

Year 1, Unit 6 Human Physiology

Content Area: **Science**
Course(s): **IB Biology, HL**
Time Period: **Fourth Marking Period**
Length: **5 weeks**
Status: **Published**

Unit Overview

Students will learn about multiple human body systems and explain how they relate to each other.

STAGE 1- DESIRED RESULTS

- 6.1 Use models as representations of the real world—dialysis tubing can be used to model absorption in the intestine.
- 6.2 Theories are regarded as uncertain—William Harvey overturned theories developed by the ancient Greek philosopher Galen on movement of blood in the body.
- 6.3 Risks associated with scientific research—Florey and Chain’s tests on the safety of penicillin would not be compliant with current protocol on testing.
- 6.4 Obtain evidence for theories—epidemiological studies have contributed to our understanding of the causes of lung cancer.
- 6.5 Cooperation and collaboration between groups of scientists—biologists are contributing to research into memory and learning.
- 6.6 Developments in scientific research follow improvements in apparatus—William Harvey was hampered in his observational research into reproduction by lack of equipment. The microscope was invented 17 years after his death.

Standards

2020 New Jersey Student Learning Standards- Science

Science and Engineering Practices

- Asking Questions and Defining Problems

- Constructing Explanations and Designing Solutions
- Developing and Using Models
- Engaging in Argument from Evidence

Cross Cutting Concepts

- Cause and Effect
- Patterns
- Scale, Proportion, and Quantity
- Stability and Change
- Structure and Functions
- Systems and System Models

Disciplinary Core Ideas

Life Sciences

- LS1A: Structure and Functions
- LS1B: Growth and Development of Organisms
- LS1C: Organization for Matter and Energy Flow in Organisms
- LS1D: Information Processing
- LS3A: Inheritance of Traits

Essential Questions

6.1 How does the structure of the wall of the small intestine allow it to move, digest and absorb food?

6.2 How does the blood system continuously transport substances to cells and simultaneously collects waste products?

6.3 How does the human body have structures and processes that resist the continuous threat of invasion by pathogens?

6.4 How do the lungs actively ventilate to ensure that gas exchange can occur passively?

6.5 How do neurons transmit the message, synapses modulate the message?

6.6 How are hormones used when signals need to be widely distributed?

Enduring Understanding

Students will understand how the body systems are all interconnected with each other, each playing a vital role in survival of an individual. Students will have an appreciation for the small mechanisms that allow for the overall body to function.

Students will know...

6.1

- The contraction of circular and longitudinal muscle of the small intestine mixes the food with enzymes and moves it along the gut.
- The pancreas secretes enzymes into the lumen of the small intestine.
- Enzymes digest most macromolecules in food into monomers in the small intestine.
- Villi increase the surface area of epithelium over which absorption is carried out.
- Villi absorb monomers formed by digestion as well as mineral ions and vitamins.
- Different methods of membrane transport are required to absorb different nutrients.

6.2

- Arteries convey blood at high pressure from the ventricles to the tissues of the body.
- Arteries have muscle cells and elastic fibers in their walls.
- The muscle and elastic fibers assist in maintaining blood pressure between pump cycles.
- Blood flows through tissues in capillaries. Capillaries have permeable walls that allow exchange of materials between cells in the tissue and the blood in the capillary.
- Veins collect blood at low pressure from the tissues of the body and return it to the atria of the heart.
- Valves in veins and the heart ensure circulation of blood by preventing backflow.
- There is a separate circulation for the lungs.
- The heart beat is initiated by a group of specialized muscle cells in the right atrium called the sinoatrial node.
- The sinoatrial node acts as a pacemaker.
- The sinoatrial node sends out an electrical signal that stimulates contraction as it is propagated through the walls of the atria and then the walls of the ventricles.
- The heart rate can be increased or decreased by impulses brought to the heart through two nerves from the medulla of the brain.
- Epinephrine increases the heart rate to prepare for vigorous physical activity.

6.3

- The skin and mucous membranes form a primary defence against pathogens that cause infectious disease.
- Cuts in the skin are sealed by blood clotting.
- Clotting factors are released from platelets.

- The cascade results in the rapid conversion of fibrinogen to fibrin by thrombin.
- Ingestion of pathogens by phagocytic white blood cells gives non-specific immunity to diseases.
- Production of antibodies by lymphocytes in response to particular pathogens gives specific immunity.
- Antibiotics block processes that occur in prokaryotic cells but not in eukaryotic cells.
- Viruses lack a metabolism and cannot therefore be treated with antibiotics. Some strains of bacteria have evolved with genes that confer resistance to antibiotics and some strains of bacteria have multiple resistance.

