School District of Marshfield Course Syllabus

Course Name: Biomedical Innovation PS PLTW
Length of Course: Year
Credit: 1 Credit

Program Goal:

The School District of Marshfield K-12 Science Program will prepare and motivate learners to explore, problem solve and collaborate with their classmates to interpret science and explain the world around them. Learners will acquire knowledge and evidence that promotes creative solutions through the evaluation and understanding of scientific theories and evidence. Learners will collect, analyze and reason with scientific data through investigations that ultimately allow for the generation of scientific explanations. Critical thinking skills will elevate natural curiosity, make sense of scientific data and promote scientific literate citizens.

Course Description:

In this capstone course, students apply their knowledge and skills to answer questions or solve problems related to the biomedical sciences. Students design innovative solutions for the health challenges of the 21st century as they work through progressively challenging open-ended problems, addressing topics such as clinical medicine, physiology, biomedical engineering, and public health. Throughout the course, students are expected to present their work to an adult audience that may include representatives from the local business and healthcare community.

In the Biomedical Innovation course, students will be asked to apply what they have learned in the previous three courses to solve unique problems in science, medicine, and healthcare. Each problem is staged as a mission – a unique set of tasks the students must work through to achieve their desired objective. Students are presented with each problem in a Mission File – a document that includes a case brief, a list of completion tasks, links to available resources, as well as a reflection section. Working through the missions not only exposes students to current issues in biomedical science, but it also provides skills-based instruction in research and experimentation – tools students will use to design innovative solutions to real-world problems. Students will use what they learn in these missions as they develop and implement their independent project at the end of the year. A teacher may use additional resources in the community – the guidance of other teachers in the school, the advice of scientists or biomedical professionals, or the knowledge presented in scientific literature to help students achieve each goal.

Common Core State Standards for English Language Arts Anchor Standards (AS)
Reading (R)
• AS.R.1 Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. • AS.R.2 Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas. • AS.R.4 Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone. • AS.R.6 Assess how point of view or purpose shapes the content and style of a text. • AS.R.7 Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words. • AS.R.8 Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence. • AS.R.9 Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take. • AS.R.10 Read and comprehend complex literary and informational texts independently and proficiently.
Writing (W)

- AS.W.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
- AS.W.2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
- AS.W.3 Write narratives to develop real or imagined experiences or events using effective technique, well- chosen details, and well-structured event sequences.
- AS.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- AS.W.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.
- AS.W.6 Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
- AS.W.7 Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.
- AS.W.8 Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
- AS.W.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.
- AS.W.10 Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

Speaking and Listening (SL)

- AS.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
- AS.SL.2 Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
- AS.SL.3 Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.
- AS.SL.4 Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.
- AS.SL.5 Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
- AS.SL.6 Adapt speech to a variety of contexts and communicative tasks, demonstrating command of formal English when indicated or appropriate.

Language (L)

- AS.L.1 Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
- AS.L.2 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
- AS.L.4 Determine or clarify the meaning of unknown and multiple-meaning words and phrases by using context clues, analyzing meaningful word parts, and consulting general and specialized reference materials, as appropriate.
- AS.L.5 Demonstrate understanding of word relationships and nuances in word meanings.
- AS.L.6 Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Common Core State Standards for Mathematics

Quantities (Q)

- N.Q.1 Use units as a way to understand problems and to guide the solution of multistep problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.
- N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Seeing Structure in Expression (SSE)

- A.SSE.1 Interpret expressions that represent a quantity in terms of its context.
- A.SSE.1a Interpret parts of an expression, such as terms, factors, and coefficients.

Creating Equations (CED)

- A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.

Reasoning with Equations and Inequalities (REI)

- A.REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
- A.REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
- A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Interpreting Functions (IF)

- F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.
- F.IF.7 Graph functions expressed symbolically and show key features of the graph, by

hand in simple cases and using technology for more complicated cases.

Interpreting Categorical and Quantitative Data (ID)

- S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).
- S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
- S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
- S.ID.9 Distinguish between correlation and causation.

