SCN117 Biology (BA)

Last Updated: Wednesday, September 27, 2017 by Rachel Villanova
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STATEMENT OF PURPOSE

Just as Physics was the science that had the greatest impact on twentieth century civilization with the advent of atomic energy and space exploration, so Biology will prove to be the science of the twenty-first century. Breakthroughs like mammalian cloning and the completion of the Human Genome Project will eventually prove to have far-reaching effects on many aspects of human society. The Biology I course thus has an important role in preparing students to live in this “biocentric” world. One of the main goals of the Biology I program will be to bring to the attention of our students the latest discoveries taking place in biological laboratories today and anticipate what their future impact might be. It will also be stressed that students have the opportunity to actively explore Biology, problem solve and develop critical thinking skills. The value of technology as an aid in modern scientific discovery will also be addressed. In many areas technology and science have productively merged to provide solutions to scientific problems. Especially with the adoption of the New Jersey Student Learning Standards, (NJSLS), the Biology I course continues to move away from the rote memorization of isolated terms and facts and strives to weave together the latest conceptual themes and scientific inquiry to provide students with a framework of understanding that will enable them to assimilate new information as the field continues to explode in the future. The most important piece of this conceptual framework is the acknowledgement of the interrelatedness of all organisms on the planet. This interconnection includes examples at every level of biological organization from the molecular to the ecological.

In light of the continued expansion in this field, the history of scientific discovery will be stressed. Historical achievements will be researched and examined. Students will be provided with insight into the thinking processes employed by scientists with the goal of having them exhibit these practices in the classroom, both in their attainment of new knowledge and in their experimental studies. Students must be able to isolate important facts and organize them, form hypotheses based on these facts, test alternatives, proficiently collect data, and draw conclusions. These skills must be communicated effectively to their instructor and their peers consistent with the methods of science in the real world. Importantly, the Biology I program will convey that science is ultimately a human enterprise subject to all the faults inherent in any human activity.

It is also acknowledged that the group of students that take Biology I is a heterogeneous one and that various modes of instruction, engagement and assessment must be utilized to address the different learning styles present in these young men and women as they become enlightened about the living world around us.

**Special Note for the 2015-16 School Year: In 2014, the New Jersey State Department of Education adopted the New Jersey Science Standards for Science (NJSLS) that set forth a vision for science education where the Science and Engineering Practices (SEPs), Disciplinary Core Ideas (DCIs) of science, and Crosscutting Concepts (CCCs) of science are blended seamlessly into a three dimensional learning environment for all students. The transition to NJSLS across New Jersey and in the Parsippany Troy Hills School District will be deliberate, and full implementation of NJSLS in New Jersey is planned for the 2016-17 school year. The shifts required in NJSLS implementation are fundamental, and revision of curriculum requires careful consideration of these changes as well as time to develop, pilot, and implement. During this transitional period, resources in support of NJSLS are being developed for teachers' use in buildings and through Professional Development. A core team of experienced teachers attended NJSLS curriculum training in July 2015, and are steadily working to build units that will be implemented throughout the 2015-16 school year, units that incorporate active learning for students, giving them the opportunities to Engage, Explore, Explain, Elaborate and Evaluate Science. As our master teachers implementN these new units their experiences and feedback provide momentum for the unfolding new curricula. Separately we assess students to gauge progress and inform instruction. For students in grades 9 through 12 are administered in the form of a midterm and final exam for full year courses. *Special Note: Only final exams are administered at the end of quarter courses and semester courses.

RATIONALE

Biology I is a full year course open to sophomores, juniors, and seniors. The course seeks to provide students with experiences, knowledge, and skills in the area of science in general and about the living world specifically that will enable them to succeed in future science classes as well as become a scientifically literate citizen in a society where that trait will not be considered a luxury. A conceptual framework will be utilized to provide students with a means of uniting isolated facts into a cohesive whole.

This course is aligned with the New Jersey Student Learning Standards for Science, (NJSLS) the New Jersey Student Learning Standards, (NJSLS) for Technology (NJSLS for Technology), theNew Jersey Student Learning Standards, (NJSLS) for Language Arts Science and Technical Subjects and the 21st Century Life and Careers Standards (NJSLS for Career Ready Practices). Using a variety of materials, resources, and instructional methods, the course reinforces the educational skills of scientific interpretation, investigation, problem-solving, critical analysis and research. District initiatives in assessment and critical reading and writing are also being emphasized.

THE LIVING CURRICULUM

Curriculum guides are designed to be working documents. Teachers are encouraged to make notes in the margins. Written comments can serve as the basis for future revisions. In addition, the teachers and administrators are invited to discuss elements of the guides as implemented in the classroom and to work collaboratively to develop recommendations for curriculum reforms as needed.

AFFIRMATIVE ACTION

During the development of this course of study, particular attention was paid to material, which might discriminate on the basis of sex, race, religion, national origin, or creed. Every effort has been made to uphold both the letter and spirit of affirmative action mandates as applied to the content, the texts and the instruction inherent in this course.

MODIFICATIONS AND ADAPTIONS: For guidelines on how to modify and adapt curricula to best meet the needs of all students, instructional staff should refer to the Curriculum Modifications and Adaptations (http://njcdd.org/wp-content/uploads/2016/08/toolsteacherspart2.pdf). Instructional staff of students with Individualized Education Plans (IEPs) must adhere to the recommended modifications outlined in each individual plan.

GENERAL GOALS

The students will:

1. learn about the physical and chemical properties of matter, the unique properties of water, and the structural components of organic compounds that comprises living things.
2. learn about the structure, function and basic organization of cells as they become a living organism.
3. learn about cellular functions such as photosynthesis, respiration, transcription, translation and cell cycle.
4. examine the role of meiosis in biological inheritance and utilize Mendel's Principles and rules of probability to solve genetic problems.
5. examine the mechanisms for gene expression, learn to detect genetic disorders, and explore the techniques involved in genetic engineering.
6. learn how genetics relates to the concepts of adaptation, natural selection, speciation and rates of evolutionary changes.
7. study the characteristics that make up the six kingdom system of classification, and explore the connections between evolutionary theory and taxonomy.
8. explore the earth's land and water biomes while learning how energy and nutrients cycle through the biosphere.
9. explore the interactions that occur within and between communities and ecosystems.
10. develop problem-solving and critical thinking skills.
11. become scientifically literate and knowledgeable members of society.

GENERAL PERSONAL SAFETY

The science classroom is potentially the most dangerous place in the school. However, this need not constitute a serious threat if the teacher and students have a thorough knowledge of the potential hazards, exercise prudent care and foresight, and use common sense. Accident prevention must be included in the performance of every task, and safety instruction must be an integral part of the overall science program.

1. Precautions should be taken to protect those in the classroom from injury from hot or corrosive materials.

a. In order to reduce the danger from caustic or hot liquids, students and teachers handling such materials should wear protective aprons (plastic or neoprene), goggles, and should roll sleeves (which can absorb the liquid), tightly to above the elbow.

b. Students should never be permitted to work with concentrated acids or bases or with boiling water while seated.

c. Burns from either hot or caustic materials should be flooded immediately and for at least ten minutes with copious amounts of cold water. Following flooding of the bum, the victim should be escorted to the school nurse as quickly possible. Clothing which has absorbed caustic materials should be removed as soon as feasible. The school nurse should be called immediately.

2. High-speed devises such as mechanical rotators, electric drills, fans, etc., should never be operated with protective shields removed or opened. Goggles must be worn.

3. Eating anything in the laboratory should be prohibited since it entails an intolerable hazard from toxic or possible infectious materials.

4. Cleanliness and order should be maintained.

a. Extraneous objects should be moved from work surface.

b. Glassware and other hardware should be maintained in a clean condition. Chemical or biological residues may constitute a reactive hazard.

c. Students should be required to thoroughly wash their hands with soap and water following a laboratory session.

5. There are several devices for protecting students and instructors against the corrosive or toxic effects of chemical reagents.

a. Aprons should be worn by all students working in a laboratory, especially when working with corrosive reagents.

b. Gloves should be worn by students when working with concentrated corrosive reagents. Gloves have a tendency to reduce dexterity, which may be a hazard in itself. Gloves are generally rubber or plastic.

c. Long hair can be a serious hazard in the laboratory and should be covered or contained. Fire and reduced visibility are just two of the hazards that result from long hair.

d. Loose clothing is another potential hazard in the laboratory. Loose clothing is less controllable than tight-fitting clothing. Glassware can be knocked off benches, clothes can come into contact with open flame, and manual dexterity can be reduced.

6. In a demonstration experiment using any flammable liquid such as alcohol, care must be taken to ensure that any flame in the room is a safe distance from the volatile liquid.

7. Demonstrations involving explosive or potentially explosive substances must be so arranged as to shield everyone from any danger. Use the safety shield to protect observers and the face shield and goggles to protect the demonstrators. Size of apparatus and quantities of reagents used in a

demonstration should be consistent with safe practice.

8. Observers should be evacuated from seats directly in front of the demonstration table, even if the possibility is remote that injury to them might occur from splattering of chemicals, inhalation of fumes, etc.

9. All persons performing science activities involving hazards to the eyes must wear approved eye protection devices. All persons in dangerous proximity must likewise be equipped.

10. Chemicals should never be tasted (or placed on the tongue or lips), nor should laboratory glassware be used as drinking vessels.

11. Sandals and open-toe shoes should not be permitted in laboratory areas unless they have a protective covering.

PARSIPPANY-TROY HILLS TOWNSHIP SCHOOLS COURSE PROFICIENCIES

In accordance with district policy as mandated by the New Jersey Administrative Code and the New Jersey Core Curriculum Content Standards, the following are proficiencies required for the successful completion of the above named course.

