

Anatomy/Physiology

Core Ideas/Crosscutting Concepts:

Introductory concepts

Hierarchy of organization from atom to organism (crosscut to biology)

Student review of cell structure and organelle functions (crosscut to biology)

Role of Latin and Greek etymology (crosscuts to foreign language)

Role of major body cavities, parts of the body

Homeostasis, systems, and + and - feedback loops (crosscut to biology and environmental science)

Ways to study Anatomy

Contrast cost, effectiveness, accuracy, safety and ease of the following techniques:

autopsy, surgery, X-ray, CT, MRI, PET

Crosscuts to economics, environmental science (hazards of radioactive substances), physics (waves, magnetism, subatomic particles)

Core Ideas/Crosscutting Concepts:

Tissues

Visually identify the body's four major tissue types (epithelial, connective, muscle, nervous), note why there are variations, and determine functional role of each tissue type within an organ or organ system.

Develop microscopy skills including use of oil immersion lens, and accurate, detailed histologic drawing with feature identification.

Integumentary System (Skin)

Overall functions of the skin, and differentiation into layers (epidermis, dermis, and subcutaneous), each of which accomplishes different purposes.

Histology of skin; visual identification of layers and features.

What is the cause of skin pigmentation, and what purpose does it serve? Why did races evolve? This is tied into evolution and anthropology (crosscutting to human geography).

Glands, esp. sweat, and tie in to thermal homeostasis

Nails and hair: composition, purpose, and human variations (hair). Crosscut to evolution (biology,).

Texture of hair (straight vs. curly) relates to keratin protein structure which, in turn, relates to individual inherited DNA sequences. (crosscut to biology)

Discuss the role UV rays and Vitamin D has on the skin.

Relate common phenomena (adaptation, referred pain) to skin receptors, and know the types. (Information processing in brain)

Effects of burns on the skin and on body metabolism and immunity. (crosscutting to health)

Learning Targets:

Biology

Cells

Characteristics of life regulated by cellular processes

Cell division and differentiation

Writing Process

Use organizers to clarify ideas for writing assignments.

Use revision strategies and resources to improve ideas and content, organization, word choice and detail.

Edit to improve sentence fluency, grammar and usage.

Apply tools to judge the quality of writing.

Writing Conventions

Spell grade-appropriate words correctly.

Use conventions of capitalization and punctuation in written work.

Use grammatical structures in written work.

Research

Use a variety of resources to gather new information with assistance.

Biology

Cellular processes

Characteristics of life regulated by cellular processes

Heredity

Genetic mechanisms and inheritance

Mutations

Evolution

Mechanisms

Natural selection

Genetic drift

Gene flow (immigration, emigration)

Agriculture and Environmental Systems

Animal Science

Body Systems

Identify the anatomy and describe the physiology of the integumentary systems (skin) and associated structures.

Core Ideas/Crosscutting Concepts:

Skeletal System

Both the structural and protective role of bones can be discovered by discussing student experiences. Hematopoietic role of bone requires histologic examination, and discussion of current medical techniques such as bone marrow transplants in cases of leukemia/ lymphoma.

Mineral bank functioning of bone draws in our first two hormones: calcitonin (thyroid) and parathyroid hormone (crosscutting to biology - homeostasis).

Dual nature of bone: hardness (Ca^{++}) and tensile strength (collagen) is introduced by the lab, and reinforced by studying vitamin disorders such as scurvy and rickets (and osteoporosis.) Crosscutting to health and chemistry.

Bone development in the embryo derives from stem cell tissue (mesenchyme) with two patterns: endochondral and intramembranous .

Bone differentiation can result in several layers: compact, spongy, periosteum and marrow cavity.

Describe the remodeling and repair of the skeleton and the homeostatic mechanisms involved
Identify and name the bones of the axial and appendicular skeletal systems and bring in features of human skeletons (crosscut to biology evolution)

Distinguish the difference between male and female pelvic girdles.

Learning Targets:

Biology

Cells

Cellular processes

Characteristics of life regulated by cellular processes

Cell division and differentiation

Classification systems are frameworks created by scientists for describing the vast diversity of organisms indicating the degree of relatedness between organisms.

Agriculture and Environmental Systems

Animal Science

Body Systems

Identify the anatomy and describe the physiology of the skeletal systems.

