Sayreville Public Schools
College Prep Biology 5 or 6 Credits

College Prep Biology

Required

Sayreville War Memorial High School

5 or 6 Credits

Full Year

Date Curriculum Approved/ Revised: _____7/19/16_____

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Statement of Purpose

Summary of the Course: The course of study is designed to expose students to the basic foundations of Biology. Biology is an all-encompassing term that includes Matter and Energy Transformations in Ecosystems, Interdependent Relationships in Ecosystems, Human Activity, Climate and Biodiversity, Cell Specialization and Homeostasis, DNA and Inheritance, Natural Selection and Evolution.

In order to demonstrate a cohesive and complete implementation plan the following general suggestions are provided:

- The use of various formative assessments are encouraged in order to provide an ongoing method of determining the current level of understanding the students have of the material presented.
- Homework, when assigned should be relevant and reflective of the current teaching taking place in the classroom.
- Organizational strategies should be in place that allow the students the ability to take the information gained in the classroom and put in in terms that are relevant to them.
- Instruction should be differentiated to allow students the best opportunity to learn.
- Assessments should be varied and assess topics of instruction delivered in class.
- Modifications to the curriculum should be included that address students with Individualized Educational Plans (IEP), English Language Learners (ELL), and those requiring other modifications (504 plans).
- Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.
- Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation.

Unit 1: Matter and Energy Transformations in Ecosystems

Summary of the Unit: In this unit of study, students *construct explanations* for the role of energy in the cycling of matter in organisms and ecosystems. They *apply mathematical concepts* to *develop evidence to support explanations* of the interactions of photosynthesis and cellular respiration, and they will *develop models to communicate these explanations*. Students also understand organism's' interactions with each other and their physical environment and how organisms obtain resources. Students utilize the crosscutting concepts of *matter and energy* and *systems, and system models* to make sense of ecosystem dynamics. Students are expected to use students *construct explanations* for the role of energy in the cycling of matter in organisms and ecosystems. They *apply mathematical concepts* to *develop evidence to support explanations* as they demonstrate their understanding of the disciplinary core ideas.

Enduring Understanding:

- Energy cannot be created or destroyed—it drives the cycling of matter within and between systems.
- Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life process
- 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 in cellular respiration at the higher level.
- 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.
- Models (e.g., physical, mathematical, computer) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.
- The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.
- 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.

Essential Questions:

Why do astrobiologists look for water on planets and not oxygen when they search for life on other planets?
Why is there no such thing as a food chain?
How can the process of photosynthesis and respiration in a cell impact ALL of Earth's systems?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.

Unit 1 Test, Quarterly Exam					
Resources: Biology Textbook, NJ Center for Teaching and Learning, other teacher created resources as appropriate.					
Topic/ Selection	**Suggested Timeline per topic**	**General Objectives**	**Instructional Activities**	**Suggested Benchmarks/ Assessments**	**NJSLS**
Cycling of Matter	6 days	Construct and revise an explanation for the cycling of matter and flow of energy in aerobic and anaerobic conditions, based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. Construct and revise an explanation for the cycling of matter and flow of energy in aerobic and anaerobic conditions, considering that most scientific knowledge is quite durable but is, in principle, subject to change based on new evidence	Biogeochemical Cycles Activity Water Cycle Model	Cycle Diagrams Post Lab questions	HS-LS 2-4, HS-LS 2-5, LA.RL.9-10.1, LA.RL.11-12.2,

		and/or reinterpretation of existing evidence.			
Flow of Energy Through an Ecosystem	6 days	Support claims for the cycling of matter and flow of energy among organisms in an ecosystem using conceptual thinking and mathematical representations of phenomena. Use a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and to show how matter and energy are conserved as matter cycles and energy flows through ecosystems Use a mathematical model to describe the conservation of atoms and molecules as they move through an ecosystem. Use proportional reasoning to describe the cycling of matter and flow of energy through an ecosystem	Ecological Pyramid Activity Food Web Mystery Organism Lab Biomagnification Lab	Ecology Quizzes/Tests Food Web Model	HS-LS 2-4, HS-LS 2-5, LA.RL.9-10.1, LA.RL.11-12.2
Photosynthesis and Cellular Respiration	6 days	Develop a model, based on evidence, to illustrate the roles of photosynthesis and cellular respiration in the cycling of carbon among the	Plant Chromatography Lab Muscle Fatigue Lab	Photosynthesis/ Respiration Foldable Fermentation Lab Report	HS-LS 2-4, HS-LS 2-5, LA.RL.9-10.1, LA.RL.11-12.2

