Principles of Biomedical Sciences
Lakewood High School
Dr. Valerie J.H. Daniluk

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If you have any questions concerning grades, homework, labs, or the class itself, please feel free to use the above contact information. I will do my best to return your text or email as promptly as possible. I am here for you, so if you have any questions please do not hesitate to contact me. **Weekly topics, activities, and assignments can be viewed on Google Classroom.**

Materials: 3-ring binder with dividers, pencils, pens and colored pencils.

All curriculum and activities are on classroom laptops. You will be assigned a laptop to use in class.

PLTW: Project Lead the Way (PLTW) is a national, not-for-profit educational program that assists high-school students in developing strong backgrounds in science and engineering. The following is the link to Project Lead the Way online: http://www.pltw.org/

I expect that this class will motivate you to work hard, help you learn to work well with others, improve your higher-level thinking skills and will ultimately result in you having a deep understanding of how the human body is organized, how it works, what can go wrong and how medical interventions can help. Make no mistake. This is a college level course and you should be prepared to put forth that level of effort. It will be like no other class you have taken. You will love it!

Objectives:

Analyze the evidence found at a crime scene and help the medical examiner uncover clues left on a body to solve a mystery. Question, diagnose, and propose treatment and care for patients in a family medical practice. Track down the source of a mysterious outbreak at a local hospital. Access and stabilize a patient during an emergency and prepare for medical surge and mobile medical care. Collaborate with professionals in other fields to innovate and design solutions to local and global medical problems. Whether seeking a career in medicine or healthcare or simply looking to for the challenge of real-world problems, students in Principles of Biomedical Science will practice how to think creatively and critically to innovate in science and will gain practical experience with experimental design and the design process.

Principles of Biomedical Science (PBS) is a full-year high school course in the PLTW Biomedical Science Program. This course serves to provide foundational knowledge and skills in fields such as biology, anatomy & physiology, genetics, microbiology, and epidemiology as well as engage students in how this content can be applied to real world situations, cases, and problems. Through both individual and collaborative team activities, projects, and problems, students will tackle real-world challenges faced by biomedical professionals in the field. They will work with the same tools and equipment used in hospitals and labs as they engage in relevant hands-on work. Students will develop skill in technical documentation to represent and communicate experimental findings and solutions to problems. In addition, students will explore how connections to other disciplines such as computer science and engineering shape the future of medicine and practice collaboration techniques that will help them connect with professionals across any field

The course contains the following units:

Unit 1- Medical Investigation
Unit 2- Clinical Care
Unit 3- Outbreaks & Emergencies
Unit 4 – Innovation, Inc.

Notebook:

Students are required to keep and maintain a notebook for this class. The notebook should be a three-ring binder with pockets in front and dividers with pockets. It is my advice to use only one binder for this class and not share it with any other classes. Materials that are to be included in this notebook are as follows:

Career Journals will be completed online on google classroom or within an assigned activity.

Grades:

The following scale will be used for grading each marking period.

70%- Tests
25% Quizzes
5%- Homework

Required Materials
3 ring binder (1 ½ or 2 inch)
Pens and pencils
Recommended
Hi-liters
Colored pencils
(available in class if you do not have your own)

WRITING COMPONENT

- For each unit, there will be notes, activities, homework, classwork, labs, lab write-ups, projects, notebook work, career journals, etc in which the students will demonstrate their mastery of the writing process. You will be asked to write professional level discussions and conclusions. This is often one of the hardest tasks to get used to in the beginning. Make sure you are putting forth your best effort at all times.

PLAGIARISM / ACADEMIC DISHONESTY

- Plagiarism and academic dishonesty are serious offenses. The academic work of a student is expected to be his/her own effort.
  - Students must give the author(s) credit for any source material used.
  - To represent ideas or interpretations taken from any sources without giving credit is a flagrant act.
  - To present a borrowed passage after having changed a few words, even if the source is cited, is also plagiarism.
  - To use another student's work is also plagiarism
- Students who commit any act of academic dishonesty will receive a failing grade in that portion of the course work. Acts of academic dishonesty will be reported to the administration.
- Your work represents your integrity as a professional. Make sure you always work toward having high standards and thus a respectable reputation as a professional.