Making Inferences and Justifying Conclusion (IC)

- S.IC.1 Understand statistics as a process from making inferences about population parameters based on a random sample from that population.
- S.IC.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?
- S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization related to each.
- S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
- S.IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
- S.IC.6 Evaluate reports based on data.

National Consortium for Health Science Education

Foundation Standard 1: Academic Foundation: Understand human anatomy, physiology, common diseases and disorders, and medical math principles.

Human Anatomy and Physiology 1:1	1.11 Identify basic levels of organization of the human body. a. Chemical b. Cellular c. Tissue d. Organs e. Systems f. Organism 1.13 Analyze basic structures and functions of human body systems (skeletal, muscular, integumentary, cardiovascular, lymphatic, respiratory, nervous, special senses, endocrine, digestive, urinary, and reproductive). a. Skeletal (bone anatomy, axial and appendicular skeletal bones, functions of bones, ligaments, types of joints) b. Muscular (microscopic anatomy of muscle tissue, types of muscle, locations of skeletal muscles, functions of muscles, tendons, directional

	movements) c. Integumentary (layers, structures and functions of skin) d. Cardiovascular (components of blood, structures and functions of blood components, structures and functions of the cardiovascular system, conduction system of the heart, cardiac cycle) e. Lymphatic (structures and functions of lymphatic system, movement of lymph fluid) f. Respiratory (structures and functions of respiratory system, physiology of respiration) g. Nervous (structures and functions of nervous tissue and system, organization of nervous system) h. Special senses (structures and functions of eye, ear, nose and tongue; identify senses for sight, hearing, smell, taste, touch) i. Endocrine (endocrine versus exocrine, structures and functions of endocrine system, hormones, regulation of hormones) j. Digestive (structures and functions of gastrointestinal tract, chemical and mechanical digestion, structures and functions of accessory organs) k. Urinary (structures and functions of urinary system, gross and microscopic anatomy, process of urine formation, urine composition, homeostatic balance) l. Reproductive (structures and functions of male and female reproductive systems, formation of gametes, hormone production and effects, menstrual cycle, and conception)
Diseases and Disorders 1:2	1.23 Describe biomedical therapies as they relate to the prevention, pathology, and treatment of disease. a. Gene testing b. Gene therapy c. Human proteomics d. Cloning e. Stem cell research
Medical Mathematics 1:3	1.31 Demonstrate competency in basic math skills and mathematical conversions as they relate to healthcare. a. Metric system (such as: centi, milli, kilo) b. Mathematical (average, ratios, fractions, percentages, addition, subtraction, multiplication, division) c. Conversions (height, weight/mass, length, volume, temperature, household measurements) 1.32 Demonstrate the ability to analyze diagrams, charts, graphs, and tables to interpret healthcare results.
Foundation Standard 2: Communications: Demonstrate methods of delivering and obtaining information, while communicating effectively.	

Concepts of Effective Communication 2:1	2.11 Model verbal and nonverbal communication. 2.13 Identify the differences between subjective and objective information. 2.15 Practice speaking and active listening skills. 2.16 Modify communication to meet the needs of the patient/client and be appropriate to the situation.
Written Communication Skills 2:3	2.31 Utilize proper elements of written and electronic communication (spelling, grammar, and formatting). 2.32 Prepare examples of technical, informative, and creative writing.
Foundation Standard 4: Employability Skills: Use employability skills to enhance employment opportunities and job satisfaction.	
Employability Skills 4:2	4.21 Apply employability skills in healthcare. a. Chain of command b. Correct grammar c. Decision making d. Flexible e. Initiative f. Integrity g. Loyalty h. Positive attitude i. Professional characteristics j. Prompt and prepared k. Responsibility l. Scope of practice m. Teamwork n. Willing to learn
Employability Preparation 4:4	4.41 Develop components of a personal portfolio. a. Letter of introduction b. Resume c. Sample Projects d. Writing Sample e. Work-based Learning Documentation f. Oral Report g. Service Learning/Community Service h. Credentials i. Technology Skills j. Leadership Examples
Foundation Standard 7: Safety Practices: Identify existing and potential hazards to clients, co-workers, and self. Employ safe work practices and follow health and safety policies and procedures to prevent injury and illness.	
Infection Control 7:1	7.11 Explain principles of infection control. a. Chain of infection b. Mode of transmission (direct, indirect, vectors, common vehicle [air, food, water], healthcare associated infections [nosocomial], opportunistic) c. Microorganisms (non-pathogenic, pathogenic,