		biosphere, atmosphere, hydrosphere, and geosphere, showing the relationships among variables in systems and their components in the natural and designed world. Develop a model, based on evidence, to illustrate the roles of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere at different scales.	Fermentation Lab Photosynthesis Chemistry Model	Photosynthesis/ Respiration Test	
Review and Assess	2 – 3 days	Students will review information gained throughout the unit in preparation for a summative assessment	Review assignment, review game or activity,	Biology summative assessment	HS-LS 2-4, HS-LS 2-5
Suggested Modifications for Special Education, English Language Learners and Gifted Students: Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA); Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.; Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).; Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).; Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).; Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.; Use project-based science learning to connect science with observable phenomena.; Structure the learning around explaining or solving a social or community-based issue.; Provide ELL students with multiple literacy strategies. ; Collaborate with after-school programs or clubs to extend learning opportunities.				

*Consistent with individual plans, when appropriate.
Suggested Technological Innovations/ Use: Google, Google Classroom, Discovery Education, Brain Pop, Amoeba Sisters, TED Ed, Kahoot, Bozeman
Cross Curricular/ 21st Century Connections: 9.1 21st Century Life and Career Skills: All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures. 9.2 21st Century Life and Career Skills: Personal Financial Literacy: All students will develop skills and strategies that promote personal and financial responsibility related to financial planning, savings, investment, and charitable giving in the global economy. 9.3 21st Century Life and Career Skills: Career Awareness, Exploration, and Preparation: All students will apply knowledge about and engage in the process of career awareness, exploration, and preparation in order to navigate the globally competitive work environment of the information age.

Unit 2: Interdependent Relationships in Ecosystems

Summary of the Unit: In this unit of study, students formulate answers to the question *"how and why do organisms interact with each other (biotic factors) and their environment (abiotic factors), and what affects these interactions?*" Secondary ideas include the interdependent relationships in ecosystems; dynamics of ecosystems; and functioning, resilience, and social interactions, including group behavior. Students use *mathematical reasoning* and *models* to make sense of carrying capacity, factors affecting biodiversity and populations, the cycling of matter and flow of energy through systems. The crosscutting concepts of *scale, proportion, and quantity* and *stability and change* are called out as organizing concepts for the disciplinary core ideas. Students are expected to use *mathematical reasoning* and *models* to demonstrate proficiency with the disciplinary core ideas.

Enduring Understanding:

- Ecosystems have carrying capacities, which are limits to the number of organisms and populations they can support. They are dependent on the scale proportion and quantity at which it occurs.
- These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease.
- Quantitative analysis can be used to compare and determine relationships among interdependent factors that affect the carrying capacity of ecosystems at different scales.
- 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.
- Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.
- If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem) as opposed to becoming a very different ecosystem.

Essential Questions:

When ecologists relocate bears, wolves, or other predators, how do they know that they will survive?
What limits the number and types of different organisms that live in one place?
How can a one or two inch rise in sea level devastate an ecosystem?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.

Unit 2 Test, Quarterly Exam

Resources: Biology Textbook, NJ Center for Teaching and Learning, other teacher created resources as appropriate.					
Topic/ Selection	**Suggested Timeline per topic**	**General Objectives**	**Instructional Activities**	**Suggested Benchmarks/ Assessments**	**NJSLS**
Carrying Capacity of Ecosystems	6 days	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. Use quantitative analysis to compare relationships among interdependent factors and represent their effects on the carrying capacity of ecosystems at different scales.	Population Ecology Lab Endangered Species Lab	Post Lab Questions Carrying Capacity Webquest	HS-LS 2-1, HS-LS 2-2, HS-LS 2-6, MA.9-12.S-IC.B, MA.9-12.S-MD.A
Biodiversity and Populations in Ecosystems	6 days	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. Use the concept of orders of magnitude to represent how factors affecting biodiversity and populations in ecosystems at one scale relate	Population Sampling Size Lab Human Population Growth Activity	Population Growth Graphing and Analysis	HS-LS 2-1, HS-LS 2-2, HS-LS 2-6, MA.9-12.S-MD.A

