Course Name : Project Lead the Way-Human Body Systems

Course Overview:
In Human Body Systems (HBS), students examine the interactions of human body systems as they explore identity, power, movement, protection, and homeostasis in the body. Exploring science in action, students build organs and tissues on a skeletal Maniken®; use data acquisition software to monitor body functions such as muscle movement, reflex and voluntary action, and respiration; and take on the roles of biomedical professionals to solve real-world medical cases.

Course Materials/Resources/Technology

1. PLTW Online Curriculum
2. PLTW Online store for purchasing materials

UNIT 1: Identity

Duration of Unit: 24 Days

Description of Unit: In Unit 1, students will explore the idea of identity. They will move from general to specific as they first explore commonalities between all humans and then move on to explore the individual differences in tissues and cells. In the course, students will work with a two-foot skeletal model produced by Anatomy in Clay® Learning System. Students will work in pairs on an assigned Maniken® and use clay to build various organs, tissues, and vessels on the skeletal frame.

Essential Questions and/or Enduring Understandings:

- In what ways do the parts of a human body system work together to carry out a specific function?
- In what ways do different human body systems work together to complete specific functions?
- How can directional terms and regional terms help describe location in the body?
- What features of structure and function are common to all humans?
- What are the main types of tissue in the human body?
- How does the structure of a type of human tissue relate to its function in the body?
- How does the distribution and structure of different types of tissue in the body contribute to personal identity?

- What are the functions of the human skeletal system?
- What are the main bones of the human skeletal system?
- What is forensic anthropology and how does this field relate to human body systems?
- How can features of bone be used to determine information about a person's gender, ethnicity, age or stature?
- What is the structure and function of DNA?
- How does DNA differ from person to person?
- What role does DNA play in our identity?
- How can tools of molecular biology be used to compare the DNA of two individuals?
- What are restriction enzymes?
- What are restriction fragment length polymorphisms?
- What is gel electrophoresis and how can the results of this technique be interpreted?
- How can the field of biometrics be used to verify and protect identity?

Academic Vocabulary:

- Anterior
- Deep
- Directional Terms
- Distal
- Dorsal
- Identity
- Inferior
- Lateral
- Medial
- Posterior
- Proximal
- Regional Terms
- Superficial
- Superior
- System
- Ventral
- Adipose tissue
- Appendicular Skeleton
- Axial Skeleton
- Connective Tissue
- Epithelial Tissue
- Femur

- Forensic Anthropology
- Humerus
- Pelvis
- Skull
- Tibia
- Tissue
- Agarose
- Biometrics
- Deoxyribonucleic acid (DNA)
- Gel electrophoresis
- Restriction enzyme
- Restriction fragment length polymorphisms (RFLPs)

Materials/Resources/Technology:

ESSENTIAL Standards	Learning Targets
Students will define regional anatomical terms (cervical, buccal, etc).	
Students will examine bones to determine the gender, race, and age of the person.	
Derive and test an equation to predict their height using their femur.	1. Enter data into a spreadsheet and create a scatter plot. 2. Create linear equations from data using spreadsheets. 3. Use a linear equation to estimate height from given lengths of bone.
Students will perform a gel electrophoresis experiment on DNA samples and investigate the action of restriction enzymes.	1. I can define gel electrophoresis and restriction enzymes. 2. I can summarize the process of gel electrophoresis and restriction length polymorphisms. 3. I can analyze DNA information using restriction enzymes and gel electrophoresis.

NICE TO KNOW Standards	**Learning Targets**

Common Formative and Summative Assessments
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UNIT 2: Communication
Duration of Unit: 35 Days
Description of Unit: Communication in the human body takes many forms. Our nervous system communicates with our organs and tissues using electrical signals. Endocrine glands secrete chemical messengers called hormones that travel through the blood to a target and bring about change. Our special senses and our skeletal and muscular systems allow us to move, gesture and speak, to communicate our ideas, and to interact with the world around us. A breakdown in communication would disrupt the body's overall homeostasis or internal balance. In this lesson, students will explore the concept of communication as it applies to everyday life, machines and technology, and as it applies to their own body.
Essential Questions and/or Enduring Understandings: ● What is communication? ● What are ways communication occurs in machines and in the human body? ● What are consequences of miscommunication in the body? ● How do the central nervous system and the peripheral nervous system work together to control the body?

