Havre Public Schools Anatomy & Physiology High School

Course Information
Course Title: Anatomy & Physiology
Grade Level: 11 and 12
Length: 1 Year
Period(s) Per Day: 1

Essential Understanding:
Anatomy and physiology is a course for students who have passed biology and are interested in working in the medical field or interested in how the body works. This course explores the structures and functions of the human body and how one determines the other. Students will also discuss how the body uses feedback loops to maintain homeostasis and if homeostasis is disrupted, diseases and disorders are developed.

Themes:
Upon completion of Anatomy and Physiology, the following underlying themes will be discussed and incorporated in the units covered in this class:

- **Homeostasis**
  Organisms will monitor the external and internal environments to keep the body alive by using multiple feedback loops
- **Hierarchy of Structure**
  Each body system is composed of increasingly complex structures working together to accomplish a singular function. Cells work together to form a tissue that organizes into an organ. Organs work together to form an organ system. The collection of organ systems works together to maintain life.
- **Structure and Function**
  The structure of cells, tissues, and organs determines the functions of those structures

Course Structure:
Each unit in Anatomy and Physiology will be designed using the following format:

Engage	Students discuss and illustrate the major concepts of the body system in the unit
Explore	Students actively explore concepts independently and collaboratively in a science lab setting.
Explain	Students develop vocabulary, label diagrams, and define major concepts and processes through class and group discussion. Students create written explanations of the concepts learned as well.
Elaborate	Students develop a deeper and broader understanding of concepts in the lab and in a variety of independent and group activities.
Evaluate	Students assess their understanding of the concepts learned during the unit.

Course Objectives & Expectations:

Structure and Function

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.

Stability and Change

- Feedback (negative or positive) can stabilize or destabilize a system.

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

Student Objectives:

By the end of this course students will:

1. Develop a vocabulary of appropriate terminology to effectively communicate information related to anatomy and physiology.
2. Recognize the anatomical structures and explain the physiological functions of body systems.
3. Recognize and explain the principle of homeostasis and the use of feedback loops to control physiological systems in the human body.
4. Use anatomical knowledge to predict physiological consequences, and use knowledge of function to predict the features of anatomical structures.
5. Recognize and explain the interrelationships within and between anatomical and physiological systems of the human body.
6. Demonstrate laboratory procedures used to examine anatomical structures and evaluate physiological functions of each organ system.

A & P Pacing Guide

Unit 1: Introduction to Anatomy and Physiology (2 weeks)

Week 1-2	**Course Introduction and Overview** - Define anatomy and physiology and explain their relationship - Describe various levels of structural organization within the human body and explain how they are related - Define and identify the importance of homeostasis to health and describe an example of a homeostatic mechanism - Use proper anatomical terminology to describe directional terms, body regions, planes of reference, and body cavities - Identify correct organ systems for each organ using a human torso model or diagrams - Identify major body cavities and the organs within - Unit 1 Assessment: Multiple Choice & Short Answer Essay Exam	LS1: LS1.C:	From Molecules to Organisms: Structures and Processes Organization for Matter and Energy Flow in Organisms

Units 2: Basic Chemistry (2 weeks)

Week 3-4	**Basic Chemistry** - Introduction to basic chemistry concepts (atoms, molecules, bonds) - Types of reactions - Properties of salt, water, and acids/bases - Biochemistry - Unit 2: Assessment: Multiple Choice & Short Answer Essay Exam	LS1: LS1.A: LS1.C:	From Molecules to Organisms: Structures and Processes Structure and Function Organization for Matter and Energy Flow in Organisms

Units 3: Cell Biology & Body Tissues (2 weeks)

