Medical Interventions (MI) - PLTW

Curriculum/Content Area: Science	**Course Length:** 2 terms
Course Title: Medical Interventions (MI) - PLTW	**Date last reviewed:** October 2017
Prerequisites: Human Body Systems (HBS) or AP Biology or Human Anatomy and Physiology	**Board approval date:** December 5, 2017
Primary Resource:	

Desired Results

Course description and purpose: Students investigate a variety of interventions involved in the prevention, diagnosis and treatment of disease as they follow the life of a fictitious family. The course is a "How-To" manual for maintaining overall health and homeostasis in the body. Students explore how to prevent and fight infection; screen and evaluate the code in human DNA; prevent, diagnose and treat cancer; and prevail when the organs of the body begin to fail. Through these scenarios, students are exposed to a range of interventions related to immunology, surgery, genetics, pharmacology, medical devices, and diagnostics.

Enduring Understandings:	**Essential Questions**:
1. Medical interventions help maintain homeostasis in order for human bodies to function at a healthy balanced level without infectious disease. 2. Disease prevention includes understanding the cause of the disease and reducing the risks associated with it. 3. Identification and diagnosis of disease consists of several stages which must be followed in order to effectively combat health issues. 4. Human genetics involves the understanding of DNA, testing and the	1. What happens to the human body when homeostasis is not maintained? 2. How disease be prevented? 3. How is disease identified and diagnosed? 4. What impact does the DNA sequence have on genetic outcomes? 5. How will advancements in research and technology improve the treatment of disease in the future?

moral and ethical decisions that must be made as a results of the professional diagnosis. 5. The treatment of disease is based on several factors and continuously changes with developments in research and new technological advancements.	

Unit 1: How to Fight Infection
1. Maintain homeostasis in the body 2. Detection methods for infectious agents 3. Usage of Antibiotics 4. Hearing Loss 5. Vaccines
Standards:
PLTW Document with Standards Listed by Unit and Lesson **Cross-Cutting Concepts** 1. **Patterns -** Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them. 2. **Cause and Effect** - Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. Changes in systems may have various causes that may not have equal effects. 3. **Scale, Proportion, and Quantity -** 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). 4. **Systems and System Models -** A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. 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. Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. 5. **Energy and Matter -** Energy cannot be created or destroyed - only moves between one place and another place, between objects and/or fields, or between systems. 6. **Structure and Function -** 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. The way an object is shaped or structured determines many of its properties.

7. **Stability and Change -** Much of science deals with constructing explanations of how things change and how they remain stable.

<u>Science and Engineering Practices</u>

1. **Asking Questions and Defining Problems**
    - Ask questions
        - 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.
    - 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.
2. **Developing and Using Models**
    - 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 and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations.
    - Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
3. **Analyzing and Interpreting Data**
    - 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.
4. **Using Mathematics and Computational Thinking**
    - Apply ratios, rates, percentages, and unit conversions in the context of complicated measurement problems involving quantities with derived or compound units (such as mg/mL, kg/m3 , acre-feet, etc.)
    - Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.

5. **Constructing Explanations and Designing Solutions**
    - 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.
6. **Engaging in Argument from Evidence**
    - 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 counter-arguments 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.
7. **Obtaining, Evaluating, and Communicating Information**
    - 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. Communicate scientific and/or technical information or ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

<u>Disciplinary Core Ideas</u>

1. **LS1.A: Structure and Function**
    a. Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
    b. 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.)
    c. 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)
2. **LS3.A: Inheritance of Traits**
    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)
3. **LS4.A: Evidence of Common Ancestry and Diversity**
    a. Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS4-1)
4. **LS4.B: Natural Selection**
    a. Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. (HS-LS4-2), (HS-LS4-3)
    b. The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3)
5. **LS 4.C: Adaptation**
    a. Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2)
    b. Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential

survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-3), (HS-LS4-4)
    c. Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3)
    d. Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (HS-LS4-5), (HS-LS4-6)

