Ohio Science

# Human Anatomy and Physiology Content Statements: Grades 9-12

Adopted 2018

**Human Anatomy and Physiology**

1. **Hierarchy of organization** AP.LO.1
   a. Research various species of organisms that have been studied in order to understand fundamental physiological processes in humans. Explain the considerations in determining what species is the best to study for a particular process. AP.LO.1.DSK.A
   a. Analyze data about various human cell types and hypothesize the relationships between structure and function. AP.LO.1.ICSC.A
   a. Identify the levels of organization from cellular to organism. AP.LO.1.RAS.A

2. **Types of tissues** AP.LO.2
   a. Simulate tissue engineering using a variety of materials (e.g., gelatin, agar, yeast). Critique the characteristics of each tissue simulation to rate its possible use in tissue grafting. AP.LO.2.DTES.A
   a. Use microscopes or virtual images to examine various tissues. Compare a range of epithelial (e.g., squamous, columnar, cuboidal), connective (e.g., cartilage, bone, blood), muscular (e.g., skeletal, cardiac, smooth) and nervous tissues. Interpret how the function of each tissue type relates to its structure. AP.LO.2.ICSC.A
   a. Create labeled illustrations or models of the four types of human tissues. AP.LO.2.RAS.A

3. **Homeostasis** AP.LO.3

   a. Design or critique a device used to maintain or monitor homeostasis for a human body process (e.g., heart rate, glucose, oxygen level). AP.LO.3.DTES.A

   a. Investigate homeostasis by measuring changes in heart rate. Compare resting heart rate to the rate after changing a variable. Present data and hypothesize ways to improve heart rates in stressed individuals (e.g., yoga, deep breathing). AP.LO.3.DSK.A

   a. After using a simulation or another data source, discuss how the data are similar to and different from the self-regulation that goes on in an actual human body. AP.LO.3.ICSC.A

   b. Research the chronic changes in the muscular, circulatory, and respiratory systems in response to starting an exercise program. Distinguish which kinds of changes result from which kinds of exercise (e.g., aerobic, anaerobic). AP.LO.3.ICSC.B

   c. Investigate ways that prions, viruses, bacteria, protozoans and multicellular parasites disturb homeostasis. Give examples of diseases caused by each category. AP.LO.3.ICSC.C

   a. Identify examples of how the body uses homeostasis to maintain balance. AP.LO.3.RAS.A

   b. Differentiate between positive and negative feedback mechanisms. AP.LO.3.RAS.B

4. **Anatomical terminology** AP.LO.4

   a. Demonstrate knowledge of anatomical directional terminology through the dissection of a three-dimensional object, such as a clay model, doll or gummy bear. AP.LO.4.ICSC.A

   a. Label a diagram of a human body with directional terms, planes and cavities. AP.LO.4.RAS.A

1. **Integumentary system** AP.SM.1
    a. Design a sunscreen that does not kill aquatic wildlife (e.g. corals). AP.SM.1.DTES.A
    a. Design an investigation to compare various sunscreens and homeopathic methods using UV sensitive paper or UV sensitive yeast strains. AP.SM.1.DSK.A
    a. Create labeled illustrations or models of skin cells and accessory structures. AP.SM.1.ICSC.A
    b. Compare the structure and function of the integument of the major classes of vertebrates. AP.SM.1.ICSC.B
    c. Explore the connection between types of cells, accessory structures, and the ability to sense temperature and pressure. AP.SM.1.ICSC.C
    d. Investigate and present data on the connection between UV/sun exposure and increased incidence of skin cancer. AP.SM.1.ICSC.D
    e. Create a presentation or infographic to inform an audience about the risks of, and dispel common myths about, UV exposure. AP.SM.1.ICSC.E
    f. Propose a plan to lower the incidence of skin cancer. AP.SM.1.ICSC.F
    g. Explore the safety of tanning salons and alternative tanning methods (e.g., spray tanning). AP.SM.1.ICSC.G
    h. Dispel myths about acne with knowledge about homeostatic imbalances in the integumentary system. AP.SM.1.ICSC.H
    a. Use microscopes, micrographs, models or illustrations to identify types of skin cells and accessory structures. AP.SM.1.RAS.A
    b. Describe the process of tissue engineering and tissue donation. AP.SM.1.RAS.B
    c. Describe what attributes need to be considered in order to be a tissue donor. AP.SM.1.RAS.C
    d. List sensory structures in the integumentary system. AP.SM.1.RAS.D
    e. Explain how UV light from sun or tanning salon exposure increases the risks of skin cancer. AP.SM.1.RAS.E
    f. Explain the cause of homeostatic imbalances (e.g., burns, skin cancers, anhidrosis, acne, eczema, scleroderma). AP.SM.1.RAS.F

