# Human Body Systems Detailed Outline

## Unit One- Identity
## Time Days (26 Days)

### Lesson 1: Identity: Human (4 Days)

**Concepts Addressed in Lesson**

1. The human body is made up of complex systems functioning together to maintain homeostasis.
2. Similarities in function and overall anatomical organization unite and identify all humans.
3. Directional terms describe the position of anatomical structures in relation to other structures or locations in the body and regional terms specify specific anatomical landmarks on the body.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Research interesting facts about the human body and identify the systems and structures involved in these facts.
- Display information about human body systems using graphic organizers.
- Diagram the relationship between multiple human body systems.
- Design a visual system that demonstrates correct use of directional and regional terms.

### Lesson 2: Identity: Tissues (12 Days)

**Concepts Addressed in Lesson:**

1. The structure and distribution of tissues in the body contribute to human identity.
2. A tissue is a group of similar cells designed to carry out a specific function.
3. The 206 bones of the human skeletal system protect the body's internal organs while allowing for movement and great range of mobility.

4. The specific structure of bone reveals information about a person's gender, stature, age and ethnicity.
5. The length of long bones in the human body can be used to mathematically predict the overall height of an individual.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- View prepared slides of human tissue and compare and contrast the structure and function of various types.
- Build muscles and fat of the face on a skeletal model to explore personal identity.
- Identify and locate bones of the human skeletal system.
- Analyze bones to determine a person's gender, age, stature and ethnicity.
- Derive a mathematical equation to determine height of an individual using the length of long bone.

## Lesson 3: Identity: Molecules and Cells (10 Days)

**Concepts Addressed in Lesson:**

1. Cells contain chromosomes, structures that house genes and ultimately code for traits.
2. Human DNA is a unique code of over three billion base pairs that provides a genetic blueprint of an individual.
3. Restriction enzymes recognize and cut specific sequences in DNA.
4. Gel electrophoresis separates DNA fragments based on size and is used in Restriction Fragment Length Polymorphism (RFLP) analysis.
5. Both physical characteristics and behavioral characteristics can be used to confirm or authenticate identity.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Digest DNA samples using two different restriction enzymes.
- Run gel electrophoresis and analyze the resulting restriction fragment length polymorphisms (RFLPs) to link a missing person with skeletal remains.
- Evaluate current technology used to verify and protect identity and design a biometrics plan specific to a real-world situation.
- Read an interview with a forensic anthropologist and write an interview with a DNA analyst.

# Unit Two – Communication
# Time Days (38 Days)

## Lesson 1: The Brain (9 Days)

**Concepts Addressed in Lesson:**

1. Communication between body systems is crucial to maintaining homeostasis.
2. The two main subdivisions of the nervous system are the central nervous system (CNS), brain and spinal cord, and the peripheral nervous system (PNS), all nervous tissues outside the brain and spinal cord.
3. The brain receives stimuli from the outside world, interprets this information and generates an appropriate response.
4. Each region within the brain helps control and regulate specific functions in the body.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Identify types of communication that occur inside the human body.
- Build components of the central nervous system on a skeletal model.
- Identify major regions of the human brain.
- Design a “brain map” that links regions of the brain with specific human actions, emotions, personality traits or functions.
- Investigate the history of brain mapping technology, including the mapping of the motor cortex and the language centers of the brain.

## Lesson 2: Electrical Communication (15 Days)

**Concepts Addressed in Lesson:**

1. Human body systems depend upon electricity as a means of sending messages between and within systems.
2. The nervous system relies on specialized cells called neurons to pass signals to and from the brain and spinal cord.
3. Neurons convey information using electrical and chemical signals.
4. An action potential is an electrical signal that is generated by the movement of ions across the cell membrane of a neuron.
5. The body’s reaction time to reflex and voluntary actions is related to the degree of processing in the nervous system.

