APHS Curriculum: Anatomy & Physiology

Course Overview:

Anatomy and physiology is the study of the structures and their functions of the human body. Students will explore the various anatomical structures and their physiological roles, and will relate this knowledge to real world concerns in the field of health sciences. Requiring intense memorization and vocabulary building, this course also utilizes lecture, discussion, team exercises, and laboratory experiences in order for students to effectively broaden their scope of understanding of the human body.

Unit 1: Introduction to Anatomy and Physiology

Unit Overview:

Students will be introduced to the study of anatomy and physiology of the human body, as the relationship between structures and their functions. This unit will provide an overview of the organ systems, a discussion of homeostasis, and an introduction to anatomical terminology.

Enduring Understanding:

The anatomy of the body enables its physiological roles. In order for living organisms to function optimally, homeostasis must be maintained systematically. To effectively communicate understanding of the body and its systems, specific and correct anatomical terminology is utilized.

Essential Questions:

- What is anatomy?
- What is physiology?
- How do anatomical structures relate to their physiological functions?
- What is homeostasis and how is it maintained?
- Why is correct anatomical terminology important?

PA Common Core:

CC.3.5.11-12.A.
Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

CC.3.5.11-12.B.
Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

CC.3.5.11-12.C.
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CC.3.5.11-12.D.
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.

CC.3.5.11-12.E.
Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

CC.3.5.11-12.F.

Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

CC.3.5.11-12.G.
Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

CC.3.5.11-12.H.
Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

CC.3.5.11-12.I.
Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

CC.3.5.11-12.J.
By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

CC.3.6.11-12.A.
Write arguments focused on *discipline-specific content.*

- Introduce precise, knowledgeable claim(s),establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s),counterclaims, reasons, and evidence.
- Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns,values, and possible biases.
- Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
- Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- Provide a concluding statement or section that follows from or supports the argument presented.

CC.3.6.11-12.B. *
Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

- Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
- Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
- Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
- Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g.,articulating implications or the significance of the topic).

CC.3.6.11-12.C.
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CC.3.6.11-12.D.
Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

CC.3.6.11-12.E.

Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

CC.3.6.11-12.F.
Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

CC.3.6.11-12.G.
Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

CC.3.6.11-12.H.
Draw evidence from informational texts to support analysis, reflection, and research.

CC.3.6.11-12.I.
Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Eligible Content:

S11.A.1.1.1 Compare and contrast scientific theories, scientific laws, and beliefs (e.g., the universal law of gravitation, how light travels, formation of moons, stages of ecological succession).
S11.A.1.1.2 Analyze and explain the accuracy of scientific facts, principles, theories, and laws.
S11.A.1.1.3 Evaluate the appropriateness of research questions (e.g., testable vs. not-testable).
S11.A.1.1.4 Explain how specific scientific knowledge or technological design concepts solve practical problems (e.g., momentum, Newton's universal law of gravitation, tectonics, conservation of mass and energy, cell theory, theory of evolution, atomic theory, theory of relativity, Pasteur's germ theory, relativity, heliocentric theory, ideal gas laws).
S11.A.1.1.5 Analyze or compare the use of both direct and indirect observation as means to study the world and the universe (e.g., behavior of atoms, functions of cells, birth of stars).
S11.A.1.2.1 Explain and apply scientific concepts to societal issues using case studies (e.g., spread of HIV, deforestation, environmental health, energy).
S11.A.1.3.1 Use appropriate quantitative data to describe or interpret change in systems (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.1.3.2 Describe or interpret dynamic changes to stable systems (e.g., chemical reactions, human body, food webs, tectonics, homeostasis).
S11.A.2.1.1 Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design.
S11.A.2.1.2 Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design.
S11.A.2.1.3 Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits.
S11.A.2.1.4 Critique the results and conclusions of scientific inquiry for consistency and logic.
S11.A.2.1.5 Communicate results of investigations using multiple representations.
S11.A.2.2.1 Evaluate appropriate methods, instruments, and scale for precise quantitative and qualitative observations (e.g., to compare properties of materials, water quality).
S11.A.2.2.2 Explain how technology (e.g., GPS, spectroscope, scanning electron microscope, pH meter, probe, interface, imaging technology, telescope) is used to extend human abilities and precision.
S11.A.3.1.1 Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts.
S11.A.3.1.2 Analyze and predict the effect of making a change in one part of a system on the system as a whole.
S11.A.3.1.3 Use appropriate quantitative data to describe or interpret a system (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.3.1.4 Apply the universal systems model of inputs, processes, outputs, and feedback to a working system (e.g., heating, motor, food production) and identify the resources necessary for operation of the system.
S11.A.3.2.1 Compare the accuracy of predictions represented in a model to actual observations and behavior.
S11.A.3.2.2 Describe advantages and disadvantages of using models to simulate processes and outcomes.

S11.A.3.2.3 Describe how relationships represented in models are used to explain scientific or technological concepts (e.g., dimensions of objects within the solar system, life spans, size of atomic particles, topographic maps).
S11.A.3.3.1 Describe or interpret recurring patterns that form the basis of biological classification, chemical periodicity, geological order, or astronomical order.
S11.A.3.3.2 Compare stationary physical patterns (e.g., crystals, layers of rocks, skeletal systems, tree rings, atomic structure) to the object's properties.
S11.B.1.1.1 Explain how structure determines function at multiple levels of organization (e.g., chemical, cellular, anatomical).
S11.B.1.1.2 Compare and contrast the structural and functional similarities and differences among living things (e.g., classify organisms into classification groups, compare systems).
S11.B.1.1.3 Compare and contrast cellular processes (e.g., photosynthesis and respiration, meiosis and mitosis, protein synthesis and DNA replication).

Concepts (What students should know):

- Basic functions of living organisms
- Relationship between anatomy and physiology
- Major levels of organization in living things
- Major organ systems of human body
- Homeostasis, maintained with negative and positive feedback loops
- Anatomical terminology

Objectives (What students should be able to do):

1. Describe the basic functions of living organisms.
2. Explain the relationship between anatomy and physiology, and describe various specialties of each discipline.
3. Identify the major levels of organization in living organisms.
4. Identify the 11 organ systems of the human body and contrast their major functions.
5. Explain the concept of homeostasis.
6. Describe how negative feedback and positive feedback are involved in homeostatic regulation.
7. Use anatomical terms to describe body sections, body regions, and relative positions.
8. Identify the major body cavities and their subdivisions.

Assessments:

All of the chemical operations underway in the body refer to
A) systemic physiology.
B) special physiology.
C) cell physiology.
D) metabolism.
E) physiological chemistry.
Answer: D
Learning Outcome: 1-1
Bloom's Taxonomy: Knowledge

Which of the following is an accurate characteristic of humans?
A) Nutrients are absorbed directly from the environment.
B) Excretion involves movement across exposed surfaces.
C) Body cells must travel to one part of the body for nutrients and to another for waste product removal.
D) Excretion is a simpler process than it is in smaller organisms.

E) Respiration is more complicated than it is in very small organisms.
Answer: E
Learning Outcome: 1-1
Bloom's Taxonomy: Comprehension

Which of the following is an accurate description of the cellular level of organization?
A) Cells consist of two or more different tissues working together to perform specific functions.
B) Cells are considered to be the largest living units in the body.
C) Cells are comprised of different molecules that interact to form larger structures, each type of which has a specific function.
D) Cells combine to form molecules with complex shapes, which determine their function(s).
E) Cardiac muscle is an example of the cellular level of organization.
Answer: C
Learning Outcome: 1-3
Bloom's Taxonomy: Comprehension

The fact that a single defective protein causes cystic fibrosis, a **multisystemic** illness, proves that
A) all organisms are composed of cells.
B) all levels of organization within an organism are interdependent.
C) chemical molecules make up cells.
D) all cells are independent of each other.
E) congenital defects can be life threatening.
Answer: B
Learning Outcome: 1-3
Bloom's Taxonomy: Application

A structure that senses change is called a(n) _____.
A) stimulus
B) receptor
C) effector
D) integration center
E) control center
Answer: B
Learning Outcome: 1-5
Bloom's Taxonomy: Knowledge

It's the middle of winter and a typically healthy person starts to exit a building without a coat, but re-enters the building to retrieve her coat. This regulation mechanism is an example of
A) negative feedback.
B) positive feedback.
C) homeostatic regulation.
D) diagnostic regulation.
E) a behavioral change and is not related to the internal environment.
Answer: E
Learning Outcome: 1-5
Bloom's Taxonomy: Application

The prevention of change, by ignoring minor variations and maintaining a normal range rather than a fixed value, is characteristic of
A) positive feedback.
B) stimulus reinforcement.
C) negative feedback.