		to those factors at another scale.			
Interactions within Ecosystems	6 days	Evaluate the claims, evidence, and reasoning that support the contention that complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. Construct explanations of how modest biological or physical changes versus extreme changes affect stability and change in ecosystems.	Ecological Interactions Lab Abiotic/Biotic Ecosystem Project	Abiotic/Biotic Ecosystem Presentation	HS-LS 2-1, HS-LS 2-2, HS-LS 2-6, LA.RL.11-12.2
Review and Assess	2 – 3 days	Students will review information gained throughout the unit in preparation for a summative assessment	Review assignment, review game or activity,	Biology summative assessment	HS-LS 2-1, HS-LS 2-2, HS-LS 2-6
Suggested Modifications for Special Education, English Language Learners and Gifted Students: Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA); Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.; Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).; Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).; Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).; Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.; Use project-based science learning to connect science with observable phenomena.;					

Structure the learning around explaining or solving a social or community-based issue.; Provide ELL students with multiple literacy strategies. ; Collaborate with after-school programs or clubs to extend learning opportunities. *Consistent with individual plans, when appropriate.
Suggested Technological Innovations/ Use: Google, Google Classroom, Discovery Education, Brain Pop, Amoeba Sisters, TED ED, Kahoot, Bozeman
Cross Curricular/ 21st Century Connections: 9.1 21st Century Life and Career Skills: All students will demonstrate the creative, critical thinking, collaboration, and problem-solving skills needed to function successfully as both global citizens and workers in diverse ethnic and organizational cultures. 9.2 21st Century Life and Career Skills: Personal Financial Literacy: All students will develop skills and strategies that promote personal and financial responsibility related to financial planning, savings, investment, and charitable giving in the global economy. 9.3 21st Century Life and Career Skills: Career Awareness, Exploration, and Preparation: All students will apply knowledge about and engage in the process of career awareness, exploration, and preparation in order to navigate the globally competitive work environment of the information age.

Unit 3: Human Activity and Climate

Summary of the Unit: In this unit of study, students examine factors that have influenced the distribution and development of human society; these factors include climate, natural resource availability, and natural disasters. Students use *computational representations* to analyze how earth systems and their relationships are being modified by human activity. Students also develop an understanding of how human activities affect natural resources and of the interdependence between humans and Earth's systems, which affect the availability of natural resources. Students will apply their engineering capabilities to reduce human impacts on earth systems and improve social and environmental cost–benefit ratios. The crosscutting concepts of *cause and effect*, *systems and systems models, stability and change*, and *the influence of engineering, technology, and science on society and the natural world* are called out as organizing concepts for the disciplinary core ideas. Students will analyze and interpret data, use mathematical and computational thinking, and construct explanations as they demonstrate understanding of the disciplinary core ideas.

Enduring Understanding:

- Resource vitality has guided the development of human society.
- Natural hazards and other geologic events have shaped the course of human history, significantly altered the sizes of human populations, and have driven human migration.
- Empirical evidence is required to differentiate between cause and correlation and make claims about how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activities.
- Changes in climate can affect population or drive mass migration.
- Current models predict that, although future regional climate changes will be complex and will vary, average global temperatures will continue to rise.
- The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases are added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and the biosphere
- 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 response to human activities.
- Human activities can modify the relationships among Earth systems.
- Although the magnitude of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts.
- Science investigations use diverse methods and do not always use the same set of procedures to obtain data.
- Scientist and engineers can develop technologies that produce less pollution and waste and that preclude ecosystem degradation.

- When evaluating solutions, it is important to take into account a range of constraints, including costs, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.

Essential Questions:
How are human activities influence the global ecosystem?
What are the relationships among earth's systems and how are those relationships being modified due to human activity?
What is the current rate of global or regional climate change and what are the associated future impacts to Earth's systems?
How can the impacts of human activities on natural systems be reduced?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.
Unit 3 Test, Quarterly Exam

Resources: Biology Textbook, NJ Center for Teaching and Learning, other teacher created resources as appropriate.