6. Errors in electrical communication can impact homeostasis in the human body.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Construct a 3D, labeled model of a neuron.
- Produce a flow chart that outlines what goes on in the body from an initial stimulus to a response.
- Use an interactive website to manipulate ions in a membrane and generate an action potential in a neuron.
- Complete a laboratory investigation using data acquisition software and probes to explore reflexes in the human body.
- Design an experiment to test factors that could impact reaction time.
- Analyze a case study, relate disease to an error in communication and create a presentation of findings.
- Use models from activities in the unit to demonstrate how an error in communication occurs and affects the function of other body systems.

## Lesson 3: Chemical Communication (6 Days)

**Concepts Addressed in Lesson:**

1. The endocrine system helps the body communicate through the use of chemical signals called hormones.
2. Hormones interact with receptors on the cell membrane or inside the cell to bring about change in a target organ.
3. Endocrine glands secrete substances directly into the blood stream while exocrine glands secrete their products through ducts into body cavities.
4. Hormones help maintain homeostasis through feedback loops.
5. A hormone imbalance can lead to disease or dysfunction.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Produce a concept map for the endocrine system.
- Design a feedback loop that shows how the body maintains proper blood glucose levels.
- Create an evidence board with a team and use this board to solve a medical mystery.
- Analyze physical symptoms of a patient and relate these symptoms to errors in chemical communication.

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

**Concepts Addressed in Lesson:**

1. The human eye converts light into a stream of nerve signals to be interpreted by the brain.
2. The structures within the human eye work to focus and process light.
3. The eye allows perception of color, depth, brightness, and optical illusions.
4. Problems with focusing light in the eye can be corrected with lenses.
5. Errors in the structure and function of the eye can lead to minor problems in acuity or debilitating disease and dysfunction.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Dissect a cow eye to observe key structures.
- 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.
- Use a model of the human eye to simulate normal vision, as well as myopia and hyperopia
- Experiment with lenses to correct problems in vision.
- Edit digital images to show how the world looks to people with various eye conditions or simulate vision disorders using modified glasses.
- Write a reflection about what life would be like with a vision disease or disorder.
- Design an informative handout that explains the tests and procedures in an eye exam.
- Research careers in the field of vision.

## Unit Three - Power
## Time Days (33 Days)

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

**Concepts Addressed in Lesson:**

1. The human body is powered by the food we consume, the water that we drink and the air that we breathe.
2. Many human body systems work to create, process and distribute the body's main resources – food, water and oxygen.

3. Factors unique to the person, such as age, weight, and overall health affect the body's ability to utilize biological resources and maintain homeostasis.
4. Factors in the environment, such as climate or temperature, affect the body's ability to utilize biological resources and maintain homeostasis.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Create a chart comparing the role food, water and oxygen play in the human body.
- List the body systems that create, process, and distribute food, water and oxygen.
- Estimate how long the human body can last without key resources and compare this estimate to a survival "rule."
- Write a disclaimer that explains how factors in the environment and how characteristics of the individual affect the ability to conserve energy.

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

**Concepts Addressed in Lesson:**

1. 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.
2. Specific enzymes digest carbohydrates, fats and proteins at sites along the digestive tract.
3. The energy provided by ingested food must be balanced against the energy expended by the body, or a weight change will occur.
4. Factors such as temperature, pH, and enzyme and substrate concentration affect the rate of an enzyme-catalyzed reaction.
5. When a process in the body requires energy, ATP is broken down to liberate energy stored in its chemical bonds.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Design and build a model of the human digestive system.
- Outline what happens to a bite of food as it travels down the digestive tract.
- Design and carry out a laboratory experiment investigating the impact environmental changes can have on enzyme function.
- Analyze diet by comparing energy inputs and outputs.

- Assess overall dietary health by preparing a detailed nutrition report for a fictional client.
- Complete an Internet investigation to learn about the structure and function of ATP.