CLASSROOM EXPECTATIONS

1. Be on time - this means inside the room when the bell rings **WITH ALL MATERIALS READY - we have MANY activities to do this year and we need EVERY minute we can spare to get them done!** If you forget your lab notebook or binder, etc, you may go get it, but risk the chance of being late to class.

2. Wear appropriate clothing. (1) Follow the school dress code (2) but ALSO follow our LAB dress code. We will do many labs and you will need to wear proper clothes and SHOES!!! Make sure you pay attention for upcoming lab dates so that you dress appropriately.

3. **CLOSED TOED SHOES FOR ALL LABS!** If you don't have closed toed shoes on a lab day you cannot participate in the lab! This means you lose your lab participation points and will need to arrange a time to make-up the lab after school.

4. Be RESPECTFUL of yourself, your classmates, and your teachers!

5. Take responsibility for your work in all situations

   i. If you miss class, it is up to YOU to get your make up work - not for me to give it to you!!!

   ii. If you are having trouble with the content of class, it is up to YOU to seek help!!! I am more than willing to help you in any way that I can, but you have to let me know that you need help.

6. **NO CHEATING** - this includes copying conclusion questions, tests, homework, etc. **NO FORM OF CHEATING WILL BE TOLERATED!!!!** Both the copier and the one who allows the other to copy will receive a zero on the assignment and an office referral! This includes ChatGPT!!

7. Follow ALL lab procedures - no goofing off, everyone MUST **ACTIVELY** participate in the lab activities; no standing back and just watching. We have a lot of material/labs to cover this year. You need to be an active participant at all times!

8. Follow ALL lab protocols - **wear your protective goggles, gloves, and aprons at all times during labs!** Failure to follow lab dress code during labs and/or participate will cause your lab privileges to be suspended for the day and/or detention and/or administrator involvement.

9. **Work is turned in ON TIME and COMPLETED**. Most outside work will be prepping for a lab by reading or completing conclusions to a lab. So completing outside classwork on time will be imperative for you

to be prepared for the following day. Most work is done in class with plenty of class time to complete! **DON'T FALL BEHIND**!! Work turned in late will lose points!

10. **A student who knows they will be absent from class** on a particular date (due to sports, vacations, field trips, etc.) is still expected to hand in any work that was assigned to be due that day. You may hand in work the day before it is due, or the morning of, but any work handed in later that the assigned class time will be counted as late.

This class can prove to be exciting, fun, and a lot of hard work. I will do my best to make this class as enjoyable, fun, interesting, and exciting for all students. I am here to help each and every one of you succeed and reach your highest potential. Just remember school is a two way street. I can only do so much on my own, and ultimately some of the responsibility falls on yourself to seek extra help if you need it, ask questions if you are confused, or perhaps seek an extra challenge.

I'm always here for extra help or lab make-ups after school.

Lab make-ups must be arranged with me in advance and must be complete within 2 days of the missed lab. If you miss a lab due to an unexcused absence and materials have been returned to storage, you will receive a zero on the lab.

Labs CANNOT be made up if you cut class or if you are removed due to not following lab safety procedures. You will receive a zero for the lab.