D) effector control.
E) both positive and negative feedback loops.
Answer: C
Learning Outcome: 1-6
Bloom's Taxonomy: Comprehension

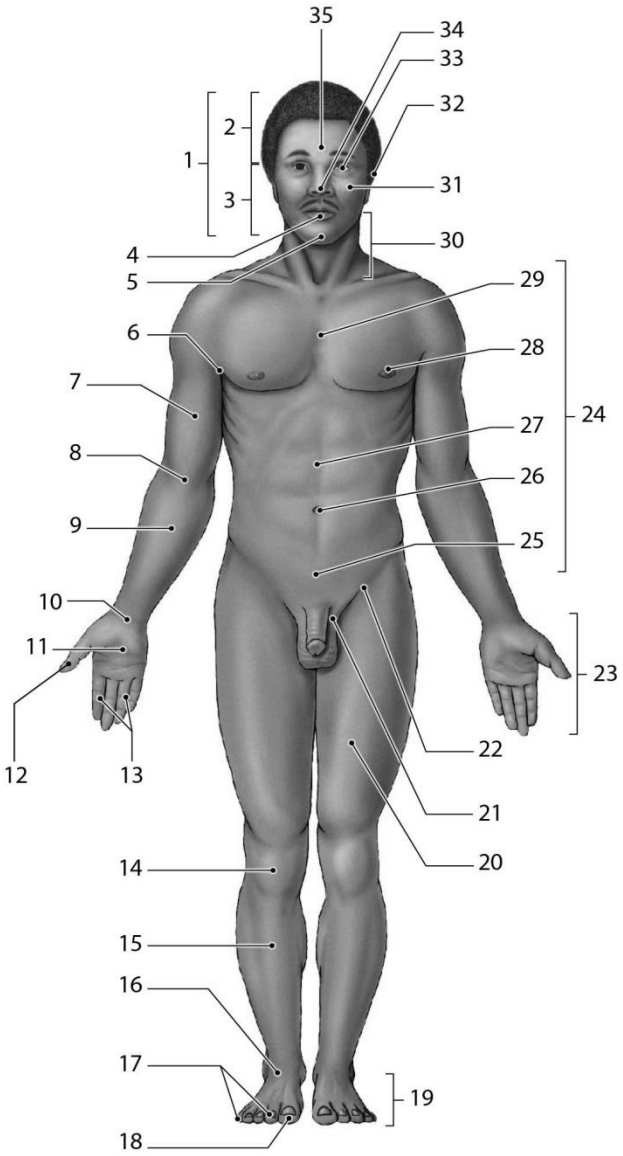

Figure 1-2 Anatomical Landmarks

Use Figure 1-2 to answer the following question(s):

Which number identifies the cephalon?
A) 24
B) 30
C) 23
D) 10
E) 1
Answer: E
Learning Outcome: 1-7

Bloom's Taxonomy: Knowledge

Which of the following structures is located superior to the nasus?
A) 35
B) 4
C) 32
D) 5
E) 30
Answer: A
Learning Outcome: 1-7
Bloom's Taxonomy: Knowledge

Which number identifies the tarsal region?
A) 16
B) 29
C) 10
D) 20
E) 9
Answer: A
Learning Outcome: 1-7
Bloom's Taxonomy: Knowledge

The leg region (#15) is also known by its anatomical term, _____.
A) tarsal
B) pedal
C) patellar
D) crural
E) carpal
Answer: D
Learning Outcome: 1-7
Bloom's Taxonomy: Comprehension

The pollex is located in which region?
A) 18
B) 23
C) 12
D) 14
E) 16
Answer: C
Learning Outcome: 1-7
Bloom's Taxonomy: Comprehension

It is a warm day and you feel a little chilled. On checking your temperature, you find that your body temperature is 1.5 degrees below normal. Suggest some possible reasons for this situation.
Answer: There are several reasons why your body temperature may have dropped. Your body may be losing heat faster than it is being produced. This, however, is more likely to occur on a cool day. Various chemical factors, such as hormones, may have caused a decrease in your metabolic rate, and thus your body is not producing as much heat as it normally would. Alternatively, you may be suffering from an infection that has temporarily changed the set point of the body's "thermostat." This would seem to be the most likely explanation considering the circumstances given in the question.
Learning Outcome: 1-5
Bloom's Taxonomy: Analysis

Textual References and Resources:

Essentials of Anatomy and Physiology, 6th ed. Martini & Bartholomew, 2013.

- Ch.1, an introduction to anatomy and physiology, p. 2-25

Anatomy and Physiology Coloring Workbook: A Complete Study Guide, 10th ed. Elaine N. Marieb, 2012

- Ch.1, the human body: an orientation, p.1-16

Unit 2: Levels of Organization – Chemical, Cellular and Tissue

Unit Overview:

Students will review basic biological principles and concepts, such as metabolism, enzyme activity, properties of water, acids and bases, the structure and function of the biological macromolecules (carbohydrates, proteins, lipids and nucleic acids), cell theory, and cellular structures and functions. Students will also focus on the tissue level of organization in the human body, specifically the four basic tissue types and their forms, functions and interactions.

Enduring Understanding:

All the activities of the human body are the end result of interactions between chemicals. Both inorganic and organic compounds are crucial to the structure and function of the body systems. Basic tissue types compose the complex organ systems of the human body.

Essential Questions:

- Why are chemical reactions important in physiology?
- What are the roles of inorganic compounds in living systems?
- What are the structures and functions of organic compounds in the human body?
- How do enzymes enable biochemical reactions?
- What is cell theory?
- What are the major cellular structures and their functions?
- How are proteins synthesized?
- What is the cell cycle?
- What are the basic tissue types and their interrelationships?

PA Common Core:

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CC.3.6.11-12.E.
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CC.3.6.11-12.F.
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question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

CC.3.6.11-12.G.
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Eligible Content:

S11.A.1.1.1 Compare and contrast scientific theories, scientific laws, and beliefs (e.g., the universal law of gravitation, how light travels, formation of moons, stages of ecological succession).
S11.A.1.1.2 Analyze and explain the accuracy of scientific facts, principles, theories, and laws.
S11.A.1.1.3 Evaluate the appropriateness of research questions (e.g., testable vs. not-testable).
S11.A.1.1.4 Explain how specific scientific knowledge or technological design concepts solve practical problems (e.g., momentum, Newton's universal law of gravitation, tectonics, conservation of mass and energy, cell theory, theory of evolution, atomic theory, theory of relativity, Pasteur's germ theory, relativity, heliocentric theory, ideal gas laws).
S11.A.1.1.5 Analyze or compare the use of both direct and indirect observation as means to study the world and the universe (e.g., behavior of atoms, functions of cells, birth of stars).
S11.A.1.2.1 Explain and apply scientific concepts to societal issues using case studies (e.g., spread of HIV, deforestation, environmental health, energy).
S11.A.1.3.1 Use appropriate quantitative data to describe or interpret change in systems (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.1.3.2 Describe or interpret dynamic changes to stable systems (e.g., chemical reactions, human body, food webs, tectonics, homeostasis).
S11.A.2.1.1 Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design.
S11.A.2.1.2 Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design.
S11.A.2.1.3 Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits.
S11.A.2.1.4 Critique the results and conclusions of scientific inquiry for consistency and logic.
S11.A.2.1.5 Communicate results of investigations using multiple representations.
S11.A.2.2.1 Evaluate appropriate methods, instruments, and scale for precise quantitative and qualitative observations (e.g., to compare properties of materials, water quality).
S11.A.2.2.2 Explain how technology (e.g., GPS, spectroscope, scanning electron microscope, pH meter, probe, interface, imaging technology, telescope) is used to extend human abilities and precision.
S11.A.3.1.1 Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts.
S11.A.3.1.2 Analyze and predict the effect of making a change in one part of a system on the system as a whole.
S11.A.3.1.3 Use appropriate quantitative data to describe or interpret a system (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.3.1.4 Apply the universal systems model of inputs, processes, outputs, and feedback to a working system (e.g., heating, motor, food production) and identify the resources necessary for operation of the system.
S11.A.3.2.1 Compare the accuracy of predictions represented in a model to actual observations and behavior.
S11.A.3.2.2 Describe advantages and disadvantages of using models to simulate processes and outcomes.
S11.A.3.2.3 Describe how relationships represented in models are used to explain scientific or technological concepts (e.g., dimensions of objects within the solar system, life spans, size of atomic particles, topographic maps).
S11.A.3.3.1 Describe or interpret recurring patterns that form the basis of biological classification, chemical periodicity, geological order, or astronomical order.
S11.A.3.3.2 Compare stationary physical patterns (e.g., crystals, layers of rocks, skeletal systems, tree rings, atomic structure) to the object's properties.

S11.B.1.1.1 Explain how structure determines function at multiple levels of organization (e.g., chemical, cellular, anatomical).
S11.B.1.1.2 Compare and contrast the structural and functional similarities and differences among living things (e.g., classify organisms into classification groups, compare systems).
S11.B.1.1.3 Compare and contrast cellular processes (e.g., photosynthesis and respiration, meiosis and mitosis, protein synthesis and DNA replication).

Concepts (What students should know):

- Chemical reactions important to physiology
- Role of enzymes in metabolism
- Inorganic compounds (water, acids, bases, buffers) and their roles
- Structure and function of organic compounds (carbohydrates, lipids, proteins, nucleic acids)
- Relationship between chemicals and cells
- Cell theory
- Cellular transport mechanisms and purpose
- Cellular structures and functions (membranes, organelles, nucleus)
- Protein synthesis
- Cell cycle
- Cellular differentiation/ specialization
- Basic tissue types of body (epithelial, connective, muscle and neural), their roles and interrelationships
- Effects of aging and injury on cells and tissues

Objectives (What students should be able to do):

1. Use chemical notation to symbolize chemical reactions, and distinguish among the three major types of chemical reactions that are important for studying physiology.
2. Describe the crucial role of enzymes in metabolism.
3. Distinguish between organic and inorganic compounds.
4. Explain how the chemical properties of water make life possible.
5. Describe the pH scale and the role of buffers in body fluids.
6. Describe the functional roles of inorganic compounds.
7. Discuss the structures and functions of carbohydrates, lipids, proteins and nucleic acids
8. Explain the relationship between chemicals and cells.
9. List the main points of the cell theory.
10. Describe the processes of cellular transport and explain their physiological roles.
11. Describe the organelles of a typical cell and indicate their specific functions.
12. Summarize the process of protein synthesis.
13. Describe the stages of the cell life cycle, including mitosis, interphase, and cytokinesis, and explain their significance.
14. Discuss the relationship between cell division and cancer.
15. Define differentiation and explain its importance.
16. Identify the body's four basic types of tissues and describe their roles.
17. Describe the characteristics and functions of epithelial cells.
18. Describe the relationship between form and function for each type of epithelium.
19. Compare the structures and functions of the various types of connective tissues.
20. Explain how epithelial and connective tissues combine to form four types of tissue membranes, and specify the functions of each.