## Lesson 3: Oxygen (8 Days)

**Concepts Addressed in Lesson:**

1. Oxygen is essential for human life because it is necessary for the production of ATP, the primary source of cellular energy.
2. 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.
3. The transfer of oxygen and carbon dioxide molecules between the lungs, bloodstream, and cells is by simple diffusion and is dependent on concentration gradients.
4. During normal breathing, a healthy individual is using only a small percentage of the total capacity of his or her lungs.
5. The efficiency of oxygen removal from the air is dependent on the physical conditioning of the individual; during and after exercise the concentration of oxygen removed from the air is increased compared to when the individual is at rest.
6. Various diseases or medical conditions can affect lung capacity and efficiency.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Use proper technique and LabVIEW to measure lung capacity and absorption of oxygen from air.
- 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.
- Explore careers related to lung function by writing a resume for a respiratory therapist.

## Lesson 4: Water (11 Days)

**Concepts 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. The nephron is the structural and functional unit of the kidney.
3. Through filtration, reabsorption, and secretion, the nephron assists in maintaining normal values of water, electrolytes, pH, and blood pressure in the body.
4. The hormones aldosterone and antidiuretic hormone (ADH) both help regulate the amount of water in the body; however, they each work by a different mechanism.
5. Malfunctions in the body can be identified through noticeable changes in the composition of urine and these changes can be detected through urinalysis.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Build the organs of the urinary system on a skeletal model.
- Complete a dissection to explore the anatomy of the kidney.
- Create a "map" of the kidney that shows the path of urine formation.
- Create a poster that shows the connections between urine and blood and demonstrates the exchange of ions and fluids that occurs across the nephron.
- Complete mathematics calculations to estimate the filtration rate of the glomerulus.
- Use appropriate Internet sources to investigate the role of hormones in maintaining a water balance in the body.
- Add glands, hormones, and target organs that are involved in water balance to a graphic organizer, to feedback loops, as well as to a skeletal model.
- Analyze the urine of four fictional patients to diagnose disease and dysfunction in other human body systems.

# Unit Four - Movement
# Time Days (42 Days)

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

**Concepts Addressed in Lesson:**

1. The skeletal system works with the muscular system to move the human body.
2. A joint is the location at which two or more bones connect, allowing movement and providing support to the human skeleton.

3. Joints can be classified by either their structure or their function.
4. Synovial joints, freely moveable joints, allow both gross and precise movements of the appendicular skeleton.
5. Range of motion describes a joint's possible movements as well as provides a measure of overall flexibility at a joint.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Use appropriate Internet research techniques to obtain information about the different types of synovial joints.
- Dissect and manipulate a cow elbow to learn about joint anatomy and motion.
- Demonstrate terms that describe 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)

**Concepts 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.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Use proper microscope technique to examine the different types of muscle tissue.
- Construct a spaghetti muscle to investigate muscle structure.
- Build simple arm muscles on a skeletal model to illustrate the rules of muscle structure and action.
- Sculpt a muscle group on a skeletal model.
- Identify the action of "mystery muscles" by observing muscle structure.

- Test the effect of varying solutions of ATP on the contraction of muscle tissue.
- Design a model to demonstrate the process of muscle contraction as well as the phenomenon of rigor mortis.
- Build nerve roots and nerves on a skeletal model.

**Lesson 3: Blood Flow** (11 Days)

**Concepts Addressed in Lesson:**

1. Cardiac and smooth muscle play a role in the movement of blood around the human body.
2. The heart pumps blood to the lungs to pick up oxygen and to the body to deliver this oxygen.
3. 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.
4. Veins contain valves that prevent the backflow of blood.
5. 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.
6. Increased blood pressure in vessels can indicate possible blockages and these blockages can interrupt blood flow to an organ or limb.
7. Lifestyle choices, such as poor diet and smoking, can lead to the development of blood flow disorders.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Trace blood flow in pulmonary and systemic circulation by creating a graphic organizer of the heart.
- Compare and contrast the structure of arteries, veins and capillaries.
- Design a way to explain the formation of varicose veins.
- Build a heart and circulatory routes on a skeletal model.
- Find various pulse points around the body and use heart rate data to calculate and assess cardiac output.
- Analyze a four-part case that looks at the effects of smoking on circulation and blood pressure.
- Measure peripheral pulses using Doppler ultrasound and calculate an ankle brachial index (ABI).

