

BIG IDEAS

Homeostasis is maintained through physiological processes.

Gene expression, through protein synthesis, is an interaction between genes and the environment.

Organ systems have complex interrelationships to maintain homeostasis.

Learning Standards

Curricular Competencies	Content
<i>Students are expected to be able to do the following:</i> Questioning and predicting • Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal, local, or global interest • Make observations aimed at identifying their own questions, including increasingly abstract ones, about the natural world • Formulate multiple hypotheses and predict multiple outcomes Planning and conducting • Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative) • Assess risks and address ethical, cultural, and/or environmental issues associated with their proposed methods • Use appropriate SI units and appropriate equipment, including digital technologies, to systematically and accurately collect and record data • Apply the concepts of accuracy and precision to experimental procedures and data: – significant figures – uncertainty – scientific notation Processing and analyzing data and information • Experience and interpret the local environment • Apply First Peoples perspectives and knowledge, other ways of knowing, and local knowledge as sources of information	<i>Students are expected to know the following:</i> • biological molecules • metabolism and enzymes • feedback loops and regulation of the body's internal environment • transport across a cell membrane • DNA: – the cell's genetic information – replication • gene expression • proteins and their relationship to the structure and function of all cells • genomics and biotechnology • micro to macro organization • organ systems: – structure and function – structural and functional interdependence – maintenance of homeostasis • lifestyle differences and their effects on human health • holistic approach to health • disease as an imbalance in homeostasis

Learning Standards (continued)

Curricular Competencies	Content
• Seek and analyze patterns, trends, and connections in data, including describing relationships between variables, performing calculations, and identifying inconsistencies • Construct, analyze, and interpret graphs, models, and/or diagrams • Use knowledge of scientific concepts to draw conclusions that are consistent with evidence • Analyze cause-and-effect relationships Evaluating • Evaluate their methods and experimental conditions, including identifying sources of error or uncertainty, confounding variables, and possible alternative explanations and conclusions • Describe specific ways to improve their investigation methods and the quality of their data • Evaluate the validity and limitations of a model or analogy in relation to the phenomenon modelled • Demonstrate an awareness of assumptions, question information given, and identify bias in their own work and in primary and secondary sources • Consider the changes in knowledge over time as tools and technologies have developed • Connect scientific explorations to careers in science • Exercise a healthy, informed skepticism and use scientific knowledge and findings to form their own investigations to evaluate claims in primary and secondary sources • Consider social, ethical, and environmental implications of the findings from their own and others' investigations • Critically analyze the validity of information in primary and secondary sources and evaluate the approaches used to solve problems • Assess risks in the context of personal safety and social responsibility	

Learning Standards (continued)

Curricular Competencies	Content
Applying and innovating • Contribute to care for self, others, community, and world through individual or collaborative approaches • Cooperatively design projects with local and/or global connections and applications • Contribute to finding solutions to problems at a local and/or global level through inquiry • Implement multiple strategies to solve problems in real-life, applied, and conceptual situations • Consider the role of scientists in innovation Communicating • Formulate physical or mental theoretical models to describe a phenomenon • Communicate scientific ideas and information, and perhaps a suggested course of action, for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions, and representations • Express and reflect on a variety of experiences, perspectives, and worldviews through place	

Big Ideas – Elaborations

- **Homeostasis:**

Sample questions to support inquiry with students:

- How does the body maintain internal balance during exercise?
- What are the impacts of external stimulants (e.g., caffeine, alcohol) on the physiological balance of your body?

- **Gene expression:**

Sample questions to support inquiry with students:

- How does gene expression effect variability in human populations?
- How do humans adapt to changing internal and external conditions?

- **Organ systems:**

Sample questions to support inquiry with students:

- What is the advantage of having specialized tissues?
- How does the body respond to infection by a pathogen such as Zika virus or avian flu?
- What lifestyle decisions would improve your health?

Curricular Competencies – Elaborations

• Questioning and predicting:

Sample opportunities to support student inquiry:

- How can the study of genomics help improve or extend quality of life?
- Why do some people have sensitivity to certain foods (e.g., lactose, gluten)?
- How does caffeine affect the brain?
- Observe the effects of different concentrations of sugar on the diffusion rate across the membrane of an egg that has its shell dissolved with acetic acid.
- Examine healthy lung tissue and a smoker's lung tissue under the microscope to observe differences.
- Consult Elders and knowledge keepers to find out how local plants are used by First Peoples.
- Based on your understanding of cells and the plasma membrane, hypothesize how salmon can live in both freshwater and saltwater environments during their lifecycle.