9.3 – Career & Technical Education (CTE)
Content Area: 21st Century Life and Careers

CONTENT AREA:	9.3 CAREER AND TECHNICAL EDUCATION
HEALTH SCIENCE CAREER CLUSTER•	
Number	**Standard Statement**
At the end of Grade 12, Career and Technical Education Program completers will be able to:	
CAREER CLUSTER•:	***HEALTH SCIENCE (HL)***
9.3.HL.1	Determine academic subject matter, in addition to high school graduation requirements, necessary for pursuing a health science career.
9.3.HL.2	Explain the healthcare workers' role within their department, their organization and the overall healthcare system.
9.3.HL.3	Identify existing and potential hazards to clients, coworkers, visitors and self in the healthcare workplace.
9.3.HL.4	Evaluate the roles and responsibilities of individual members as part of the healthcare team and explain their role in promoting the delivery of quality health care.
9.3.HL.5	Analyze the legal and ethical responsibilities, limitations and implications of actions within the healthcare workplace.
9.3.HL.6	Evaluate accepted ethical practices with respect to cultural, social and ethnic differences within the healthcare workplace.
PATHWAY:	***BIOTECHNOLOGY RESEARCH & DEVELOPMENT (HL-BRD)***
9.3.HL-BRD.1	Summarize the goals of biotechnology research and development within legal and ethical protocols.
9.3.HL-BRD.2	Apply the fundamentals of biochemistry, cell biology, genetics, mathematical concepts, microbiology, molecular biology, organic chemistry and statistics to conduct effective biotechnology research and development of products.
9.3.HL-BRD.3	Demonstrate basic knowledge of recombinant DNA, genetic engineering, bioprocessing, monoclonal antibody production, nanotechnology, bioinformatics, genomics, proteomics and transcriptomics to conduct biotechnology research and development.
9.3.HL-BRD.4	Demonstrate the principles of solution preparation, sterile techniques, contamination control, and measurement and calibration of instruments used in biotechnology research.
9.3.HL-BRD.5	Determine processes for product design and production and how that work contributes to an understanding of the biotechnology product development process.
9.3.HL-BRD.6	Summarize and explain the larger ethical, moral and legal issues related to biotechnology research, product development and use in society.

9.3 – Career & Technical Education (CTE)
Content Area: 21st Century Life and Careers

CONTENT AREA:	9.3 CAREER AND TECHNICAL EDUCATION
HEALTH SCIENCE CAREER CLUSTER®	
Number	Standard Statement
PATHWAY:	DIAGNOSTIC SERVICES (HL-DIA)
9.3.HL-DIA.1	Communicate key diagnostic information to healthcare workers and patients in an accurate and timely manner.
9.3.HL-DIA.2	Assess and report patient's/client's health status in order to monitor and document patient progress.
9.3.HL-DIA.3	Demonstrate the principles of body mechanics for positioning, transferring and transporting of patients/clients, and perform them without injury to the patient/client or self.
9.3.HL-DIA.4	Explain procedures and goals to the patient/client accurately and effectively, using strategies to respond to questions and concerns.
9.3.HL-DIA.5	Select, demonstrate and interpret diagnostic procedures.
PATHWAY:	HEALTH INFORMATICS (HL-HI)
9.3.HL-HI.1	Communicate health information accurately and within legal and regulatory guidelines, upholding the strictest standards of confidentiality.
9.3.HL-HI.2	Describe the content and diverse uses of health information.
9.3.HL-HI.3	Demonstrate the use of systems used to capture, retrieve and maintain confidential health information from internal and external sources.
PATHWAY:	SUPPORT SERVICES (HL-SUP)
9.3.HL-SUP.1	Describe, differentiate and safely perform the responsibilities of healthcare support services roles.
9.3.HL-SUP.2	Demonstrate work practices that maintain a clean and healthy healthcare facility to reduce or eliminate pathogenic organisms.
9.3.HL-SUP.3	Follow established internal and external guidelines in order to provide high-quality, effective support services in the healthcare facility.
9.3.HL-SUP.4	Maximize available resources for proper care and use of healthcare equipment and materials.
9.3.HL-SUP.5	Implement healthcare facility standards in order to maintain high-quality healthcare facilities.