- What are the functions of the main regions of the brain?
- How do scientists determine which areas of the brain are associated with specific actions, emotions or functions?
- How does communication happen within the body?
- What is the basic structure and function of a neuron?
- How do the different types of neurons work together to send and receive signals?
- How are electrical impulses created in the human body?
- How do neurons convey information using both electrical and chemical signals?
- What factors impact our ability to react to a stimulus?
- How and why does reaction time differ in reflex and voluntary actions?
- How do errors in communication impact homeostasis in the human body?
- How can biomedical professionals help treat, cure and improve the quality of life of those suffering from nervous system disorders?
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Academic Vocabulary:

- Brain Stem
- Central nervous system
- Cerebellum
- Cerebrum
- Gyrus
- Limbic System
- Lobe
- Peripheral nervous system
- Phrenology
- Sulcus
- Action Potential
- Axon
- Dendrite
- Ion
- Myelin sheath
- Neurologist
- Neuron
- Neurotransmitter
- Reaction Time
- Reflex
- Synapse
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ESSENTIAL Standards	Learning Targets
Students will create a structure/function map for the different parts of the brain.	1. Students can label the different lobes of the brain correctly. 2. Students can identify the main function for each lobe and region of the brain. 3. Students can predict symptoms from afflicted regions of the brain.
Students will conduct an experiment to investigate reflexes and voluntary responses and their respective neurological pathway.	1. Students define reflex and reaction time. 2. Students calculate the speed of neurological transmission and describe conditions that may alter the rate (action potential). 3. Students summarize action potential and explain two ways that reflex reactions help maintain homeostasis in the human body.
Students will construct a concept map detailing the action of hormones for regulating blood glucose levels.	1. Students can identify positive and negative feedback loops. 2. Students will construct a concept map detailing the action of hormones for regulating blood glucose levels. 3. Describe two potential problems in the insulin-glucose feedback loop that produce an imbalance to homeostasis.
Students will examine how corrective lens are used to improve vision.	1. Students define refraction, accommodation, visual acuity, and astigmatism. 2. Students explain the causes of hyperopia and myopia. Label structure/function of eye. 3. Students summarize how corrective lenses are prescribed to resolve hyperopia and myopia.
NICE TO KNOW Standards	**Learning Targets**
Common Formative and Summative Assessments	
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Unit 3: Power

Duration of Unit: 33 Days

Description of Unit:
With each breath, we take in oxygen that feeds our cells and fuels the production of energy. Water nourishes our tissues and helps regulate the level of chemicals in the body. The carbohydrates, proteins, and fats that we ingest in food supply energy, as well as building materials the body uses for growth and maintenance. Each of these resources is vital to human survival.

Essential Questions and/or Enduring Understandings:

- What are the resources the human body needs to survive?
- What role does food play in the human body?
- What role does water play in the human body?
- What role does oxygen play in the human body?
- What human body systems work to create, process or distribute the body's main power sources?
- How do personal factors and environmental factors impact the body's ability to survive without air, food or water?
- What are the functions of the digestive system?
- How does the structure of each organ in the digestive system relate to its function?
- How does the digestive system assist in maintaining the water balance in the body?
- How do enzymes assist the process of digestion?
- How do factors such as temperature, pH and concentration of enzyme or substrate affect the rate of enzyme-catalyzed reactions?
- What are BMI and BMR?
- How can BMI and BMR help assess healthy diet and weight?
- What are the health risks associated with being overweight or underweight?
- What body systems are affected when a person is overweight or underweight?
- What is ATP?
- How is energy released from ATP and used to do work in the body?
- How do the air you breathe and the food you eat relate directly to the production of energy in the form of ATP?
- Why do we need oxygen?
- How do we breathe?
- How does the oxygen we inhale get to all of our cells?
- How much air do we normally breathe in and out?