The student will:

1. demonstrate the ability to work in groups to safely solve biological problems and perform laboratory investigations.
2. select and safely use appropriate instrumentation to design and conduct investigations.
3. make measurements of length mass, volume and temperature using the metric system.
4. describe the characteristics of living things.
5. 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.
6. develop and use a model to Illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
7. 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.
8. explain how the properties of water impact living things.
9. diagram and explain the pH scale.
10. plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
11. use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
12. construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions
13. use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
14. describe the historical development of the cell theory.
15. describe cell structure including the functions of the various organelles.
16. compare eukaryote with prokaryotes, plant cells with animal cells and unicellular organisms with multi-cellular organisms.
17. compare and contrast the mechanisms of transport across cell membranes.
18. discuss the experiments and methods leading to the discovery of the structure of DNA and its significance as the molecule of inheritance.
19. describe the structures and functions of DNA and RNA and explain their roles in protein synthesis and replication.
20. describe how the surface area to volume ratio affects cell division.

21. describe the events that take place in each stage of the cell cycle.
22. relate the principles of dominance, segregation and independent assortment to patterns of inheritance and to meiosis.
23. utilize a Punnett Square, and the Laws of Probability to determine the outcome of monohybrid and dihybrid crosses.
24. explain the relationship between DNA, genes, alleles and chromosomes.
25. explain how various types of mutations affect heredity.
26. explain and solve genetic crosses involving various modes of gene expression, such as incomplete, dominance, co-dominance, sex-linkage and polygenic, multiple allele and sex influenced inheritance.
27. describe the role of plasmids, restriction enzymes and gel electrophoresis in genetic engineering.
28. understand the ethical issues involved in genetic engineering.
29. discuss the development of Darwin's theory of evolution and cite evidence that supports the theory of evolution by natural selection.
30. compare the methods of absolute and relative dating of fossils.
31. describe the fossil, embryological, anatomical and biochemical evidence for evolution.
32. relate evolutionary theory to genetics in terms of speciation.
33. list the taxonomic hierarchy and explain how they relate to one another.
34. describe the general characteristics of the six kingdoms.
35. compare and contrast the different theories on the origin of life and list major evolutionary events.
36. recognize that the evolution of life on Earth has changed the composition of the Earth's atmosphere through time.
37. define infectious and non-infectious disease and describe the methods by which diseases are spread.
38. describe the cycling of nutrients and the flow of energy through ecosystems.
39. describe what symbiosis is and identify the three types of symbiotic relationships.
40. assess the environmental risks and benefits associated with human activity.
41. distinguish between naturally occurring extinctions and those caused by human activity.

SCN117 Biology					
Unit	**Essential Questions**	**Enduring Understanding**	**Suggested Activities**	**Evaluation / Assessment**	**Resources**
Scientific Investigation and Safety *(Week 1, 2 Weeks)*	How do Biologists conduct scientific investigations safely?	Understanding and respect for the safety rules in a laboratory are vital to a successful Science experience. Safety guidelines are designed to prevent accidents from occurring, and yield quality results.	• Thoroughly review and discuss safety guidelines in a Science classroom. Carefully read and sign a safety contract, keep a copy in their work folder for easy reference. • Have students participate in a teacher prepared Lab Safety Scavenger Hunt in the classroom/laboratory. • Work in groups to design an experiment that investigates factors that affect solubility of a material or Weathering Rate on Earth Materials. • Conduct lab, *Using a Compound Microscope* (Miller/Levine). Use a typed letter "e" and prepare a wet mount slide. • Conduct microscope lab, *Comparing Plant and Animal Cells* (Miller/Levine).	**Other: Teacher Rubric** Signed Safety contract Experimental design and group work will be assessed using teacher-designed rubric. **Performance: Lab Assignment** Group work, collaboration and safety awareness will be assessed during these activities, and consistently through the school year. **Other: Teacher Observation** Accuracy of measurements	GRADING PROCEDURES **MARKING PERIOD GRADES** **Long and Short Term Assessments which may include: 90%** • Tests, quizzes, and/or worksheets • Authentic assessments • Technology applications • Projects, reports, presentations • Laboratory investigations • Data Analysis • Analysis of assigned readings **Daily Assessments which may include: 10%**

					• Active engagement in class activities • Demonstration of knowledge and understanding of course material • Skills and safety practices during lab investigations • Do Now/Exit Questions • Homework **Full Year Course** • Each marking period shall count as 20% of the final grade (80% total). The midterm assessment, and final assessment will each count as 10% of the final grade (20% total).

NJ: 2016 SLS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12
NJ: Grades 11-12
Reading: Science & Technical Subjects
Craft and Structure
NJSLSA.R4 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.
RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.
NJSLSA.R6 Assess how point of view or purpose shapes the content and style of a text.
RST.11-12.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
Integration of Knowledge and Ideas
NJSLSA.R7 Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.
RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
NGSS: Science and Engineering Practices
NGSS: 9-12
Practice 1. Asking questions (for science) and defining problems (for engineering)
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.
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.
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.
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.
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.
Practice 6. Constructing explanations (for science) and designing solutions (for engineering)
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.
Practice 7. Engaging in argument from evidence
Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.
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.
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.
NGSS: Disciplinary Core Ideas
NGSS: 9-12
ESS2: Earth's Systems
ESS2.C: The Roles of Water in Earth's SurfaceProcesses
The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy,transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HSESS2-5)

Career Ready Practices

NJ: 2014 SLS: 21st Century Life and Careers
NJ: All Grades
Career Ready Practices
Career Ready Practices
CRP1. Act as a responsible and contributing citizen and employee.

CRP2. Apply appropriate academic and technical skills.

CRP3. Attend to personal health and financial well-being.

CRP4. Communicate clearly and effectively and with reason.

CRP7. Employ valid and reliable research strategies.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them. CRP12. Work productively in teams while using cultural global competence. 					
The Structural and Chemical Basis of Life *(Week 3, 6 Weeks)*	How do organisms live and grow? How does life result from chemical structure and function?	All living organisms are made of cells. While a simple definition of life can be difficult to capture, all living organisms can be characterized by common aspects of their structure and functioning.	• Contribute to a discussion comparing the meaning of the words biology and biochemistry. Utilizing the definitions of both words to discuss the hierarchy in life. In groups, utilize iPads or textbook to research and identify the organization from atom to biosphere. Model and communicate the organization of life utilizing classroom supplies. Evaluate each other's models. • Complete coloring plate, *Animal Cell/Plant Cell* (Griffin). They will write an essay describing how life as a plant cell might be different than an animal cell. • Complete Pogil Guided Activity "Prokaryotic Cells and Eukaryotic" https://pogil.org/uploads/media_items/prokaryotic-and-eukaryotic-cells-student.original.pdf • Download and execute the iCell App and complete and applicable activity comparing and contrasting animal and plant cells. App is also a useful tool and reference for future use. • Conduct microscope lab, *Comparing Plant and Animal Cells* (Miller/Levine). • Observe one drop of cement glue in water, discuss whether what they observe is a living organism. Collaboratively construct and argue	**Oral: Discussion** Participation in class discussion, generated characteristic list, and ultimate application in identifying living samples will be assessed for understanding. **Oral: Presentation** Students will identify the location of all four macromolecules within a cell and explain their overall function in maintaining homeostasis **Other: Quiz** **Quizzes** · Organic Molecule · Characteristics of Life/Levels of Organization **Performance: Lab Assignment** Students will setup a calorimeter in an effort to quantify the amount of energy stored in various foods. Students will evaluate and explain their findings in regards to nutritional value, energy storage, and molecular size. Extension: Have students design a calorimeter or device/tracking method that people can use to monitor diet and nutrition (HS-ETS1-2). **Performance: Authentic Task Evaluate and Explain** *Major Lab Investigation* Students will design a lab where they will test a series of unknown foods in the effort to identify the	GRADING PROCEDURES **MARKING PERIOD GRADES** **Long and Short Term Assessments which may include: 90%** • Tests, quizzes, and/or worksheets • Authentic assessments • Technology applications • Projects, reports, presentations • Laboratory investigations • Data Analysis • Analysis of assigned readings

			a list of characteristics that define a living organism. Utilize that finalized list to assess a series of station samples (example can be seen in Living vs Nonliving Lab on www.stemmom.org) or *Powerpoint* scenario (such as 'Is Sammy Alive?') to determine living status. • Read *Are Viruses Alive?* An Informative Reading Work Sample Assessment. Article and Analysis Questions can be found at https://www.mesd.k12.or.us/cms/lib8/OR01915807/Centricity/Domain/35/Are_Viruses_Alive.pdf Utilize the article to explain why viruses walk the fine line of being living/nonliving and why we ultimately consider them to be nonliving. • Participate in the "Martian Car Debate", https://www.biologycorner.com/worksheets/martian.html, where one set of students need to convince the judge that a car is living and another set debates that the car is not living using scientific evidence and justification. Teacher generated rubric may be used to help students understand clear expectations of the debate. • Contribute to a discussion on the structure and function of nucleic acids. Utilize iPads or physical objects to model DNA and RNA. Construct an explanation on the interdependence of DNA, RNA, and proteins in the overall function of an organism. • Discuss the importance of cells as the basic unit of life. Discuss the organization within internal	macromolecules found in the food. Utilizing their findings, students will construct explanations on the role the food has on the function of the organism; students will construct the molecular formula, and describe the overall end result for the molecules in the food. **Summative: Test: Written Summative Assessments** · Biochemistry Unit Test Career Ready Practices	**Daily Assessments which may include: 10%** • Active engagement in class activities • Demonstration of knowledge and understanding of course material • Skills and safety practices during lab investigations • Do Now/Exit Questions • Homework **Full Year Course** • Each marking period shall count as 20% of the final grade (80% total). The midterm assessment, and final assessment will each count as 10% of the final grade (20% total).

			structures that allow the cell to function. Communicate understanding that human systems are made up of a group of interacting atoms and molecules. ● Observe the following indicators: o Benedict solutions for carbohydrates o Sudan solution and/or grease spot test for lipids o Biuret solution for proteins ● Discuss the structure and function of simple and complex carbohydrates. Observe examples and/or build models of simple and complex molecular structures. Evaluate a series of molecules and argue which molecules are considered to be carbohydrates. Demonstrate on paper or by models, dehydration synthesis and hydrolysis. ● Discuss the structure and function of lipids. Be able to explain why it is important to monitor the intake of lipids in relation to their function in the body. ● Discuss the structure and function of proteins. View a series of animations on the function of proteins throughout the body. ● Complete "The Gift of Protein" activity found at http://scienceteacherprogram.org/pdf/GiftOfProtein.pdf Students will create specific bracelets using colored beads and instructions. Once completed they will understand the beads are representing different Amino Acids and their unique orders is what creates a specific protein. Students will then observe three dimensional or electronic models of various		

			proteins. Construct an explanation on how the structure of a protein affects proper function. Utilize the class activity and additional research to support their argument. ● Perform a lab that investigates the effects of temperature and enzyme/substrate concentration on enzyme reaction rates. Examples are "Toothpick-ase Lab" found at https://www.paulding.k12.ga.us/cms/lib010/GA01903603/Centricity/Domain/540/Toothpickase%20lab%202013%202014.pdf or "Temperature and Enzymes" found in Pearson's Lab Manual B ● Design a lab testing a series of unknown foods to identify the macromolecules found in the food. Utilizing their findings, construct explanations on the role the food has on the function of the organism; identify/construct the molecular formula. ● Communicate the importance of the organic molecules on the overall function. Use specific body system(s) to explain the role the organic molecule plays in homeostasis. ● Contribute to a discussion of what a calorie measures. Analyze a graph that shows different physical activities and the amount of calories they burn. Accurately interpret a nutritional label. ● Model, construct explanations, and provide evidence on the location and function of the organic molecule in regards to homeostasis on the organism and cellular level.		