2. **Skeletal system** AP.SM.2

   a. Design and create a model of a prosthetic limb that can a perform a task (e.g., lift or carry an object). AP.SM.2.DTES.A

   b. Design a bone model with cardstock and tape to meet specific parameters (e.g., strength). Test how well the model meets the parameters. AP.SM.2.DTES.B

   c. Design a better cast for fractures, identifying the materials, type of fixation, etc. AP.SM.2.DTES.C

   d. Design a system to analyze movement/joint stability in specified movements. AP.SM.2.DTES.D

   a. Compare bone structures in various vertebrates. Associate the structure of bones with their function (e.g., hollow bones in birds, fused radioulna in frogs). Dissection (e.g., chicken legs, pigs, cats) can be used as a point of comparison. AP.SM.2.ICSC.A

   b. Measure femur length and perform associated calculations to find height. Graph results to compare genders and ages. AP.SM.2.ICSC.B

   c. Create a model of each type of bone and identify features. AP.SM.2.ICSC.C

   d. Research gender and age data for common fractures. Discuss patterns that emerge. Develop explanations for common injuries for given age/gender classifications. AP.SM.2.ICSC.D

   e. Develop an action plan to help the elderly prevent bone density loss. AP.SM.2.ICSC.E

   f. Record (e.g., drawings, video) common athletic movements and identify bones and joints involved and anatomical movement represented. AP.SM.2.ICSC.F

   a. Create an illustration of a long bone and label all structures. AP.SM.2.RAS.A

   b. Use models or illustrations to identify and name bones and important bony features of the human skeleton. AP.SM.2.RAS.B

   c. Identify, label and describe the types of bones using graphics, images, X-ray images or lab bone specimens. AP.SM.2.RAS.C

   d. Create an illustration of different stages of bone development and destruction, including fracture repair. AP.SM.2.RAS.D

   e. List and describe factors that affect bone density. AP.SM.2.RAS.E

   f. Identify the movement involved in moving specified joints. AP.SM.2.RAS.F

3. **Muscular system** AP.SM.3

   a. Design and construct an artificial hand from common household items where the fingers flex and extend to perform a task. AP.SM.3.DTES.A

   a. Design, plan, and conduct an investigation on muscle fatigue using basic exercise equipment (e.g., tennis ball, clothespin, textbook). Collect data and analyze. AP.SM.3.DSK.A

   b. Choose opposing major muscle groups and design an investigation to compare contraction length and/or force. AP.SM.3.DSK.B

   a. Explore muscle fatigue in relationship to handedness, gender, height and other factors. AP.SM.3.ICSC.A

   b. Create a presentation describing and differentiating between muscle tissue types. AP.SM.3.ICSC.B

   c. Build a model using household items to demonstrate the steps of the sliding filament theory. AP.SM.3.ICSC.C

   d. Research and present findings over the uses for steroids, risks of use and alternative treatment options. AP.SM.3.ICSC.D

   e. Create a presentation to inform the public about the risks of anabolic steroid abuse. AP.SM.3.ICSC.E

   f. Create a product which describes symptoms, treatments and prognosis for varying muscle disorders. Develop a plan to reduce risks and prevent muscle atrophy associated with the disorder. AP.SM.3.ICSC.F

   a. Provide an example of muscle fatigue and describe the physiology behind it. AP.SM.3.RAS.A

   b. Use microscopes, micrographs, models or illustrations to identify muscle tissue types. AP.SM.3.RAS.B

   c. Define and describe the types of connective tissue. AP.SM.3.RAS.C

   d. Research anabolic steroids, their effects on the body, medical applications and risk factors of their use. AP.SM.3.RAS.D

   e. Identify common muscle disorders and give common symptoms and treatments. AP.SM.3.RAS.E