6. **PS3.A: Definitions of Energy**
    a. At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy . (HSPS3-2), (HS-PS3-3)
7. **PS3.B: Conservation of Energy and Energy Transfer**
    a. Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1, HS-PS3-4)
8. **PS4.A: Waves and Their Applications**
    a. The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. (HS-PS4-1)

Learning Targets:

1. I can recognize that medical interventions are measures to improve health or alter the course of an illness and can be used to prevent, diagnose, and treat disease.
2. I can recognize that diagnostic tests for infectious diseases can provide qualitative and quantitative results.
3. I can analyze connections between individuals in a disease outbreak.
4. I can understand the structure and function of different bacteria.
5. I can explain the method of action for different antibiotics.
6. I can identify the structure and function of the ear.
7. I can perform various tests to evaluate hearing.
8. I can describe how vaccines interact with the human immune system.
9. I can describe how vaccines are produced.

Assessment Evidence:

Performance Assessment Options
May include, but are not limited to the following:
- Lab Experiments
- Lab Journals

Other assessment options
May include, but are not limited to the following:
- Unit Assessment

Digital Tools & Supplementary Resources:

- Vernier probeware and software
- Inspiration
- Edvotek Gel Electrophoresis Machinery

Unit 2: How to Screen What Is In Your Genes
1. Genetic Testing and Screening 2. Gene Therapy 3. Reproductive Cloning
Standards:
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1. **Asking Questions and Defining Problems**
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    - 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.
2. **Developing and Using Models**
    - 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.
3. **Analyzing and Interpreting Data**
    - 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.
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    - 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.
5. **Engaging in Argument from Evidence**
    - 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 counter-arguments 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.

6. **Obtaining, Evaluating, and Communicating Information**
    - 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.
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Disciplinary Core Ideas

LS1.A: Structure and Function

- Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
- 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.)
- 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)

LS3.A: Inheritance of Traits

- 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)

LS3.B: Variation of Traits

- In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS-LS3-2)

Learning Targets:

1. I can explain the way in which the human genome is analyzed and used for genetic counseling.
2. I can describe how genetic testing plays a roles in prenatal care.
3. I can explain how gene therapy can treat a genetic disorder.
4. I can debate the ethics, safety and overall effectiveness of gene therapy.
5. I can outline the process for reproductive cloning.

Assessment Evidence:

Performance Assessment Options	**Other assessment options**
May include, but are not limited to the following: ● Lab Experiments ● Lab Journals	*May include, but are not limited to the following:* ● Unit Assessment

Digital Tools & Supplementary Resources:

- Vernier probeware and software
- Inspiration
- Edvotek Gel Electrophoresis Machinery

Unit 3: How to Conquer Cancer

1. Detecting Cancer
2. Reducing Cancer Risk
3. Treating Cancer
4. Future Cancer Treatments

Standards:

PLTW Document with Standards Listed by Unit and Lesson

Cross-Cutting Concepts

1. **Patterns -** Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.
2. **Cause and Effect** - Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. Changes in systems may have various causes that may not have equal effects.
3. **Scale, Proportion, and Quantity -** 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).

4. **Systems and System Models -** A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. 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. Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models.
5. **Structure and Function -** 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. The way an object is shaped or structured determines many of its properties.
6. **Stability and Change -** Much of science deals with constructing explanations of how things change and how they remain stable.

Science and Engineering Practices

1. **Asking Questions and Defining Problems**
    - Ask questions
        - 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.
2. **Developing and Using Models**
    - 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 and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations.
- Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.

3. **Planning and Carrying Out Investigations**
   - 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.
4. **Analyzing and Interpreting Data**
   - 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.
5. **Using Mathematics and Computational Thinking**
   - Apply techniques of algebra and functions to represent and solve scientific and engineering problems.
6. **Constructing Explanations and Designing Solutions**
   - 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.
7. **Engaging in Argument from Evidence**
    - Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
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Disciplinary Core Ideas

1. **LS1.A: Structure and Function**
    a. Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
    b. 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.)

    c. 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)

