



School District of Marshfield **Course Syllabus**

Course Name: PLTW: Principles of the Biomedical Sciences (PBS)
Length of Course: Year
Credits: 1

Course Description:

This course provides an introduction to the biomedical sciences through exciting "hands-on" projects and problems. Student work involves the study of human medicine, research processes and an introduction to bio-informatics. Students investigate the human body systems and various health conditions including heart disease, diabetes, sickle-cell disease, hypercholesterolemia, and infectious diseases. A theme through the course is to determine the factors that led to the death of a fictional person. After determining the factors responsible for the death, the students investigate lifestyle choices and medical treatments that might have prolonged the person's life. Key biological concepts including: homeostasis, metabolism, inheritance of traits, feedback systems, and defense against disease are embedded in the curriculum. Engineering principles including: the design process, feedback loops, fluid dynamics, and the relationship of structure to function are incorporated in the curriculum where appropriate.

Prerequisite: Concurrent enrollment in college prep science and math courses. Freshman status or consent of instructor.

Learning Targets:

Unifying Concepts and Processes

- Systems, order, and organization
 - A system is an organized group of related objects or components that form a whole.
 - Systems have boundaries, components, resources flow (input and output), and feedback.
 - Order—behavior of units of matter, objects, organisms, or events in the universe—can be described statistically.
 - Types and levels of organization provide useful ways of thinking about the world.

- Evidence, models, and explanation
 - Evidence consists of observations and data on which to base scientific explanations.
 - Models are tentative schemes or structures that correspond to real objects, events, or classes of events, and that have explanatory power.
 - Scientific explanations incorporate existing scientific knowledge and new evidence from observations, experiments, or models into internally consistent, logical statements.

- Change, constancy, and measurement
 - Although most things are in the process of becoming different—changing—some properties of objects and processes are characterized by constancy.
 - Interactions within and among systems result in change.
 - Changes in systems can be quantified.
 - Mathematics is essential for accurately measuring change.
 - Scale includes understanding that different characteristics, properties, or relationships within a system might change as its dimensions are increased or decreased.

- Form and function
 - The form or shape of an object or system is frequently related to use, operation, or function.
 - Students should be able to explain function by referring to form and to explain form by referring to function.

NSES Content Standard A: Science As Inquiry *As a result of activities in grades 9-12, all students should*

- LT 1: Develop abilities necessary to do scientific inquiry
- 1.1 *Identify questions and concepts that guide scientific investigation.*
 - 1.2 *Design and conduct scientific investigations.*
 - 1.3 *Use technology and mathematics to improve investigations*
 - 1.4 *Formulate and revise scientific explanations and models using logic and evidence.*
 - 1.5 *Recognize and analyze alternative explanations and models.*
 - 1.6 *Communicate and defend a scientific argument.*

LT 2: Develop understandings about scientific inquiry

- 2.1 *Scientists usually inquire about how physical, living, or designed systems function.*
- 2.2 *Scientists conduct investigations for a variety of reasons.*
- 2.3 *Scientists rely on technology to enhance the gathering and manipulation of data.*
- 2.4 *Mathematics is essential in scientific inquiry.*
- 2.5 *Scientific explanations must adhere to criteria such as: a proposed explanation must be logically consistent; it must abide by the rules of evidence; it must be open to questions and possible modification; and it must be based on historical and current scientific knowledge.*
- 2.6 *Results of scientific inquiry—new knowledge and methods—emerge from different types of investigations and public communication among scientists.*

NSES Content Standard B: Physical Science *As a result of activities in grades 9-12, all students should-*

LT 3: Develop an understanding of the structure of atoms

- 3.1 *Matter is made of minute particles called atoms.*
- 3.2 *The atom's nucleus is composed of protons and neutrons.*

LT 4: Develop an understanding of the structure and properties of matter

- 4.1 *Atoms interact with one another by transferring or sharing electrons that are furthest from the nucleus.*
- 4.2 *An element is composed of a single type of atom.*
- 4.3 *Bonds between atoms are created when electrons are paired up by being transferred or shared.*
- 4.4 *The physical properties of compounds reflect the nature of the interactions among its molecules.*
- 4.5 *Carbon atoms can bond to one another in chains, rings, and branching networks to form a variety of structures, including synthetic polymers, oils, and the large molecules essential to life.*

LT 5: Develop an understanding of chemical reactions

- 5.1 *Chemical reactions occur all around us, for example health care, cooking, cosmetics, and automobiles. Complex chemical reactions involving carbon-based molecules take place constantly in every cell in our bodies.*

- 5.2 *Chemical reactions may release or consume energy.*
- 5.3 *A large number of important reactions involve the transfer of either electrons (oxidation/reduction reactions) or hydrogen ions (acid/base reactions) between reacting ions, molecules, or atoms.*