NJ: 2016 SLS: English Language Arts
NJ: Grades 9-10
Speaking and Listening
Comprehension and Collaboration
NJSLSA.SL1 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.
SL.9-10.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
NJSLSA.SL3 Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric.
SL.9-10.3. Evaluate a speaker's point of view, reasoning, and use of evidence and rhetoric, identifying any false reasoning or distorted evidence.
NJ: 2016 SLS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12
NJ: Grades 9-10
Reading: Science & Technical Subjects
Key Ideas and Details
NJSLSA.R1 Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
RST.9-10.1. Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
NJSLSA.R3 Analyze how and why individuals, events, or ideas develop and interact over the course of a text.
RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks attending to special cases or exceptions defined in the text.
Craft and Structure
NJSLSA.R4 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.
RST.9-10.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
Integration of Knowledge and Ideas
NJSLSA.R7 Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.
RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
NJ: 2014 SLS: Technology
NJ: Grades 9-12
8.1 Educational Technology
8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
A. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.

8.1.12.A.2 Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
D. Digital Citizenship: Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.

8.1.12.D.1 Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work.
E: Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.

8.1.12.E.1 Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.
NGSS: Disciplinary Core Ideas
NGSS: 9-12
LS1: From Molecules to Organisms: Structures and Processes
LS1.A: Structure and Function
Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
LS1.B: Growth and Development ofOrganisms
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 complexorganism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4)
LS1.C: Organization for Matter and Energy Flow in Organisms
The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5)
LS2: Ecosystems: Interactions, Energy, and Dynamics
LS2.A: Interdependent Relationships in Ecosystems
Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and non-living resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1),(HSLS2-2)

NJ: 2014 SLS: 21st Century Life and Careers
NJ: All Grades
Career Ready Practices
Career Ready Practices
CRP2. Apply appropriate academic and technical skills.

CRP3. Attend to personal health and financial well-being.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP7. Employ valid and reliable research strategies.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

CRP11. Use technology to enhance productivity.

CRP12. Work productively in teams while using cultural global competence.

Homeostasis and Water Balance *(Week 9, 5 Weeks)*	How does life maintain itself? Why are water's unique properties so important for life as we know it?	Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environments. The structures of materials determine their properties. As a result of water's bent shape and polarity, water has unique properties, such as an ability to dissolve most substances. These properties are responsible for many important characteristics of nature.	• Observe a demonstration of celery in water, salt water, distilled water. With a partner, predict expected results. Sketch experimental setup and record hypotheses. • Explain any observed changes using key terms (water, solution, solvent, solute, etc.). Sketch observations, compose explanation. • Discuss explanations, focusing on water's structure, polarity, and special properties. • With a partner, brainstorm/describe examples of the various properties. • Perform a "Water Olympics" Lab where students apply and observe the unique properties of water through different activities. • Offer definitions of acids and bases. With lab partner, test various substances with red cabbage juice and/or pH meter or strips. Use results to create a color scale that can be used to test pH, compare results to other groups and to standardized pH paper. Explain any differences using understanding of accuracy and precision. • With predetermined materials and solutions, have lab groups design and execute a lab determining the effect of Acid Rain on Seeds (Can refer to Acid Rains and Seeds Lab in Pearson's Lab Manual B). Have students make environmental connections. Have students research how human activity influences Acid Rain and its environment effects on biodiversity; then research potential	**Formative: Oral: Discussion** Sketches, predictions, and participation in class discussions will be formatively assessed for understanding **Performance: Lab Assignment** Designed lab activities and resulting pH scales will be assessed for accuracy and understanding **Performance: Lab Assignment** Lab report conclusions will be assessed for understanding. Students can make a photo journal of examples of key terms from the unit (homeostasis, osmosis, etc.). They can take selfies of themselves with examples of each and write a short caption to explain. Students can create a comic strip, cartoon, poem or other form of artistic communication to explain homeostasis and water balance. Lab report conclusion will be assessed for level of understanding **Summative: Other: Teacher Observation** **Evaluate** Teacher designed summative Assessment for the unit	GRADING PROCEDURES **MARKING PERIOD GRADES** **Long and Short Term Assessments which may include: 90%** • Tests, quizzes, and/or worksheets • Authentic assessments • Technology applications • Projects, reports, presentations • Laboratory investigations • Data Analysis • Analysis of assigned readings **Daily Assessments which may include: 10%** • Active engagement

			technological solutions to reduce impact and carbon footprints. • Hypothesize the effects of soaking a chicken egg in vinegar, share predictions, conduct experiment, analyze results. Discuss the purpose of the shell and later, the membrane left behind. Continue with the "Eggsperiment Lab" to hypothesize, demonstrate, and discuss results after soaking shell-less egg in water vs. corn syrup. • Working in pairs/small groups define the terms solution, solute, and solvent. Discuss. Predict what would happen if a plant were given a solution instead of water or a hospital patient given pure water instead of a saline solution. Explain predictions and use evidence from Eggsperiment to justify. • Perform a traditional Diffusion & Osmosis Lab using Dialysis Tubing and Starch, Water, and Glucose Solutions. Example: 'Detecting Diffusion' Pearson Lab Manual B • Using microscopes and various plant cells (red onion, elodea, etc.), determine the impact of solutions on cells. Document procedures, hypotheses, and observations. • Perform a lab using agar cubes to investigate the limits of cell growth with emphasis on Surface Area to Volume Ratio. • Discuss how plants exchange materials with their environments and why they would need to do so. Regroup as a class and share ideas. Discuss the term homeostasis, and discuss what plants might have to do to maintain homeostasis.		in class activities • Demonstration of knowledge and understanding of course material • Skills and safety practices during lab investigations • Do Now/Exit Questions • Homework **Full Year Course** • Each marking period shall count as 20% of the final grade (80% total). The midterm assessment, and final assessment will each count as 10% of the final grade (20% total).

			• Examine different types of leaves, discuss their observations *("Why is the top waxy/shiny? Why is the underside different? Etc.")* Using clear nail polish, make impressions of the underside to view under the microscope. Sketch observations - leading to the observation of guard cells/stomata. Hypothesize about their function. As a class, discuss. Explore stomata behavior under different environmental or species circumstances.		

NJ: 2016 SLS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12
NJ: Grades 9-10
Reading: Science & Technical Subjects
Craft and Structure
NJSLSA.R4 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.
RST.9-10.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
Integration of Knowledge and Ideas
NJSLSA.R7 Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.
RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
NGSS: Disciplinary Core Ideas
NGSS: 9-12
LS1: From Molecules to Organisms: Structures and Processes
LS1.A: Structure and Function
Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
LS1.C: Organization for Matter and Energy Flow in Organisms
The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5)
LS2: Ecosystems: Interactions, Energy, and Dynamics
LS2.A: Interdependent Relationships in Ecosystems
Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and non-living resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it notfor the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1),(HSLS2-2)
LS2.B: Cycles of Matter and Energy Transfer inEcosystems
Photosynthesis and cellular respiration (including anaerobic processes)provide most of the energy for life processes. (HS-LS2-3)

ESS3: Earth and Human Activity
ESS3.C: 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)

NJ: 2014 SLS: 21st Century Life and Careers
NJ: All Grades
Career Ready Practices
Career Ready Practices
CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP6. Demonstrate creativity and innovation.

CRP7. Employ valid and reliable research strategies.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

Energy *(Week 14, 7 Weeks)*	How do organisms obtain and use the matter and energy they need to live and grow?	Sustaining life requires substantial energy and material inputs. As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different	• Perform iodine (starch indicator) test on plant leaves, both light exposed and non light exposed. Work in pairs/groups and determine possible explanations for results. • Read "Life's Greatest Invention: Photosynthesis" and discuss the following questions or complete the following activities for understanding: o *What is the author's overall attitude towards photosynthesis?* o Create a Venn diagram that compares the types of life that existed on Earth prior to and after photosynthesis. o Write a word equation to describe the early version of photosynthesis.	**Oral: Discussion** Scientific explanations will be assessed for accuracy and understanding Class discussion/responses will be assessed for level of understanding and need for further instruction. **Oral: Presentation** Scientific explanations will be assessed for accuracy and understanding **Performance: Lab Assignment** Participation in lab activity , lab data and conclusion will be assessed for understanding.	GRADING PROCEDURES **MARKING PERIOD GRADES** **Long and Short Term Assessments which may include: 90%** • Tests, quizzes, and/or worksheets • Authentic assessments

		products. The results of these chemical reactions is that energy is transferred from one system of interacting molecules to another.	o According to the reading, *How did the evolution of oxygen-using microbes pave the way for the evolution of complex life and its colonization of land?* ● Perform Plant Pigment and Photosynthesis (Pearson Lab Manual B), a chromatography lab demonstrating different chlorophylls are made of different colored pigments. Have class brainstorm and discuss why there are different colored pigments, their functions, and what advantages plants have that contain multiple pigments. ● Have students answer Life Science Assessment Probes "The Giant Sequoia Tree" and/or "Needs of Seeds". Save answers and revisit at the end of the unit. Give students a chance to edit and explain any revisions and have a class discussion on their preconceived notions and what content was learned in the big picture that helped change their minds. ● Design an investigation to explore the effects of differing conditions (sun, shade, light intensity, etc) on the rate of photosynthesis. ● Contribute to a discussion "How Do Biological Organisms Use Energy?" (http://serendip.brynmawr.edu/exchange/bioactivities/energy). ● Work to complete groups of related questions and then conclude with a class discussion to probe thinking and help develop an understanding of the concepts. ● Complete activity "How Do Muscles Get the Energy They Need for		● Technology applications ● Projects, reports, presentations ● Laboratory investigations ● Data Analysis ● Analysis of assigned readings **Daily Assessments which may include: 10%** ● Active engagement in class activities ● Demonstration of knowledge and understanding of course material ● Skills and safety practices during lab investigations ● Do Now/Exit Questions ● Homework **Full Year Course**