1. **Nervous system** AP.IC.1
    a. Examine the basic design of artificial limbs that integrate with the nervous system to provide the recipient control of the device. AP.IC.1.DTES.A
    b. High school athletes are reported to be more susceptible to brain damage than their peers. Use scientific evidence to support or refute this claim. If this claim is accurate, suggest a possible way to reduce Chronic Traumatic Encephalopathy (CTE) injuries in high school athletes. AP.IC.1.DTES.B
    c. Use correlations of symptoms caused by brain injuries to critique personal protective equipment (e.g., bicycle helmet, hard hats) and suggest modifications to improve their design. AP.IC.1.DTES.C
    d. Design a prototype of a new medical device for an amputee, including the transfer of electrical impulses to neurons. AP.IC.1.DTES.D
    a. Design and implement an investigation to measure muscular response to stimuli. AP.IC.1.DSK.A
    b. Explore some of the difficulties of investigating brain function and critique the limitations in treating damage and disease in the brain and other parts of the nervous system. AP.IC.1.DSK.B
    c. Design an investigation to compare reaction times and reflex times. AP.IC.1.DSK.C
    d. Design and implement an investigation to measure the effect of a depressant or stimulant on a model organism's nervous system (e.g., C. elegans, Daphnia). AP.IC.1.DSK.D
    a. Compare the structures and functions of the central nervous system with the structures and functions of the peripheral nervous system. AP.IC.1.ICSC.A
    b. Evaluate scientific claims for and against the use of environmental toxins/neurotoxins (e.g., lead, mercury, radon). Provide peer-reviewed scientific evidence to support your claims. AP.IC.1.ICSC.B
    c. Construct a 3D model of a neuron that can be used to illustrate anatomy, action potential propagation, simple nerve pathways (reflex arc) and neurotransmitter function. AP.IC.1.ICSC.C
    d. Critique the current treatment(s) available for a neurological disease (e.g., Parkinson's, MS, Huntington's). AP.IC.1.ICSC.D
    e. Predict the outcome of tumor growth in different regions of the brain. AP.IC.1.ICSC.E
    f. Relate the development of the brain to decision-making skills. AP.IC.1.ICSC.F
    g. Correlate the relationship between a brain injury occurring in a specific region and the expressed symptoms. AP.IC.1.ICSC.G
    h. Determine the validity of left brain/right brain dominance. AP.IC.1.ICSC.H
    i. Determine if the structure and function of the nervous system are similar to the operating system of a computer. AP.IC.1.ICSC.I
    j. Compare the structure of another vertebrate brain (e.g., sheep) to the human brain. AP.IC.1.ICSC.J

k. Measure reaction and reflex times and explain the differences in your recorded data. AP.IC.1.ICSC.K

l. Differentiate between spinal and cranial nerves AP.IC.1.ICSC.L

m. Explain how the density of nerve endings in different body areas and the ability of nerves to adapt to stimuli relate to human physiology. AP.IC.1.ICSC.M

n. Explain the symptoms of a chosen neurologic disorder based upon the physiology of the disorder. AP.IC.1.ICSC.N

o. Describe how opioids interfere with chemical communication in the brain. Predict how a change in membrane potential would impact action potential propagation in an axon. AP.IC.1.ICSC.O

p. Create a model of action potential propagation and/or neurotransmitter function. AP.IC.1.ICSC.P

a. Identify the main structures and functions of the central nervous system and the peripheral nervous system. AP.IC.1.RAS.A

b. Using microscopes, micrographs, models or illustrations, identify the cells of the nervous tissue. AP.IC.1.RAS.B