- How much air can our lungs actually hold?
- How do we measure lung capacity?
- How efficient are our lungs at capturing oxygen from the air?
- Why might some people be more efficient at capturing oxygen than others?
- How do we measure oxygen capture?
- What are examples of diseases or medical conditions that would affect breathing and/or oxygen capture?
- How does a respiratory therapist assist patients with ventilation and utilization of oxygen?
- What are the components of an effective resume?
- What are the functions of the urinary system?
- What are the major organs of the urinary system?
- What is the general structure of the kidney and how does this structure relate to kidney function?
- How does the kidney form urine?
- What is the relationship between blood and urine?
- What is the function of the nephron?
- How do filtration, secretion and reabsorption in the nephron help maintain a fluid and electrolyte balance in the body?
- How do the hormones ADH and aldosterone affect the nephron and the body's overall water balance?
- What is urinalysis?
- How can the composition of urine provide clues about problems in other human body systems?

Academic Vocabulary:

- Homeostasis
- Macromolecule
- Resource
- Adenosine triphosphate (ATP)
- Anabolism
- Basal metabolic rate (BMR)
- Body mass index (BMI)
- Bolus
- Calorie
- Catabolism
- Catalyst
- Digestion
- Digestive system
- Enzyme
- Esophagus
- Gallbladder

- Gastrointestinal tract
- Large intestine
- Liver
- Metabolism
- Monomer
- Oral cavity
- Pancreas
- Peristalsis
- Pharynx
- Polymer
- Salivary amylase
- Salivary glands
- Small intestine
- Stomach
- Substrate
- Abdominal cavity
- Alveoli
- Bronchi
- Diaphragm
- Intercostal muscle
- Minute Volume
- Residual Volume
- Résumé
- Spirometer
- Thoracic cavity
- Tidal Volume
- Vital Capacity
- Adrenal glands
- Aldosterone
- Antidiuretic Hormone (ADH)
- Excretion
- Filtration
- Glomerular Filtration
- Glomerulus
- Kidney
- Nephron
- Ureter

- Urethra
- Urinalysis
- Urinary bladder
- Urinary system
- Urine

ESSENTIAL Standards	Learning Targets
Students will design an experiment investigating the action of catalase under different conditions (pH, temperature, etc).	1. Students define and describe the role of enzymes in the body and identify locations of digestive organs. 2. Students summarize mechanical and chemical digestion of food. 3. Students predict and explain the effectiveness of enzymes in varying biochemical environments.
Students will research the structure and function of ATP and model the process of cellular respiration.	1. Label the structure of ATP and define its general function in the body. 2. Summarize the production (cellular respiration) and use of ATP in the body. 3. Compare and contrast aerobic and anaerobic cellular respiration for the production of ATP.
Students will conduct an experiment to measure lung capacity of several individuals.	1. Students can describe the structure and function of the respiratory system. 2. Students can explain the process of spirometry and define the results. 3. Students can complete calculations from spirometry data to diagnose potential respiratory problems.
Students will build a model of the nephron and explain how it filters the blood.	
Students will research the hormones that maintain the body's water balance and create a feedback loop diagram.	1. Label the structures and define the functions for the parts of the kidney and nephron. Define the part of the brain responsible for regulating thirst. 2. Create a feedback loop diagramming the homeostasis of water and the role of the ADH and aldosterone. 3. Predict how alterations to the feedback loop result in the altered regulation of water balance (e.g. diabetes insipidus, hypertension, hypotension).

NICE TO KNOW Standards	Learning Targets

Common Formative and Summative Assessments
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Unit 4: Movement

Duration of Unit: 38 Days

Description of Unit:
Students explore the role of food and oxygen in the production of energy in the form of ATP. They also examine joints and have been shown how muscles and bones work together to move the body. Students will combine information about power and movement to describe how the body fuels and responds to exercise. Exercise physiology is the field of science that looks at how the body meets the demands of intense exercise. The human body systems work together to prepare the body for exercise, fuel the body through an event and, at the conclusion of exercise, help the body return to homeostasis.

Essential Questions and/or Enduring Understandings:

- What role do joints play in the human body?
- How are joints classified by both structure and function?
- What are the different types of synovial joints?
- What role do cartilage, tendons, and ligaments play at a joint?
- What terms describe the path of movement at a joint?
- What is range of motion?
- How do you measure the range of motion of a particular joint movement?
- How do bones, muscles and joints work together to enable movement and locomotion for the human body?
- How do muscles assist with movement of the body and of substances around the body?
- How do the structure and function of the three types of muscle tissue compare?