			Athletic Activity?" to compare aerobic and anaerobic respiration, as well as show how energy and matter are transformed. http://serendip.brynmawr.edu/exchange/bioactivities/energyathlete. • Perform an in class demonstration or do as a mini lab: Using methylene blue indicator mixed in water to show the production of carbon dioxide after exercise. Predict what would increase the rate of carbon dioxide? Justify how to test qualitatively and/or quantitatively. • Investigate how sugar concentrations influence the rate of anaerobic respiration in yeast. Design, implement, and analyze results. • Demonstrate a familiarity with the terms "activation energy", "enzyme", and "active site". Complete a laboratory activity to observe the breakdown of lactose with the enzyme lactase. Test the effects of temperature and pH on enzyme activity. • Participate in a "Cellular Respiration in Yeast" inquiry-based lab, developing connection between food and getting energy into cells. Observe the "Big Picture" at www.sumanasinc.com/webcontent/animations/content/cellularrespiration.html. • Contribute to a class discussion of regarding the necessary components and conditions for cellular respiration. In small groups, summarize the findings of the lab, how it relates to cellular respiration, and to energy required by living		• Each marking period shall count as 20% of the final grade (80% total). The midterm assessment, and final assessment will each count as 10% of the final grade (20% total).

			organisms. Support explanations by engaging in argumentation using results from lab and connections to scientific knowledge. With findings, present a visual representation of this process of energy transfer. ● Open/close their dominant hand as fast as they can (or squeeze tennis balls) for as long as they can. Provide hypotheses for observed phenomena. ● Build connections between photosynthesis and cellular respiration and construct an explanation as to how these processes are connected and exhibit the cycling of matter and flow of energy. Make connections to Biogeochemical cycles.		

NJ: 2016 SLS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12
NJ: Grades 9-10
Reading: Science & Technical Subjects
NJSLSA.R2 Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
RST.9-10.2. Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
NJSLSA.R3 Analyze how and why individuals, events, or ideas develop and interact over the course of a text.
RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks attending to special cases or exceptions defined in the text.
Craft and Structure
NJSLSA.R4 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.
RST.9-10.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
Integration of Knowledge and Ideas
NJSLSA.R7 Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.
RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
NJ: 2014 SLS: Technology
NJ: Grades 9-12
8.1 Educational Technology

8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
A. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.

8.1.12.A.3 Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
E: Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.

8.1.12.E.1 Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.
NGSS: Disciplinary Core Ideas
NGSS: 9-12
LS1: From Molecules to Organisms: Structures and Processes
LS1.C: Organization for Matter and Energy Flow in Organisms
The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5)
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 (suchas proteins or DNA), used for example to form new cells. (HS-LS1-6)
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)
As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another and release energy to the surrounding environment and to maintain body temperature. Cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. (HS-LS1-7)
LS2: Ecosystems: Interactions, Energy, and Dynamics
LS2.A: Interdependent Relationships in Ecosystems
Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and non-living resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it notfor the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1),(HSLS2-2)
LS2.B: Cycles of Matter and Energy Transfer inEcosystems
Photosynthesis and cellular respiration (including anaerobic processes)provide most of the energy for life processes. (HS-LS2-3)
Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy incellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matterreacts to release energy for life functions, some matter is stored in newlymade structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4)
Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere,atmosphere, oceans, and geosphere through chemical, physical,geological, and biological processes. (HS-LS2-5)
LS2.C: Ecosystem Dynamics,Functioning, and Resilience
A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance toan ecosystem occurs, it may return to its more or less original status (i.e.,the ecosystem is resilient), as opposed to becoming a very differentecosystem. Extreme fluctuations in conditions or the size of anypopulation, however, can challenge the functioning of ecosystems interms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6)

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) **ESS2: Earth's Systems** **ESS2.D: Weather and Climate** Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HSESS2-6),(HS-ESS2-7) **PS3: Energy** **PS3.D: Energy in Chemical Processes and Everyday Life** Although energy cannot be destroyed, it can be converted to less usefulforms—for example, to thermal energy in the surrounding environment.(HS-PS3-3),(HS-PS3-4) Copyright © State of New Jersey, 1996 - 2016.					
NJ: 2014 SLS: 21st Century Life and Careers **NJ: All Grades** **Career Ready Practices** **Career Ready Practices** CRP2. Apply appropriate academic and technical skills. CRP3. Attend to personal health and financial well-being. CRP4. Communicate clearly and effectively and with reason. CRP6. Demonstrate creativity and innovation. CRP11. Use technology to enhance productivity. CRP12. Work productively in teams while using cultural global competence. Copyright © State of New Jersey, 1996 - 2016.					
Genetics and Inheritance *(Week 21, 9 Weeks)*	How can probability be used to predict genetic traits? How is the hereditary information in genes inherited and expressed?	Genes and chromosomes determine the expressions of the inherited traits. All species tend to maintain themselves from generation to generation using the	• Using paper cutouts, generate proper sequence of the stages of mitosis and/or meiosis. • Draw and label the cell cycle and discuss which activities take place in each phase. • Compose a professional letter posing as Gregor Mendel, describing his findings on heredity. • Conduct lab, *What Phenotypic Ratio is Seen in a Dihybrid Cross?* (Merrill)	**Other: Peer Assessment** Sequence will be assessed for accuracy Letter will be assessed using peer-editing practices Ratios will be assessed for accuracy Self-assess/peer assess **Oral: Discussion** Class discussion with teacher survey for understanding **Other: Teacher Rubric**	GRADING PROCEDURES **MARKING PERIOD GRADES** **Long and Short Term Assessments which may include: 90%**

		same genetic code. However, there are genetic mechanisms that lead to variation in a population.	• Demonstrate rules of probability through a coin flipping activity. • Complete activities that compare and contrast haploid and diploid cells. Have students identify where to find each type of cell in the stages of mitosis and meiosis. • Conduct "Genetics with a Smile" lab. Students will flip coins to determine the genotypic and phenotypic outcome of their baby. Analysis questions will follow. • Solve a series of monohybrid and dihybrid crosses using the Punnett Square Method. • Diagram the relationship between DNA, genes, alleles and chromosomes. • Given a written paragraph with numerous typographical errors, identify the type of chromosomal mutation each mistake represents. • Model typical chromosomes and mutations such as insertion, deletion, inversion, and translocation. • Conduct a Forensics based Lab where students will perform blood typing techniques (using simulated blood samples and Rh factor solutions) to find the potential suspect. • Conduct lab, Karyotypes (Miller/Levine). They will engage in matching chromosome pairs, determining the sex and identifying the chromosome disorder. • Research a disorder that is caused by a point mutation and present findings orally to class. • Conduct lab, *Constructing a Human Pedigree* (Miller/ Levine), which will	Diagram will be assessed using teacher-generated rubric **Oral: Discussion** Class discussion with teacher survey for understanding **Performance: Authentic Task** Karyotype diagnosis will be assessed for accuracy **Other: Teacher Rubric** Assess research using teacher-generated rubric and presentation using student **Other: Peer Assessment** Pedigree will be assessed for accuracy Genotypic and phenotypic ratios will be assessed for accuracy **Performance: Lab Assignment** Constructed plasmid will be assessed for choice of restriction enzyme and completeness of inserted gene **Oral: Discussion** Class discussion with teacher survey for understanding **Other: Peer Assessment** Research/answers assessed for accuracy **Performance: Lab Assignment** Decision-making sheet, group work, paper, and presentation will be assessed using teacher-made bioethics rubric	• Tests, quizzes, and/or worksheets • Authentic assessments • Technology applications • Projects, reports, presentations • Laboratory investigations • Data Analysis • Analysis of assigned readings **Daily Assessments which may include: 10%** • Active engagement in class activities • Demonstration of knowledge and understanding of course material • Skills and safety practices during lab investigations

			study the genetic path of a disorder through a family. • Solve Punnett Square problems that depict the various modes of inheritance including sex linked disorders. • Watch the Watson and Crick Science History Rap Battle Video and discuss the scientists who played major roles in the discovery of the 3D model of DNA. • Perform an activity where messages/codes are transcribed and then translated into proteins. • Have students investigate the manner in which DNA is replicated and demonstrate the semi-conservative model.		• Do Now/Exit Questions • Homework **Full Year Course** • Each marking period shall count as 20% of the final grade (80% total). The midterm assessment, and final assessment will each count as 10% of the final grade (20% total).

NJ: 2016 SLS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12
NJ: Grades 9-10
Reading: Science & Technical Subjects
NJSLSA.R2 Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
RST.9-10.2. Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
NJSLSA.R3 Analyze how and why individuals, events, or ideas develop and interact over the course of a text.
RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks attending to special cases or exceptions defined in the text.
Craft and Structure
NJSLSA.R4 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.
RST.9-10.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
NJSLSA.R5 Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text (e.g., a section, chapter, scene, or stanza) relate to each other and the whole.
RST.9-10.5. Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).