21. Describe the three types of muscle tissue and the special structural features of each.
22. Discuss the basic structure and role of neural tissue.
23. Explain how injuries affect the tissues of the body.
24. Describe how aging affects the tissues of the body.

Assessments:

Performance descriptors - TBD

Textual References and Resources:

Essentials of Anatomy and Physiology, 6th ed. Martini & Bartholomew, 2013.

- Ch.2, the chemical level of organization, p. 26-55
- Ch.3, cell structure and function, p.56-90
- Ch.4, the tissue level of organization, p.91-121

Anatomy and Physiology Coloring Workbook: A Complete Study Guide, 10th ed. Elaine N. Marieb, 2012

- Ch.2, basic chemistry, p.17-32
- Ch. 3, cells and tissues, p.33-56

Unit 3: Support and Movement: The Integumentary, Skeletal and Muscular Systems

Unit Overview:

Students will examine and explain the structures and functions of the components of the integumentary system, composed of skin, secretory glands, hair and nails. Students will also identify the various bones and joints that compose the skeletal system, as well as describe their roles in protection, support and movement. Students will describe the organization of muscle tissue, the muscle tissue types, and the energetics involved in muscular action. Students will relate the type of muscle to its location and function in the human body.

Enduring Understanding:

The integumentary, skeletal and muscular systems provide protection, support and motion for the human body, working together to perform and maintain these physiological necessities.

Essential Questions:

- What are the layers of human skin and their roles in the body?
- What are the bones of the body and their functions?
- How are the muscles of the body classified?
- How do muscles work?

PA Common Core:

CC.3.5.11-12.A.
Cite specific textual evidence to support analysis ofscience and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

CC.3.5.11-12.B.
Determine the central ideas or conclusions of a text;summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

CC.3.5.11-12.C.
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CC.3.5.11-12.D.
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.

CC.3.5.11-12.E.
Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

CC.3.5.11-12.F.
Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

CC.3.5.11-12.G.
Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

CC.3.5.11-12.H.
Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

CC.3.5.11-12.I.

Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

CC.3.5.11-12.J.
By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

CC.3.6.11-12.A.
Write arguments focused on *discipline-specific content.*

- Introduce precise, knowledgeable claim(s),establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s),counterclaims, reasons, and evidence.
- Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns,values, and possible biases.
- Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
- Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- Provide a concluding statement or section that follows from or supports the argument presented.

CC.3.6.11-12.B. *
Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

- Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
- Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
- Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
- Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g.,articulating implications or the significance of the topic).

CC.3.6.11-12.C.
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CC.3.6.11-12.D.
Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

CC.3.6.11-12.E.
Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

CC.3.6.11-12.F.
Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

CC.3.6.11-12.G.
Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

CC.3.6.11-12.H.
Draw evidence from informational texts to support analysis, reflection, and research.

CC.3.6.11-12.I.
Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Eligible Content:

S11.A.1.1.1 Compare and contrast scientific theories, scientific laws, and beliefs (e.g., the universal law of gravitation, how light travels, formation of moons, stages of ecological succession).
S11.A.1.1.2 Analyze and explain the accuracy of scientific facts, principles, theories, and laws.
S11.A.1.1.3 Evaluate the appropriateness of research questions (e.g., testable vs. not-testable).
S11.A.1.1.4 Explain how specific scientific knowledge or technological design concepts solve practical problems (e.g., momentum, Newton's universal law of gravitation, tectonics, conservation of mass and energy, cell theory, theory of evolution, atomic theory, theory of relativity, Pasteur's germ theory, relativity, heliocentric theory, ideal gas laws).
S11.A.1.1.5 Analyze or compare the use of both direct and indirect observation as means to study the world and the universe (e.g., behavior of atoms, functions of cells, birth of stars).
S11.A.1.2.1 Explain and apply scientific concepts to societal issues using case studies (e.g., spread of HIV, deforestation, environmental health, energy).
S11.A.1.3.1 Use appropriate quantitative data to describe or interpret change in systems (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.1.3.2 Describe or interpret dynamic changes to stable systems (e.g., chemical reactions, human body, food webs, tectonics, homeostasis).
S11.A.2.1.1 Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design.
S11.A.2.1.2 Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design.
S11.A.2.1.3 Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits.
S11.A.2.1.4 Critique the results and conclusions of scientific inquiry for consistency and logic.
S11.A.2.1.5 Communicate results of investigations using multiple representations.
S11.A.2.2.1 Evaluate appropriate methods, instruments, and scale for precise quantitative and qualitative observations (e.g., to compare properties of materials, water quality).
S11.A.2.2.2 Explain how technology (e.g., GPS, spectroscope, scanning electron microscope, pH meter, probe, interface, imaging technology, telescope) is used to extend human abilities and precision.
S11.A.3.1.1 Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts.
S11.A.3.1.2 Analyze and predict the effect of making a change in one part of a system on the system as a whole.
S11.A.3.1.3 Use appropriate quantitative data to describe or interpret a system (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.3.1.4 Apply the universal systems model of inputs, processes, outputs, and feedback to a working system (e.g., heating, motor, food production) and identify the resources necessary for operation of the system.
S11.A.3.2.1 Compare the accuracy of predictions represented in a model to actual observations and behavior.
S11.A.3.2.2 Describe advantages and disadvantages of using models to simulate processes and outcomes.
S11.A.3.2.3 Describe how relationships represented in models are used to explain scientific or technological concepts (e.g., dimensions of objects within the solar system, life spans, size of atomic particles, topographic maps).
S11.A.3.3.1 Describe or interpret recurring patterns that form the basis of biological classification, chemical periodicity, geological order, or astronomical order.
S11.A.3.3.2 Compare stationary physical patterns (e.g., crystals, layers of rocks, skeletal systems, tree rings, atomic structure) to the object's properties.
S11.B.1.1.1 Explain how structure determines function at multiple levels of organization (e.g., chemical, cellular, anatomical).
S11.B.1.1.2 Compare and contrast the structural and functional similarities and differences among living things (e.g., classify organisms into classification groups, compare systems).
S11.B.1.1.3 Compare and contrast cellular processes (e.g., photosynthesis and respiration, meiosis and mitosis, protein synthesis and DNA replication).

Concepts (What students should know):

- Structures and functions of the epidermis, dermis and hypodermis
- Identity and purpose of various skin glands and their secretions
- Anatomical structure and physiological production of hair and nails
- Effects of aging and injury of the skin
- Primary functions of the skeletal system
- Identity and classification of bones (shape, compact, spongy)
- Remodeling and homeostatic mechanisms, and ossification of bones
- Effects of aging on the skeletal system
- Components and functions of the axial and appendicular divisions of the skeleton
- Major categories of joints and their form and functions
- Relationship between skeletal system and other body systems
- Organization of muscle tissue
- Muscle contractions and energy use by muscle tissue
- Structure and function of major muscle types (skeletal, smooth, cardiac)
- Relationship of muscle name to appearance, location and function
- Origins, insertions and actions of main axial and appendicular muscles
- Effects of aging and injury on muscle tissue

Objectives (What students should be able to do):

1. Describe the main structural features of the epidermis, and explain the functional significance of each.
2. Explain what accounts for individual differences in skin color, and discuss the response of melanocytes to sunlight exposure.
3. Describe the interaction between sunlight and vitamin D_3 production.
4. Describe the structure and functions of the dermis.
5. Describe the structure and functions of the hypodermis.
6. Describe the mechanisms that produce hair and the structural basis for hair texture and color.
7. Discuss the various kinds of glands in the skin, and list the secretions of those glands.
8. Describe the anatomical structure of nails, and explain how they are formed.
9. Explain how the skin responds to injury and repairs itself.
10. Summarize the effects of aging on the skin.
11. Describe the primary functions of the skeletal system.
12. Classify bones according to shape, and compare the structures and functions of compact and spongy bone.
13. Compare the mechanisms of intramembranous ossification and endochondral ossification.
14. Describe the remodeling and homeostatic mechanisms of the skeletal system.
15. Summarize the effects of the aging process on the skeletal system.
16. Name the components and functions of the axial and appendicular skeletons.
17. Identify the bones of the skull, discuss the differences in structure and function of the various vertebrae, and describe the roles of the thoracic cage.
18. Identify the bones of the pectoral and pelvic girdles and the upper and lower limbs, and describe their various functions.
19. Contrast the major categories of joints, and link their structural features to joint functions.