- How are muscle fibers and membranes organized to form a whole skeletal muscle?
- What do skeletal muscle structure and attachment to bones tell you about function?
- How are muscles named?
- What are the requirements for muscle contraction?
- What role do calcium and ATP play in muscle contraction?
- What is a sarcomere?
- How does a sarcomere contract and lengthen to cause muscle contraction?
- How is the condition rigor mortis related to muscle contraction?
- How do nerves interact with muscles?
- How can we assess muscle function?
- What types of muscle help move blood around the body?
- What is the relationship between the heart and the lungs?
- What is the pathway of blood in and out of the heart in pulmonary and systemic circulation?
- How do the structure of arteries, veins and capillaries relate to their function in the body?
- What unique features of veins help move blood back to the heart?
- What are varicose veins?
- Why don't we ever hear about varicose arteries?
- What are the major arteries and veins in the body and which regions do they serve?
- What is cardiac output?
- How does cardiac output help assess overall heart health?
- How does an increased or decreased cardiac output impact the body?
- What is blood pressure?
- How can the measurement of blood pressure in the legs be used to assess circulation?
- What is peripheral artery disease?
- Why can smoking lead to peripheral artery disease?
- What is the connection between power and movement in the body?
- How does the body maintain a supply of ATP during exercise?
- What body systems are involved with powering an athlete through a running race?
- What is muscle fatigue?
- How are we able to overcome muscle fatigue?
- What are performance-enhancing drugs?
- How do specific performance-enhancing drugs affect the human body?
- Why should certain performance-enhancing drugs be banned from athletic competition?
- What are areas to consider when designing a training plan for an athlete?

Academic Vocabulary:

- Abduction
- Adduction
- Articular cartilage

- Articulation
- Ball-and-socket joint
- Cartilage
- Circumduction
- Dorsiflexion
- Extension
- Flexion
- Goniometer
- Hinge joint
- Hyaline cartilage
- Joint
- Ligament
- Plantar flexion
- Range of Motion
- Rotation
- Synovial cavity
- Synovial fluid
- Synovial joint
- Tendon
- Actin
- Afferent neurons
- Cardiac muscle
- Carpal tunnel syndrome
- Contract
- Efferent neurons
- Endomysium
- Epimysium
- Fascicle
- Insertion
- Muscle
- Myofibril
- Myosin
- Nerve
- Origin
- Perimysium
- Plexus
- Rigor mortis
- Sarcomere
- Skeletal muscle
- Sliding filament mechanism
- Smooth muscle
- Striation
- Tropomyosin
- Troponin

- Aorta
- Arteriole
- Artery
- Arteriosclerosis
- Atherosclerosis
- Atrium
- Blood pressure
- Capillary
- Cardiac muscle
- Cardiac output
- Circulation
- Coronary Artery
- Heart rate
- Peripheral artery disease
- Peripheral vascular disease
- Pulmonary Circulation
- Pulse
- Smooth muscle
- Stroke volume
- Systemic Circulation
- Valve
- Varicose vein
- Vein
- Ventricle
- Venule
- Aerobic
- Anabolic steroids
- Anaerobic
- Blood Doping
- Cellular respiration
- Creatine phosphate
- Erythropoietin
- Glycogen
- Lactic acid
- Muscle Fatigue

ESSENTIAL Standards	Learning Targets
Students will research the anatomy and physiology of the different types of joints.	1. Students can identify the different types of joints from a diagram. 2. Students can describe the movement associated with each joint type. 3. Students can describe how changes to joint structure affect movement (e.g. separated shoulder, cow v. human hinge joint).
Students will conduct an	1. Define and label the components of the sarcomere.

experiment to determine the reaction of skeletal muscle fibers to various concentrations of ATP.	2. Determine what components and concentrations lead to greatest percent contraction of a muscle fiber. 3. Explain why the differences in ATP concentration relate to percent contraction of the muscle fiber.
Students will research the mechanics of muscle contractions and describe the steps of the sliding filament theory.	1. Students can identify the different filaments in a sarcomere. 2. Students can summarize the process of muscle contraction using the sliding filament theory. 3. Students can explain the cause of rigor mortis/muscle cramps using the sliding filament theory.
Students will examine case studies of smokers and the diseases (peripheral vascular disease, etc) that can impact the limbs and conduct an ankle brachial index (ABI).	
Students will research the impact of exercise on body systems.	
NICE TO KNOW Standards	**Learning Targets**
Common Formative and Summative Assessments	

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