NJSLSA.R6 Assess how point of view or purpose shapes the content and style of a text.
RST.9-10.6. Determine the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
Integration of Knowledge and Ideas
NJSLSA.R7 Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.
RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
NJSLSA.R9 Analyze and reflect on how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.
RST.9-10.9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
NJSLSA.R10 Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.
RST.9-10.10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.
Writing
Text Types and Purposes
NJSLSA.W1 Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.
WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.
NJSLSA.W2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
WHST.9-10.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
Production and Distribution of Writing
NJSLSA.W4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
WHST.9-10.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
NJSLSA.W6 Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
WHST.9-10.6. Use technology, including the Internet, to produce, share, and update writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
NJ: 2016 SLS: Mathematics
NJ: HS: Num/Quantity
Quantities
HSN-Q.A. Reason quantitatively and use units to solve problems.
HSN-Q.A.1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
HSN-Q.A.2. Define appropriate quantities for the purpose of descriptive modeling.
Mathematical Practice
MP.The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.
MP.3. Construct viable arguments and critique the reasoning of others.

MP.4. Model with mathematics.

MP.6. Attend to precision.

NJ: 2016 SLS: Science
NJ: HS Life Sciences
HS-LS1 From Molecules to Organisms: Structures and Processes
Performance Expectations

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-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

HS-LS3 Heredity: Inheritance and Variation of Traits
Performance Expectations

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.

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.

HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

NJ: 2014 SLS: Technology
NJ: Grades 9-12
8.1 Educational Technology
8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
A. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.

8.1.12.A.1 Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources.
8.1.12.A.2 Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
F: Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

8.1.12.F.1 Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
8.2 Technology Education, Engineering, Design, and Computational Thinking
B. Technology and Society: Knowledge and understanding of human, cultural and society values are fundamental when designing technology systems and products in the global society.

8.2.12.B.1 Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review.

NJ: 2014 SLS: 21st Century Life and Careers
NJ: All Grades
Career Ready Practices
Career Ready Practices
CRP1. Act as a responsible and contributing citizen and employee.

CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

Evolution & Classification *(Week 30, 5 Weeks)*	How do organisms change over time in response to changes in the environment. What evidence shows that species are related.	All life on earth evolved from a common ancestor that first appeared billions of years ago. Variations exist in all species and allows some individuals to better survive in a particular environment than others.	• Research and create a poster or timeline demonstrating the events that shaped and molded Darwin and the Theory of Evolution. • Simulate changes in moth population due to pollution and predation, and observe how species can change over time. • Graph data using a spreadsheet. Discuss potential patterns of Evolution and population changes. • Complete coloring plate, *Homologous Structures* (Alcamo), then prepare a written statement explaining what homologous structures indicate about evolutionary trends. • Complete "Dry Lab: Evidence of Evolution" which covers Anatomical Structures, Biochemical Evidence, Theory of Superposition in Fossils, and Embryology. • Perform 'Investigating Hominoid Fossils' in Pearson's Lab Manual B. Students will measure and compare skulls and hands to reveal evidence for the evolution of humans.	**Other: Teacher Rubric** Brochure will be assessed using teacher-generated rubric **Oral: Discussion** Class discussion with teacher survey for understanding of simulation **Other: Teacher Rubric** Graph scored using teacher-generated rubric **Other: Peer Assessment** Paragraph will be assessed using peer editing practices Fossil dating will be assessed for accuracy. **Performance: Lab Assignment** Homologies and essay will be assessed for accuracy and clarity **Other: Peer Assessment** Presentations will be peer assessed **Performance: Skill Demonstration** Completed analysis questions will be assessed for accuracy **Oral: Discussion** Self-assess using teacher-provided key	GRADING PROCEDURES **MARKING PERIOD GRADES** **Long and Short Term Assessments which may include: 90%** • Tests, quizzes, and/or worksheets • Authentic assessments • Technology applications • Projects, reports, presentations • Laboratory investigations • Data Analysis

			• Analyze characteristics and biochemical evidence of organisms to create a cladogram. • Demonstrate Natural Selection by performing a guided inquiry lab: 'Competing for Resources' found Pearson's Lab Manual B or 'The Bird Beak Buffet Lab' at http://extension.oregonstate.edu/hoodriver/sites/default/files/4h/stem_activity_-_biologist_-_bird_beak_buffet_lesson.pdf • Classify randomly assigned organisms into the applicable taxonomy placement. • Scientifically name a random unidentified organism by executing a dichotomous key. • Investigate a specified website to classify a bear, an orchid, and a sea cucumber according to descriptions of selected kingdoms, phyla, classes, orders, families, genera and species by navigating through the website. • Work in groups to determine which kingdom a fictitious organism (teacher provided) fits into and present/defend their conclusion to the class. • Complete coloring plates, *The Origin of Organic Molecules* and *The Origin of Life on Earth* (Alcamo). • View video segment from United Streaming, *Elements of Biology: Biological Evolution.* They will complete their thoughts in writing explaining how evolution has changed the Earth's atmosphere and then share their ideas with the class.	Self-assess using website-provided feedback **Other: Peer Assessment** Presentations will be peer assessed using teacher-generated rubric. **Other: Peer Assessment** Conclusion statement will be assessed using teacher-generated rubric Assess for accuracy **Other: Quiz** Self-assess using video quiz and class discussion	• Analysis of assigned readings **Daily Assessments which may include: 10%** • Active engagement in class activities • Demonstration of knowledge and understanding of course material • Skills and safety practices during lab investigations • Do Now/Exit Questions • Homework **Full Year Course** • Each marking period shall count as 20% of the final grade (80% total).

					The midterm assessment, and final assessment will each count as 10% of the final grade (20% total).

NJ: 2016 SLS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12
NJ: Grades 9-10
Reading: Science & Technical Subjects
NJSLSA.R2 Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
RST.9-10.2. Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
Craft and Structure
NJSLSA.R4 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.
RST.9-10.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
NJSLSA.R5 Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text (e.g., a section, chapter, scene, or stanza) relate to each other and the whole.
RST.9-10.5. Analyze the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy).
NJSLSA.R6 Assess how point of view or purpose shapes the content and style of a text.
RST.9-10.6. Determine the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
NJSLSA.R8 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.
RST.9-10.8. Determine if the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
NJSLSA.R9 Analyze and reflect on how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.
RST.9-10.9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
NJSLSA.R10 Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.
RST.9-10.10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.
Writing
Text Types and Purposes
NJSLSA.W1 Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.
WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.
NJSLSA.W2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
WHST.9-10.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Production and Distribution of Writing
NJSLSA.W4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
WHST.9-10.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
NJSLSA.W6 Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
WHST.9-10.6. Use technology, including the Internet, to produce, share, and update writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
NJ: 2014 SLS: Technology
NJ: Grades 9-12
8.1 Educational Technology
8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
A. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.

8.1.12.A.1 Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources.
8.1.12.A.2 Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
F: Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

8.1.12.F.1 Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
NGSS: Disciplinary Core Ideas
NGSS: 9-12
ESS2: Earth's Systems
ESS2.E:Biogeology
The many dynamic and delicate feedbacks between the biosphereand other Earth systems cause a continual co-evolution of Earth'ssurface and the life that exists on it. (HS-ESS2-7)

NJ: 2016 SLS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12
NJ: Grades 9-10
Reading: Science & Technical Subjects
NJSLSA.R2 Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
RST.9-10.2. Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
NJSLSA.R3 Analyze how and why individuals, events, or ideas develop and interact over the course of a text.
RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks attending to special cases or exceptions defined in the text.
Craft and Structure
NJSLSA.R4 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.
RST.9-10.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

Integration of Knowledge and Ideas
NJSLSA.R7 Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.
RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
NJ: 2014 SLS: Technology
NJ: Grades 9-12
8.1 Educational Technology
8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
A. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.

8.1.12.A.3 Collaborate in online courses, learning communities, social networks or virtual worlds to discuss a resolution to a problem or issue.
E: Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.

8.1.12.E.1 Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.
NGSS: Disciplinary Core Ideas
NGSS: 9-12
LS1: From Molecules to Organisms: Structures and Processes
LS1.C: Organization for Matter and Energy Flow in Organisms
The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5)
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 (suchas proteins or DNA), used for example to form new cells. (HS-LS1-6)
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)
As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another and release energy to the surrounding environment and to maintain body temperature. Cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. (HS-LS1-7)
LS2: Ecosystems: Interactions, Energy, and Dynamics
LS2.A: Interdependent Relationships in Ecosystems
Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and non-living resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it notfor the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2-1),(HSLS2-2)
LS2.B: Cycles of Matter and Energy Transfer inEcosystems
Photosynthesis and cellular respiration (including anaerobic processes)provide most of the energy for life processes. (HS-LS2-3)
Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy incellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matterreacts to release energy for life functions, some matter is stored in newlymade structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. (HS-LS2-4)

Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere,atmosphere, oceans, and geosphere through chemical, physical,geological, and biological processes. (HS-LS2-5) **LS2.C: Ecosystem Dynamics,Functioning, and Resilience** A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance toan ecosystem occurs, it may return to its more or less original status (i.e.,the ecosystem is resilient), as opposed to becoming a very differentecosystem. Extreme fluctuations in conditions or the size of anypopulation, however, can challenge the functioning of ecosystems interms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6) 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) **ESS2: Earth's Systems** **ESS2.D: Weather and Climate** Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HSESS2-6),(HS-ESS2-7) **PS3: Energy** **PS3.D: Energy in Chemical Processes and Everyday Life** Although energy cannot be destroyed, it can be converted to less usefulforms—for example, to thermal energy in the surrounding environment.(HS-PS3-3),(HS-PS3-4) Copyright © State of New Jersey, 1996 - 2016.					
NJ: 2014 SLS: 21st Century Life and Careers **NJ: All Grades** **Career Ready Practices** **Career Ready Practices** CRP2. Apply appropriate academic and technical skills. CRP4. Communicate clearly and effectively and with reason. Copyright © State of New Jersey, 1996 - 2016					
Ecological Systems *(Week 35, 6 Weeks)*	How do matter and energy link organisms to each other and their environments. How do humans have an impact on the diversity and stability of ecosystems.	Matter needed to sustain life is continually recycles among and between organisms and the environment. Organisms and their environment are interconnected . Changes in	• Compare a food chain and a food web, draw each, and label the organisms in each as producer, primary consumer, secondary consumer or tertiary consumer. Have students draw a complimenting energy pyramid to show the movement of energy (10% rule) and reduction of Biomass as one moves up each trophic level. • Participate in the Carbon Cycle Game (_ https://climatechangelive.org/img/fc	**Written: Essay** Analysis questions and coloring plates will be assessed for accuracy. Essay assessed for clarity **Other: Quiz** Online quiz provides feedback to student with which they will self-assess **Other: Teacher Observation** Assess for accuracy **Oral: Discussion** Class discussion following game with teacher survey for understanding	GRADING PROCEDURES **MARKING PERIOD GRADES** **Long and Short Term Assessments which may include: 90%** • Tests, quizzes,