	aerobic, anaerobic) d. Classifications (bacteria, protozoa, fungi, viruses, parasites) 7.12 Differentiate methods of controlling the spread and growth of microorganisms. a. Aseptic control (antisepsis, disinfection, sterilization, sterile technique) b. Standard precautions c. Isolation precautions d. Blood borne pathogen precautions e. Vaccinations
Personal Safety 7:2	7.21 Apply personal safety procedures based on Occupational Safety and Health Administration (OSHA) and Centers for Disease Control (CDC) regulations. 7.22 Demonstrate principles of body mechanics.
Common Safety Hazards 7:4	7.41 Observe all safety standards related to the Occupational Exposure to Hazardous Chemicals Standard (Safety Data Sheets (SDSs)). (www.osha.gov) 7.42 Comply with safety signs, symbols, and labels.
Emergency Procedures and Protocols 7:5	7.51 Practice fire safety in a healthcare setting.
Foundation Standard 8: Teamwork: Identify roles and responsibilities of individual members as part of the healthcare team.	
Healthcare Teams 8:1	8.12 Identify characteristics of effective teams. a. Active participation b. Commitment c. Common goals d. Cultural sensitivity e. Flexibility f. Open to feedback g. Positive attitude h. Reliability i. Trust j. Value individual contributions
Team Member Participation 8:2	8.21 Recognize methods for building positive team relationships (such as: mentorships and teambuilding). 8.22 Analyze attributes and attitudes of an effective leader. a. Characteristics (interpersonal skills, focused on results, positive) b. Types (autocratic, democratic, laissez faire) c. Roles (sets vision, leads change, manages accountability) 8.23 Apply effective techniques for managing team conflict (negotiation, assertive communication, gather the facts, clear expectations, mediation).
Foundation Standard 9: Health Maintenance Practices: Differentiate between wellness and disease. Promote disease prevention and model healthy behaviors.	

Healthy Behaviors 9:1	9.11 Promote behaviors of health and wellness (such as: nutrition, weight control, exercise, sleep habits). 9.12 Describe strategies for prevention of disease. a. Routine physical exams b. Medical, dental, and mental health screenings c. Community health education outreach programs d. Immunizations e. Stress management f. Avoid risky behaviors
Foundation Standard 10: Technical Skills: Apply and demonstrate technical skills and knowledge common to health career specialties.	
Technical Skills 10:1	10.11 Apply procedures for measuring and recording vital signs including the normal ranges (temperature, pulse, respirations, blood pressure, pain).
Foundation Standard 11: Information Technology in Healthcare: Apply information technology practices common across health professions.	
Basic Computer Skills 11:3	11.31 Apply basic computer concepts and terminology necessary to use computers and other mobile devices. 11.32 Demonstrate basic computer troubleshooting procedures (such as: restart, check power supply, refresh browser, check settings). 11.33 Demonstrate use of file organization and information storage. 11.34 Identify uses of basic word processing, spreadsheet, and database applications. 11.35 Evaluate validity of web-based resources.

Next Generation Science Standards (NGSS)

From Molecules to Organisms: Structures and Processes

- HS.LS1.1 Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
- HS.LS1.2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- HS.LS1.3 Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Ecosystems: Interactions, Energy, and Dynamics

- Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Engineering Design

- HS.ETS1.1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- HS.ETS1.2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HS.ETS1.3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Matter and Its Interactions- Chemical Reactions

