Human Body Systems Detailed Outline

Unit One - Identity
Time Days (26 Days)

Lesson 1: Identity: Human (4 Days)
Understandings Addressed in Lesson

1. The human body is made up of complex systems functioning together to maintain homeostasis.
2. Directional terms describe the position of anatomical structures in relation to other structures or locations in the body, and regional terms specify distinct anatomical landmarks on the body.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Identify the systems and structures involved in basic body processes.
- Explain the functions of different human body systems, and list the major organs within each system.
- Describe how multiple body systems are interconnected and how those interconnections and interactions are necessary for life.
- Explain how directional terms and regional terms can be used to pinpoint location on the body.
- Show the relationship between multiple human body systems.
- Demonstrate the correct use of directional and regional terms.
- Illustrate key directional term pairs on a model of the human body.

Lesson 2: Identity: Tissues (12 Days)
Understandings Addressed in Lesson:

1. A tissue is a group of similar cells designed to carry out a specific function.
2. The bones of the human skeletal system protect the body’s internal organs while allowing for movement and great range of mobility.
3. The specific structure of bone reveals information about a person’s gender, stature, age, and ethnicity.
4. The length of long bones in the human body can be used to mathematically predict the overall height of an individual.
Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Identify characteristics of the four categories of human tissue.
- Describe the functions of the human skeletal system.
- Recognize that differences in bone structure contribute to a person’s unique identity.
- Recognize that there is a relationship between the length of long bones and the overall height of an individual.
- Analyze the structure of various human tissue types to infer function.
- Identify and locate bones of the human skeletal system.
- Interpret bone markings, bone landmarks, and bone measurements to determine a person’s gender, age, stature, and ethnicity.
- Derive and analyze a linear equation.

Lesson 3: Identity: Molecules and Cells (10 Days)
Understandings Addressed in Lesson:

1. Human DNA is a unique code of over three billion base pairs that provides a genetic blueprint of an individual.
2. Restriction enzymes recognize and cut specific sequences in DNA.
3. Gel electrophoresis separates DNA fragments based on size and is used in Restriction Fragment Length Polymorphism (RFLP) analysis.
4. Physical characteristics can be used to confirm or authenticate identity.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Explain how restriction enzymes cut DNA.
- Describe how gel electrophoresis separates DNA fragments.
- Recognize that gel electrophoresis can be used to examine DNA differences between individuals.
- Outline current biometrics technology.
- Digest DNA samples using restriction enzymes.
- Demonstrate the steps of gel electrophoresis and analyze the resulting restriction fragment length polymorphisms (RFLPs).

Unit Two – Communication
Time Days (38 Days)

Lesson 1: The Brain (9 Days)
Understandings Addressed in Lesson:
1. Communication between body systems is crucial to maintaining homeostasis.
2. The brain receives stimuli from the outside world, interprets this information, and generates an appropriate response.
3. Each region within the brain helps control and regulate specific functions in the body.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Describe the structure and function of the central nervous system.
- Identify major regions of the human brain.
- Match regions of the brain with their primary function in the human body.
- Apply knowledge of brain structure and function to determine the parts of the brain related to specific human actions, emotions, and/or dysfunctions.
- Interpret how a breakdown in communication in the central nervous system would impact the function of the human body.

Lesson 2: Electrical Communication (15 Days)
Understandings Addressed in Lesson:

1. Neurons convey information using electrical and chemical signals.
2. The body’s reaction time to reflex and voluntary actions is related to the degree of processing in the nervous system.
3. Errors in electrical communication can impact homeostasis in the human body.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Recognize that the nervous system relies on specialized cells called neurons to pass signals to and from the brain and spinal cord.
- Describe how the movement of ions across the cell membrane of a neuron generates an action potential and propogates electrical signals.
- Explain how neurons communicate at the synapse.
- Describe how brain processing differs in reflex and voluntary responses.
- Outline what goes on in the human body from an initial stimulus to a response.
- Analyze experimental data to explore reaction time and reflexes in the human body.
- Design an experiment to test factors that impact reaction time.
- Analyze case studies to determine the effects of a communication breakdown in the nervous system on the human body.

Lesson 3: Chemical Communication (6 Days)
Understandings Addressed in Lesson:
1. The endocrine system helps the body communicate through the use of chemical signals called hormones.
2. Hormones help maintain homeostasis through feedback loops.
3. A hormone imbalance can lead to disease or dysfunction.