		one part of the system will affect other parts of the system.	k/file/carbon_cycle_game.pdf) and write a short description of how this activity depicts movement of carbon atoms through the ecosystem. Have students spiral back to show where macromolecules, cellular respiration and photosynthesis fit into this biogeochemical cycle. • Participate in the Nitrogen Cycle Game (https://www.midlandisd.net/cms/lib01/TX01000898/Centricity/Domain/96/nitrogen_cycle_game.pdf). Read a short accompanying passage and answer questions. • Conduct lab, *The Oxygen Cycle* (Miller/Levine). They will demonstrate the interdependence that exists among organisms on Earth. • Conduct lab, *Relationships in an Ecosystem* (Miller/Levine), in order to demonstrate the types of relationships that exist among organisms. • List several examples of each type of symbiotic relationship. Research and role play specific symbiotic relationships and have class guess which one is on display. • Investigate teacher-selected internet sites to research an environmental concern, identify contributing human activities, and analyze the potential long-reaching effects; then develop a proposal to reduce environmental risk in our world. • Produce a multimedia presentation using text, graphics, moving images and sound that distinguishes between naturally-occurring	**Other: Teacher Rubric** Written description will be assessed using teacher-generated rubric **Other: Teacher Rubric** Conclusion statement assessed using teacher-generated rubric **Performance: Lab Assignment** Lab report will be assessed using teacher-generated rubric **Other: Peer Assessment** Peer assessment followed by class discussion with teacher survey for understanding **Other: Teacher Rubric** Proposal will be assessed using teacher-generated rubric **Oral: Presentation** Multimedia presentation will be assessed using teacher-generated rubric	and/or worksheets • Authentic assessments • Technology applications • Projects, reports, presentations • Laboratory investigations • Data Analysis • Analysis of assigned readings **Daily Assessments which may include: 10%** • Active engagement in class activities • Demonstration of knowledge and understanding of course material • Skills and safety practices during lab investigations • Do Now/Exit Questions • Homework

			extinctions and those caused by humans. • Complete the 'Oh deer' Lab Activity which simulates carrying capacity and changes in deer populations. • Complete the Student Exploration Electronic Lab: 'Rabbit Population by Season' Gizmo. Students will view changes and analyze data to understand key concepts of carrying capacity, density independent & density independent limiting factors etc.		**Full Year Course** • Each marking period shall count as 20% of the final grade (80% total). The midterm assessment, and final assessment will each count as 10% of the final grade (20% total).

NJ: 2016 SLS: Literacy in History/Social Studies, Science, & Technical Subjects 6-12
NJ: Grades 9-10
Reading: Science & Technical Subjects
NJSLSA.R2 Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
RST.9-10.2. Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
NJSLSA.R3 Analyze how and why individuals, events, or ideas develop and interact over the course of a text.
RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks attending to special cases or exceptions defined in the text.
Craft and Structure
NJSLSA.R4 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.
RST.9-10.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
NJSLSA.R6 Assess how point of view or purpose shapes the content and style of a text.
RST.9-10.6. Determine the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.
NJSLSA.R8 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.
RST.9-10.8. Determine if the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
NJSLSA.R9 Analyze and reflect on how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.

RST.9-10.9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

NJSLSA.R10 Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.

RST.9-10.10. By the end of grade 10, read and comprehend science/technical texts in the grades 9–10 text complexity band independently and proficiently.

Writing

Text Types and Purposes

NJSLSA.W1 Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.

WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

NJSLSA.W2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

WHST.9-10.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

Production and Distribution of Writing

NJSLSA.W4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WHST.9-10.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

NJSLSA.W6 Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

WHST.9-10.6. Use technology, including the Internet, to produce, share, and update writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

Research to Build and Present Knowledge

NJSLSA.W7 Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.

WHST.9-10.7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

NJSLSA.W8 Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

WHST.9-10.8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

NJSLSA.W9 Draw evidence from literary or informational texts to support analysis, reflection, and research.

WHST.9-10.9. Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

NJSLSA.W10 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.

WHST.9-10.10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

NJ: 2014 SLS: Technology

NJ: Grades 9-12

8.1 Educational Technology

F: Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

8.1.12.F.1 Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.

8.2 Technology Education, Engineering, Design, and Computational Thinking

B. Technology and Society: Knowledge and understanding of human, cultural and society values are fundamental when designing technology systems and products in the global society.

8.2.12.B.1 Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review.

NGSS: Disciplinary Core Ideas
NGSS: 9-12
ESS2: Earth's Systems
ESS2.D: Weather and Climate
Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6),(HS-ESS2-4)
ESS3: Earth and Human Activity
ESS3.A: Natural Resources
All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulationscan change the balance of these factors. (HS-ESS3-2)
ESS3.B: Natural Hazards
Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1)
ESS3.C: Human Impacts on Earth Systems
The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)
ESS3.D: Global Climate Change
Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in responseto human activities. (HS-ESS3-6)

NJ: 2014 SLS: 21st Century Life and Careers
NJ: All Grades
Career Ready Practices
Career Ready Practices
CRP1. Act as a responsible and contributing citizen and employee.

CRP2. Apply appropriate academic and technical skills.

CRP4. Communicate clearly and effectively and with reason.

CRP5. Consider the environmental, social and economic impacts of decisions.

CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.

Appendix A Sample Authentic Assessment
(Week 1, 1 Week)

PLEASE SEE ATTACHMENT UNDER EVALUATION / ASSESSMENT

Sample Authentic Assessment
Performance: Authentic Task
SAMPLE Authentic Assessment- ethical consideration of NON-PRESCRIPTION DRUG LEGISLATION

PROBLEM SCENARIO:

Carol was a sixteen-year-old, high school junior. She was an honor student, played on the school soccer team, and ran winter and spring track. Due to her busy schedule, Carol was often very tired and found it difficult to complete school work at the end of the day. A friend showed Carol a dietary supplement that he had purchased at a health food store. The product claimed it would boost energy levels and promote weight loss "naturally." Carol carefully read the label and was impressed that the active ingredient was "natural." There was no warning on the label about adverse effects associated with the product.

Carol decided to try the dietary supplement. She noticed an increased energy level and managed to lose two pounds. Carol decided to double the dose in order to increase these wonderful results. You cannot get too much of a natural thing, can you?

Three days after increasing her intake of the dietary supplement, Carol collapsed during track practice. She was rushed to the hospital where she was pronounced dead a short time later. Her grieving parents were told that the cause of death was a heart attack. An autopsy later revealed that the heart attack was most likely due to the high level of ephedrine in her blood. The source of the ephedrine was determined to be the "natural" dietary supplement that Carol was taking.

Carol's parents were unaware that their daughter had been using this product. They studied the package that she had purchased and understood that Carol had no way of realizing that the danger of ephedrine was well documented. The over-the-counter availability of the product angered them. The lack of warnings on the label only made the matter worse.

You are confused by how this could have happened to so healthy a young woman, and you are determined to ensure it does not needlessly happen to someone again. Therefore, you have now become a member of a research team who is scheduled to speak before a congressional committee to plead for legislation that will enable the FDA to regulate the labeling of non-prescription drugs, in particular, dietary supplements containing ephedrine. You will be expected to deliver conclusive evidence that this product was indeed the cause of Carol's death and convince the legislature that this practice must be changed.

Sample Authentic Assessment (Continued)

RATIONALE:

This will enable the students to research a prominent issue and then participate in a discussion that reveals the complexity of the decision-making process with regard to the legislatures of the State and Federal governments regarding the pharmaceutical industry. The effective use of the problem-solving methodologies will lead the learner through the steps of ethical and informed decision making. The instructional methods planned provide each individual with the opportunity to understand the factual information, analyze data while making strong connections to other life issues, and propose viable solutions to serious problems.

TEACHER NOTES:

- Students will work in groups of three to determine the stakeholders (those who would be affected by the decision being made) in this scenario.
- Each group will share their list of stakeholders with the class and collectively determine the stakeholders for this particular issue.
- Each group will prepare a strong defense of their position, which will be presented orally to the class who will then act as the legislating body.
- Each student will also write a reaction paper that explains his/her own personal view of the dilemma. This paper will include factual, substantiated information regarding the potential dangers associated with non-prescription drugs.
- Students will then conduct a follow-up activity in which they assume the role of one of the stakeholder groups. They must argue from that position regardless of their personal belief.

Genetic Screening in the Workplace
Decision-Making Sheet

Name: ________________________________

1. State the ethical question(s) that is (are) raised in this situation.

2. List all of the relevant facts.

3. Identify the values that play a role in this issue.

4. List several possible solutions.

5. Choose the solution you think is best and justify your choice.

SAMPLE AUTHENTIC ASSESSMENT RUBRIC.docx

Appendix B Sample Lab Activity

(Week 1, 1 Week)

SEE ATTACHMENTS UNDER EVALUATION / ASSESSMENT

Lab Activity
Performance: Lab Assignment
TIME SEQUENCE COMPARING NORMAL MITOSIS
TO
ABNORMAL MITOSIS IN CANCER CELLS

OBJECTIVE:

What is the normal time sequence for the stages of mitosis and how is the timing altered in cancer cells?

MATERIALS:

Prepared slide of onion root tip
Compound microscope
Graph paper

PROCEDURE:

PART I

- Obtain a clean onion root tip slide and scan it under low power. Adjust the light for optimum viewing.

- Switch to high power and center your slide so that you have a field of view in which all the cells are in various stages of mitosis (including interphase).

- Start at the top right corner of the field and record the stage of each cell in Data Table 1. Count your cells in a systematic manner. This will be considered Area 1.