**Lesson 4: Energy and Motion: Exercise Physiology** (10 Days)

**Concepts Addressed in Lesson:**

1. The body uses high energy molecules such as creatine phosphate, glycogen and glucose to supply ATP to working muscle.
2. 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.
3. Performance-enhancing drugs may initially produce noticeable changes in athletic performance, but come with serious health risks.
4. 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.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Use appropriate Internet research techniques to investigate the reaction of the body systems to moderate and intense exercise.
- Create a timeline of the body's response to the stages of exercise.
- Complete a laboratory investigation using data acquisition software and probes to explore muscle fatigue.
- Design an experiment to test the effect of feedback, coaching or competition on muscle fatigue.
- Design a comprehensive training plan for an athlete training for a particular event.
- Present a detailed training plan to the perspective client.

# Unit Five – Protection
# Time Days (22 Days)

**Lesson 1: The Skin** (6 Days)

**Concepts Addressed in Lesson:**

1. The skin is composed of two main layers, the epidermis and the dermis, and contains accessory organs such as sweat glands and hair follicles.
2. The skin is a dynamic organ that functions in protection, temperature regulation, sensation, excretion and absorption in the human body.
3. Burn damage to skin can impact numerous body functions and body systems.
4. Both the body's ability to sense pain and to suppress pain help protect the human body from injury and death.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Design and build a 3-D model of human skin displaying tissue layers and accessory organs.
- Model and describe how damage to skin through burns can affect both the functions of the skin and other body systems.
- Write diary entries that describe the role of various treatment methods and biomedical professionals in the care and rehabilitation of burn victims.
- Outline what happens inside the body when a person feels pain.

## Lesson 2: Bones (8 Days)

**Concepts Addressed in Lesson:**

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

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Dissect a section of long bone and draw a detailed diagram of relevant anatomy.
- Use proper microscope technique to view prepared slides of compact and spongy bone.
- Use appropriate Internet research techniques to obtain information about the different types of bone fractures.
- Analyze bone breaks shown in X-rays and match the images with descriptions of the injuries.
- Write an advertisement for a job opening for an X-ray technician.
- Produce a feedback loop that illustrates how the body maintains a calcium balance.
- Draw diagrams of the stages of bone healing after injury.

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

**Concepts 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. A type of white blood cells called B lymphocytes is responsible for the production of antibodies and has the ability to remember invaders once they have entered the body.
4. Many organ systems as well as other cells, tissues, organs and secretions play a role in protecting the human body.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Use appropriate Internet research techniques to obtain information about the structure and function of the lymphatic and immune system.
- Build lymph vessels and nodes on a skeletal model.
- Analyze simulated blood samples to determine blood type and determine potential donors for a transfusion.
- Produce and analyze a family pedigree for blood type.
- Graph antibody data collected after an infection and relate this data to the response of body cells.
- Use information presented in a computer animation to create a flow chart of immune response to a common cold.

# Unit Six – Homeostasis
# Time Days (14 Days)

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

**Concepts 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.

**Performance Objectives Addressed in Lesson:**
*It is expected that students will:*

- Design an innovative medical intervention or invention to protect the human body in extreme external environments.
- Organize information about body function in detailed graphic organizers.
- Create and present computer presentations to defend the design of a medical intervention.
- Use appropriate Internet research techniques to study the etiology, diagnosis and treatment of a disease or disorder.
- Trace disease in human systems by generating a fictional case study and compiling a patient case file.
- Model a disease and a medical intervention on a skeletal model.
- Write a reflection on personal identity and on career aspirations.