Week 4-5	**Cell Biology & Body Tissues**
	- Describe the structure of the plasma membrane and how structure relates to function
	- Identify the major organelles of a cell, their structure, and their function
	- Define the types of movement through a membrane
	  - Osmosis
	  - Active transport
	  - Diffusion
	  - Facilitated diffusion
	  - Endocytosis and exocytosis
	- Identify the primary tissue types of the body (epithelial, connective, muscular, nervous) and their chief subcategories
	- Explain how the major tissue types differ structurally and functionally
	- Discuss the process of tissue repair and the inflammatory response
	- Demonstrate proper care and use of a microscope by examining prepared slides
	- Examine and differentiate between various kinds of tissue using a microscope and prepared slides
	  - Epithelial: squamous, stratified, cuboidal, columnar, and transitional
	  - Connective: adipose, blood, cartilage, bone, dense, areolar
	  - Nervous: neuron, neuroglia
	  - Muscular: smooth, skeletal, cardiac
	- State the location of the tissue types in the body
	- List the general functions and location of each membrane type
		LS1:
		
		LS1.A:
		
		LS1.C:
			From Molecules to Organisms: Structures and Processes
			
			Structure and Function
			
			Organization for Matter and Energy Flow in Organisms

- Cutaneous
- Mucous
- Serous
- Synovial

- Compare the structure of the major membrane types
- Unit 3: Assessment: Multiple Choice & Short Answer Essay Exam

Unit 4: Integumentary System (2 weeks)

Week 6-7	- Summarize the functions of the skin and explain how these functions are accomplished - Describe the structure and function of the dermis and epidermal layers - Name the factors that determine skin color, and describe the function of melanin - Name the glands of the skin, their function, and describe the secretions they produce - Sebaceous - Sweat - Apocrine - Eccrine - Describe the accessory organs of the skin and their function - Nails - Hair - Identify some health disorders of the integumentary system and their causes (may include, but not limited to): - Skin cancer - Acne - Burns - Staph scalded skin syndrome - Vitiligo - Distinguish between the epidermis, dermis and subcutaneous layers of the skin using anatomical structures and function - Explain how new hair, nail, and skin cells are formed and the process of keratinization - Identify the layers of the skin, hair follicles and glands in a prepared slide and diagram - Unit 4 Assessment: Multiple Choice & Short Answer Essay Exam	LS1: LS1.A: LS1.C:	From Molecules to Organisms: Structures and Processes Structure and Function Organization for Matter and Energy Flow in Organisms

Unit 5: Skeletal System (4 weeks)

Week 8-11	- List and explain the function of the skeletal system
	- Differentiate between the basic structure of compact and cancellous bone
	- Identify microscopic bone structures including
	  - Haversian systems
	  - Osteocytes
	  - Osteoclasts
	  - Osteoblasts
	  - Bone matrix
	  - Periosteum
	- Explain the process of bone formation, growth and repair
	- Describe some disorders and diseases affecting the skeletal system (may include, but not limited to):
	  - Osteoma Acia
	  - Rickets
	  - Osteoarthritis
	  - Rheumatoid arthritis
	  - Compound/simple fractures
	  - Osteoporosis
	- Distinguish between and identify the bones within the axial skeleton and the appendicular skeleton
	- Locate and name the major bones of the human skeleton
	- Distinguish by examination the different types of vertebrae
	- Identify bones and their major processes from an assembled and disarticulated skeleton
	- Describe and locate the different types of joints and compare the amount of movement allowed by each
	  - Synovial, fibrous, and cartilaginous
	- Compare major categories of joints as to their structure and mobility
	- Demonstrate or identify the various body movements
	- Unit 5 Assessment: Multiple Choice & Short Answer Essay Exam
	- Engineering Project: Designing, Constructing, and Building a Prosthetic Leg
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			From Molecules to Organisms: Structures and Processes
			
			Structure and Function
			
			Organization for Matter and Energy Flow in Organisms

Unit 6: Muscular System (4 weeks)