20. Describe how the structural and functional properties of synovial joints permit the dynamic movements of the skeleton.
21. Explain the relationship between joint structure and mobility of representative axial and appendicular articulations.
22. Explain the functional relationships between the skeletal system and other body systems.
23. Specify the functions of skeletal muscle tissue.
24. Describe the organization of muscle at the tissue level.
25. Identify the structural components of a sarcomere.
26. Explain the key steps involved in the contraction of a skeletal muscle fiber beginning at the neuromuscular junction.
27. Compare the different types of muscle contractions.
28. Describe the mechanisms by which muscles obtain the energy to power contractions.
29. Relate the types of muscle fibers to muscle performance, and distinguish between aerobic and anaerobic endurance.
30. Contrast the structures and functions of skeletal, cardiac, and smooth muscle tissues.
31. Explain how the name of a muscle can help identify its location, appearance, or function.
32. Identify the main axial muscles of the body together with their origins, insertions, and actions.
33. Identify the main appendicular muscles of the body together with their origins, insertions, and actions.
34. Describe the effects of aging on muscle tissue.
35. Discuss the functional relationships between the muscular system and other organ systems.

Assessments:

Performance descriptors - TBD

Textual References and Resources:

Essentials of Anatomy and Physiology, 6th ed. Martini & Bartholomew, 2013.

- Ch.5, the integumentary system p. 122-140
- Ch.6, the skeletal system, p.141-190
- Ch.18, the muscular system, p.191-243

Anatomy and Physiology Coloring Workbook: A Complete Study Guide, 10th ed. Elaine N. Marieb, 2012

- Ch.4, the skin and body membranes, p.57-72
- Ch. 5, the skeletal system, p.73-102
- Ch.6, the muscular system, p.103-130

Unit 4: Control and Communication: The Nervous System, Senses and Endocrine System

Unit Overview:

Students will explore the central and peripheral nervous systems, studying their structures and functions at both the microscopic and macroscopic levels. Students will relate their examination of the nervous system and the physical senses to their own learning processes. Students will also learn about hormones and their roles in their study of the endocrine system. Students will broaden their perspectives through a deeper understanding of how the physiology of the human body is impacted by its control and communication systems.

Enduring Understanding:

The anatomical design of the nervous and endocrine systems highlights the relationship between form and function. The structures of the various neural cells are indicative of their roles in the human body. Effective communication and control are essential for optimal physiological performance, and the nervous and endocrine systems enable the body to interact at every level, from the chemical to the organismal. These systems are especially vital to the body's ability to learn, as well to maintain homeostasis.

Essential Questions:

- How does the nervous system function?
- How do our senses interact with our nervous system and impact our ability to learn?
- How are hormones important in physiological control and communication?

PA Common Core:

CC.3.5.11-12.A.
Cite specific textual evidence to support analysis ofscience and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

CC.3.5.11-12.B.
Determine the central ideas or conclusions of a text;summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

CC.3.5.11-12.C.
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CC.3.5.11-12.D.
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.

CC.3.5.11-12.E.
Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

CC.3.5.11-12.F.
Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

CC.3.5.11-12.G.
Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

CC.3.5.11-12.H.

Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

CC.3.5.11-12.I.
Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

CC.3.5.11-12.J.
By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

CC.3.6.11-12.A.
Write arguments focused on *discipline-specific content.*

- Introduce precise, knowledgeable claim(s),establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s),counterclaims, reasons, and evidence.
- Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns,values, and possible biases.
- Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
- Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- Provide a concluding statement or section that follows from or supports the argument presented.

CC.3.6.11-12.B. *
Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

- Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
- Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
- Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
- Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g.,articulating implications or the significance of the topic).

CC.3.6.11-12.C.
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CC.3.6.11-12.D.
Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

CC.3.6.11-12.E.
Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

CC.3.6.11-12.F.
Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

CC.3.6.11-12.G.

Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

CC.3.6.11-12.H.
Draw evidence from informational texts to support analysis, reflection, and research.

CC.3.6.11-12.I.
Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Eligible Content:

S11.A.1.1.1 Compare and contrast scientific theories, scientific laws, and beliefs (e.g., the universal law of gravitation, how light travels, formation of moons, stages of ecological succession).
S11.A.1.1.2 Analyze and explain the accuracy of scientific facts, principles, theories, and laws.
S11.A.1.1.3 Evaluate the appropriateness of research questions (e.g., testable vs. not-testable).
S11.A.1.1.4 Explain how specific scientific knowledge or technological design concepts solve practical problems (e.g., momentum, Newton's universal law of gravitation, tectonics, conservation of mass and energy, cell theory, theory of evolution, atomic theory, theory of relativity, Pasteur's germ theory, relativity, heliocentric theory, ideal gas laws).
S11.A.1.1.5 Analyze or compare the use of both direct and indirect observation as means to study the world and the universe (e.g., behavior of atoms, functions of cells, birth of stars).
S11.A.1.2.1 Explain and apply scientific concepts to societal issues using case studies (e.g., spread of HIV, deforestation, environmental health, energy).
S11.A.1.3.1 Use appropriate quantitative data to describe or interpret change in systems (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.1.3.2 Describe or interpret dynamic changes to stable systems (e.g., chemical reactions, human body, food webs, tectonics, homeostasis).
S11.A.2.1.1 Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design.
S11.A.2.1.2 Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design.
S11.A.2.1.3 Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits.
S11.A.2.1.4 Critique the results and conclusions of scientific inquiry for consistency and logic.
S11.A.2.1.5 Communicate results of investigations using multiple representations.
S11.A.2.2.1 Evaluate appropriate methods, instruments, and scale for precise quantitative and qualitative observations (e.g., to compare properties of materials, water quality).
S11.A.2.2.2 Explain how technology (e.g., GPS, spectroscope, scanning electron microscope, pH meter, probe, interface, imaging technology, telescope) is used to extend human abilities and precision.
S11.A.3.1.1 Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts.
S11.A.3.1.2 Analyze and predict the effect of making a change in one part of a system on the system as a whole.
S11.A.3.1.3 Use appropriate quantitative data to describe or interpret a system (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.3.1.4 Apply the universal systems model of inputs, processes, outputs, and feedback to a working system (e.g., heating, motor, food production) and identify the resources necessary for operation of the system.
S11.A.3.2.1 Compare the accuracy of predictions represented in a model to actual observations and behavior.
S11.A.3.2.2 Describe advantages and disadvantages of using models to simulate processes and outcomes.
S11.A.3.2.3 Describe how relationships represented in models are used to explain scientific or technological concepts (e.g., dimensions of objects within the solar system, life spans, size of atomic particles, topographic maps).
S11.A.3.3.1 Describe or interpret recurring patterns that form the basis of biological classification, chemical periodicity, geological order, or astronomical order.
S11.A.3.3.2 Compare stationary physical patterns (e.g., crystals, layers of rocks, skeletal systems, tree rings, atomic structure) to the object's properties.
S11.B.1.1.1 Explain how structure determines function at multiple levels of organization (e.g., chemical, cellular, anatomical).
S11.B.1.1.2 Compare and contrast the structural and functional similarities and differences among living things (e.g., classify organisms into classification groups, compare systems).

S11.B.1.1.3 Compare and contrast cellular processes (e.g., photosynthesis and respiration, meiosis and mitosis, protein synthesis and DNA replication).

Concepts (What students should know):

- Anatomical divisions of the nervous system (central and peripheral) and functional divisions (afferent and efferent)
- Structures and functions of neurons and neuroglia
- Generation and propagation of action potentials
- Roles of gray matter and white matter
- Locations and functions of the major regions of the brain
- Identity, locations and functions of the cranial nerves
- Steps of a reflex arc
- Physiology of the principle sensory and motor pathways
- Structures and functions of sympathetic and parasympathetic divisions of the autonomic nervous system
- Effects of aging on nervous system
- Structure and physiology of the senses and the organs involved
- Effects of aging on the general and special senses
- Role of intercellular communication in homeostasis
- Complementary roles of endocrine and nervous systems
- Various types of hormones, their roles, and their origins
- Interactions between the endocrine system and other organ systems

Objectives (What students should be able to do):

1. Describe the anatomical and functional divisions of the nervous system.
2. Distinguish between neurons and neuroglia on the basis of structure and function.
3. Describe the events involved in the generation and propagation of an action potential.
4. Describe the structure of a synapse, and explain the mechanism of nerve impulse transmission at a synapse.
5. Describe the three meningeal layers that surround the central nervous system.
6. Discuss the roles of gray matter and white matter in the spinal cord.
7. Name the major regions of the brain, and describe the locations and functions of each.
8. Name the cranial nerves, relate each pair of cranial nerves to its principal functions, and relate the distribution pattern of spinal nerves to the regions they innervate.
9. Describe the steps in a reflex arc.
10. Identify the principal sensory and motor pathways, and explain how it is possible to distinguish among sensations that originate in different areas of the body.
11. Describe the structures and functions of the sympathetic and parasympathetic divisions of the autonomic nervous system.
12. Summarize the effects of aging on the nervous system.
13. Give examples of interactions between the nervous system and other organ systems.
14. Explain how the organization of receptors for the general senses and the special senses affects their sensitivity.
15. Identify the receptors for the general senses, and describe how they function.

