major structures of the heart and its function in pumping blood. Students will demonstrate an understanding of transport of gases and the exchange of gases as articulated via the cardiovascular and respiratory systems.

A. Describe the location of the heart in the body, and identify its major anatomical areas on a model or diagram
B. Describe the structure and functions of the four heart chambers. Name each chamber and provide the name and general route of its associated great vessels
C. Explain what information can be gained from an electrocardiogram
D. Compare and contrast the structure and function of arteries, veins, and capillaries
E. List the composition and functions of blood, including erythrocytes, leukocytes, plasma, and clotting factors
F. Describe the ABO and Rh blood groups and explain the basis of transfusion reactions
G. Explain the importance of blood testing as a diagnostic tool
H. Discuss the unique features of special circulations of the body: arterial to the brain, hepatic portal, pulmonary, and fetal
I. Describe the structure and function of the lungs and pleural coverings
J. Explain the relative roles of the respiratory muscles and lung elasticity in effecting volume changes that cause air to flow into and out of lungs
K. Describe how oxygen and carbon dioxide are transported in the blood
L. Describe physical factors that influence respiration rate

Eligible Content and Related Standards:

State Standards:

3.1.12.A6: Analyze how cells in different tissues/organs are specialized to perform specific functions.

3.1.12.A5: Analyze how structure is related to function at all levels of biological organization from molecules to organisms.

3.1.12.A1: Relate changes in the environment to various organisms’ ability to compensate using homeostatic mechanisms.
Assessment Anchors:
BIO.A.1.2.2: Describe relationships between structure and function at various levels of biological organization.
BIO.A.4.2.1: Explain how organisms maintain homeostasis

Content:
A. Blood components
B. Blood groups and typing; diagnostics
C. Clotting factors
D. Structure and function of the heart, its coverings, and blood vessels
E. Mechanisms involved in heart pumping, blood pressure
F. Arteries, veins, arterioles, venules, capillaries
G. Interpreting an electrocardiogram
H. Interpreting heart sounds via stethoscope
I. Unique features of cardiovascular system: fetal, pulmonary, brain, hepatic
J. Structure and function of lungs and pleural coverings
K. Musculature involved in respiration
L. Elasticity, alveoli, surfactants: role in respiration

Instructional Strategies:
PowerPoint-based lecture
Group activities and projects
Laboratory investigations
Daily questions
Text reading/questions
Online interactives, games, review activities
Smartboard quizzes, games, activities
Online practice tests
Quizlet, Socrative, EdPuzzle, kahoot
Workbook activities
Use of models
Graphic organizers
Interpreting data tables and graphs
Dissection as appropriate (sheep heart)
Microscopic investigation as appropriate

**Remediation:**
Adapted Reading
Vocabulary Review (flash cards: physical and on quizlet)
Re-teaching Activities (small-group, one-on-one instruction)

**Enrichment:**
Lab Research
Case Studies
Science journal articles

**Assessment Criteria:**
Text-based assessment questions
Oral questions and answers
Class discussions
Teacher created quizzes, tests, essays

**Resources and Materials:**
Text resources (print and digital)
PowerPoint slide shows
Lab packets, as appropriate
Microscope slides
Student stethoscopes
Website resources: HASPI, Biology corner, HHMI, learn.genetics.utah.edu
Internet materials, as appropriate Current newspaper/ magazine articles, as appropriate
Unit 7: Defense—Lymphatic and the Immune systems

Unit Outcomes:
Students will be able to describe the processes involved in the human immune defense system, the nature of the lymph, and the relationship between the two systems.

A. Name two major structures composing the lymphatic system and explain how this system is functionally related to the cardiovascular and immune systems.
B. Describe the general location, structure, and function of lymph nodes
C. Explain the importance of phagocytosis and killer cells in nonspecific body defense
D. Explain how fever helps protect the body against invading pathogens
E. Explain the antigen-antibody relationship
F. Compare and contrast the origin, maturation process, and general function of B and T lymphocytes; describe the role of macrophages and other phagocytes in immunity
G. Describe the causes and effects of immunodeficiencies, allergies, and autoimmune diseases.

Eligible Content and Related Standards:
State Standards:
3.1.12.A6: Analyze how cells in different tissues/organs are specialized to perform specific functions.
3.1.12.A5: Analyze how structure is related to function at all levels of biological organization from molecules to organisms.
3.1.12.A1: Relate changes in the environment to various organisms’ ability to compensate using homeostatic mechanisms.

Assessment Anchors:
BIO.A.1.2.2: Describe relationships between structure and function at various levels of biological organization.
BIO.A.4.2.1: Explain how organisms maintain homeostasis

Applicable Writing Standards

Applicable Math Standards
State Standards: 2.3.11.E, 2.6.11.A, 2.6.11.C, 2.6.11.E, 2.7.11.A, 2.7.11.E
Content:
A. Lymph composition, production, location, circulation
B. Lymph nodes
C. Types of lymph cells
D. Antigens and antibodies: defense against various pathogens (bacterial, viral, fungal, protists)
E. B cells and T cells: origin, production, function
F. Macrophages and phagocytosis
G. Immune disorders: immunodeficiency, allergies, autoimmune diseases

Instructional Strategies:
PowerPoint-based lecture
Group activities and projects
Laboratory investigations
Daily questions
Text reading/questions
Online interactives, games, review activities
Smartboard quizzes, games, activities
Online practice tests
Quizlet, Socrative, EdPuzzle, kahoot
Workbook activities
Use of models
Graphic organizers
Interpreting data tables and graphs
Dissection/microscopic slide investigation as appropriate

Remediation:
Adapted Reading
Vocabulary Review (flash cards: physical and on quizlet)
Re-teaching Activities (small-group, one-on-one instruction)
**Enrichment:**
Lab Research  
Case Studies  
Science journal articles  

**Assessment Criteria:**
Text-based assessment questions  
Oral questions and answers  
Class discussions  
Teacher created quizzes, tests, essays  

**Resources and Materials:**
Text resources (print and digital)  
PowerPoint slide shows  
Lab packets, as appropriate  
Microscope slides  
Website resources: HASPI, Biology corner, HHMI, learn.genetics.utah.edu  
Internet materials, as appropriate  
Current newspaper/ magazine articles, as appropriate