Week 12-16	- Describe similarities and differences in the structure and function of the three types of muscle tissue, and indicate where they are found in the body
	- Describe the gross and microscopic anatomy of skeletal muscle
	- Describe how an action potential is initiated in a muscle cell and the events of muscle cell contraction
	- Distinguish between the following movements
	  - Flexion/extension
	  - Rotation/circumduction
	  - Abduction/adduction
	  - Supination/pronation
	- Identify some human superficial muscles including their name, origin, insertion, antagonist muscle group, and primary action
	- List and describe some problems/diseases of the muscular system (may include, but not limited to):
	  - Cerebral palsy
	  - Muscular dystrophy
	  - Use of anabolic steroids
	- Identify and describe each type of muscle tissue microscopically
	- Name and locate the major structures of a skeletal muscle fiber
	- Distinguish between the origin and insertion of a muscle
	- Describe the general actions of prime movers, synergists, and antagonists
	- Unit 6 Assessment: Multiple Choice & Short Answer Essay Exam
	- Engineering Project: Designing, Constructing, and Building a Hand
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		LS1.A:
		
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			From Molecules to Organisms: Structures and Processes
			
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			Organization for Matter and Energy Flow in Organisms

Unit 7: Nervous System (4 weeks)

Week 17-20	- Name and describe the functions of the two major divisions of the nervous system - Describe the structure of neurons and the function of their components - Explain how a nerve impulse is conducted along a neuron as well as from one neuron to another - Resting potential	LS1: LS1.A: LS1.C:	From Molecules to Organisms: Structures and Processes Structure and Function Organization for Matter and Energy Flow in Organisms

	- Action potential - Synaptic transmission - List the parts of a reflex arc and describe its function - Discuss the meningeal layers of the central nervous system - Name the major parts of the brain and spinal cord and state the function of each - Discuss the formation of cerebrospinal fluid and its circulation - Contrast the structure and function of the autonomic and somatic nervous system - Distinguish between sympathetic and parasympathetic divisions of the autonomic system - Identify disorders of the nervous system and their causes (may include, but not limited to): - Parkinson's disease - Multiple sclerosis - Tetanus - Alzheimer's - Strokes - Poliomyelitis - Identify the major parts of a brain through dissection - Demonstrate several reflex actions - Identify important anatomical areas on a spinal cord such as nerve plexuses, connective tissue coverings, and white/gray matter - Unit 7 Assessment: Multiple Choice & Short Answer Essay Exam	LS1.D	Information Processing

Unit 8: Special Senses (2 weeks)

Week 21-22	- Distinguish between somatic senses and special senses - Name the five kinds of receptors and explain their functions - Explain the relationship between the senses of smell and taste and the mechanism for each - Name the parts of the ear and the function of each - Name the parts of the eye and the function of each - Identify the major ear structures - Trace the pathway of sound vibrations from the tympanic membrane to the hearing receptors - Identify the major eye structures on a dissection specimen	LS1: LS1.A: LS1.C: LS1.D	From Molecules to Organisms: Structures and Processes Structure and Function Organization for Matter and Energy Flow in Organisms Information Processing

	- List the structures through which light passes as it travels from the cornea to the retina - Unit 8 Assessment: Multiple Choice & Short Answer Essay Exam		

Unit 9: Endocrine System (2 weeks)

Week 23-24	- Name and locate the major endocrine glands and tissues of the body from a model or diagram - Differentiate between the effects of steroid and non-steroid hormones on target cells - List hormones produced by the endocrine glands and the physiological effects of each - Describe how the hypothalamus regulates hormone secretion from the pituitary gland - Describe pathological consequences of hypersecretion and hyposecretion of various hormones - Describe and give an example of a negative feedback mechanism in hormonal production and control - Unit 9 Assessment: Multiple Choice & Short Answer Essay Exam	LS1: LS1.A: LS1.C: LS1.D	From Molecules to Organisms: Structures and Processes Structure and Function Organization for Matter and Energy Flow in Organisms Information Processing

Unit 10: Blood & Cardiovascular System (4 weeks)