c. Use microscopes, micrographs, models or illustrations to identify the main structures of the brain. AP.IC.1.RAS.C

d. List the functions of the cerebrum, cerebellum and brainstem. AP.IC.1.RAS.D

e. Create labeled illustrations or models of the human brain that include structure and function. AP.IC.1.RAS.E

f. Use microscopes, micrographs, models or illustrations to identify the main structures of the spinal cord. AP.IC.1.RAS.F

g. Use microscopes, micrographs, models or illustrations to identify the main structures of a nerve. AP.IC.1.RAS.G

h. Use graphs of membrane potential vs. time; distinguish between depolarization, repolarization and hyperpolarization. AP.IC.1.RAS.H

2. **Special senses** AP.IC.2

   a. Choose a disease causing a homeostatic imbalance to vision. Use a picture as a control, and modify the picture to show how the picture would be seen by an individual with the chosen visual disease. Design a possible medical device that could alleviate the symptom. AP.IC.2.DTES.A

   b. Choose a disease causing a homeostatic imbalance to the sense of hearing. Modify a sound file to illustrate the effects of the damage and suggest possible medical devices that could alleviate the symptoms. AP.IC.2.DTES.B

   c. Design a device to direct whales from areas of danger (e.g. the site of a major underwater oil well failure). AP.IC.2.DTES.C

   d. Use the mechanism by which bats capture prey in darkness to design an assistive technology for visual impairment. AP.IC.2.DTES.D

   a. Propose hypotheses for how the vertebrate eye first appeared in a common ancestor as a simple organ or clump of cells that detected light and the direction from which it came. Explain the possible adaptive significance of this photosensitivity. AP.IC.2.DSK.A

   b. Propose one or more evolutionary hypotheses to explain the differences and similarities in the structure and function of vertebrate eyes and molluscan eyes. AP.IC.2.DSK.B

   c. Examine the evolutionary origin of the bones involved in hearing in mammals from the earliest chordates. AP.IC.2.DSK.C

   d. Design and carry out an investigation to determine how smell and taste are related in the body and how sensory messages to the brain contribute to flavor perception. AP.IC.2.DSK.D

   e. Propose one or more hypotheses to explain why a dog's sense of smell is much more sensitive than a human's. AP.IC.2.DSK.E

   a. Examine binocular vision by performing various eye tests. Identify common defects of the eye (e.g., astigmatism, color blindness) and their common treatments. AP.IC.2.ICSC.A

   b. Investigate a specific neurological effect of aging and explain how this leads to a homeostatic imbalance (e.g., glaucoma, hyperopic). AP.IC.2.ICSC.B

   c. Compare the structure of the vertebrate eye and the molluscan eye. Design a poster using physiological differences between the vertebrate eye and the molluscan eye to explain why mollusks will never suffer the homeostatic imbalance of detached retina. AP.IC.2.ICSC.C

   d. Explain how the inner ear maintains equilibrium and balance. AP.IC.2.ICSC.D

   e. Investigate a specific neurological effect of aging and explain how this leads to a homeostatic imbalance (e.g., tinnitus). AP.IC.2.ICSC.E

   f. Explain how chemoreceptor function is blocked by a chemical such as miraculin or by Gymnema sylvestre tea. AP.IC.2.ICSC.F

   a. Trace the pathway of light through the eye. AP.IC.2.RAS.A

b. Use microscopes, micrographs, models or illustrations to identify the main structures of the eye, and their functions. AP.IC.2.RAS.B

c. Use models or illustrations to identify the main structures in the inner, outer, and middle ear. AP.IC.2.RAS.C

d. Listen to different tones and identify patterns of hearing ability. AP.IC.2.RAS.D

e. Describe sensorineural and conductive hearing pathways. AP.IC.2.RAS.E

f. Use models, illustrations or slides to identify the anatomical structures related to taste and smell (e.g., taste buds, gustatory cells, papillae, cilia). AP.IC.2.RAS.F