16. Describe the sensory organs of smell, and discuss the processes involved in olfaction.
17. Describe the sensory organs of taste, and discuss the processes involved in gustation.
18. Identify the internal and accessory structures of the eye, and explain their functions.
19. Explain how we form visual images and distinguish colors, and discuss how the central nervous system processes visual information.
20. Describe the parts of the external, middle, and internal ear, and the receptors they contain, and discuss the processes involved in the senses of equilibrium and hearing.
21. Describe the effects of aging on smell, taste, vision, and hearing.
22. Explain the role of intercellular communication in homeostasis, and describe the complementary roles of the endocrine and nervous systems.
23. Contrast the major structural classes of hormones, and explain the general mechanisms of hormonal action on target organs.
24. Describe the location, hormones, and functions of the pituitary gland.
25. Describe the location, hormones, and functions of the thyroid gland.
26. Describe the location, hormones, and functions of the parathyroid glands.
27. Describe the location, hormones, and functions of the adrenal glands.
28. Describe the location of the pineal gland, and discuss the functions of the hormone it produces.
29. Describe the location, hormones, and functions of the pancreas.
30. Discuss the functions of the hormones produced by the kidneys, heart, thymus, testes, ovaries, and adipose tissue.
31. Explain how hormones interact to produce coordinated physiological responses, and describe how the endocrine system responds to stress and is affected by aging.
32. Give examples of interactions between the endocrine system and other organ systems.

Assessments:

Textual References and Resources:

Essentials of Anatomy and Physiology, 6th ed. Martini & Bartholomew, 2013.

- Ch.8, the nervous system p. 244-304
- Ch.9, the general and special senses, p.305-344
- Ch.10, the endocrine system, p.345-378

Anatomy and Physiology Coloring Workbook: A Complete Study Guide, 10th ed. Elaine N. Marieb, 2012

- Ch.7, the nervous system, p.131-162
- Ch. 8, special senses, p.163-180
- Ch.8, the endocrine system, p.181-192

Unit 5: Transport and Exchange: Cardiovascular and Respiratory Systems

Unit Overview:

Students will learn about the anatomy and physiology of the cardiovascular and respiratory systems. Through examination of the cardiovascular system components (heart, vessels, blood cells) students will gain insight to the mechanisms involved in the transportation of nutrients, wastes and gases through the body, and as well as how the body reacts to injury and aging. Students will also study the components and functions of the respiratory system and their importance at the cellular, tissue and organismal levels. Understanding the factors that affect the performance of heart and lungs will enable students to apply their knowledge to health concerns. Students will also focus on the integration of the circulatory and respiratory systems in supporting homeostasis and overall health.

Enduring Understanding:

The cardiovascular system, composed of the heart, vessels and blood tissue, is essential to the transportation of nutrients, gases and wastes throughout the body, as well as in the body's response to injury. The respiratory system (including the structures of the lung, oral/nasal cavities and diaphragm) enables gas exchange, and its integration with the circulatory system allows for the optimal performance of the complex organism that is the human body. Knowledge and understanding of the various factors affecting the performance of the cardiovascular and respiratory systems engenders greater health awareness, and improved decision making in health issues.

Essential Questions:

- What are the components of the cardiovascular system and their roles?
- What factors affect the performance of the cardiovascular system?
- How is blood flow regulated in the body?
- How does the respiratory system effect gas exchange between internal and external environments?
- How do the respiratory and circulatory systems coordinate in the transportation and exchange of gases?
- What factors affect the performance of the respiratory system?

PA Common Core:

CC.3.5.11-12.A.
Cite specific textual evidence to support analysis ofscience and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

CC.3.5.11-12.B.
Determine the central ideas or conclusions of a text;summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

CC.3.5.11-12.C.
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CC.3.5.11-12.D.
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.

CC.3.5.11-12.E.
Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

CC.3.5.11-12.F.
Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

CC.3.5.11-12.G.
Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

CC.3.5.11-12.H.
Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

CC.3.5.11-12.I.
Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

CC.3.5.11-12.J.
By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

CC.3.6.11-12.A.
Write arguments focused on *discipline-specific content.*

- Introduce precise, knowledgeable claim(s),establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s),counterclaims, reasons, and evidence.
- Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns,values, and possible biases.
- Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
- Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- Provide a concluding statement or section that follows from or supports the argument presented.

CC.3.6.11-12.B. *
Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

- Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
- Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
- Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
- Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g.,articulating implications or the significance of the topic).

CC.3.6.11-12.C.
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CC.3.6.11-12.D.
Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

CC.3.6.11-12.E.
Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

CC.3.6.11-12.F.
Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

CC.3.6.11-12.G.
Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

CC.3.6.11-12.H.
Draw evidence from informational texts to support analysis, reflection, and research.

CC.3.6.11-12.I.
Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Eligible Content:

S11.A.1.1.1 Compare and contrast scientific theories, scientific laws, and beliefs (e.g., the universal law of gravitation, how light travels, formation of moons, stages of ecological succession).
S11.A.1.1.2 Analyze and explain the accuracy of scientific facts, principles, theories, and laws.
S11.A.1.1.3 Evaluate the appropriateness of research questions (e.g., testable vs. not-testable).
S11.A.1.1.4 Explain how specific scientific knowledge or technological design concepts solve practical problems (e.g., momentum, Newton's universal law of gravitation, tectonics, conservation of mass and energy, cell theory, theory of evolution, atomic theory, theory of relativity, Pasteur's germ theory, relativity, heliocentric theory, ideal gas laws).
S11.A.1.1.5 Analyze or compare the use of both direct and indirect observation as means to study the world and the universe (e.g., behavior of atoms, functions of cells, birth of stars).
S11.A.1.2.1 Explain and apply scientific concepts to societal issues using case studies (e.g., spread of HIV, deforestation, environmental health, energy).
S11.A.1.3.1 Use appropriate quantitative data to describe or interpret change in systems (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.1.3.2 Describe or interpret dynamic changes to stable systems (e.g., chemical reactions, human body, food webs, tectonics, homeostasis).
S11.A.2.1.1 Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design.
S11.A.2.1.2 Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design.
S11.A.2.1.3 Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits.
S11.A.2.1.4 Critique the results and conclusions of scientific inquiry for consistency and logic.
S11.A.2.1.5 Communicate results of investigations using multiple representations.
S11.A.2.2.1 Evaluate appropriate methods, instruments, and scale for precise quantitative and qualitative observations (e.g., to compare properties of materials, water quality).
S11.A.2.2.2 Explain how technology (e.g., GPS, spectroscope, scanning electron microscope, pH meter, probe, interface, imaging technology, telescope) is used to extend human abilities and precision.
S11.A.3.1.1 Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts.
S11.A.3.1.2 Analyze and predict the effect of making a change in one part of a system on the system as a whole.
S11.A.3.1.3 Use appropriate quantitative data to describe or interpret a system (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.3.1.4 Apply the universal systems model of inputs, processes, outputs, and feedback to a working system (e.g., heating, motor, food production) and identify the resources necessary for operation of the system.
S11.A.3.2.1 Compare the accuracy of predictions represented in a model to actual observations and behavior.
S11.A.3.2.2 Describe advantages and disadvantages of using models to simulate processes and outcomes.
S11.A.3.2.3 Describe how relationships represented in models are used to explain scientific or technological concepts (e.g., dimensions of objects within the solar system, life spans, size of atomic particles, topographic maps).
S11.A.3.3.1 Describe or interpret recurring patterns that form the basis of biological classification, chemical periodicity, geological order, or astronomical order.

S11.A.3.3.2 Compare stationary physical patterns (e.g., crystals, layers of rocks, skeletal systems, tree rings, atomic structure) to the object's properties.
S11.B.1.1.1 Explain how structure determines function at multiple levels of organization (e.g., chemical, cellular, anatomical).
S11.B.1.1.2 Compare and contrast the structural and functional similarities and differences among living things (e.g., classify organisms into classification groups, compare systems).
S11.B.1.1.3 Compare and contrast cellular processes (e.g., photosynthesis and respiration, meiosis and mitosis, protein synthesis and DNA replication).

Concepts (What students should know):

- Characteristics, components and functions of blood and plasma
- Structure and function of red blood cells
- Categories and production of white blood cells, based on their structures and roles
- Factors affecting blood types
- Mechanisms that control blood loss, and the form, function and production of platelets
- Anatomy of the heart, including major vessels, chambers and valves, and the blood flow pathway
- Events of action potential in cardiac muscle
- Events of the cardiac cycle
- Factors affecting cardiac output, stroke volume, heart rate
- Structure and function of three major categories of blood vessels
- Mechanisms that regulate blood flow and pressure in vessels and tissues, as well of movement of fluids
- Coordination of circulatory, vasomotor and respiratory systems to control blood flow
- General functional patterns and involved vessels of the pulmonary and systemic circuits
- Differences between adult and fetal circulations
- Effects of aging on the circulatory system
- Anatomy and functions of respiratory system components (lungs, bronchioles, alveoli)
- Differences and similarities of external and internal respiration
- Physical principles governing movement and diffusion of gases into and out of the body
- Factors influencing respiratory rate
- Effects of aging on the respiratory system
- Interactions of respiratory and other body systems

Objectives (What students should be able to do):

1. Describe the components and major functions of blood, and list the physical characteristics of blood.
2. Describe the composition and functions of plasma.
3. List the characteristics and functions of red blood cells, describe the structure and function of hemoglobin, indicate how red blood cell components are recycled, and explain erythropoiesis.
4. Discuss the factors that determine a person's blood type, and explain why blood typing is important.
5. Categorize the various white blood cells on the basis of their structures and functions, and discuss the factors that regulate their production.
6. Describe the structure, function, and production of platelets.
7. Describe the mechanisms that control blood loss after an injury.
8. Describe the anatomy of the heart, including blood supply and pericardium structure, and trace the flow of blood through the heart, identifying the major blood vessels, chambers, and heart valves.