Week 25-28	- List the functions of blood
	- Describe the structure, function and life cycle of erythrocytes
	- Identify the various types of leukocytes and the role each plays in the body
	- Describe the components of plasma and give their functions
	- Describe the major events of hemostasis
	- Explain the basis of ABO and Rh incompatibilities
	- Identify various disorders of the blood (may include, but not limited to):
	  - Anemia
	  - Leukemia
	  - Hemophilia
	  - Sickle cell anemia
	  - Polycythemia
	- Examine blood cells, identifying erythrocytes and the five types of leukocytes
	- Perform a differential white blood cell count and give examples of disorders that produce abnormal blood test values
	- Describe the structure and function of the heart
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		LS1.A:
		
		LS1.C:
			From Molecules to Organisms: Structures and Processes
			
			Structure and Function
			
			Organization for Matter and Energy Flow in Organisms

- Describe the flow of blood through the heart, naming each chamber, valve, and vessel through which the blood passes
- Explain the structure and function of the conduction system of the heart
- Distinguish between systemic, cardiac, and pulmonary circulation
- Describe the intrinsic and extrinsic regulation of the heart
- Distinguish between an artery, vein, and capillary based on structure, location, and function
- Describe the exchange of material across the capillary membrane
- Explain the mechanisms of return of venous blood to the heart
- Describe how blood pressure is created, monitored, and controlled
- Identify some major vessels of the body and the areas they service
- Identify various disorders (may include, but not limited to):
    - Tachycardia
    - Heart murmurs
    - Pericarditis
    - Coronary heart disease
    - Heart failure
    - Aneurysm
    - Hypertension
    - Arteriosclerosis
- Identify major structural features of the heart on a dissection specimen
- Examine pulse, determine pulse rates
- If possible, use a stethoscope to identify cardiac cycle sounds and a sphygmomanometer to measure blood pressure
- Locate major arteries and veins in the pulmonary and systemic circuits using a chart or model
- Identify major structures of the heart through dissection
- Unit 10 Assessment: Multiple Choice & Short Answer Essay Exam

Unit 11: Lymphatic & Immune System (2 weeks)

Week 29-30	Describe the structure and principal functions of the lymph system Describe how lymph is formed and transported	LS1:	From Molecules to Organisms: Structures and Processes

	- Name three lymphatic organs and explain the functions of each - Locate and identify the major lymphatic pathways - Describe the structure of a lymph node - Identify the major microscopic structures of a lymph node, thymus, and spleen - Distinguish between innate (non-specific) and adaptive (specific) defenses and provide examples of each - Differentiate between antibody and antigen - Compare the functions of the B- and T-cell lymphocytes - Discuss the relationship between the HIV virus and the immune system disease, AIDS - Unit 11 Assessment: Multiple Choice & Short Answer Essay Exam	LS1.A: LS1.C:	Structure and Function Organization for Matter and Energy Flow in Organisms

Unit 12: Respiratory System (3 weeks)

Week 31-33	- Name the structures and describe the functions of the upper and lower respiratory tracts
	- Identify respiratory air volumes during normal and forceful breathing efforts
	- Describe the mechanisms responsible for inspiration and expiration, including pressure changes, muscular contractions, and nervous control
	- Explain how alterations in blood carbon dioxide levels, blood pH, and blood oxygen levels affect respiration
	- Discuss the role of partial pressure in the exchange of gases in lungs and tissues
	- Explain the role of hemoglobin in the transport of gases
	- Describe three ways in which carbon dioxide is carried in the blood
	- Identify respiratory problems and causes of conditions (may include, but not limited to):
	  - Tuberculosis
	  - Emphysema
	  - Asthma
	  - Pneumonia
	  - Pleurisy
	  - Lung cancer
	  - Hyperventilation
	  - Cystic fibrosis
	- Label the major respiratory system structures on a diagram or model
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		LS1.A:
		