NSES Content Standard C: Life Science *As a result of activities in grades 9-12, all students should-*

LT 6: Develop an understanding of the cell

- 6.1 *Cells have particular structures that underlie their functions.*
- 6.2 *Most cell functions involve chemical reactions.*
- 6.3 *Cells store and use information to guide their functions.*
- 6.4 *Cells can differentiate, and complex multicellular organisms are formed as a highly organized arrangement of differentiated cells.*

LT 7: Develop an understanding of molecular basis of heredity

- 7.1 *In all organisms, the instructions for specifying the characteristics of the organism are carried in DNA, a large polymer formed from subunits of four kinds (A, G, C, and T).*
- 7.2 *Most of the cells in a human contain two copies of each of 22 different chromosomes. In addition, there is a pair of chromosomes that determines sex: females have two X chromosomes and males have one X and one Y chromosome*
- 7.3 *Changes in DNA (mutations) occur spontaneously at low rates.*

LT 8: Develop an understanding of matter, energy, and organization in living systems

- 8.1 *The chemical bonds of food molecules contain energy.*
- 8.2 *The complexity and organization of organisms accommodates the need for obtaining, transforming, transporting, releasing, and eliminating the matter and energy used to sustain the organism.*
- 8.3 *As matter and energy flows through different levels of organization of living systems—cells, organs, organisms, communities—and between living systems and the physical environment, chemical elements are recombined in different ways.*

NSES Content Standard E: Science and Technology *As a result of activities in grades 9-12, all students should-*

LT 9: Develop abilities for technological design

- 9.1 *Identify a problem or design an opportunity*
- 9.2 *Propose designs and choose between alternative solutions.*
- 9.3 *Implement a proposed solution.*
- 9.4 *Evaluate the solution and its consequences.*
- 9.5 *Communicate the problem, process, and solution.*

LT 10: Develop an understanding about science and technology

- 10.1 *Scientists in different disciplines ask different questions, use different methods of investigation, and accept different types of evidence to support their explanations.*
- 10.2 *Science often advances with the introduction of new technologies.*
- 10.3 *Creativity, imagination, and a good knowledge base are all required in the work of science and engineering.*
- 10.4 *Science and technology are pursued for different purposes.*

NSES Content Standard F: Science in Personal and Social Perspectives *As a result of activities in grades 9-12, all students should-*

LT 11: Develop an understanding of personal and community health

- 11.1 *Hazards and potential for accidents exist.*
- 11.2 *The severity of disease symptoms is dependent on many factors, such as human resistance and the virulence of the disease-producing organism.*
- 11.3 *Personal choice concerning fitness and health involves multiple factors.*
- 11.4 *Selection of foods and eating patterns determine nutritional balance.*

LT 12: Develop understanding of science and technology in local, national, and global challenges

- 12.1 *Understanding basic concepts and principles of science and technology should precede active debate about the economics, policies, politics, and ethics of various science- and technology-related challenges.*
- 12.2 *Progress in science and technology can be affected by social issues and challenges.*

NSES Content Standard G: History and Nature of Science *As a result of activities in grades 9-12, all students should-*

LT 13: Develop an understanding of science as a human endeavor
13.1 Individuals and teams have contributed and will continue to contribute to the scientific enterprise.

LT 14: Develop an understanding of the nature of scientific knowledge
*14.1 Science distinguishes itself from other ways of knowing and from other bodies of knowledge
through the use of empirical standards, logical arguments, and skepticism, as scientists strive for
the best possible explanations about the natural world.*
14.2 Scientific explanations must meet certain criteria.
*14.3 Because all scientific ideas depend on experimental and observational confirmation, all scientific
knowledge is, in principle, subject to change as new evidence becomes available.*

LT 15: Develop an understanding of historical perspectives
15.1 In history, diverse cultures have contributed scientific knowledge and technologic inventions.
15.2 Usually, changes in science occur as small modifications in extant knowledge.
*15.3 Occasionally, there are advances in science and technology that have important and long-lasting
effects on science and society.*
*15.4 The historical perspective of scientific explanations demonstrates how scientific knowledge
changes by evolving over time, almost always building on earlier knowledge.*

First Quarter – 9 weeks

1. Unit 1: Human Body Systems

Second Quarter – 9 weeks

2. Unit 2: Heart Attack

Third Quarter – 9 weeks

3. Unit 3: Diabetes (3 weeks)

4. Unit 4: Sickle Cell Disease (3 weeks)

5. Unit 5: Hypercholesterolemia (3 weeks)

Fourth Quarter – 9 weeks

6. Unit 6: Infectious Disease (3 weeks)

7. Unit 7: Medical Interventions (3 weeks)

8. Unit 8: Grant Proposal (3 weeks)

Required Core Resources: None