**Knowledge and Skills Addressed in Lesson:**

It is expected that students will:

- Describe the way in which hormones interact with target cells.
- Recognize that the human body uses feedback mechanisms to maintain proper hormone levels.
- Model a feedback loop that shows how the body maintains homeostasis.
- Analyze physical symptoms of a patient and relate these symptoms to errors in chemical communication.

**Lesson 4: Communication with the Outside World (8 Days)**

**Understandings Addressed in Lesson:**

1. The structures within the human eye work to focus and process light.
2. The eye allows perception of color, depth, brightness, and optical illusions.
3. Errors in the structure and function of the eye can lead to problems in acuity or dysfunction.
4. Problems with focusing light in the eye can be corrected with lenses.

**Knowledge and Skills Addressed in Lesson:**

It is expected that students will:

- Identify the key structures of the eye.
- Demonstrate how light is processed in the eye in a person with normal vision, as well as a person with myopia or hyperopia.
- Explain the tests and procedures in a typical eye exam.
- Diagram the path of light as it enters the eyes and travels to the brain for processing.
- Evaluate visual perception by testing depth perception, peripheral vision, color vision, and visual acuity.
- Experiment with lenses to refocus light and correct problems with vision.

**Unit Three - Power**

Time Days (33 Days)

**Lesson 1: Introduction to Power (2 Days)**

**Understandings Addressed in Lesson:**
1. Many human body systems work to create, process, and distribute the body’s main resources – food, water, and oxygen.

**Knowledge and Skills Addressed in Lesson:**

It is expected that students will:

- List and describe the human body systems that create, process, and distribute food, water, and oxygen.
- Recognize that factors unique to the person, such as age, weight, and overall health affect the body’s ability to utilize biological resources and maintain homeostasis.
- Recognize that factors in the environment, such as climate or temperature, affect the body’s ability to utilize biological resources and maintain homeostasis.
- Estimate how long the human body can last without food, without water, and without oxygen.

**Lesson 2: Food (12 Days)**

**Understandings Addressed in Lesson:**

1. Enzymes are usually proteins and act as catalysts which speed up chemical reactions in the human body. (Optional)
2. The digestive system consists of the gastrointestinal tract and the accessory digestive organs which function together to chemically and mechanically digest food, absorb water and nutrients, and remove wastes.
3. Metabolism, the sum of all the chemical reactions that occur within the body, is required to maintain homeostasis.
4. When a process in the body requires energy, ATP is broken down to liberate energy stored in its chemical bonds.

**Knowledge and Skills Addressed in Lesson:**

It is expected that students will:

- Recognize that enzymes are designed to be highly specific, and the structure of the enzyme’s active site determines the substrate it acts upon. (Optional)
- Recognize that factors such as temperature, pH, and enzyme and substrate concentration affect the rate of an enzyme-catalyzed reaction.
- List specific enzymes that digest carbohydrates, fats, and proteins at sites along the digestive tract.
- Describe the structure and function of the organs in the digestive system.
- Explain how energy is stored in ATP.
- Model the interaction between enzymes and their corresponding substrates. (Optional)
- Outline what happens to a bite of food as it travels down the digestive tract.
- Design a laboratory experiment investigating the impact that environmental changes can have on enzyme function and analyze the results.
• Analyze energy inputs and outputs in the body to assess overall health.

Lesson 3: Oxygen (8 Days)

Understandings Addressed in Lesson:

1. The structure of the lungs and the close association between the lungs and the vessels of the cardiovascular system facilitate the transport of oxygen to all cells in the body.
2. During normal breathing, a healthy individual is using only a small percentage of the total capacity of his or her lungs.
3. The amount of oxygen required by the cells in a body depends on the activity level of the cells.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

• Describe the structure of the respiratory system, especially the lungs, and the basic mechanics of breathing.
• Explain how the structure of the lungs facilitates the exchange of oxygen and carbon dioxide between air and the body.
• Recognize that during and after exercise the concentration of oxygen removed from the air is increased compared to when the individual is at rest.
• Use sensors to measure lung capacity and oxygen capture.
• Analyze data collected using a spirometer to determine tidal volume, vital capacity, and minute volume.
• Analyze data collected using an oxygen sensor to determine the change in oxygen concentration of inhaled air versus exhaled air.