		LS1.C:
			From Molecules to Organisms: Structures and Processes
			
			Structure and Function
			
			Organization for Matter and Energy Flow in Organisms

- Recognize ciliated epithelium and lung tissue on a microscopic slide
- Trace the movement of air through the respiratory tract
- Unit 12 Assessment: Multiple Choice & Short Answer Essay Exam

Unit 13: Digestive System (3 weeks)

Week 33-35	- Describe the location and functions of the organs of the alimentary canal
	- Explain the difference between mechanical and enzymatic digestion and the organs which perform each
	- Describe mastication, deglutition, and peristalsis
	- Label the parts of a typical tooth and describe the functions of the different types of teeth
	- Explain the role of the accessory organs in the digestive process
	  - Salivary glands
	  - Pancreas
	  - Gallbladder
	  - Liver
	- Discuss the functions and sources of the major enzymes
	  - Amylase
	  - Pepsin
	  - Lipase
	  - Trypsin
	  - Proteases
	- List the stomach secretions, describe their functions, and explain how each is regulated
	- Identify the major components of pancreatic secretion, their functions and how they are regulated
	- Describe bile, its source, composition, function and regulation
	- List the major functions of the liver
	- List the anatomical and histological characteristics of the small intestine that account for its large surface area
	- List the anatomical and histological characteristics and functions of the large intestine
	- Explain the hepatic portal system and its relation to the digestive system
		LS1:
		
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		LS1.C:
			From Molecules to Organisms: Structures and Processes
			
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	- Describe the processes of carbohydrate, lipid, and protein digestion, absorption, and metabolism
	- Describe the diseases/disorders of the digestive system (may include, but not limited to):
	  - Heartburn
	  - Gastric/duodenal ulcers
	  - Hepatitis
	  - Appendicitis
	  - Jaundice
	  - Cirrhosis
	  - Constipation
	  - Diarrhea
	- Locate and identify digestive and accessory organs with a model
	- Describe the histology of the gastrointestinal wall, including the four layers, villi, and microvilli
	- Investigate the action of pancreatic enzymes on carbohydrates and/or lipids and the effect of temperature on enzymatic activity
	- Unit 13 Assessment: Multiple Choice & Short Answer Essay Exam		

Unit 14: Urinary System (2 weeks)

Week 36-37	- List the organs of the urinary system and state a function of each
	- Describe the structure and location of the nephron within the kidney and explain the functions of its parts
	- Trace the path of blood through the renal blood vessels
	- Explain the production and composition of glomerular filtrate
	- Identify principal factors that influence filtration pressure and explain how they affect the rate of filtration
	- Trace the path of filtrate through a renal tubule
	- Explain tubular reabsorption and secretion and how they affect the composition of urine
	- Explain the regulation of urine concentration and volume dealing with hormonal, neural, and chemical controls
	- Describe the micturition reflex
	- Discuss disorders of the urinary system (may include, but not limited to):
	  - Renal failure
	  - Dialysis
	  - Kidney stones
		LS1:
		
		LS1.A:
		
		LS1.C:
			From Molecules to Organisms: Structures and Processes
			
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- Cystitis
- Describe the location of the kidneys
- Locate and identify the gross anatomical features of a kidney using a model or diagram
- Describe the features of a nephron and locate them in a model
- Conduct urinalysis tests and use them to determine the substances present in a urine specimen
- Unit 14 Assessment: Multiple Choice & Short Answer Essay Exam

Unit 15: Reproductive System (2 weeks)