Core Ideas/Crosscutting Concepts:

Articulations

Distinguish among different types of joints based on structure or function.

Describe the movements the skeleton can do and relate the movements to the types of joints.

Explain the relationship between joint structure and mobility or range of motion of the joint. A common misconception is that all joints are freely moveable. (crosscutting to health and math with box and whisker plot)

Learning Targets:

Science Inquiry and Application Grades

All students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:

Identify questions and concepts that guide scientific investigations;

Design and conduct scientific investigations;

Use technology and mathematics to improve investigations and communications;

Formulate and revise explanations and models using logic and evidence (critical thinking);

Recognize and analyze explanations and models; and

Biology

Cells

Cellular processes

Cell division and differentiation

English Language Arts

Research

Communications: Oral and Visual

Give persuasive presentations that structure ideas and arguments in a logical fashion, clarify and defend positions with relevant evidence and anticipate and address the audience's concerns.

Writing

Writing Conventions

Core Ideas/Crosscutting Concepts:

Digestive System

Gastrointestinal Tube: Histological organization, regions, location and size

Concept that food is not really part of you until it is absorbed.

Concept of symbiotic bacteria in lower intestine crosses with ecology.

Sphincters restricting flow

pH changes throughout tube

Enzymatic activity throughout digestive system crosscuts with enzymes and biological molecules (monomers/polymers) in biology and chemical reactions in chemistry

Endocrine controls of pancreas (insulin) crosscuts with health.

Accessory Organs: Gallbladder, Liver, Pancreas

Liver as detoxification organ crosscuts with health (alcohol, drugs)

Neural controls over digestion: involuntary and voluntary

Learning Targets:

Chemistry

Structure and Properties of Matter

Phases of matter

Interactions of Matter

Chemical reactions

Biology

Cells

Cell structure and function

Structure, function and interrelatedness of cell organelles

Cellular processes

Characteristics of life regulated by cellular processes

Photosynthesis, chemosynthesis, cellular respiration

Cell division and differentiation

Agriculture and Environmental Systems

Animal Science

Identify the anatomy and describe the physiology of the digestive systems.

Core Ideas/Crosscutting Concepts:

Respiratory System

The respiratory system operates based on principles of diffusion and gas laws. (Connects to chemistry)

It is an interplay between air moving and containing structures (Ex. alveoli) and blood moving and containing structures (Ex. capillaries).

The respiratory system supports cellular respiration by providing reactants and removing waste products. (connects to Biology I)

This system is designed to maintain homeostasis of gases (oxygen and CO₂) and pH.

Mechanical movement of air is aided by negative pressure breathing involving diaphragm and pleural cavities, and specialized upper respiratory features such as the epiglottis, nasal cavities and bronchial tree. (Connects to physics)

The respiratory system influences the heart in many ways, altering pressure levels, and producing gas levels that affect heart rate and strength of contraction. (Ex. HAPE)

Lungs have a built in cleaning and immune system to keep invaders at bay. Exposure to air pollutants including smoking diminishes these immune capabilities. (Connects to health)

Brain controls in the pons and medulla affect rate and rhythm of breathing, and respond to changing levels of oxygen, carbon dioxide and pH.

Learning Targets:

Science Inquiry and Application

All students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:

Design and conduct scientific investigations;

Use technology and mathematics to improve investigations and communications;

Chemistry

Interactions of Matter

Chemical reactions

Types of reactions

Equilibrium

Acids/bases

Gas laws

Ideal gas law

Biology

Diversity and Interdependence of Life

Ecosystems

Homeostasis

Equilibrium and disequilibrium

Cells

Cell structure and function

Structure, function and interrelatedness of cell organelles

Eukaryotic cells and prokaryotic cells

Cellular processes

Core Ideas/Crosscutting Concepts:

The Cardiovascular system carries, moves and delivers gases, nutrients, ions and wastes to and from the body's tissues.

Diffusion is the main process involved in these movements. (Crosscut to Biology)

This provides homeostasis for the body.

The blood has plasma with varied solutes, white blood cells that control immunity, erythrocytes that carry gases and platelets which control hemostasis.

The blood absorbs consumed nutrients from the intestines and provides them to tissues through capillaries, and removes body wastes to the kidneys for excretion. The blood absorbs oxygen from the lungs, delivers this to tissues, and removes waste CO₂ from tissues (and dumps them through the lungs).