9. Explain the events of an action potential in cardiac muscle, describe the conducting system of the heart, and identify the electrical events recorded in a normal electrocardiogram.
10. Explain the events of the cardiac cycle, and relate the heart sounds to specific events in this cycle.
11. Define cardiac output, describe the factors that influence heart rate and stroke volume, and explain how adjustments in stroke volume and cardiac output are coordinated at different levels of physical activity.
12. Distinguish among the types of blood vessels based on their structure and function.
13. Explain the mechanisms that regulate blood flow through blood vessels, and discuss the mechanisms that regulate movement of fluids between capillaries and interstitial spaces.
14. Describe the control mechanisms that interact to regulate blood flow and pressure in tissues, and explain how the activities of the cardiac, vasomotor, and respiratory centers are coordinated to control blood flow through tissues.
15. Explain the cardiovascular system's homeostatic response to exercising and hemorrhaging.
16. Describe the three general functional patterns in the pulmonary and systemic circuits.
17. Identify the major arteries and veins of the pulmonary circuit.
18. Identify the major arteries and veins of the systemic circuit.
19. Identify the differences between fetal and adult circulation patterns, and describe the changes in the patterns of blood flow that occur at birth.
20. Discuss the effects of aging on the cardiovascular system.
21. Give examples of interactions between the cardiovascular system and the other organ systems.
22. Describe the primary functions of the respiratory system, and explain how the respiratory exchange surfaces are protected from debris, pathogens, and other hazards.
23. Identify the structures that conduct air to the lungs, and describe their functions.
24. Describe the functional anatomy of alveoli, and the superficial anatomy of the lungs.
25. Define and compare the processes of external respiration and internal respiration.
26. Describe the physical principles governing the movement of air into the lungs and the actions of the respiratory muscles.
27. Describe the physical principles governing the diffusion of gases into and out of the blood.
28. Describe how oxygen and carbon dioxide are transported in the blood.
29. List the factors that influence the rate of respiration, and describe the reflexes that regulate respiration.
30. Describe the changes in the respiratory system that occur with aging.
31. Give examples of interactions between the respiratory system and other body systems.

Assessments:

Performance descriptors - TBD

Textual References and Resources:

Essentials of Anatomy and Physiology, 6th ed. Martini & Bartholomew, 2013.

- Ch.11, the cardiovascular system: blood, p. 379-404
- Ch.12, the cardiovascular system: the heart, p.405-427
- Ch.13, the cardiovascular system: blood vessels and circulation, p.428-469
- Ch.15, the respiratory system, p.503-534

Anatomy and Physiology Coloring Workbook: A Complete Study Guide, 10th ed. Elaine N. Marieb, 2012

- Ch.11, the cardiovascular system, p.205-234
- Ch. 13, the respiratory system, p.235-276

Unit 6: Immunity: The Lymphatic System

Unit Overview:

Students will study the structures and their functions of the lymphatic system, involving focus on lymph tissues and the various types of white blood cells. Students will be able to identify the mechanisms employed by the body during immune responses, and distinguish between the specific and nonspecific defenses. Students will learn about immune disorders and allergies, as well as about the factors which affect the immune system, and how they apply to clinical issues.

Enduring Understanding:

The immune defenses of the human body utilize, but are not limited to, the components of the lymphatic system. However, lymph tissue and the involved white blood cells are essential in both specific and nonspecific defenses. Mechanisms of the lymphatic system in detecting and responding to injury and infection work in conjunction with other body systems (e.g. circulatory, integumentary systems) to protect and maintain the overall homeostasis and health of the body.

Essential Questions:

- What are the components of the lymphatic system?
- How does the body utilize nonspecific (innate) and specific (adaptive) immune defenses?
- What are the mechanisms of immune disorders and allergies?
- How does the lymphatic system coordinate with other body systems to effect immunity?

PA Common Core:

CC.3.5.11-12.A.
Cite specific textual evidence to support analysis ofscience and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

CC.3.5.11-12.B.
Determine the central ideas or conclusions of a text;summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

CC.3.5.11-12.C.
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CC.3.5.11-12.D.
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.

CC.3.5.11-12.E.
Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

CC.3.5.11-12.F.
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CC.3.5.11-12.I.
Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

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By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

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- Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
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CC.3.6.11-12.C.
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Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

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Eligible Content:

S11.A.1.1.1 Compare and contrast scientific theories, scientific laws, and beliefs (e.g., the universal law of gravitation, how light travels, formation of moons, stages of ecological succession).
S11.A.1.1.2 Analyze and explain the accuracy of scientific facts, principles, theories, and laws.
S11.A.1.1.3 Evaluate the appropriateness of research questions (e.g., testable vs. not-testable).
S11.A.1.1.4 Explain how specific scientific knowledge or technological design concepts solve practical problems (e.g., momentum, Newton's universal law of gravitation, tectonics, conservation of mass and energy, cell theory, theory of evolution, atomic theory, theory of relativity, Pasteur's germ theory, relativity, heliocentric theory, ideal gas laws).
S11.A.1.1.5 Analyze or compare the use of both direct and indirect observation as means to study the world and the universe (e.g., behavior of atoms, functions of cells, birth of stars).
S11.A.1.2.1 Explain and apply scientific concepts to societal issues using case studies (e.g., spread of HIV, deforestation, environmental health, energy).
S11.A.1.3.1 Use appropriate quantitative data to describe or interpret change in systems (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.1.3.2 Describe or interpret dynamic changes to stable systems (e.g., chemical reactions, human body, food webs, tectonics, homeostasis).
S11.A.2.1.1 Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design.
S11.A.2.1.2 Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design.
S11.A.2.1.3 Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits.
S11.A.2.1.4 Critique the results and conclusions of scientific inquiry for consistency and logic.
S11.A.2.1.5 Communicate results of investigations using multiple representations.
S11.A.2.2.1 Evaluate appropriate methods, instruments, and scale for precise quantitative and qualitative observations (e.g., to compare properties of materials, water quality).
S11.A.2.2.2 Explain how technology (e.g., GPS, spectroscope, scanning electron microscope, pH meter, probe, interface, imaging technology, telescope) is used to extend human abilities and precision.
S11.A.3.1.1 Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts.
S11.A.3.1.2 Analyze and predict the effect of making a change in one part of a system on the system as a whole.
S11.A.3.1.3 Use appropriate quantitative data to describe or interpret a system (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.3.1.4 Apply the universal systems model of inputs, processes, outputs, and feedback to a working system (e.g., heating, motor, food production) and identify the resources necessary for operation of the system.
S11.A.3.2.1 Compare the accuracy of predictions represented in a model to actual observations and behavior.
S11.A.3.2.2 Describe advantages and disadvantages of using models to simulate processes and outcomes.
S11.A.3.2.3 Describe how relationships represented in models are used to explain scientific or technological concepts (e.g., dimensions of objects within the solar system, life spans, size of atomic particles, topographic maps).
S11.A.3.3.1 Describe or interpret recurring patterns that form the basis of biological classification, chemical periodicity, geological order, or astronomical order.
S11.A.3.3.2 Compare stationary physical patterns (e.g., crystals, layers of rocks, skeletal systems, tree rings, atomic structure) to the object's properties.
S11.B.1.1.1 Explain how structure determines function at multiple levels of organization (e.g., chemical, cellular, anatomical).
S11.B.1.1.2 Compare and contrast the structural and functional similarities and differences among living things (e.g., classify organisms into classification groups, compare systems).

S11.B.1.1.3 Compare and contrast cellular processes (e.g., photosynthesis and respiration, meiosis and mitosis, protein synthesis and DNA replication).
S11.B.2.1.1 Explain the theory of evolution by interpreting data from fossil records, similarities in anatomy and physiology, or DNA studies that are relevant to the theory of evolution.

Concepts (What students should know):

- Anatomy and function of the lymphatic system components
- Differences between innate and adaptive immunity
- Describe the structure and function of various white blood cells (antibodies; T-cells, B-cells)
- The mechanism of immune disorders and allergies
- Effects of aging on the lymphatic system

Objectives (What students should be able to do):

1. Distinguish between innate (nonspecific) and adaptive (specific) defenses.
2. Identify the major components of the lymphatic system, and explain the functions of each.
3. List the body's innate (nonspecific) defenses and explain how each functions.
4. Define adaptive (specific) defenses, identify the forms and properties of immunity, and distinguish between cell-mediated immunity and antibody-mediated (humoral) immunity.
5. Discuss the different types of T cells and their roles in the immune response.
6. Discuss B cell sensitization, activation, and differentiation, describe the structure and function of antibodies, and explain the primary and secondary immune responses to antigen exposure.
7. List and explain examples of immune disorders and allergies, and discuss the effects of stress on immune function.
8. Describe the effects of aging on the lymphatic system and the immune response.
9. Give examples of interactions between the lymphatic system and other body systems.

Assessments:

Performance descriptors - TBD

Textual References and Resources:

Essentials of Anatomy and Physiology, 6th ed. Martini & Bartholomew, 2013.