- After completing the count in the first area, move the slide to a new area and perform the identification and count a second time. Record this data in the table as well.

- Repeat the procedure a third time, with yet another field of view.

Sample Lab Activity (Procedures/Part I continued)

- On a separate sheet of unlined paper make a drawing of one cell in each of the various stages. Be sure to draw only what you actually see, but include all details that are visible. Your drawings will not necessarily look exactly like the ones in a text book.

- Return to Data Table 1 and record the total numbers of cells in each phase **for all three trial areas**.

- Add the total number of cells viewed in each stage. Write the total count of cells viewed in all three trials in the appropriate place on the data table.

- There is a direct relationship between the number of cells counted in a given stage of mitosis and the time that that stage takes to complete. This may be calculated if the total time for mitosis in onion root tip cells is known. (The total time is measured from interphase to interphase). It is generally acknowledged that this time for onion cells is 720 minutes (12 hours). Set-up a ratio of the number of cells in each phase compared to the total number of cell counted, then multiply this fraction by the total time (720 minutes) needed to complete one mitotic division. Thus, the time for a specific phase is equal to:

- Using your data, calculate the time required for the completion of each stage. **Be sure to use the totals for all three trials**. Enter these results in the appropriate column of Data Table 1.

- Prepare a bar graph to illustrate your results. The vertical axis should be marked in "minutes to complete each stage." On the horizontal axis, allow equal space for each of the stages beginning with interphase and ending with telophase.

PART II: Mitotic Cell Division In Cancer Cells

- An important characteristic of cancer cells is that they no longer follow their normal timing of mitosis. You may have heard cancer cells called "runaway cells" that have no control on their rate of reproduction. It is this characteristic that allows some cancer cells to grow and spread quite rapidly. In this section, you will analyze data to determine the differences in timing of mitosis between normal and cancerous stomach cells in a chicken.

- Study the data in Table 2. Assume that the total time needed for one normal mitotic division of these cells is 625 minutes. Calculate, in the same manner as before, the total time needed for each normal phase of mitosis. Enter this data in the appropriate column of Data Table 2.

Sample Lab Activity (Procedure/Part II continued)

- Repeat this analysis for the data in Table 3. In the case of cancer cells, however, the total time required for one mitotic division is only 448 minutes. Enter the time required for each stage in Data Table 3.

- Prepare another bar graph, similar to your first, using the data from Tables 2 and 3. Put the data for both the normal and cancer cells in each phase directly next to each other.

CONCLUSION QUESTIONS:

Refer to your data and graph from Part 1 to answer the following:

1. Which stage in the mitotic cycle takes the most time? What percentage of the total time is this?

2. Why do you think that this stage (the one in question 1) takes so long? What activities in relation to mitosis are occurring during this phase?

3. Which stage is the second longest? What percentage of the total time does this stage take? Again, what events are occurring during this stage identified in question 3?

4. List the remaining stages in order, from longest to shortest duration.

Referring to your data and graph from Part II answer the following:

1. How does the data for each phase in the normal chicken cell compare with that of the onion root tip cell? Are the percentages of time for the two longest phases similar? Can you make a general conclusion based on this information?

2. In which stages are the most dramatic differences in timing between normal and cancerous chicken cells?

3. What nuclear and cytoplasmic changes would you expect to find in cancer cells, as compared to their normal counterparts? (HINT: What events would be most affected by the alteration in the timing sequence of mitosis?)

Sample_Lab_Activity.docx

Appendix C Lab Report Rubric
(Week 1, 1 Week)
SEE ATTACHMENT UNDER EVALUATION AND ASSESSMENT

Lab Report Rubric
Written: Report
LAB_REPORT_RUBRIC.docx

Appendix D Oral Report Rubric
(Week 1, 1 Week)
SEE ATTACHMENT UNDER EVALUATION / ASSESSMENT
ORAL PRESENTATION RUBRIC.docx

Oral Presentation Rubric
Oral: Presentation
Oral Presentation Rubric.docx

Appendix E Peer Conference Checklist
(Week 1, 1 Week)
SEE ATTACHMENT UNDER EVALUATION / ASSESSMENT

Peer Conference Checklist
Other: Peer Assessment
PEER CONFERENCE CHECKLIST.docx

Appendix F Self Assessment
(Week 1, 1 Week)
PLEASE SEE ATTACHMENT UNDER EVALUATION / ASSESSMENT

PORTFOLIO AND SELF.docx

Self Assessment
Project: Personal
Self Assessment.docx

Appendix G Teacher Resources for Biochemistry

(Week 1, 1 Week)

Sample Biochemistry Unit Plan.docx

Name:____Date:_________Pd: ________

Testing for Organic Molecules Lab

Objective

In this lab you will design and conduct a controlled experiment where you will test for the presence of organic molecules in a series of unknown foods. You will need to have the student research proposal stamped prior to the start of the lab.

Things to include

The following is a list of questions and information that must be included in your lab report. Keep in mind your lab report is not limited to the following criteria. See the lab report rubric for all essential components that are necessary in your laboratory investigation and lab report.

- As you begin testing the unknowns, make predictions on what the unknowns might be.
- For each unknown elaborate on what role the unknowns play in homeostasis.
- Include a molecular structure of the unknowns.
- Make sure you have included qualitative and quantitative data.

Name:____Date:____________Pd: _____

Calculating Food Calories

DATA CALCULATIONS:

- **($q = mC\Delta T$) (1000 cal = 1kcal = 1 nutritional Cal)**
- **Remember that 1 ml of water weighs 1 g**
- **The specific heat of water is 1 calorie/gram ^{0}C**

1. How many kilocalories/gram are in cheerios if in a calorimeter experiment the 7 gram cheerio lost 3 grams when it was burned surrounding a 100 ml water bath. The temperature of the water found to increase from an initial temperature of 21.2°C to a final temperature of 24.4°C.
a) How many Calories/gram are in cheerios?

b) If you were to consume 47 grams of cheerios, how many calories would you be consuming?

2. How many kilocalories/gram is in a taco if in a calorimeter experiment the 53-gram taco after burned measured 52.99 grams surrounding a 100 ml water bath. The temperature of the water found to increase from an initial temperature of 21.0°C to a final temperature of 61.0°C.
a) How many Calories/gram are in a taco?

b) How many calories would you be consuming if you were to have three tacos?

3. Which food source overall is high in calories eating 2Tbsp (32 g) of peanut butter at 190 Calories or 9 pieces (85 g) of potato chips at 150 Calories? Explain.

4. If a candy bar has a total mass of 80.0 grams. In a calorimeter experiment, a 0.5-g sample of this candy bar was burned in a calorimeter surrounded by 500 mL of water. The temperature of the water in contact with the burning candy bar was measured and found to increase from an initial temperature of 21.2°C to a final temperature of 26.4°C.
a) How many Calories/gram are in a candy bar?

b) Calculate the total caloric content of the candy bar in Calories.

Are Viruses Alive?

Although viruses challenge our concept of what "living" means, they are vital members of the web of life
Aug 8, 2008 |By Luis P. Villarreal

Editor's Note: This story was originally published in the December 2004 issue of Scientific American.

In an episode of the classic 1950s television comedy *The Honeymooners*, Brooklyn bus driver Ralph Kramden loudly explains to his wife, Alice, “You know that I know how easy you get the virus.” Half a century ago even regular folks like the Kramdens had some knowledge of viruses—as microscopic bringers of disease. Yet it is almost certain that they did not know exactly what a virus was. They were, and are, not alone.

For about 100 years, the scientific community has repeatedly changed its collective mind over what viruses are. First seen as poisons, then as life-forms, then biological chemicals, viruses today are thought of as being in a gray area between living and nonliving: they cannot replicate on their own but can do so in truly living cells and can also affect the behavior of their hosts profoundly. The categorization of viruses as nonliving during much of the modern era of biological science has had an unintended consequence: it has led most researchers to ignore viruses in the study of evolution. Finally, however, scientists are beginning to appreciate viruses as fundamental players in the history of life.

Coming to Terms

It is easy to see why viruses have been difficult to pigeonhole. They seem to vary with each lens applied to examine them. The initial interest in viruses stemmed from their association with diseases—the word “virus” has its roots in the Latin term for “poison.” In the late 19th century researchers realized that certain diseases, including rabies and foot-and-mouth, were caused by particles that seemed to behave like bacteria but were much smaller. Because they were clearly biological themselves and could be spread from one victim to another with obvious biological effects, viruses were then thought to be the simplest of all living, gene-bearing life forms.

Their demotion to inert chemicals came after 1935, when Wendell M. Stanley and his colleagues, at what is now the Rockefeller University in New York City, crystallized a virus— tobacco mosaic virus—for the first time. They saw that it consisted of a package of complex biochemicals. But it lacked essential systems necessary for metabolic functions, the biochemical activity of life. Stanley shared the 1946 Nobel Prize— in chemistry, not in physiology or medicine—for this work. Further research by Stanley and others established that a virus consists of nucleic acids (DNA or RNA) enclosed in a protein coat that may also shelter viral proteins involved in infection. By that description, a virus seems more like a chemistry set than an organism. But when a virus enters a cell (called a host after

infection), it is far from inactive. It sheds its coat, bares its genes and induces the cell’s own replication machinery to reproduce the intruder’s DNA or RNA and manufacture more viral protein based on the instructions in the viral nucleic acid. The newly created viral bits assemble and, voilà, more virus arises, which also may infect other cells.

These behaviors are what led many to think of viruses as existing at the border between chemistry and life. More poetically, virologists Marc H. V. van Regenmortel of the University of Strasbourg in France and Brian W. J. Mahy of the Centers for Disease Control and Prevention have recently said that with their dependence on host cells, viruses lead “a kind of borrowed life.” Interestingly, even though biologists long favored the view that viruses were mere boxes of chemicals, they took advantage of viral activity in host cells to determine how nucleic acids code for proteins: indeed, modern molecular biology rests on a foundation of information gained through viruses.