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	NJSLS
Changes in Climate influenced by Human Activity	5 days	Construct an explanation based on valid and reliable evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. Use empirical evidence to differentiate between how the availability of natural resources, occurrence of natural hazards, and changes	Ecological Footprint Project	Ecological Footprint Presentation	HS-ESS 3-1, HS-ESS 3-4, HS-ESS 3-5, HS-ESS 3-6, HS-ETS 1-3, LA.RL.11-12.9

		in climate have influenced human activity.			
Earth Systems	5 days	Use a computational representation to illustrate the relationships among Earth systems and how these relationships are being modified due to human activity. Describe the boundaries of Earth systems. Analyze and describe the inputs and outputs of Earth systems.	Carbon Cycle Graphing	Carbon Cycle Graphing Analysis	HS-ESS 3-1, HS-ESS 3-4, HS-ESS 3-5, HS-ESS 3-6, HS-ETS 1-3, MA.9-12.S-MD.A
Future Climate Change	5 days	Analyze geosciences data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. Quantify and model change and rates of change in geosciences data and rates of global or regional climate change and associated impacts to Earth systems.	Biogeochemical Cycles Trends Activity Future Energy/Climate Lab	Biogeochemical Cycles Trends Model Post Lab questions	HS-ESS 3-1, HS-ESS 3-4, HS-ESS 3-5, HS-ESS 3-6, HS-ETS 1-3, MA.9-12.S-MD.A
Human Activities on Natural Systems	5 days	Evaluate or refine a technological solution that reduces impacts of human	Alternative Energy Research	Alternative Energy Proposal	HS-ESS 3-1, HS-ESS 3-4, HS-ESS 3-5, HS-ESS

		activities on natural systems based on scientific knowledge and student-generated sources of evidence; prioritize criteria and tradeoff considerations.			3-6, HS-ETS 1-3,LA.W.11-12.
Review and Assess	2 – 3 days	Students will review information gained throughout the unit in preparation for a summative assessment	Review assignment, review game or activity,	Biology summative assessment	HS-ESS 3-1, HS-ESS 3-4, HS-ESS 3-5, HS-ESS 3-6, HS-ETS 1-3

Suggested Modifications for Special Education, English Language Learners and Gifted Students: Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA); Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.; Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).; Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).; Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).; Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.; Use project-based science learning to connect science with observable phenomena.; Structure the learning around explaining or solving a social or community-based issue.; Provide ELL students with multiple literacy strategies. ; Collaborate with after-school programs or clubs to extend learning opportunities.

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Suggested Technological Innovations/ Use: Google, Google Classroom, Discovery Education, Brain Pop, Amoeba Sisters, TED Ed, Kahoot, Bozeman

Cross Curricular/ 21st Century Connections:

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9.2 21st Century Life and Career Skills: Personal Financial Literacy: All students will develop skills and strategies that promote personal and financial responsibility related to financial planning, savings, investment, and charitable giving in the global economy.
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Unit 4: Human Activity and Biodiversity

Summary of the Unit: In this unit of study, *mathematical models* provide support for students' conceptual understanding of systems and students' ability to *design, evaluate, and refine solutions* for reducing the impact of human activities on the environment and maintaining biodiversity. Students create or revise a simulation to test solutions for mitigating adverse impacts of human activity on biodiversity. Crosscutting concepts of *systems and system models* play a central role in students' understanding of science and engineering practices and core ideas of ecosystems. Mathematical models also provide support for students' conceptual understanding of systems and their ability to develop design solutions for reducing the impact of human activities on the environment and maintaining biodiversity.

Enduring Understanding:

- The sustainability of human societies and the biodiversity that supports them require responsible management of natural resources.
- Change and rates of change can be quantified and modeled over very short or very long periods. Some system changes are irreversible.
- New technologies can have deep impacts on society and the environment including some that are not anticipated.
- 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.
- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).
- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth.
- When evaluating solutions, it is important to take into account a range of constraints—including costs, safety, reliability, and aesthetics—and to consider social, cultural, and environmental impacts.
- Changes in the physical environment, whether naturally occurring or human induced, have contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline—and sometimes the extinction—of some species.
- Both physical models and computers can be used in various ways to aid the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test ways of solving a problem or to see which one is most efficient or economical, and in making a persuasive presentation to a client about how a given design will meet his or her needs.