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3. **Endocrine system** AP.IC.3

a. Critique the medical devices used by diabetics to monitor and treat blood sugar and propose solutions to address any identified flaws. AP.IC.3.DTES.A

b. Propose one or more technological or engineering solution(s) to control broad-leafed "weeds" without using potential environmental endocrine disruptors. AP.IC.3.DTES.B

a. Explain how environmental endocrine disruptors can lead to an increase in the incidence rate of breast cancer in women in developed but not in developing countries. AP.IC.3.DSK.A

a. Analyze patient data to diagnose a hormone imbalance and provide suggestions for treatment. AP.IC.3.ICSC.A

b. Research and prepare a poster for peers identifying where they are exposed to environmental endocrine disruptors in their daily lives. AP.IC.3.ICSC.B

a. Draw examples of negative and positive feedback loops. Predict the effect of changes in hormone levels. AP.IC.3.RAS.A

1. **Blood** AP.T.1
    a. Critique available artificial blood products. AP.T.1.DTES.A
    b. Design artificial blood products. AP.T.1.DTES.B
    a. Design a process to identify unknown blood types to determine transfusion compatibility or paternity. AP.T.1.DSK.A
    b. Propose one or more hypotheses to explain the global distribution of the ABO blood groups in humans. AP.T.1.DSK.B
    c. Compare the original distribution of sickle-cell anemia in human populations with the global distribution of malaria. Propose one or more hypotheses to explain the distributions and make predictions based on your hypotheses. AP.T.1.DSK.C
    a. Investigate the process of agglutination and describe its consequences. AP.T.1.ICSC.A
    b. Create a global distribution map of the frequency of the ABO blood groups among native, human populations. AP.T.1.ICSC.B
    c. Prepare blood transfusion guidelines that a medical assistant can use to understand which patients can receive which type(s) of blood and why blood typing is important for blood transfusions. Include the concepts of "universal donor" and "universal recipient". AP.T.1.ICSC.C
    d. Diagnose homeostatic imbalances (e.g., anemia, sickle-cell anemia, leukemia, sepsis) by analyzing laboratory data (e.g., blood sample, patient symptoms, family history). AP.T.1.ICSC.D
    e. Construct a pedigree of a family history and create a genetic counseling plan to advise the patient and family. AP.T.1.ICSC.E
    a. Identify ABO phenotypes and genotypes. AP.T.1.RAS.A
    b. Identify Rh phenotypes and genotypes. AP.T.1.RAS.B
    c. Use Punnett squares to explain the inheritance of blood types. AP.T.1.RAS.C
    d. Create a labeled illustration or model of blood to explain the relationship between antigens, antibodies and blood type (e.g., ABO/Rh). AP.T.1.RAS.D
    e. Explain the role of hemoglobin. AP.T.1.RAS.E

2. **Cardiovascular system** AP.T.2

   a. Critique available artificial heart and valve products. AP.T.2.DTES.A

   b. Analyze data to explain why long-term exposure to microgravity can be dangerous to the cardiovascular system. Propose counter-measures to minimize effects of microgravity. AP.T.2.DTES.B

   c. Design a device to clear an occluded artery. AP.T.2.DTES.C

   a. Investigate the structures and function of the human heart by dissecting a sheep heart, which is similar in structure and function. Trace the flow of blood through the vessels, valves, and chambers of the heart and explore the role the organ plays in the propulsion of blood through the pulmonary and systemic circuits. AP.T.2.DSK.A

   b. Dissect various vertebrate hearts to compare mammalian hearts with those of birds (4-chambered), amphibians (3-chambered) and fish (2-chambered). Trace the flow of blood through the vessels, valves, and chambers of the heart and explore the role the organ plays in the propulsion of blood through the pulmonary and systemic circuits. Use findings to develop an understanding of the function of the 4-chambered heart to support endothermic organisms. AP.T.2.DSK.B

   c. Manipulate and measure cardiac output to investigate the relationship between heart rate, volume and cardiac output. AP.T.2.DSK.C

   d. Diagnose homeostatic imbalances by analyzing signs and symptoms, laboratory data, ECG/EKGs and imaging studies. Create an evidence-based treatment plan. AP.T.2.DSK.D