Consumption of excessive fats clogs the arteries and compromises CV function. (Crosscut to health)

The heart is a double pump, which responds to differing body conditions by changing its rate or stroke volume.

Its neural circuitry allows a simultaneous contraction of atria followed by a simultaneous contraction of ventricles.

The brain controls this by monitoring both blood pressure and gas levels in outgoing arteries.

Blood pressure reflects cardiovascular functioning, and, when too high or low, can reflect or result in systemic disease.

Valves prevent backflow within heart for greater energy efficiency.

Learning Targets:

Science Inquiry and Application

All students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:

Identify questions and concepts that guide scientific investigations;

Design and conduct scientific investigations;

Use technology and mathematics to improve investigations and communications;

Recognize and analyze explanations and models; and

Communicate and support a scientific argument.

Physical Science

Forces and Motion

Displacement, velocity (constant, average and instantaneous) and acceleration

Interpreting position vs. time and velocity vs. time graphs

Forces

Types of forces (gravity, friction, normal, tension)

Biology

Evolution

Mechanisms

Natural selection

Gene flow (immigration, emigration)

Diversity of Life

Variation of organisms within a species due to population genetics and gene frequency

Ecosystems

Homeostasis

Equilibrium and disequilibrium

Cells

Cell structure and function

Structure, function and interrelatedness of cell organelles

Eukaryotic cells and prokaryotic cells

Cellular processes

Characteristics of life regulated by cellular processes

Cell division and differentiation

Agriculture and Environmental Systems

Animal Science

Identify the anatomy and describe the physiology of the circulatory systems.

Core Ideas/Crosscutting Concepts:

Nervous systems operate by the same principles: chemical (synapses and glial cell secretions) and electric signals (action potentials) but have some unique structures as well (Ex. blood brain barrier or ventricles in CNS).

Gated channels allow fluctuations of ion concentrations along neuron membranes, allowing electric signals to flow. Myelin sheaths speed up transmission and prevent jumping from one axon to another.

Synapses involve a variety of neurotransmitters, both excitatory and inhibitory. Summation determines what the final reaction will be in the neuron. Chemicals such as medicines or illicit drugs can affect the CNS by affecting synapses or neurotransmitters.

Sensory, association and motor neurons work together to determine type and speed of reactions to stimuli, and whether memory or learning will occur.

Reflexes occur independent of brain involvement, and are protective.

The cortex is regionalized wrt function, and areas of the body are mapped for sensory and motor localization. Deeper areas of the brain serve functions of relay (thalami), motor coordination (basal ganglia and cerebellum), fluid control (ventricles) and mood/impulses (limbic system).

Peripheral nerves are typically mixed sensory/motor, whereas the spinal cord is regionalized wrt sensory and motor tracts.

Autonomic nervous system contrasts from the somatic system in that it is involuntary, and contains both stimulatory (sympathetic) and relaxing (parasympathetic) branches, striving for homeostasis.

Learning Targets:

Biology

Diversity and Interdependence of Life

Ecosystems

Homeostasis

Equilibrium and disequilibrium

Cells

Cell structure and function

Structure, function and interrelatedness of cell organelles

Eukaryotic cells and prokaryotic cells

Cellular processes

Characteristics of life regulated by cellular processes

Photosynthesis, chemosynthesis, cellular respiration

Chemistry

Interactions of Matter

Chemical reactions

Energy

Equilibrium

Acids/bases

Science Inquiry and Application

All students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:

Identify questions and concepts that guide scientific investigations;

Design and conduct scientific investigations;

Use technology and mathematics to improve investigations and communications;

Formulate and revise explanations and models using logic and evidence (critical thinking);

Recognize and analyze explanations and models; and

Communicate and support a scientific argument.

Agriculture and Environmental Systems

Identify the anatomy and describe the physiology of the nervous systems.

Core Ideas/Crosscutting Concepts:

Excretory system

Kidneys service the cardiovascular system by cleaning toxins out of blood (the main one being urea, a protein breakdown product) and regulating fluid and ion balance (homeostasis).

The nephron is the basic functional unit of the kidney; it filters blood, reabsorbs water and ions to reconstitute the blood, and secretes toxins and excesses actively.