• DCI - PS1.B The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions. (HS-PS1-2), (HS-PS1-7)	
Engineering Design - Defining and Delimiting Engineering Problems	
• DCI - ETS1.A Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-PS2-3) • DCI - ETS1.A Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. (HS-ETS1-1) • DCI - ETS1.B When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (HS- ETS1-3)	
Engineering Design - Optimizing the Design Solution	
• DCI - ETS1.C Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (secondary to HS-PS1-6)	
From Molecules to Organisms: Structures and Processes - Structure and Function	
• DCI - LS1.A Systems of specialized cells within organisms help them perform the essential functions of life. (HS- LS1-1) • DCI - LS1.A All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1), (Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.) • DCI - LS1.A Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2) • DCI - LS1.C The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6)	
Heredity: Inheritance and Variation of Traits - Inheritance of Traits	
• DCI - LS3.A Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA . All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function. (HS-LS3-1) • DCI - LS3.B Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors. (HS-LS3-2), (HS-LS3-3)	
Asking questions and defining problems	
Science and Engineering Practices	• Ask questions o - that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.

	○ - that arise from examining models or a theory, to clarify and/or seek additional information and relationships. ○ - to determine relationships, including quantitative relationships, between independent and dependent variables. ○ - to clarify and refine a model, an explanation, or an engineering problem. • Evaluate a question to determine if it is testable and relevant. • Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory. • Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. • Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.
Developing and Using Models	
Science and Engineering Practices	• Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism or system in order to select or revise a model that best fits the evidence or design criteria. • Design a test of a model to ascertain its reliability. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. • Develop a complex model that allows for manipulation and testing of a proposed process or system. • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
Planning and Carrying Out Investigations	
Science and Engineering Practices	• Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled. • Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. • Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts. • Select appropriate tools to collect, record, analyze, and evaluate data. Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated.
Analyzing and Interpreting Data	

Science and Engineering Practices	• Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. • Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data. • Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. • Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success. Select appropriate tools to collect, record, analyze, and evaluate data. Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated.
Using Mathematics and Computational Thinking	
Science and Engineering Practices	• Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system. • Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations. • Apply techniques of algebra and functions to represent and solve scientific and engineering problems.
Constructing Explanations and Designing Solutions	
Science and Engineering Practices	• Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. • Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. • Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. • Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
Engaging in Argument from Evidence	
Science and Engineering Practices	• Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments. • Construct, use, and/or present an oral and written argument or counterarguments based on data and evidence.

	• Make and defend a claim based on evidence about the natural world or the effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations).
Obtaining, Evaluating, and Communicating Information	
Science and Engineering Practices	• Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. • Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem. • Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. • Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible.
Patterns	
Crosscutting Concepts	• Mathematical representations are needed to identify some patterns. • Patterns of performance of designed systems can be analyzed and interpreted to reengineer and improve the system. • Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.
Cause and Effect: Mechanism and Prediction	
Crosscutting Concepts	• Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering. • Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. • Systems can be designed to cause a desired effect. • Changes in systems may have various causes that may not have equal effects.
Scale, Proportion, and Quantity	
Crosscutting Concepts	• Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
Systems and System Models	
Crosscutting Concepts	• Systems can be designed to do specific tasks. • Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.
Structure and Function	

Crosscutting Concepts	• A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. • The way an object is shaped or structured determines many of its properties and functions. • The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials.

Key Vocabulary:			
Abstract	Alternative hypothesis	Autopsy	Case Control study
Casual Relationship	Clone	Cohort Study	Coliform
Correlation	Cross Sectional Study	Design Process	DNA Ligase
Dose Response	Environmental health	Epidemiology	Experimental study
Grant	Incidence	Innovation	Ligation
Null hypothesis	Observational study	Paired t-test	Plasmid
PCR	Prospective Cohort study	Retrospective Cohort study	Statistical significance
P value	Recombinant DNA	Vector	Prototype
Toxicology	Triage		

Topics/Content Outline- Units and Themes:

Biomedical Innovation Unit Summary:

- Problem 1 Design of an Effective Emergency Room
- Problem 2 Exploring Human Physiology
- Problem 3 Design of a Medical Innovation
- Problem 4 Investigating Environmental Health
- Problem 5 Combating a Public Health Issue
- Problem 6 Molecular Biology in Action (Optional)
- Problem 7 Forensic Autopsy (Optional)
- Problem 8 Independent Project (Optional)

Primary Resource(s):

Project Lead The Way Medical Intervention Curriculum