   a. Based on labeled illustrations, explain the components needed for an artificial heart and/or its components. AP.T.2.ICSC.A

   b. Describe the relationship between the structure and specialized function of cardiac muscle cells. AP.T.2.ICSC.B

   c. Create labeled illustrations, models, or written descriptions to differentiate between arteries, arterioles, capillaries, venules and veins in terms of structure and function. AP.T.2.ICSC.C

   d. Describe how microgravity can be applied on Earth to treat or prevent circulatory diseases. AP.T.2.ICSC.D

   e. Diagnose an individual by analyzing an electrocardiogram. AP.T.2.ICSC.E

   f. Create labeled illustrations or models of congenital cardiovascular defects and explain how they disrupt normal cardiac function. AP.T.2.ICSC.F

   a. Create labeled illustrations or models to describe the pathway of blood through the valves, chambers and major vessels of the heart. AP.T.2.RAS.A

   b. Create labeled illustrations or models to describe the pathway of blood through the pulmonary and systemic circuits. AP.T.2.RAS.B

   c. Identify the functions of the cardiovascular system. AP.T.2.RAS.C

   d. Identify the cells and tissues of the cardiovascular system. AP.T.2.RAS.D

   f. Identify the components of cardiac output. AP.T.2.RAS.F

g. Explain the relationship between heart rate, volume and cardiac output. AP.T.2.RAS.G

h. Match electrocardiogram (ECG/EKG) waves to events in the cardiac cycle. AP.T.2.RAS.H

i. Describe the features of an electrocardiogram (ECG/EKG) used to identify homeostatic imbalances. AP.T.2.RAS.I

j. Identify homeostatic imbalances of the cardiovascular system. AP.T.2.RAS.J

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**3. Lymphatic and immune systems** AP.T.3

a. Explain how antibiotic resistance arises in a microbial population using insights from an understanding of evolution through natural selection. AP.T.3.DSK.A

b. Design an experiment to test the effectiveness of antibacterial products. AP.T.3.DSK.B

a. Create a public service announcement highlighting the benefits of vaccinations for children, including risks to the population at large. AP.T.3.ICSC.A

b. Compare the treatment of bacterial and viral infections. Include concepts of nonspecific and specific resistance. AP.T.3.ICSC.B

c. Create a community education campaign to increase awareness about the transmission of insect-transmitted diseases, their causes and prevention. AP.T.3.ICSC.C

d. Critique the effectiveness of tonsil removal on infection rates. AP.T.3.ICSC.D

e. Design a model to demonstrate the spread of a pathogen throughout a population. AP.T.3.ICSC.E

a. Create labeled illustrations or models of the cells of the immune system. AP.T.3.RAS.A

b. Explain how the immune system works. AP.T.3.RAS.B

c. Describe the uses for Enzyme-Linked Immunosorbent Assay (ELISA). AP.T.3.RAS.C

d. Identify and describe the structures and functions of the lymphatic system. AP.T.3.RAS.D

e. Create a flowchart to demonstrate the circulation of lymph throughout the body. AP.T.3.RAS.E

f. Describe the mechanisms of autoimmune responses. AP.T.3.RAS.F

1. **Digestive system** AP.AE.1

    a. Propose a redesign of an alimentary canal segment and/or accessory digestive organ. AP.AE.1.DTES.A

    b. Propose a procedure as a potential cure for cirrhosis or ulcers using tissue engineering techniques. AP.AE.1.DTES.B

    c. Explore the types of bariatric surgeries and compare their safety and effectiveness to determine whether this is an effective weight-loss solution. Explain the advantages and disadvantages. AP.AE.1.DTES.C

    d. Research global geographic variation in the prevalence of lactase persistence. Relate this geographic variation in the ability to chemically digest milk sugar to the cultural history of dairy livestock domestication. Consider the timeframe of microevolutionary changes between human populations. AP.AE.1.DTES.D

    a. Investigate the relative lengths of the alimentary canal of various vertebrates with differing diets. Propose hypotheses to explain the relationship between relative length and diet. AP.AE.1.DSK.A