Week 38-40	- Name the parts of the male and female reproductive system and their functions - Describe the structure of the testes and ovaries and the formation of gametes - Describe the route sperm cells follow from the site of their production to outside the body - Describe the structure of the penis - Explain the hormonal control of male and female reproduction - Describe the process of ovulation and fertilization - Trace the pathway of an egg after ovulation - List major events of the menstrual cycle - Discuss disorders of the reproductive system (may include, but not limited to): - Breast cancer - Pelvic inflammatory disease - Infertility - Prostate cancer - Sexually transmitted diseases - Examine microscopic structures of mammalian ovary and sperm, relating structure to function - Locate and name the structures of the male and female reproductive systems using a model or diagram - Describe the effects of FSH and LH on ovarian and testicular function - Unit 15 Assessment: Multiple Choice & Short Answer Essay Exam	LS1: LS1.A: LS1.B LS1.C:	From Molecules to Organisms: Structures and Processes Structure and Function Growth and Development of Organisms Organization for Matter and Energy Flow in Organisms

Timeline

Unit 1:	Introduction to Anatomy and Physiology	2 weeks
Unit 2:	Basic Chemistry	2 weeks
Unit 3:	Cell Biology & Body Tissues	2 weeks
Unit 4:	Integumentary System	2 weeks
Unit 5:	Skeletal System	4 weeks
Unit 6:	Muscular System	4 weeks
Unit 7:	Nervous System	4 weeks
Unit 8:	Special Senses	2 weeks
Unit 9:	Endocrine System	2 weeks
Unit 10:	Blood & Cardiovascular System	4 weeks
Unit 11:	Lymphatic & Immune System	2 weeks
Unit 12:	Respiratory System	3 weeks
Unit 13:	Digestive System	3 weeks
Unit 14:	Urinary System	2 weeks
Unit 15:	Reproductive System	2 weeks

Montana Content Standards

Students who demonstrate understanding can:

Develop and use a model to illustrate the organizational structure of interacting systems that provide specific functions within multicellular organisms. HS-LS1-2 NGSS Identifier

Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. HS-LS1-3 NGSS Identifier

Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy. HS-LS1-7 NGSS Identifier

Construct an explanation using evidence from multiple sources to describe the role of cellular division and differentiation in producing and maintaining complex organisms. HS-LS1-4 NGSS Identifier

Next Generation Science Standards

Students who demonstrate understanding can:

HS-LS1-2.	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS1-3.	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
HS-LS1-4.	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

Disciplinary Core Ideas (DCI)

LS1.A: Structure and Function

- Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)

- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)
- Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)

LS1.B: Growth and Development of Organisms

- In multicellular organisms' individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4)

LS1.C: Organization for Matter and Energy Flow in Organisms

- As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken, and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7)

<u>Crosscutting Concepts (CCC)</u>

1. **Patterns:**
   Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
2. **Cause and effect:**
   Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
3. **Scale, proportion, and quantity:**
   In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
4. **Systems and system models:**
   Defining the system under study-specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
5. **Energy and matter:**
   Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
6. **Structure and function:**

The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

7. **Stability and change:**
   For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Science and Engineering Practices (SEP)

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Montana Technology Standards

TI.ID.9-12 The innovative designer content standards for ninth-twelfth grade

§ TI.ID.9-12.1 initiate a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems

TI.CT.9-12 The computational thinker content standards for ninth-twelfth grade

§ TI.CT.9-12.2 collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making

§ TI.CT.9-12.3 break down problems into component parts, extract key information and develop descriptive models to understand complex systems or facilitate problem-solving

TI.CC.9-12 The creative communicator content standards for ninth-twelfth grade

§ TI.CC.9-12.1 choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication

§ TI.CC.9-12.2 create original works or responsibly repurpose or remix digital resources into new creative works

Resources

Next Generation Science Standards, Disciplinary Core Ideas, and Crosscutting Concepts: http://www.nextgenscience.org/overview-dci

Science Model Curriculum Guide: 9-12 Earth and Space Science: http://montanateach.org/resources/montana-science-model-curriculum-guide-by-grade-level-grade-9-12-earth-and-space-science/

Montana Office of Public Instruction Montana Technology Standards https://opi.mt.gov/Educators/Teaching-Learning/K-12-Content-Standards/Technology-Standards

National Academies of Sciences, Engineering, and Medicine. 2012. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press. https://doi.org/10.17226/13165

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