• Planning and conducting:

Sample opportunities to support student inquiry:

- What are some risks and ethical issues associated with making a dietary plan for yourself or someone else?
- Consider the impact of placebos on the effectiveness of a health product or service.
- Design an experiment to test the effects of exercise on the cardiovascular and respiratory systems.
- Assess advantages and disadvantages of cloning or growing body parts for transplant.

• Processing and analyzing data and information:

Sample opportunities to support student inquiry:

- Consult with local Elders and knowledge keepers to determine some health conditions that may be treated with First Peoples traditional medicines. Which body systems might be affected?
- Analyze data showing the interrelationship between two different organ systems.
- Plot graphs to show respiratory and cardiovascular variables (e.g., heart rate, blood pressure, respiratory rate) before and after exercise. Identify patterns in these variables. Compare blood pressure changes during exercise to high resting blood pressure (hypertension).
- Explain why a diet of foods with a high glycemic index causes insulin resistance and Type II diabetes.

• Evaluating:

Sample opportunities to support student inquiry:

- How can knowledge of your own genome affect your potential future application for life insurance?
- How has DNA sequencing changed our understanding of DNA?
- How can biotechnology and genomics be used to help with space exploration?
- How would you evaluate a health claim made by an advertiser on the Internet?
- Evaluate how the precision of instruments, sample size, limiting variables, and bias introduced by the subject and experimenter influence the results of an experiment.

Curricular Competencies – Elaborations

- Identify the limitations of the induced-fit and lock-and-key models of enzymatic activity.
- Evaluate the validity and evidence behind personal genome-sequencing kits.
- Evaluate the individual and societal risks of cloning body parts for organ transplants.
- **Applying and innovating:**
Sample opportunities to support student inquiry:
 - How might biotechnology be used to improve crop health and yields in local and global communities?
 - Help promote healthy brain function by introducing novel activities such as games, physical activities, languages, and music that can be learned and shared with your local community.
 - Develop a healthy dietary plan for a high-performance athlete. How does it compare to a safe dietary plan for an average high school student?
- **Communicating:**
Sample opportunity to support student inquiry:
 - Using evidence, develop a public service announcement that highlights the importance of healthy, safe lifestyle options for teenagers. What would be some appropriate ways to share your findings about head injuries in sports with elementary and middle school students (i.e., concussion awareness)?
- **place:** Place is any environment, locality, or context with which people interact to learn, create memory, reflect on history, connect with culture, and establish identity. The connection between people and place is foundational to First Peoples perspectives.

Content – Elaborations

- **biological molecules:**
 - water, acids, bases, buffers
 - dehydration and synthesis reactions
 - organic molecules: carbohydrates, lipids, proteins, nucleic acids, ATP
- **metabolism:**
 - anabolism and catabolism
 - ATP production and utilization
 - models and regulation of enzymatic reactions (e.g., lock-and-key model)
- **enzymes:**
 - substrate, coenzyme, activation energy
 - regulation of enzyme activity (e.g., allosteric inhibition)
- **feedback loops:**
 - negative:
 - maintaining normal body temperature
 - normal CO₂ and glucose levels in blood
 - positive:
 - temperature regulation (heat stroke, hypothermia)
 - CO₂ levels in blood (acidosis)
 - oxytocin in childbirth
 - blood clotting
- **transport across a cell membrane:**
 - structure of the plasma membrane
 - selective permeability
 - diffusion, osmosis, facilitated transport, active transport, endocytosis, exocytosis
- **gene expression:** protein synthesis
- **structure and function of all cells:** structural proteins, hormones, enzymes
- **genomics:** Human Genome Project, 1000 Genomes Project, 1000 Plant Genomes Project, personal genomics
- **biotechnology:** cloning, recombinant DNA, GMOs, transgenic organisms, genetic modification, gene therapy
- **organization:** molecules, organelles, cells, tissues, organs, organ systems, organisms
- **organ systems:** nervous, endocrine, digestive, cardiovascular, lymphatic/immune, respiratory, urinary, reproductive
- **lifestyle differences:** dietary plans, exercise, sleep, smoking, salt intake, alcohol consumption, drugs, vaccinations, contraception, fertility drugs
- **holistic approach:** health care that integrates mind, body, and spirit with community
- **disease:** may occur when one or more body systems fail to maintain homeostasis (e.g., ulcers, hypertension, lactose intolerance, diabetes, HIV-AIDS)