    b. Design models of mechanical and chemical digestion using varied materials. AP.AE.1.DSK.B

    c. Compare the efficiency of human digestion and ruminant digestion. AP.AE.1.DSK.C

    d. Assess the claim that probiotic foods are healthy. Provide evidence to support or refute this claim. AP.AE.1.DSK.D

    a. Journal daily food choices and relate it to the current USDA Choose My Plate recommendations. AP.AE.1.ICSC.A

    b. Explain how bariatric surgery impacts the digestive system. AP.AE.1.ICSC.B

    c. Explain how hydrochloric acid (HCl) in the stomach aids in digestion and provides protection from pathogens. AP.AE.1.ICSC.C

    d. Prepare a presentation on the importance of symbiotic colonic bacteria. AP.AE.1.ICSC.D

    a. Trace food from the mouth to the anus and describe what happens in each region. AP.AE.1.RAS.A

    b. Describe the structure and function of accessory digestive organs. AP.AE.1.RAS.B

    c. Explain the role of a specific enzyme in the digestive process. Include where it is produced, where it enters the alimentary canal, the pH range in which it works best, the types of molecules it chemically digests and what products the chemical breakdown forms. AP.AE.1.RAS.C

    d. Distinguish mechanical from chemical digestion. AP.AE.1.RAS.D

    e. Identify the regions of the stomach and their functions. AP.AE.1.RAS.E

    f. Identify tissue and cell types in digestive and accessory organs using microscopes, slides, micrographs, models or illustrations. AP.AE.1.RAS.F

2. **Respiratory system** AP.AE.2

   a. Design an action plan to improve the air quality in an area with low air quality (e.g., construction dust in a building). AP.AE.2.DTES.A

   b. Determine the design specifications of a face mask to filter fine particulate matter (PM 2.5 particles) resulting from the combustion of fossil fuels. AP.AE.2.DTES.B

   c. Design a device to improve the respiratory function in athletes. AP.AE.2.DTES.C

   a. Design a model to show how cold/flu impacts respiratory function. Use the model to investigate how various remedies alleviate symptoms. AP.AE.2.DSK.A

   b. Investigate factors which alter respiratory volumes. Compare breathing in obstructive and restrictive diseases (e.g., simulate obstructive disease by wrapping a belt around the chest and tightening appropriately, simulate restrictive disease by pursing lips around a straw). Collect data on respiratory volumes during obstructive and restrictive respiratory disorders (e.g., use a tape measure to measure the thoracic cavity as an estimate of volume). AP.AE.2.DSK.B

   c. Investigate local air quality and asthma or other pulmonary disease rates. Formulate an argument for how the air quality in an area impacts local respiratory health. AP.AE.2.DSK.C

   d. Perform an investigation to compare pre- and post- exercise data (e.g., breathing rate, depth, tidal volume). AP.AE.2.DSK.D

   a. Explain mammalian (including human) respiration by comparing it to the respiratory anatomy and physiology of the other major vertebrate groups (e.g., cephalochordates/urochordates, fish, amphibians, amniotes). AP.AE.2.ICSC.A

   b. Interpret spirometry data and match it to the appropriate "patients"; normal, asthmatic, smoker, athlete. Provide evidence to support your claim. AP.AE.2.ICSC.B

   c. Explore asthma rates, pollution levels and ozone levels, globally. AP.AE.2.ICSC.C

   d. Create a poster or other graphic comparing the size of PM 2.5 particles generated by combustion of fossil fuels to the size of particles that can be diffused by the surfaces of the respiratory system (including the size of red blood cells). AP.AE.2.ICSC.D

   a. Identify sections of the respiratory tree by histological slides/images. AP.AE.2.RAS.A

   b. Explain how the structure in each portion of the respiratory tree supports its function. AP.AE.2.RAS.B

   c. List the normal respiratory volumes. AP.AE.2.RAS.C

   d. Explain what factors alter respiratory volumes. AP.AE.2.RAS.D

   e. Name muscles used for inspiration and expiration. AP.AE.2.RAS.E

   f. Explain the physiological effects and damages caused by PM 2.5 particles generated by the combustion of fossil fuels. AP.AE.2.RAS.F