- Ch.14, the lymphatic system p. 470-502

Anatomy and Physiology Coloring Workbook: A Complete Study Guide, 10th ed. Elaine N. Marieb, 2012

- Ch.12, the lymphatic system and body defenses, p.235-258

Unit 7: Metabolism and Homeostasis: Digestive and Urinary Systems

Unit Overview:

Students will identify, describe and explain the major structures and functions of the digestive system, as well as the involved accessory organs. Relating their knowledge of biochemistry, students will examine metabolic processes at the cellular level, and identify the nutrition requirements of the body and describe how changes in nutrition can affect the body as a whole. Students will also study the organs and structures of urinary system, and their roles in maintaining the balance necessary to homeostasis. Interactions between the digestive, urinary and other body systems will be explored, as well as the effect of aging on these systems. Clinical scenarios in which students can apply their understanding of the digestive system, metabolic processes, and urinary system, will be explored.

Enduring Understanding:

The digestive system functions at the organ, cellular and chemical levels in order to provide the body with the necessary organic molecules. Involving both major structures (oral cavity, esophagus, stomach, large and small intestines) and accessory organs (liver, pancreas, gall bladder), the digestive system takes in and metabolizes the needed nutrients for use in the body, from large inaccessible molecules, to forms which the body more readily employ. The body's metabolism involves the many chemical reactions that enable optimal performance. The urinary system functions as a filtration system, removing wastes and maintaining water and electrolyte balance. Both the digestive and urinary systems are crucial in the maintenance of homeostasis.

Essential Questions:

- What are the major structures of the digestive system and their functions?
- What are the accessory organs of the digestive system and their functions?
- How do the vital metabolic processes of the body work?
- How are wastes removed from metabolic processes?
- What are the major structures of the urinary system and their functions?
- How does the urinary system function in the maintenance of homeostasis?

PA Common Core:

CC.3.5.11-12.A.
Cite specific textual evidence to support analysis ofscience and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

CC.3.5.11-12.B.
Determine the central ideas or conclusions of a text;summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

CC.3.5.11-12.C.
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CC.3.5.11-12.D.
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.

CC.3.5.11-12.E.
Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

CC.3.5.11-12.F.

Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

CC.3.5.11-12.G.
Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

CC.3.5.11-12.H.
Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

CC.3.5.11-12.I.
Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

CC.3.5.11-12.J.
By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

CC.3.6.11-12.A.
Write arguments focused on *discipline-specific content.*

- Introduce precise, knowledgeable claim(s),establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s),counterclaims, reasons, and evidence.
- Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns,values, and possible biases.
- Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
- Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- Provide a concluding statement or section that follows from or supports the argument presented.

CC.3.6.11-12.B. *
Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

- Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
- Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
- Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
- Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g.,articulating implications or the significance of the topic).

CC.3.6.11-12.C.
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CC.3.6.11-12.D.
Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

CC.3.6.11-12.E.

Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

CC.3.6.11-12.F.
Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

CC.3.6.11-12.G.
Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

CC.3.6.11-12.H.
Draw evidence from informational texts to support analysis, reflection, and research.

CC.3.6.11-12.I.
Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Eligible Content:

S11.A.1.1.1 Compare and contrast scientific theories, scientific laws, and beliefs (e.g., the universal law of gravitation, how light travels, formation of moons, stages of ecological succession).
S11.A.1.1.2 Analyze and explain the accuracy of scientific facts, principles, theories, and laws.
S11.A.1.1.3 Evaluate the appropriateness of research questions (e.g., testable vs. not-testable).
S11.A.1.1.4 Explain how specific scientific knowledge or technological design concepts solve practical problems (e.g., momentum, Newton's universal law of gravitation, tectonics, conservation of mass and energy, cell theory, theory of evolution, atomic theory, theory of relativity, Pasteur's germ theory, relativity, heliocentric theory, ideal gas laws).
S11.A.1.1.5 Analyze or compare the use of both direct and indirect observation as means to study the world and the universe (e.g., behavior of atoms, functions of cells, birth of stars).
S11.A.1.2.1 Explain and apply scientific concepts to societal issues using case studies (e.g., spread of HIV, deforestation, environmental health, energy).
S11.A.1.3.1 Use appropriate quantitative data to describe or interpret change in systems (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.1.3.2 Describe or interpret dynamic changes to stable systems (e.g., chemical reactions, human body, food webs, tectonics, homeostasis).
S11.A.2.1.1 Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design.
S11.A.2.1.2 Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design.
S11.A.2.1.3 Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits.
S11.A.2.1.4 Critique the results and conclusions of scientific inquiry for consistency and logic.
S11.A.2.1.5 Communicate results of investigations using multiple representations.
S11.A.2.2.1 Evaluate appropriate methods, instruments, and scale for precise quantitative and qualitative observations (e.g., to compare properties of materials, water quality).
S11.A.2.2.2 Explain how technology (e.g., GPS, spectroscope, scanning electron microscope, pH meter, probe, interface, imaging technology, telescope) is used to extend human abilities and precision.
S11.A.3.1.1 Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts.
S11.A.3.1.2 Analyze and predict the effect of making a change in one part of a system on the system as a whole.
S11.A.3.1.3 Use appropriate quantitative data to describe or interpret a system (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.3.1.4 Apply the universal systems model of inputs, processes, outputs, and feedback to a working system (e.g., heating, motor, food production) and identify the resources necessary for operation of the system.
S11.A.3.2.1 Compare the accuracy of predictions represented in a model to actual observations and behavior.
S11.A.3.2.2 Describe advantages and disadvantages of using models to simulate processes and outcomes.

S11.A.3.2.3 Describe how relationships represented in models are used to explain scientific or technological concepts (e.g., dimensions of objects within the solar system, life spans, size of atomic particles, topographic maps).
S11.A.3.3.1 Describe or interpret recurring patterns that form the basis of biological classification, chemical periodicity, geological order, or astronomical order.
S11.A.3.3.2 Compare stationary physical patterns (e.g., crystals, layers of rocks, skeletal systems, tree rings, atomic structure) to the object's properties.
S11.B.1.1.1 Explain how structure determines function at multiple levels of organization (e.g., chemical, cellular, anatomical).
S11.B.1.1.2 Compare and contrast the structural and functional similarities and differences among living things (e.g., classify organisms into classification groups, compare systems).
S11.B.2.1.1 Explain the theory of evolution by interpreting data from fossil records, similarities in anatomy and physiology, or DNA studies that are relevant to the theory of evolution.

Concepts (What students should know):

- Major structures of the digestive system (oral cavity, esophagus, stomach, small and large intestines) and their roles
- Structures, roles and regulation of the accessory organs of the digestive system (pancreas, liver, gallbladder)
- Nutrient requirements of the body and their chemical digestion and absorption
- Processes involved in metabolism and synthesis of organic molecules (carbohydrates, lipids, proteins, nucleic acids)
- Dietary requirements and the effect of poor diet and aging on digestive and overall health
- Location and structures of the urinary system (kidneys, ureters, bladder) and their functions
- Major functions of the nephron and processes of urine formation and control
- Factors affecting glomerular filtration pressure and rate
- Importance and mechanisms of water and electrolyte balance in homeostasis
- Buffering systems for balancing pH in intracellular and extracellular environmnets
- Examples of interactions of the digestive and urinary systems, as well as the involvement of metabolic processes

Objectives (What students should be able to do):

1. Identify the organs of the digestive system, list their major functions, and describe the four layers of the wall of the digestive tract.
2. Discuss the anatomy of the oral cavity, and list the functions of its major structures.
3. Describe the structures and functions of the pharynx and esophagus, and the key events of the swallowing process.
4. Describe the anatomy of the stomach, including its histological features, and discuss its roles in digestion and absorption.
5. Describe the anatomy of the small intestine, including its histological features, and explain the functions and regulation of intestinal secretions.
6. Describe the structure and functions of the pancreas, liver, and gallbladder, and explain how their activities are regulated.
7. Describe the structure of the large intestine, including its regional specializations, and list its absorptive functions.
8. List the nutrients required by the body, describe the chemical digestion of organic nutrients, and discuss the absorption of organic and inorganic nutrients.
9. Describe the effects of aging on the digestive system.

10. Give examples of interactions between the digestive system and each of the other organ systems.
11. Define metabolism and energetics, and explain why cells need to synthesize new organic molecules.
12. Describe the basic steps involved in glycolysis, the citric acid cycle, and the electron transport system, and summarize the energy yields of glycolysis and cellular respiration.
13. Describe the pathways involved in lipid metabolism, and summarize mechanisms of lipid transport and distribution.
14. Discuss protein metabolism and the use of proteins as an energy source.
15. Discuss nucleic acid metabolism and the limited use of nucleic acids as an energy source.
16. Explain what constitutes a balanced diet, and why such a diet is important.
17. Define metabolic rate, describe the factors involved in determining an individual's BMR, and discuss the homeostatic mechanisms that maintain a constant body temperature.
18. Describe the age-related changes in dietary requirements.
19. Identify the components of the urinary system, and describe the system's three primary functions.
20. Describe the locations and structural features of the kidneys, trace the path of blood flow to, within, and from a kidney, and describe the structure of the nephron.
21. Discuss the major functions of each portion of the nephron, and outline the processes involved in urine formation.
22. Describe the factors that influence glomerular filtration pressure and the glomerular filtration rate (GFR).
23. Describe the structures and functions of the ureters, urinary bladder, and urethra, discuss the control of urination, and describe the micturition reflex.
24. Define the terms *fluid balance*, *electrolyte balance*, and *acid-base balance*, discuss their importance for homeostasis, and describe how water and electrolytes are distributed within the body.
25. Explain the basic mechanisms involved in maintaining fluid balance and electrolyte balance.
26. Explain the buffering systems that balance the pH of the intracellular and extracellular fluids, and identify the most common threats to acid-base balance.
27. Describe the effects of aging on the urinary system.
28. Give examples of interactions between the urinary system and other body systems.