2. **LS1.B: Growth and Development of Organisms**
    a. In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4)
3. **LS3.A: Inheritance of Traits**
    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)
4. **LS3.B: Variation of Traits**
    a. In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited. (HS-LS3-2)
5. **LS 4.C: Adaptation**
    a. Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline–and sometimes the extinction–of some species. (HS-LS4-5), (HS-LS4-6)
6. **PS4.A: Waves and Their Applications**
    a. Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them. (HS-PS4-5)
7. **PS4.B: Electromagnetic Radiation**
    a. When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat). Shorter wavelength electromagnetic radiation (ultraviolet, X-rays, gamma rays) can ionize atoms

and cause damage to living cells. (HS-PS4-4)

8. **ETS1.A Defining and Delimiting Engineering Problems**
    a. 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.

Learning Targets:

1. I can recognize that there are many different types of cancer, each with specific risk factors, manifestations in the body and treatment options.
2. I can explain the use of different diagnostic tools used in cancer screenings.
3. I can compare and contrast normal cells and cancer cells.
4. I can identify factors that increase the risk of cancer and ways to reduce the risk.
5. I can conduct a controlled experiment.
6. I can compare and contrast the positives and negatives of the different types of cancer treatments.
7. I can recognize the purpose of artificial limbs and how they function on the human body.
8. I can recognize that all drugs do not act the same way for all individuals.
9. I can recognize that clinical trials are regulated by strict guidelines and conducted in a variety of ways.

Assessment Evidence:

Performance Assessment Options
May include, but are not limited to the following:
- Lab Experiments
- Lab Journals

Other assessment options
May include, but are not limited to the following:
- Unit Assessment

Digital Tools & Supplementary Resources:

- Vernier probeware and software
- Inspiration
- Edvotek Gel Electrophoresis Machinery

Unit 4: How to Prevail When Organs Fail

1. Manufacturing Human Proteins
2. Organ Failure
3. Organ Transplant
4. Future of Organ Transplant and Donation

Standards:

PLTW Document with Standards Listed by Unit and Lesson

Cross-Cutting Concepts

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5. **Structure and Function -** 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. The way an object is shaped or structured determines many of its properties.
6. **Stability and Change -** Much of science deals with constructing explanations of how things change and how they remain stable. Feedback (negative or positive) can stabilize or destabilize a system.

Science and Engineering Practices

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    - Ask questions
        - 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.
    - 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.

2. **Developing and Using Models**
    - 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 and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations.
    - Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
3. **Analyzing and Interpreting Data**
    - 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.
4. **Constructing Explanations and Designing Solutions**
    - 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.
5. **Engaging in Argument from Evidence**
    - 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 counter-arguments 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.

6. **Obtaining, Evaluating, and Communicating Information**
    - 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. Communicate scientific and/or technical information or ideas (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (i.e., orally, graphically, textually, mathematically).

<u>Disciplinary Core Ideas</u>

1. **LS1.A: Structure and Function**
    a. Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
    b. 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.)
    c. 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)
    d. Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)
2. **LS3.A: Inheritance of Traits**
    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)

3. **ETS1.A Defining and Delimiting Engineering Problems**
   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)

Learning Targets:

1. I can describe the evolution of the methods used to diagnose and treat diabetes from the 1800s through today.
2. I can outline the process of bacterial transformation.
3. I can explain the structure and function of human proteins.
4. I can diagnose end stage renal failure.
5. I can explain how dialysis machines work.
6. I can identify the surgical techniques involved in a live donor transplant.
7. I can identify the tissues and organs that can be transplanted.
8. I can perform simulated laparoscopic and general surgical techniques.
9. I can describe how xenotransplantation or tissue engineering works, as well as their potential risks, benefits, challenges, and ethical or moral concerns.

Assessment Evidence:

Performance Assessment Options *May include, but are not limited to the following:* ● Lab Experiments ● Lab Journals	**Other assessment options** *May include, but are not limited to the following:* ● Unit Assessment ● End of Course Assessment

Digital Tools & Supplementary Resources:

- Vernier probeware and software
- Inspiration
- Edvotek Gel Electrophoresis Machinery