   g. Differentiate between tidal volume and breathing rate. AP.AE.2.RAS.G

   h. Explain how to determine breathing rate and depth. AP.AE.2.RAS.H

3. **Urinary system** AP.AE.3

   a. Design a device that serves as a "mini dialysis" machine to be used in patients with renal failure. List and discuss the limitations. AP.AE.3.DTES.A

   a. Design a model using dialysis tubing and some common solute to demonstrate the movement of wastes from interstitial fluid to the renal tube. AP.AE.3.DSK.A

   b. Match representative urine lab values (concentrations) with mock patient scenarios for a condition (e.g., high ADH, dehydration, excess coffee, urinary tract infection, diuretics). Create a treatment plan for the patient. AP.AE.3.DSK.B

   a. Illustrate filtration, secretion and reabsorption of ions/molecules in the kidney. AP.AE.3.ICSC.A

   b. Explain the relationship between the renal system and other organ systems (e.g., vascular). Include complications of renal failure. AP.AE.3.ICSC.B

   c. Interpret lab values to determine what ions/proteins need to be altered during dialysis. AP.AE.3.ICSC.C

   d. Create a pamphlet that explains the impact of diet on blood chemistry and how that affects kidney function, especially in those on dialysis. AP.AE.3.ICSC.D

   e. Compare the functions of current hemodialysis machines with the actual kidneys. AP.AE.3.ICSC.E

   f. Illustrate or describe the roles of osmosis and diffusion in the process of urine formation. AP.AE.3.ICSC.F

   g. Explain what lab values you would expect in various patient scenarios (e.g., infection, dehydration). AP.AE.3.ICSC.G

   h. Kangaroo rats live in the Mojave Desert of the U.S. Predict how the relative dimensions of their nephrons compare with those of humans. Justify the prediction. AP.AE.3.ICSC.H

   a. Trace the formation of urine through the processes of osmosis and diffusion. AP.AE.3.RAS.A

   b. Describe the basic physiological processes accomplished by the nephron (filtration, reabsorption, secretion). AP.AE.3.RAS.B

   c. Describe the process by which the body eliminates excess fluids. AP.AE.3.RAS.C

   d. Identify normal urine concentrations. AP.AE.3.RAS.D

   e. Illustrate or describe the roles of osmosis and diffusion in the process of urine formation. AP.AE.3.RAS.E

   f. Explain how molecules/hormones influence the body's hydration status. AP.AE.3.RAS.F

   g. Identify the impacts of drinking too much water (i.e., hyperhydration). AP.AE.3.RAS.G

   h. Describe the gross and histological structure of the urinary bladder. Relate the structure of the urinary bladder to its function. AP.AE.3.RAS.H

1. **Reproductive system** AP.R.1
    a. Design an artificial womb (ectogenesis) that could support embryonic life. AP.R.1.DTES.A
    a. Examine how environmental variables can impact sea urchin fertilization. AP.R.1.DSK.A
    a. Develop a visual graphic with a timeline indicating the evolution of reproductive physiology in mammals from egg laying monotremes, marsupials and then placental mammals. AP.R.1.ICSC.A
    b. Display the current global distribution of monotreme, marsupial and placental mammals. Propose one or more hypotheses to explain these observed distribution patterns. AP.R.1.ICSC.B
    c. Interpret information from a case study to discuss the misconception that all menstrual cycles last 28 days. AP.R.1.ICSC.C
    d. Design a poster or similar graphic to inform peers of the global, human population over the last 5,000 years. AP.R.1.ICSC.D
    a. Identify the structures of the male reproductive system and the functions of each structure. AP.R.1.RAS.A
    b. Identify the structures of the female reproductive system and the functions of each structure. AP.R.1.RAS.B
    c. Explain the pathway of a gamete through each reproductive system. AP.R.1.RAS.C
    d. Compare the processes of oogenesis and spermatogenesis. AP.R.1.RAS.D