Molecular biologists went on to crystallize most of the essential components of cells and are today accustomed to thinking about cellular constituents—for example, ribosomes, mitochondria, membranes, DNA and proteins—as either chemical machinery or the stuff that the machinery uses or produces. This exposure to multiple complex chemical structures that carry out the processes of life is probably a reason that most molecular biologists do not spend a lot of time puzzling over whether viruses are alive. For them, that exercise might seem equivalent to pondering whether those individual subcellular constituents are alive on their own. This myopic view allows them to see only how viruses co-opt cells or cause disease. The more sweeping question of viral contributions to the history of life on earth, which I will address shortly, remains for the most part unanswered and even unasked.

To Be or Not to Be

The seemingly simple question of whether or not viruses are alive, which my students often ask, has probably defied a simple answer all these years because it raises a fundamental issue: What exactly defines “life?” A precise scientific definition of life is an elusive thing, but most observers would agree that life includes certain qualities in addition to an ability to replicate. For example, a living entity is in a state bounded by birth and death. Living organisms also are thought to require a degree of biochemical autonomy, carrying on the metabolic activities that produce the molecules and energy needed to sustain the organism. This level of autonomy is essential to most definitions.

Viruses, however, parasitize essentially all biomolecular aspects of life. That is, they depend on the host cell for the raw materials and energy necessary for nucleic acid synthesis, protein synthesis, processing and transport, and all other biochemical activities that allow the virus to multiply and spread. One might then conclude that even though these processes come under viral direction, viruses are simply nonliving parasites of living metabolic systems. But a spectrum may exist between what is certainly alive and what is not.

A rock is not alive. A metabolically active sack, devoid of genetic material and the potential for propagation, is also not alive. A bacterium, though, is alive. Although it is a single cell, it can generate energy and the molecules needed to sustain itself, and it can reproduce. But what about a seed? A seed might not be

considered alive. Yet it has a potential for life, and it may be destroyed. In this regard, viruses resemble seeds more than they do live cells. They have a certain potential, which can be snuffed out, but they do not attain the more autonomous state of life.

Another way to think about life is as an emergent property of a collection of certain nonliving things. Both life and consciousness are examples of emergent complex systems. They each require a critical level of complexity or interaction to achieve their respective states. A neuron by itself, or even in a network of nerves, is not conscious—whole brain complexity is needed. Yet even an intact human brain can be biologically alive but incapable of consciousness, or “brain-dead.” Similarly, neither cellular nor viral individual genes or proteins are by themselves alive. The enucleated cell is akin to the state of being braindead, in that it lacks a full critical complexity. A virus, too, fails to reach a critical complexity. So life itself is an emergent, complex state, but it is made from the same fundamental, physical building blocks that constitute a virus. Approached from this perspective, viruses, though not fully alive, may be thought of as being more than inert matter: they verge on life. In fact, in October, French researchers announced findings that illustrate afresh just how close some viruses might come. Didier Raoult and his colleagues at the University of the Mediterranean in Marseille announced that they had sequenced the genome of the largest known virus, Mimivirus, which was discovered in 1992. The virus, about the same size as a small bacterium, infects amoebae. Sequence analysis of the virus revealed numerous genes previously thought to exist only in cellular organisms. Some of these genes are involved in making the proteins encoded by the viral DNA and may make it easier for Mimivirus to co-opt host cell replication systems. As the research team noted in its report in the journal *Science*, the enormous complexity of the Mimivirus’s genetic complement “challenges the established frontier between viruses and parasitic cellular organisms.”

Impact on Evolution

Debates over whether to label viruses as living lead naturally to another question: Is pondering the status of viruses as living or nonliving more than a philosophical exercise, the basis of a lively and heated rhetorical debate but with little real consequence? I think the issue *is* important, because how scientists regard this question influences their thinking about the mechanisms of evolution.

Viruses have their own, ancient evolutionary history, dating to the very origin of cellular life. For example, some viral- repair enzymes—which excise and resynthesize damaged DNA, mend oxygen radical damage, and so on— are unique to certain viruses and have existed almost unchanged probably for billions of years.

Nevertheless, most evolutionary biologists hold that because viruses are not alive, they are unworthy of serious consideration when trying to understand evolution. They also look on viruses as coming from host genes that somehow escaped the host and acquired a protein coat. In this view, viruses are fugitive host genes that have degenerated into parasites. And with viruses thus dismissed from the web of life, important contributions they may have made to the origin of species and the maintenance of life may go unrecognized. (Indeed, only four of the 1,205 pages of the 2002 volume *The Encyclopedia of Evolution* are devoted to viruses.)

Of course, evolutionary biologists do not deny that viruses have had some role in evolution. But by viewing viruses as inanimate, these investigators place them in the same category of influences as, say, climate change. Such external influences select among individuals having varied, genetically controlled traits; those individuals most able to survive and thrive when faced with these challenges go on to reproduce most successfully and hence spread their genes to future generations.

But viruses directly exchange genetic information with living organisms—that is, within the web of life itself. A possible surprise to most physicians, and perhaps to most evolutionary biologists as well, is that most known viruses are persistent and innocuous, not pathogenic. They take up residence in cells, where they may remain dormant for long periods or take advantage of the cells’ replication apparatus to reproduce at a slow and steady rate. These viruses have developed many clever ways to avoid detection by the host immune system— essentially every step in the immune process can be altered or controlled by various genes found in one virus or another.

Furthermore, a virus genome (the entire complement of DNA or RNA) can permanently colonize its host, adding viral genes to host lineages and ultimately becoming a critical part of the host species’ genome. Viruses therefore surely have effects that are faster and more direct than those of external forces that simply select among more slowly generated, internal genetic variations. The huge population of viruses, combined with their rapid rates of replication and mutation, makes them the world’s leading source of genetic innovation: they constantly “invent” new genes. And unique genes of viral origin may travel, finding their way into other organisms and contributing to evolutionary change.

Data published by the International Human Genome Sequencing Consortium indicate that somewhere between 113 and 223 genes present in bacteria and in the human genome are absent in well-studied organisms—such as the yeast *Saccharomyces cerevisiae*, the fruit fly *Drosophila melanogaster* and the nematode *Caenorhabditis elegans*—that lie in between those two evolutionary extremes. Some researchers thought that these organisms, which arose after bacteria but before vertebrates, simply lost the genes in question at some point in their evolutionary history. Others suggested that these genes had been transferred directly to the human lineage by invading bacteria.

My colleague Victor DeFilippis of the Vaccine and Gene Therapy Institute of the Oregon Health and Science University and I suggested a third alternative: viruses may originate genes, then colonize two different lineages—for example, bacteria and vertebrates. A gene apparently bestowed on humanity by bacteria may have been given to both by a virus.

In fact, along with other researchers, Philip Bell of Macquarie University in Sydney, Australia, and I contend that the cell nucleus itself is of viral origin. The advent of the nucleus— which differentiates eukaryotes (organisms whose cells contain a true nucleus), including humans, from prokaryotes, such as bacteria—cannot be satisfactorily explained solely by the gradual adaptation of prokaryotic cells until they became eukaryotic. Rather the nucleus may have evolved from a persisting large DNA virus that made a permanent home within prokaryotes. Some support for this idea comes from sequence data showing that the gene for a DNA polymerase (a DNAcopying enzyme) in the virus called T4, which infects bacteria, is closely related to other DNA polymerase genes in both eukaryotes and

the viruses that infect them. Patrick Forterre of the University of Paris-Sud has also analyzed enzymes responsible for DNA replication and has concluded that the genes for such enzymes in eukaryotes probably have a viral origin.

From single-celled organisms to human populations, viruses affect all life on earth, often determining what will survive. But viruses themselves also evolve. New viruses, such as the AIDS-causing HIV-1, may be the only biological entities that researchers can actually witness come into being, providing a real-time example of evolution in action.

Viruses matter to life. They are the constantly changing boundary between the worlds of biology and biochemistry. As we continue to unravel the genomes of more and more organisms, the contributions from this dynamic and ancient gene pool should become apparent. Nobel laureate Salvador Luria mused about the viral influence on evolution in 1959. “May we not feel,” he wrote, “that in the virus, in their merging with the cellular genome and reemerging from them, we observe the units and process which, in the course of evolution, have created the successful genetic patterns that underlie all living cells?” Regardless of whether or not we consider viruses to be alive, it is time to acknowledge and study them in their natural context—within the web of life.

Protein Puzzles

Is Sammy Alive Teacher Notes
Discussion Questions Using Bloom’s Taxonomy

1. **Knowledge, Identification, and Recall:** Does the student know the information?
What happened to Sammy?
Who supported the operations?
What events led to his injuries?
Identify… The injuries
Define…
List…

2. **Understanding and Comprehension:** Does the student understand?
In your own words define life.
Summarize when you believe Sammy was no longer living.
What does it mean to be alive?
How do you know when the right time is to make a life decision?

3. **Application:** Can the student use previously learned information in a new situation? Adapting and applying the seven characteristics from the Martian to Sammy.
Describe how you would react if you had to make the decisions for a loved one in Sammy’s case.
How might these decisions be viewed from others?

Where else might this apply?
Explain how one might use…
Use…

4. **Analysis and Synthesis:** Can the student dissect and reassemble the idea or issue? Can the student view the issue from a different perspective? Can the student examine the available facts and offer alternative interpretations and solutions?
What caused the to respond this way?
Why might medical coverage encourage or discourage the use of medicine?
How could the incentives be realigned to support in-home care?

5. **Evaluation:** Can the student assess, form opinions, establish appropriate standards and criteria, evaluate ethical dilemmas, and critically examine an issue or idea?
Which method, procedure, or solution is better?
Can you evaluate this idea in terms of…?
Which approach would you chose? Why?
Judge, select, or rate…
Soda Can Calorimeter

Appendix H Teacher Resources for Homeostasis

(Week 1, 1 Week)
PLEASE SEE ATTACHMENT UNDER RESOURCES

Introduction to Osmosis.docx

Appendix I Teacher Resources for Energy Unit

(Week 1, 1 Week)
Enzyme activity graphs.docx

Textbooks

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Videos

Race for the Double Helix. British Broadcasting Corporation, Horizon Films, 1987.

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Suggested differentiated topics for the 3 levels of Biology as per the June 2017 PD Day.docx