PATHWAY:	THERAPEUTIC SERVICES HL-THR
9.3.HL-THR.1	Utilize communication strategies to answer patient/client questions and concerns on planned procedures and goals.

9.3 – Career & Technical Education (CTE)
Content Area: 21st Century Life and Careers

CONTENT AREA:	9.3 CAREER AND TECHNICAL EDUCATION
HEALTH SCIENCE CAREER CLUSTER•	
Number	Standard Statement
9.3.HL-THR.2	Communicate patient/client information among healthcare team members to facilitate a team approach to patient care.
9.3.HL-THR.3	Utilize processes for assessing, monitoring and reporting patient's/clients' health status to the treatment team within protocol and scope of practice.
9.3.HL-THR.4	Evaluate patient/client needs, strengths and problems in order to determine if treatment goals are being met.

Next Generation Science Standards

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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☐ Unit 4

HS.LS1.2

Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

HS.LS1.3

Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

HS.LS1.4

Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

☐ Unit 1 ☑ Unit 2 ☑ Unit 3 ☐ Unit 4

HS.LS1.6

Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

Ecosystems: Interactions, Energy, and Dynamics

HS.LS2.5

Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

HS.LS2.8

Evaluate the evidence for the role of group behavior on an individual's and species' chances to survive and reproduce.

☐ Unit 1 ☐ Unit 2 ☐ Unit 3 ☑ Unit 4

Next Generation Science Standards

Heredity: Inheritance and Variation of Traits

HS.LS3.1

Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☐ Unit 4

HS.LS3.2

Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.

☐ Unit 1 ☑ Unit 2 ☑ Unit 3 ☐ Unit 4

HS.LS3.3

Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

☐ Unit 1 ☑ Unit 2 ☑ Unit 3 ☐ Unit 4

Biological Evolution: Unity and Diversity

HS.LS4.3

Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

☐ Unit 1 ☐ Unit 2 ☑ Unit 3 ☐ Unit 4

Earth and Human Activity

HS.ESS3.4

Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

☐ Unit 1 ☐ Unit 2 ☐ Unit 3 ☑ Unit 4

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.

☐ Unit 1 ☐ Unit 2 ☐ Unit 3 ☑ Unit 4

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.

☐ Unit 1 ☐ Unit 2 ☐ Unit 3 ☑ Unit 4

Next Generation Science Standards

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.

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☑ Unit 4

HS.ETS1.4

Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

☐ Unit 1 ☐ Unit 2 ☑ Unit 3 ☐ Unit 4

Disciplinary core ideas

PS1.A Matter and Its Interactions - Structure and Properties of Matter

• Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. (HS-PS1-1)

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

• The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states. (HS-PS1-1)

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

• A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart. (HS-PS1-4)

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

PS3.A Energy - Definitions of Energy

• Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HSPS3-1), (HS-PS3-2)

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

• At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy . (HSPS3-2), (HS-PS3-3)

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

Next Generation Science Standards

PS3.B Energy - Conservation of Energy and Energy Transfer

- 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)

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

- The availability of energy limits that can occur in any system. (HS-PS3-1)

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

- Uncontrolled systems always evolve toward more stable states— that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). (HS-PS3-4)

☑ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

ETS1.A Engineering Design - Defining and Delimiting Engineering Problems

- 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)

☐ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- 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)

☐ Unit 1 ☐ Unit 2 ☐ Unit 3 ☑ Unit 4

ETS1.B Engineering Design - Developing Possible Solutions

- 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)

☐ Unit 1 ☐ Unit 2 ☑ Unit 3 ☑ Unit 4

- 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)

☐ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

LS1.A From Molecules to Organisms: Structures and Processes - Structure and Function

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

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

Next Generation Science Standards

• 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.)