Assessments:

Performance descriptors - TBD

Textual References and Resources:

Essentials of Anatomy and Physiology, 6th ed. Martini & Bartholomew, 2013.

- Ch.16, the digestive system p. 535-574
- Ch.17, metabolism and energetics, p.575-601
- Ch.18, the urinary system, p.602-639

Anatomy and Physiology Coloring Workbook: A Complete Study Guide, 10th ed. Elaine N. Marieb, 2012

- Ch.14, the digestive system and body metabolism, p.277-304
- Ch. 15, the urinary system, p.305-324

Unit 8: Reproduction and Development: The Reproductive System and Genetics

Unit Overview:

Students will study the structures and functions of the male and female reproductive systems, as well as the role of hormones in fertilization and fetal development. Students will explore the events of human development, especially fertilization through early childhood, and examine the influence of genetics on development.

Enduring Understanding:

The structures of the male and female reproductive systems are designed for human propagation. Through the processes of oogenesis and spermatogenesis, eggs and sperm are formed so that fertilization restores the diploid chromosome number. While the male system delivers the sperm, the female system is capable for supporting the zygote's development and differentiation through embryonic and fetal stages until birth. Hormones are key in control of the reproductive systems, and human development is greatly influenced by the resulting genetic diversity enabled by sexual reproduction.

Essential Questions:

- What are the structures and functions of the male and female reproductive systems?
- How are eggs and sperm formed?
- How do hormones influence the reproductive systems?
- How does the zygote develop and differentiate into an adult human?
- How do genetics impact human development?

PA Common Core:

CC.3.5.11-12.A.
Cite specific textual evidence to support analysis ofscience and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.

CC.3.5.11-12.B.
Determine the central ideas or conclusions of a text;summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

CC.3.5.11-12.C.
Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

CC.3.5.11-12.D.
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.

CC.3.5.11-12.E.
Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.

CC.3.5.11-12.F.
Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

CC.3.5.11-12.G.
Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

CC.3.5.11-12.H.

Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

CC.3.5.11-12.I.
Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

CC.3.5.11-12.J.
By the end of grade 12, read and comprehend science/technical texts in the grades 11–12 text complexity band independently and proficiently.

CC.3.6.11-12.A.
Write arguments focused on *discipline-specific content.*

- Introduce precise, knowledgeable claim(s),establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s),counterclaims, reasons, and evidence.
- Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns,values, and possible biases.
- Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
- Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
- Provide a concluding statement or section that follows from or supports the argument presented.

CC.3.6.11-12.B. *
Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

- Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
- Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
- Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
- Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers.
- Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g.,articulating implications or the significance of the topic).

CC.3.6.11-12.C.
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CC.3.6.11-12.D.
Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

CC.3.6.11-12.E.
Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

CC.3.6.11-12.F.
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CC.3.6.11-12.G.

Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

CC.3.6.11-12.H.
Draw evidence from informational texts to support analysis, reflection, and research.

CC.3.6.11-12.I.
Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Eligible Content:

S11.A.1.1.1 Compare and contrast scientific theories, scientific laws, and beliefs (e.g., the universal law of gravitation, how light travels, formation of moons, stages of ecological succession).
S11.A.1.1.2 Analyze and explain the accuracy of scientific facts, principles, theories, and laws.
S11.A.1.1.3 Evaluate the appropriateness of research questions (e.g., testable vs. not-testable).
S11.A.1.1.4 Explain how specific scientific knowledge or technological design concepts solve practical problems (e.g., momentum, Newton's universal law of gravitation, tectonics, conservation of mass and energy, cell theory, theory of evolution, atomic theory, theory of relativity, Pasteur's germ theory, relativity, heliocentric theory, ideal gas laws).
S11.A.1.1.5 Analyze or compare the use of both direct and indirect observation as means to study the world and the universe (e.g., behavior of atoms, functions of cells, birth of stars).
S11.A.1.2.1 Explain and apply scientific concepts to societal issues using case studies (e.g., spread of HIV, deforestation, environmental health, energy).
S11.A.1.3.1 Use appropriate quantitative data to describe or interpret change in systems (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.1.3.2 Describe or interpret dynamic changes to stable systems (e.g., chemical reactions, human body, food webs, tectonics, homeostasis).
S11.A.2.1.1 Critique the elements of an experimental design (e.g., raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data, and drawing conclusions) applicable to a specific experimental design.
S11.A.2.1.2 Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design.
S11.A.2.1.3 Use data to make inferences and predictions, or to draw conclusions, demonstrating understanding of experimental limits.
S11.A.2.1.4 Critique the results and conclusions of scientific inquiry for consistency and logic.
S11.A.2.1.5 Communicate results of investigations using multiple representations.
S11.A.2.2.1 Evaluate appropriate methods, instruments, and scale for precise quantitative and qualitative observations (e.g., to compare properties of materials, water quality).
S11.A.2.2.2 Explain how technology (e.g., GPS, spectroscope, scanning electron microscope, pH meter, probe, interface, imaging technology, telescope) is used to extend human abilities and precision.
S11.A.3.1.1 Apply systems analysis, showing relationships (e.g., flowcharts, concept maps), input and output, and measurements to explain a system and its parts.
S11.A.3.1.2 Analyze and predict the effect of making a change in one part of a system on the system as a whole.
S11.A.3.1.3 Use appropriate quantitative data to describe or interpret a system (e.g., biological indices, electrical circuit data, automobile diagnostic systems data).
S11.A.3.1.4 Apply the universal systems model of inputs, processes, outputs, and feedback to a working system (e.g., heating, motor, food production) and identify the resources necessary for operation of the system.
S11.A.3.2.1 Compare the accuracy of predictions represented in a model to actual observations and behavior.
S11.A.3.2.2 Describe advantages and disadvantages of using models to simulate processes and outcomes.
S11.A.3.2.3 Describe how relationships represented in models are used to explain scientific or technological concepts (e.g., dimensions of objects within the solar system, life spans, size of atomic particles, topographic maps).
S11.A.3.3.1 Describe or interpret recurring patterns that form the basis of biological classification, chemical periodicity, geological order, or astronomical order.
S11.B.1.1.1 Explain how structure determines function at multiple levels of organization (e.g., chemical, cellular, anatomical).
S11.B.1.1.2 Compare and contrast the structural and functional similarities and differences among living things (e.g., classify organisms into classification groups, compare systems).
S11.B.1.1.3 Compare and contrast cellular processes (e.g., photosynthesis and respiration, meiosis and mitosis, protein synthesis and DNA replication).

S11.B.2.1.1 Explain the theory of evolution by interpreting data from fossil records, similarities in anatomy and physiology, or DNA studies that are relevant to the theory of evolution.
S11.B.2.1.2 Explain the role of mutations, differential reproduction, and gene recombination in changing the genetic makeup of a population.
S11.B.2.1.3 Explain the role of selective breeding and biotechnology in changing the genetic makeup of a population.
S11.B.2.2.1 Describe how genetic information is expressed (i.e., DNA, genes, chromosomes, transcription, translation, and replication).
S11.B.2.2.2 Compare and contrast mitosis and meiosis in passing on genetic information.
S11.B.2.2.3 Explain how different patterns of inheritance affect population variability (i.e., multiple alleles, codominance, dominance, recessiveness, sex-influenced traits, and sex-linked traits).

Concepts (What students should know):

- Major structures and functions of the male and female reproductive systems
- Processes of spermatogenesis and oogenesis
- Role of hormones in the reproductive systems
- Effects of aging on the reproductive systems
- Relationship between differentiation and development
- Events of fertilization, differentiation, development and labor and delivery
- Coordination of the female reproductive system and other organ systems in development of the fetus
- Relation of genetics to human development

Objectives (What students should be able to do):

1. List the basic components of the human reproductive system, and summarize the functions of each.
2. Describe the components of the male reproductive system; list the roles of the reproductive tract and accessory glands in producing spermatozoa; describe the composition of semen; and summarize the hormonal mechanisms that regulate male reproductive function.
3. Describe the components of the female reproductive system; explain the process of oogenesis in the ovary; discuss the ovarian and uterine cycles; and summarize the events of the female reproductive cycle.
4. Discuss the physiology of sexual intercourse in males and females.
5. Describe the age-related changes that occur in the reproductive system.
6. Give examples of interactions between the reproductive system and each of the other organ systems.
7. Explain the relationship between differentiation and development, and describe the various stages of development.
8. Describe the process of fertilization.
9. List the three stages of prenatal development, and describe the major events of each.
10. Explain how the three germ layers participate in the formation of extraembryonic membranes, and discuss the importance of the placenta as an endocrine organ.
11. Describe the interplay between maternal organ systems and the developing fetus, and discuss the structural and functional changes in the uterus during gestation.
12. List and discuss the events that occur during labor and delivery.
13. Identify the features and physiological changes of the postnatal stages of life.
14. Relate the basic principles of genetics to the inheritance of human traits.

Assessments:

Textual References and Resources:

Essentials of Anatomy and Physiology, 6th ed. Martini & Bartholomew, 2013.

- Ch.19, the reproductive system p. 640-673
- Ch.20, development and inheritance, p.674-694

Anatomy and Physiology Coloring Workbook: A Complete Study Guide, 10th ed. Elaine N. Marieb, 2012

- Ch.16, the reproductive system, p.325-350