The renal corpuscle is the most vulnerable part of nephron, filtering only the smallest solutes and water. The glomerular basement membrane is vulnerable to attack by autoimmune processes.

The kidney begins by making generic daily urine, and then customizes this urine for the day's needs based on information coming from the juxtaglomerular apparatus and four hormones: aldosterone,

renin, angiotensin and antidiuretic hormone.

The loop of Henle runs a countercurrent multiplier which continues to concentrate urine even as it decreases in volume by adjusting the interstitium to always be more concentrated than the same medullary level of urine that's in the descending or ascending loop.

The urinary bladder stores urine, and, with the use of an involuntary (parasympathetic spinal reflex) and voluntary sphincter, it releases urine to the exterior of the body by way of a urethra.

Urine can be studied to judge the health of the kidneys and the blood, to assess hydration status, to pick up infections, and metabolic disorders.

Learning Targets:

Science Inquiry and Application

During the years of grades 9 through 12, all students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:

Identify questions and concepts that guide scientific investigations;

Design and conduct scientific investigations;

Use technology and mathematics to improve investigations and communications;

Formulate and revise explanations and models using logic and evidence (critical thinking);

Recognize and analyze explanations and models; and

Communicate and support a scientific argument.

Core Ideas/Crosscutting Concepts:

Reproductive System

Male system is set up to have "fresh" gametes, producing sperm only from puberty on, making fresh sperm daily, and delivering sperm and newly made seminal fluid within seconds to the female.

Scrotum is designed to regulate sperm temperature, keeping them cooler than typical body temp.

Testes are pressurized by tunica albuginea, comprised of seminiferous tubules whose progenitors to mature sperm mature from the outside in, undergoing two meiotic divisions to become haploid and having half the chromosome count.

Sperm are protected and nourished by Sertoli cells and seminal fluid. Due to their lack of cytoplasm and organelles, they are extremely vulnerable and have a short life span once out of the body. They are also

protected from immunologic attack by their own body.

Male hormones control sperm maturation and secondary sex characteristics.

Epididymis store sperm, vas carry sperm to base of bladder where 3 accessory organs add ingredients to make up semen.

Vasectomies are performed by cutting the vas, thus preventing pregnancies.

Prostate gland hypertrophies later in life, causing problems and sometimes cancer.

The penis undergoes erection by filling cavernous spaces with blood under parasympathetic control. Ejaculation is a sympathetic process involving skeletal and smooth muscle contractions.

Impotence is the inability to achieve erection (many causes) and infertility is the inability to make adequate or healthy sperm.

Female Reproductive System

Ovaries: Ovarian cycle involves the maturation of several ova per month from precursor cells which have already completed early stages during fetal period. This results in "older" eggs as a woman enters middle age. Granulosa cells nourish the developing gametes, and Graffian follicles are the most mature stage. Only one ovum is released per month, and meiosis is completed only during fertilization.

Several hormones govern the menstrual cycle, which allow maturation and ovulation of eggs, and cyclic preparation then stripping off of uterine endometrium. Pregnancy usually occurs when ovum maturation and location within fallopian tubes is correct. Birth control pills alter menstrual hormones to prevent pregnancy.

Fallopian tubes carry ovum to uterus, whose lining, under influence of both mother and baby's hormones, maintains a thick lining and allow placental development.

Cervix protects uterus from infection, holds baby in, and is helped in the latter by supportive ligaments of the uterus.

Vagina is designed to admit the penis and hold semen for prolonged periods of time.

Female genitals have more subtle changes during sex than males, but anatomic and physiologic changes such as gland secretion and muscular contraction occur to promote fertilization.

Special hormones are released associated with pregnancy, such as HCG and oxytocin.

Learning Targets:

Science Inquiry and Application

During the years of grades 9 through 12, all students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:

Identify questions and concepts that guide scientific investigations;

Use technology and mathematics to improve investigations and communications;

Formulate and revise explanations and models using logic and evidence (critical thinking);

Biology

Heredity

Cellular genetics

Structure and function of DNA in cells

Genetic mechanisms and inheritance

Mutations

Diversity and Interdependence of Life

Ecosystems

Homeostasis

Cells

Cell structure and function

Structure, function and interrelatedness of cell organelles

Eukaryotic cells and prokaryotic cells

Cellular processes

Characteristics of life regulated by cellular processes

Cell division and differentiation