6.4

- Ventilation maintains concentration gradients of oxygen and carbon dioxide between air in alveoli and blood flowing in adjacent capillaries.
- Type I pneumocytes are extremely thin alveolar cells that are adapted to carry out gas exchange.
- Type II pneumocytes secrete a solution containing surfactant that creates a moist surface inside the alveoli to prevent the sides of the alveolus adhering to each other by reducing surface tension.
- Air is carried to the lungs in the trachea and bronchi and then to the alveoli in bronchioles.
- Muscle contractions cause the pressure changes inside the thorax that force air in and out of the lungs to ventilate them.
- Different muscles are required for inspiration and expiration because muscles only do work when they contract.

6.5

- Neurons transmit electrical impulses.
- The myelination of nerve fibers allows for saltatory conduction.
- Neurons pump sodium and potassium ions across their membranes to generate a resting potential.
- An action potential consists of depolarization and repolarization of the neuron.
- Nerve impulses are action potentials propagated along the axons of neurons.
- Propagation of nerve impulses is the result of local currents that cause each successive part of the axon to reach the threshold potential.
- Synapses are junctions between neurons and between neurons and receptor or effector cells.
- When presynaptic neurons are depolarized they release a neurotransmitter into the synapse.
- A nerve impulse is only initiated if the threshold potential is reached.

6.6

- Insulin and glucagon are secreted by β and α cells of the pancreas respectively to control blood glucose concentration.
- Thyroxine is secreted by the thyroid gland to regulate the metabolic rate and help control body temperature.
- Leptin is secreted by cells in adipose tissue and acts on the hypothalamus of the brain to inhibit appetite.
- Melatonin is secreted by the pineal gland to control circadian rhythms.
- A gene on the Y chromosome causes embryonic gonads to develop as testes and secrete testosterone.
- Testosterone causes pre-natal development of male genitalia and both sperm production and development of male secondary sexual characteristics during puberty.
- Estrogen and progesterone cause pre-natal development of female reproductive organs and female secondary sexual characteristics during puberty.
- The menstrual cycle is controlled by negative and positive feedback mechanisms involving ovarian and

pituitary hormones.

Students will be able to...

6.1

- Analyze the processes occurring in the small intestine that result in the digestion of starch and transport of the products of digestion to the liver.
- Explain the use of dialysis tubing to model absorption of digested food in the intestine.

6.2

- Critique William Harvey's discovery of the circulation of the blood with the heart acting as the pump.
- Analyze pressure changes in the left atrium, left ventricle and aorta during the cardiac cycle.
- Hypothesize the causes and consequences of occlusion of the coronary arteries.

6.3

- Hypothesize the causes and consequences of blood clot formation in coronary arteries.
- Critique Florey and Chain's experiments to test penicillin on bacterial infections in mice.
- Explain the effects of HIV on the immune system and methods of transmission.

6.4

- Hypothesize the causes and consequences of lung cancer.
- Assess the causes and consequences of emphysema.
- Explain the external and internal intercostal muscles, and diaphragm and abdominal muscles as examples of antagonistic muscle action.

6.5

- Infer the secretion and reabsorption of acetylcholine by neurons at synapses.
- Explain the blocking of synaptic transmission at cholinergic synapses in insects by binding of neonicotinoid pesticides to acetylcholine receptors.

6.6

- Explain the causes and treatment of Type I and Type II diabetes.
- Explain the testing of leptin on patients with clinical obesity and reasons for the failure to control the disease.
- Explain the causes of jet lag and use of melatonin to alleviate it.
- Critique the use in IVF of drugs to suspend the normal secretion of hormones, followed by the use of artificial doses of hormones to induce superovulation and establish a pregnancy.
- Critique William Harvey's investigation of sexual reproduction in deer.

STAGE 2- EVIDENCE OF LEARNING

Formative Assessment

- Exit Card / Ticket
- Inside-Outside Circle Discussion (Fishbowl)
- Observation
- Questions & Answers
- Quiz
- Web or Concept Map

Authentic Assessments

6.1

- Skill: Production of an annotated diagram of the digestive system.
- Skill: Identification of tissue layers in transverse sections of the small intestine viewed with a microscope or in a micrograph.

6.2

- Skill: Identification of blood vessels as arteries, capillaries or veins from the structure of their walls.
- Skill: Recognition of the chambers and valves of the heart and the blood vessels connected to it in dissected hearts or in diagrams of heart structure.

6.4

- Skill: Monitoring of ventilation in humans at rest and after mild and vigorous exercise.

6.5

- Skill: Analysis of oscilloscope traces showing resting potentials and action potentials.

6.6

- Skill: Annotate diagrams of the male and female reproductive system to show names of structures and their functions.

Laboratories will be used for assessment

Quizzes will be given.

Benchmark Assessments

Chapter tests will be given.

STAGE 3- LEARNING PLAN

Instructional Map

Helpful strategies to implement the IB Biology curriculum

6.1

- Students should know that amylase, lipase and an endopeptidase are secreted by the pancreas. The name trypsin and the method used to activate it are not required.
- Students should know that starch, glycogen, lipids and nucleic acids are digested into monomers and that cellulose remains undigested.
- Tissue layers should include longitudinal and circular muscles, mucosa and epithelium.