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• 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)

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• 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)

☐ Unit 1 ☑ Unit 2 ☑ Unit 3 ☐ Unit 4

LS1.B From Molecules to Organisms: Structures and Processes - Growth and Development of Organisms

• 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)

☐ Unit 1 ☑ Unit 2 ☑ Unit 3 ☐ Unit 4

LS1.C From Molecules to Organisms: Structures and Processes - Organization for Matter and Energy Flow in Organisms

• 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)

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☐ Unit 4

• As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6), (HS-LS1-7)

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

• As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7)

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

Next Generation Science Standards

LS2.B Ecosystems: Interactions, Energy, and Dynamics - Cycles of Matter and Energy Transfer in Ecosystems

• Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. (HS-LS2-3)

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

LS2.C Ecosystems: Interactions, Energy, and Dynamics - Ecosystem Dynamics, Functioning, and Resilience

• Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7)

☐ Unit 1 ☐ Unit 2 ☐ Unit 3 ☑ Unit 4

LS3.A Heredity: Inheritance and Variation of Traits - 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)

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☐ Unit 4

• 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)

☐ Unit 1 ☑ Unit 2 ☑ Unit 3 ☐ Unit 4

• 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)

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

LS4.A Biological Evolution: Unity and Diversity - Evidence of Common Ancestry and Diversity

• 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)

☐ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

Next Generation Science Standards

LS4.B Biological Evolution: Unity and Diversity - Natural Selection

- 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)

☐ Unit 1 ☐ Unit 2 ☑ Unit 3 ☐ Unit 4

- The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3)

☐ Unit 1 ☐ Unit 2 ☑ Unit 3 ☐ Unit 4

LS4.D Biological Evolution: Unity and Diversity - Biodiversity and Humans

- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7), (Note: This Disciplinary Core Idea is also addressed by HS-LS4-6.)

☐ Unit 1 ☐ Unit 2 ☐ Unit 3 ☑ Unit 4

ESS3.C Earth and Human Activity - Human Impacts on Earth Systems

- Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)

☐ Unit 1 ☐ Unit 2 ☐ Unit 3 ☑ Unit 4

Science and Engineering Practice

Practice 1 - Asking questions and defining problems in 9-12 builds on K-8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations.

- 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- Evaluate a question to determine if it is testable and relevant.

☑ Unit 1 ☑ Unit 2 ☐ Unit 3 ☑ Unit 4

Next Generation Science Standards

• 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• 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.

☐ Unit 1 ☐ Unit 2 ☑ Unit 3 ☑ Unit 4

Practice 2 Developing and Using Models
Modeling in 9-12 builds on K-8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

• 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.

☐ Unit 1 ☐ Unit 2 ☑ Unit 3 ☑ Unit 4

• Design a test of a model to ascertain its reliability.

☐ Unit 1 ☐ Unit 2 ☐ Unit 3 ☑ Unit 4

• 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.

☐ Unit 1 ☐ Unit 2 ☑ Unit 3 ☑ Unit 4

• Develop a complex model that allows for manipulation and testing of a proposed process or system.

☐ Unit 1 ☐ Unit 2 ☐ Unit 3 ☑ Unit 4

• Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

Next Generation Science Standards

Practice 3 Planning and Carrying Out Investigations
Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

Practice 4 Analyzing and Interpreting Data
Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

Next Generation Science Standards

• Evaluate the impact of new data on a working explanation and/or model of a proposed process or system.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

Practice 5 Using Mathematics and Computational Thinking
Mathematical and computational thinking in 9- 12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

• Create and/or revise a computational model or simulation of a phenomenon, designed device, process, or system.

☐ Unit 1 ☐ Unit 2 ☑ Unit 3 ☑ Unit 4

• Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

☐ Unit 1 ☐ Unit 2 ☑ Unit 3 ☐ Unit 4

• Apply techniques of algebra and functions to represent and solve scientific and engineering problems.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• 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.)

☐ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

Practice 6 Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 9-12 builds on K-8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.

• Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables.

☑ Unit 1 ☐ Unit 2 ☑ Unit 3 ☑ Unit 4

Next Generation Science Standards

• 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• 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.