Lesson 4: Water (11 Days)

Understandings Addressed in Lesson:

1. The urinary system helps maintain homeostasis in the body by filtering the blood, regulating water and electrolyte concentration, maintaining the pH balance of the blood, and ridding the body of liquid waste called urine.
2. Through filtration, reabsorption, and secretion, the nephron assists in maintaining normal values of water, electrolytes, pH, and blood pressure in the body.
3. The hormones aldosterone and antidiuretic hormone (ADH) both help regulate the amount of water in the body.
4. Malfunctions in the body can be identified through noticeable changes in the composition of urine, and these changes can be detected through urinalysis.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:
- Describe the structure and function of the human urinary system.
- Describe how the structure of the kidney relates to its function in the body.
- Recognize that the nephron is the structural and functional unit of the kidney.
- Describe the connections between urine and blood and the exchange of ions and fluids that occurs across the nephron.
- Illustrate the path of urine formation through the kidney.
- Estimate the filtration rate of the glomerulus and relate mathematical estimates to the function of the human kidney.
- Analyze urinalysis results to diagnose disease and dysfunction in human body systems.

**Unit Four - Movement**

*Time Days (42 Days)*

**Lesson 1: Joints and Motion (5 Days)**

**Understandings Addressed in Lesson:**

1. The skeletal system works with the muscular system to move the human body.
2. The types of joints found in the human body differ in both structure and function and are classified as such. U
3. Range of motion describes a joint’s possible movements as well as provides a measure of overall flexibility at a joint.

**Knowledge and Skills Addressed in Lesson:**

It is expected that students will:

- Recognize that a joint is the location at which two or more bones connect, allowing movement and providing support to the human skeleton.
- Describe the motion at joints, such as flexion and extension.
- Demonstrate the types of movement possible at a joint and match range of motion photographs to specific actions.
- Measure range of motion of human joints using a goniometer.

**Lesson 2: Muscles (15 Days)**

**Understandings Addressed in Lesson:**

1. Through contraction and relaxation, the three different types of muscle tissue - skeletal, cardiac, and smooth - produce body movements, stabilize body position, move substances within the body, and regulate heat.
2. The structure of the muscle and attachment of this muscle to bone directly relates to the function of each skeletal muscle.
3. Muscles are composed of units called sarcomeres, which contract and shorten when exposed to electrical stimuli.
4. Calcium ions and ATP play a role in the contraction of muscle fibers.
5. Neurons are packed together in wiring called nerves, and these nerves take electrical messages from the brain to muscle.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Describe how the three types of muscle tissue differ in structure and function.
- Explain the sliding filament mechanism of muscle contraction.
- Recognize the connection between nerves and muscle.
- Analyze muscle tissue structure using a microscope.
- Interpret muscle function by examining its structure and its attachment to bones.
- Test the effect of varying solutions of ATP on the contraction of muscle tissue.
- Demonstrate the process of muscle contraction as well as the phenomenon of rigor mortis.

Lesson 3: Blood Flow (11 Days)

Understandings Addressed in Lesson:

1. The heart pumps blood to the lungs to pick up oxygen and to the body to deliver this oxygen.
2. The structure of arteries, veins, and capillaries relates directly to the function of each vessel and to the amount of pressure exerted on the vessel walls.
3. Changes in cardiac output, the amount of blood that is pumped out by the ventricles per minute, often signal diseases of the heart, and these changes can impact the function of other body systems.
4. Increased blood pressure in vessels can indicate possible blockages, and these blockages can interrupt blood flow to an organ or limb.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

- Explain the relationship between the heart and the lungs.
- Identify the body’s major arteries and veins and name the body region supplied by each.
- Recognize that unlike arteries, veins contain valves that prevent the backflow of blood.
- Describe pulse and blood pressure as they relate to cardiovascular health.
- Recognize that lifestyle choices, such as poor diet and smoking, can lead to the development of blood flow disorders.
- Trace blood flow in pulmonary and systemic circulation.
- Calculate and interpret cardiac output values and relate the amount of blood pumped by the heart to the health of other body systems and organs.
- Measure peripheral pulses using Doppler ultrasound and calculate an ankle brachial index (ABI).
• Interpret the ankle brachial index (ABI) to determine possible blockages in blood vessels.

Lesson 4: Energy and Motion: Exercise Physiology (10 Days)
Understandings Addressed in Lesson:

1. Exercise requires the coordinated effort of many human body systems, including the nervous system, the muscular system, the skeletal system, the cardiovascular system, and the respiratory system.
2. An athlete training for an intense physical event needs to consider diet, exercise, hydration, and injury prevention as well as track his or her progress and modify the plan to meet the demands of exercise.