6.3

- Diagrams of skin are not required.
- Subgroups of phagocyte and lymphocyte are not required but students should be aware that some lymphocytes act as memory cells and can quickly reproduce to form a clone of plasma cells if a pathogen carrying a specific antigen is re-encountered.
- The effects of HIV on the immune system should be limited to a reduction in the number of active lymphocytes and a loss of the ability to produce antibodies, leading to the development of AIDS.

6.4

- Ventilation can either be monitored by simple observation and simple apparatus or by data logging with a spirometer or chest belt and pressure meter. Ventilation rate and tidal volume should be measured, but the terms vital capacity and residual volume are not expected.
- Students should be able to draw a diagram to show the structure of an alveolus and an adjacent capillary.

6.5

- The details of structure of different types of neuron are not needed.
- Only chemical synapses are required, not electrical, and they can simply be referred to as synapses.

6.6

- The roles of FSH, LH, estrogen and progesterone in the menstrual cycle are expected.
- William Harvey failed to solve the mystery of sexual reproduction because effective microscopes were not available when he was working, so fusion of gametes and subsequent embryo development remained undiscovered.

Modification/Differentiation of Instruction

Differentiation Strategies for Special Education Students

- Remove unnecessary material, words, etc., that can distract from the content
- Use of off-grade level materials
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Time allowed
- Level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Varied homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Ability to work at their own pace
- Present ideas using auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment
- Differentiated checklists and rubrics, if available and appropriate

Differentiation Strategies for Gifted and Talented Students

- Increase the level of complexity

- Decrease scaffolding
- Variety of finished products
- Allow for greater independence
- Learning stations, interest groups
- Varied texts and supplementary materials
- Use of technology
- Flexibility in assignments
- Varied questioning strategies
- Encourage research
- Strategy and flexible groups based on formative assessment or student choice
- Acceleration within a unit of study
- Exposure to more advanced or complex concepts, abstractions, and materials
- Encourage students to move through content areas at their own pace
- After mastery of a unit, provide students with more advanced learning activities, not more of the same activity
- Present information using a thematic, broad-based, and integrative content, rather than just single-subject areas

Differentiated Strategies for ELL Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials, including visuals
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language.
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Allow students to work at their own pace
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Role play
- Provide graphic organizers, highlighted materials
- Strategy and flexible groups based on formative assessment

Differentiation Strategies for At Risk Students

- Remove unnecessary materials, words, etc., that can distract from the content
- Provide appropriate scaffolding
- Limit the number of steps required for completion
- Gradually increase the level of independence required
- Tiered centers, assignments, lessons, or products
- Provide appropriate leveled reading materials
- Deliver the content in “chunks”
- Varied texts and supplementary materials
- Use technology, if available and appropriate
- Differentiate homework and products
- Varied questioning strategies
- Provide background knowledge
- Define key vocabulary, multiple-meaning words, and figurative language
- Use audio and visual supports, if available and appropriate
- Provide multiple learning opportunities to reinforce key concepts and vocabulary
- Meet with small groups to reteach idea/skill
- Provide cross-content application of concepts
- Presenting ideas through auditory, visual, kinesthetic, & tactile means
- Provide graphic organizers and/or highlighted materials
- Strategy and flexible groups based on formative assessment

504 Plans

Students can qualify for 504 plans if they have physical or mental impairments that affect or limit any of their abilities to:

- walk, breathe, eat, or sleep
- communicate, see, hear, or speak
- read, concentrate, think, or learn
- stand, bend, lift, or work

Examples of accommodations in 504 plans include:

- preferential seating
- extended time on tests and assignments
- reduced homework or classwork

- verbal, visual, or technology aids
- modified textbooks or audio-video materials
- behavior management support
- adjusted class schedules or grading
- verbal testing
- excused lateness, absence, or missed classwork
- pre-approved nurse's office visits and accompaniment to visits
- occupational or physical therapy

Modification Strategies

- Cooperative Grouping
- Oral Directions
- Peer Tutoring
- Preferential Seating

Differentiation Strategies

High Preparation

- Alternative Assessments
- Group Investigations
- Independent Research / Project
- Varying Graphic Organizers

Low Preparation

- Flexible Grouping
- Jigsaw
- Use of Collaboration
- Work Alone / Together

Horizontal Intergration- Interdisciplinary Connections

See Appendix

Vertical Integration- Discipline Mapping

Previous courses

6th grade – Diversity of life

7th grade – Populations and Ecosystems

8th grade – Human Systems Interactions and Heredity and Adaptations

9th grade – Honors Biology

10th grade – Honors Chemistry

Possible next courses

Honors Physics

Anatomy & Physiology

IB Physics

Zoology

Forensics

Additional Materials

Videos used through McGraw Hill, Crash Course and Howard Hughes Medical Institute.

Current Research articles supplied through Newsela.