☐ Unit 1 ☐ Unit 2 ☑ Unit 3 ☑ Unit 4

Practice 7 Engaging in Argument from Evidence

• Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations (e.g., trade-offs), constraints, and ethical issues.

☐ Unit 1 ☐ Unit 2 ☑ Unit 3 ☑ Unit 4

• Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations or solutions to determine the merits of arguments.

☑ Unit 1 ☑ Unit 2 ☐ Unit 3 ☐ Unit 4

• Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• Construct, use, and/or present an oral and written argument or counterarguments based on data and evidence.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• 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).

☐ Unit 1 ☐ Unit 2 ☑ Unit 3 ☑ Unit 4

Practice 8 Obtaining, Evaluating, and Communicating Information
Obtaining, evaluating, and communicating information in 9-12 builds on K-8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.

• 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.

☐ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• 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).

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

Crosscutting Concepts

Patterns

• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• Mathematical representations are needed to identify some patterns.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

• Empirical evidence is needed to identify patterns.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

Next Generation Science Standards

Cause and Effect: Mechanism and Prediction

- 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

☐ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- Systems can be designed to cause a desired effect.

☐ Unit 1 ☐ Unit 2 ☑ Unit 3 ☑ Unit 4

- Changes in systems may have various causes that may not have equal effects.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

Scale, Proportion, and Quantity

- In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.

☐ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.

☐ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- 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).

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

Next Generation Science Standards

- Systems can be designed to do specific tasks.

☐ Unit 1 ☐ Unit 2 ☐ Unit 3 ☑ Unit 4

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.

☐ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

Structure and Function

- The way an object is shaped or structured determines many of its properties and functions.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- 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.

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

Stability and Change

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

☑ Unit 1 ☑ Unit 2 ☑ Unit 3 ☑ Unit 4

- Feedback (negative or positive) can stabilize or destabilize a system.

☐ Unit 1 ☑ Unit 2 ☑ Unit 3 ☐ Unit 4

PROJECT LEAD THE WAY
PLTW

Biomedical Sciences at Lakewood High School Student Contract

Student Agreement:

I, _____ (write name legibly)
am aware that this is a demanding course that will require college level work on my part. I will put my best effort forth every day including, being organized, efficient, hardworking, cooperative and active group member, and showing a willingness to put in time and energy in and out of class to make this class as fun and challenging as it can be. I have also read and agree to follow all of the classroom policies and safety rules set forth in this document. I agree to obtain all necessary materials for the course and tell Dr. Daniluk as soon as possible if I am unable to get any of the necessary materials. I realize that I must obey the safety rules listed above and any other rules that may be verbalized in class in order to ensure my own safety and the safety of all others in the room. I will cooperate to the fullest extent with my instructor and fellow students to maintain a safe lab environment. I will also closely follow the oral and written instructions provided by my instructor.

I am aware that any violation of this contract or the Flinn safety contract may result in any of the following: being removed from the laboratory, detention, receiving a failing grade, involvement of the administration.

Student Signature _____

Dear parent or guardian:

I feel that you should be fully informed about your child's opportunities and experiences in my class, as well as my expectations of him/her. Please read through this syllabus and the accompanying attachment so that you are fully aware of my general policies, expectations and safety requirements. No student will be allowed to perform laboratory activities until this contract and the Flinn safety contract are signed by both you and your student and are on file with me.

Your signature on this contract indicates that you have read this document and its attachments, are aware of the expectations of being a part of the PLTW Biomedical Science program, the measures taken to ensure the safety of your child in the science laboratory, and will support the Biomedical program by instructing your son/daughter to uphold all rules and expectations discussed here. This program will be very exciting and intriguing but will also be very rigorous and work intensive. A strong educational support system at home will help ensure a good foundation on which knowledge can be built. Thank you in advance for your support!

Parent Signature _____

Parent Contact Number _____

Parent Email _____