Essential Questions:

How might we change habits if we replaced the word "environment" with the word "life support system"?
Does reducing human impacts on our global life support system require social engineering or mechanical engineering?
Is the damage done to the global life support system permanent?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.
Unit 4 Exam, Quarterly Exam

Resources: Biology Textbook, NJ Center for Teaching and Learning, other teacher created resources as appropriate.,

Topic/ Selection	**Suggested Timeline per topic**	**General Objectives**	**Instructional Activities**	**Suggested Benchmarks/ Assessments**	**NJSLS**
Sustainability of Human Populations	6 days	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. Quantify and model change and rates of change in the relationships among management of natural resources, the sustainability of human populations, and biodiversity.	Demographic Transition Lab Calculating Population Growth Rate Activity Tale of Two Countries Activity	Post Lab questions	HS-LS 2-7, HS-ESS 3-3, HS-LS 4-6, HS-ETS 1-1, HS-ETS 1-2, HS-ETS 1-3, HS-ETS 1-4, LA.W.11-12, MA.9-12.S-ID.A
Impacts of Human Activities on Environment	6 days	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity based on scientific knowledge, student-	Environmental Impacts Project	Environmental Impacts Land Plot Proposal	HS-LS 2-7, HS-ESS 3-3, HS-LS 4-6, HS-ETS 1-1, HS-ETS 1-2, HS-ETS 1-3, HS-ETS 1-4, LA.W.11-12.2

		generated sources of evidence, prioritized criteria, and tradeoff considerations. Construct explanations for how the environment and biodiversity change and stay the same when affected by human activity. Evaluate a solution for reducing the impacts of human activities on the environment and biodiversity based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. Analyze costs and benefits of a solution for reducing the impacts of human activities on the environment and biodiversity based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.			
Human Impact on Biodiversity	6 days	Create or revise a simulation based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations to test a solution to mitigate	Ecological Issues Project	Ecological Issues Presentation	HS-LS 2-7, HS-ESS 3-3, HS-LS 4-6, HS-ETS 1-1, HS-ETS 1-2, HS-ETS 1-3, HS-ETS 1-4, LA.W.11-12.1, LA.W.11-12.2

		adverse impacts of human activity on biodiversity. Use empirical evidence to make claims about the impacts of human activity on biodiversity. Break down the criteria for the design of a simulation to test a solution for mitigating adverse impacts of human activity on biodiversity into simpler ones that can be approached systematically based on consideration of trade-offs. Design a solution for a proposed problem related to threatened or endangered species or to genetic variation of organisms for multiple species. Analyze costs and benefits of a solution to mitigate adverse impacts of human activity on biodiversity.			
Review and Assess	2 – 3 days	Students will review information gained throughout the unit in preparation for a summative assessment	Review assignment, review game or activity,	Biology summative assessment	HS-LS 2-7, HS-ESS 3-3, HS-LS 4-6, HS-ETS 1-1, HS-ETS 1-2, HS-ETS 1-3, HS-ETS 1-4
Suggested Modifications for Special Education, English Language Learners and Gifted Students: Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA); Structure lessons around questions that are authentic, relate to					

students' interests, social/family background and knowledge of their community.; Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).; Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).; Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).; Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.; Use project-based science learning to connect science with observable phenomena.; Structure the learning around explaining or solving a social or community-based issue.; Provide ELL students with multiple literacy strategies. ; Collaborate with after-school programs or clubs to extend learning opportunities.

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Unit 5: Cell Specialization and Homeostasis

Summary of the Unit: Students formulate an answer to the question "How do the structures of organisms enable life's functions?" Students investigate explanations for the structure and functions of cells as the basic unit of life, of hierarchical organization of interacting organ systems, and of the role of specialized cells for maintenance and growth. The crosscutting concepts of structure and function, matter and energy, and systems and system models are called out as organizing concepts for the disciplinary core ideas. Students use critical reading, modeling, and conducting investigations. Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Enduring Understanding:

- Systems of specialized cells within organisms help them perform the essential functions of life.
- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.
- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows— within and between systems at different scales.
- Feedback mechanisms maintain a living system's internal conditions within certain limits, and they mediate behaviors, allowing the system to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.
- In multicellular organisms, individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow.
- The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells.
- Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.