Knowledge and Skills Addressed in Lesson:

It is expected that students will:

• Recognize that the body uses high energy molecules such as creatine phosphate, glycogen, and glucose to supply ATP to working muscle.
• Recognize that muscle fatigue occurs with prolonged or repetitive use of a muscle group.
• Describe ways in which an athlete can prepare his or her body for the stress of an athletic event.
• Illustrate the body’s response to the stages of exercise.
• Design an experiment to test the effect of feedback, coaching, or competition on muscle fatigue.
• Interpret EMG and grip strength data to assess muscle fatigue.
• Apply knowledge of power and movement in the body to design a comprehensive training plan for an athlete.

Unit Five – Protection
Time Days (22 Days)

Lesson 1: The Skin (6 Days)
Understandings Addressed in Lesson:

1. The skin is a dynamic organ that functions in protection, temperature regulation, sensation, excretion, and absorption in the human body.
2. Burn damage to skin can impact numerous body functions and body systems.
3. Both the body’s ability to sense pain and to suppress pain help protect the human body from injury and death.

Knowledge and Skills Addressed in Lesson:
It is expected that students will:

- Recognize that the skin is composed of two main layers, the epidermis and the dermis, and contains accessory organs such as sweat glands and hair follicles.
- Explain how different degrees of burns damage layers of the skin.
- Explain how the human body senses and processes signals of pain.
- Interpret how burn damage to the skin will affect the function of the organ and overall homeostasis in the body.
- Outline what happens inside the body when a person feels pain.

**Lesson 2: Bones (8 Days)**

**Understandings Addressed in Lesson:**

1. Bones assist muscles with movement of the body and protect the internal organs from damage and injury.
2. Damage to bone, through a sprain or a fracture, can impact the function of other body organs and systems.
3. Osteoclasts and osteoblasts are specialized bone cells that function to break down old bone tissue and replace it with new.
4. Bone is constantly being broken down and reformed through the process of bone remodeling.

**Knowledge and Skills Addressed in Lesson:**

It is expected that students will:

- Recall the four main types of bone.
- Recognize that bone is a living connective tissue composed of cells and protein fibers wrapped in hard mineral salts that can adapt and change to fit the needs of the person.
- Describe the structure and function of compact and spongy bone. U1
- Describe the types of bone fractures.
- Analyze bone structure using a microscope.
- Interpret X-rays to determine specific types of bone fractures.
- Apply knowledge of hormones and of bone remodeling to explain calcium balance in the body.
- Diagram the stages of bone healing after injury.

**Lesson 3: Lymph and Blood Cells (8 Days)**

**Understandings Addressed in Lesson:**

1. The lymphatic and immune system functions to drain and distribute fluid in the body as well as protect the human body against specific invaders.
2. Antibodies are proteins found in the blood or lymph that seek out and bind to specific antigens.
3. Only certain blood types are compatible with one another and can be safely transferred from person to person in a transfusion.
4. Antibodies are produced in response to specific pathogens.

**Knowledge and Skills Addressed in Lesson:**

It is expected that students will:

- Describe the structure and function of the lymphatic and immune system.
- Recognize that a type of white blood cell called B lymphocyte is responsible for the production of antibodies and has the ability to remember invaders once they have entered the body.
- Recognize that blood type is determined by the antigens present on red blood cells.
- Describe the genetics of blood type.
- Describe the interaction between antigens and antibodies.
- Use information presented in a computer animation to create a flow chart of immune response to a common cold.
- Analyze simulated blood samples to determine blood type.
- Produce and analyze a family pedigree for blood type and determine potential donors for a transfusion.
- Graph and interpret antibody data collected after an infection and relate this data to the response of body cells.
- Diagram an immune response to a common cold.
- Apply knowledge of specific immunity to deduce how vaccines function.

**Unit Six – Homeostasis**

**Time Days (14 Days)**

**Lesson 1: Health and Wellness (14 Days)**

**Understandings Addressed in Lesson:**

1. Factors in the external environment affect the body’s internal environment and overall ability to maintain homeostasis.
2. Human body systems work together to defend against disease and injury and to maintain health and wellness.
3. Medical interventions, measures that improve health or alter the course of a disease, include preventative measures, diagnostic tests, treatments, and rehabilitation.

**Knowledge and Skills Addressed in Lesson:**

It is expected that students will:

- Describe how the body systems respond to extreme external environments.
• Explain how the systems work together to maintain homeostasis in the body and to complete basic functions such as movement and communication.
• Illustrate disease in the human body, from its initial symptoms to eventual diagnosis and treatment.
• Interpret knowledge of homeostasis in the body to design an innovative medical intervention or invention.
• Trace disease in human systems by generating a fictional case study and compiling a patient case file.