Essential Questions:

How does the structure of DNA determine the structure of proteins, and what is the function of proteins?
What do you mean they say that people are made of a system of systems?
How do feedback mechanisms maintain homeostasis?
Why aren't all elephants the same size?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit. Unit 5 Test, Quarterly Exam					
Resources: Biology Textbook, NJ Center for Teaching and Learning, other teacher created resources as appropriate.,					
Topic/ Selection	**Suggested Timeline per topic**	**General Objectives**	**Instructional Activities**	**Suggested Benchmarks/ Assessments**	**NJSLS**
DNA	5 days	Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells. Construct an explanation, based on the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future, for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life	DNA Extraction Lab Mutation Lab Protein Synthesis Lab Disorder Detectives/ Karyotype Lab Transcription and Translation Activity	DNA/RNA Base Pairing Activity	LS1.A, HS-LS 1-1, HS-LS 1-2, HS-LS 1-3, HS-LS 1-4

		through systems of specialized cells. Conduct a detailed examination of the structure and function of DNA.			
Hierarchical organization of interacting systems	5 days	Develop and use a model based on evidence to illustrate hierarchical organization of interacting systems that provide specific functions within multicellular organism. Develop and use a model based on evidence to illustrate the interaction of functions at the organism system level. Develop and use a model based on evidence to illustrate the flow of matter and energy within and between systems of an organism at different scales.	Human Body Systems Disorder Project	Levels of Organization Puzzle Post Project questions	LS1.A, HS-LS 1-1, HS-LS 1-2, HS-LS 1-3, HS-LS 1-4, LA.RL.11-12.1
Homeostasis	5 days	Plan and conduct an investigation individually and collaboratively to produce evidence that feedback mechanisms (negative and positive) maintain homeostasis.	DNA/ Homeostasis Claim, Evidence, Reasoning Research	DNA/ Homeostasis Claim, Evidence, Reasoning Graphic Organization	LS1.A, HS-LS 1-1, HS-LS 1-2, HS-LS 1-3, HS-LS 1-4, LA.RL.11-12.1

		In the planning of the investigation, decide on the types, amount, and accuracy of the data needed to produce reliable measurements, consider limitations on the precision of the data, and refine the design accordingly.			
Cell Division and Differentiation	5 days	Use a model based on evidence to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. Use a model to illustrate the role of cellular division and differentiation in terms of energy, matter, and information flows within and between systems of cells/organisms.	Cell Cycle Onion Root Microscope Lab	Cell Cycle Foldable	LS1.A, HS-LS 1-1, HS-LS 1-2, HS-LS 1-3, HS-LS 1-4, LA.RL.11-12.4
Review and Assess	2 – 3 days	Students will review information gained throughout the unit in preparation for a summative assessment	Review assignment, review game or activity,	Biology summative assessment	LS1.A, HS-LS 1-1, HS-LS 1-2, HS-LS 1-3, HS-LS 1-4

Suggested Modifications for Special Education, English Language Learners and Gifted Students: Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA); Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.; Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables,

multimedia, modeling).; Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).; Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).; Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.; Use project-based science learning to connect science with observable phenomena.; Structure the learning around explaining or solving a social or community-based issue.; Provide ELL students with multiple literacy strategies. ; Collaborate with after-school programs or clubs to extend learning opportunities.

*Consistent with individual plans, when appropriate.

Suggested Technological Innovations/ Use: Google, Google Classroom, Discovery Education, Brain Pop, Amoeba Sisters, TED Ed, Kahoot, Bozeman

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Unit 6: DNA and Inheritance

Summary of the Unit: Students analyze data develop models to make sense of the relationship between DNA and chromosomes in the process of cellular division, which passes traits from one generation to the next. Students determine why individuals of the same species vary in how they look, function, and behave. Students develop conceptual models of the role of DNA in the unity of life on Earth and use statistical models to explain the importance of variation within populations for the survival and evolution of species. Ethical issues related to genetic modification of organisms and the nature of science are described. Students explain the mechanisms of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expressions. The crosscutting concepts of structure and function, patterns, and cause and effect are used as organizing concepts for the disciplinary core ideas. Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Enduring Understanding:

- All cells contain genetic information in the form of DNA molecules.
- Genes are regions in the DNA that contain the instructions that code for the formation of proteins.
- Each chromosome consists of a single DNA molecule, and each gene on the chromosome is a particular segment of that DNA.
- The instructions for forming species' characteristics are carried in the DNA.
- All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways.
- In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation.
- Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation.
- Environmental factors can also cause mutations in genes, and viable mutations are inherited.
- Environmental factors also affect expression of traits, and hence affect the probability of occurrence of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.
- Algebraic thinking is used to examine scientific data and predict the distribution of traits in a population as they relate to the genetic and environmental factors (e.g., linear growth vs. exponential growth).
- Technological advances have influenced the progress of science, and science has influenced advances in technology.
- Science and engineering are influenced by society, and society is influenced by science and engineering.

Essential Questions:

Why can't two roses ever be identical?

How does inheritable genetic variation occur?
Can a zoologist predict the distribution of expressed traits in a population?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.
Unit 6 Test, Quarterly Exam

Resources: Biology Textbook, NJ Center for Teaching and Learning, other teacher created resources as appropriate.,

Topic/ Selection	**Suggested Timeline per topic**	**General Objectives**	**Instructional Activities**	**Suggested Benchmarks/ Assessments**	**NJSLS**
DNA and Chromosomes	6 days	Ask questions that arise from examining models or a theory to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parent to offspring. Use empirical evidence to differentiate between cause and correlation and make claims about the role of DNA and chromosomes in coding the instructions for characteristics passed from parents to offspring.	Penny 50/ 50 Chances Lab Punnett Square Lab Genes and Chromosomes Lab	Probability Questions Punnett Square Test	HS-LS 1-4 , LS 1.B, HS-LS 3-1, LS 3.B, HS-LS 3-2, MA.9-12.S-MD.A
Genetic Variations	6 days	Make and defend a claim based on evidence that inheritable genetic variations may result from new genetic combinations through	Heredity Lab Dragon Genetics Lab	Post Lab questions and analysis	HS-LS 1-4 , LS 1.B, HS-LS 3-1, LS 3.B, HS-LS 3-2

		meiosis, viable errors occurring during replication, and/or mutations caused by environmental factors. Use data to support arguments for the ways inheritable genetic variation occurs. Use empirical evidence to differentiate between cause and correlation and make claims about the ways inheritable genetic variation occurs.			
Expression of Traits	6 days	Apply concepts of statistics and probability (including determining function fits to data, slope, intercepts, and correlation coefficient for linear fits) to explain the variation and distribution of expressed traits in a population. Use mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits. Use algebraic thinking to examine scientific data on the variation and distribution of	Inheritance of Traits Lab Pedigree Investigator	Offspring Drawing Create your Pedigree Activity	HS-LS 1-4 , LS 1.B, HS-LS 3-1, LS 3.B, HS-LS 3-2

		traits in a population and predict the effect of a change in probability of traits as it relates to genetic and environmental factors.			
Review and Assess	2 – 3 days	Students will review information gained throughout the unit in preparation for a summative assessment	Review assignment, review game or activity,	Biology summative assessment	HS-LS 1-4 , LS 1.B, HS-LS 3-1, LS 3.B, HS-LS 3-2

Suggested Modifications for Special Education, English Language Learners and Gifted Students: Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA); Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.; Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).; Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).; Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).; Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.; Use project-based science learning to connect science with observable phenomena.; Structure the learning around explaining or solving a social or community-based issue.; Provide ELL students with multiple literacy strategies. ; Collaborate with after-school programs or clubs to extend learning opportunities.

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Unit 7: Natural Selection

Summary of the Unit: Students *constructing explanations* and *designing solutions*, *analyzing and interpreting data*, and *engaging in argument from evidence investigate* to make sense of the relationship between the environment and natural selection. Students also develop an understanding of the factors causing natural selection of species over time. They also demonstrate and understandings of how multiple lines of evidence contribute to the strength of scientific theories of natural selection. The crosscutting concepts of *patterns* and *cause and effect* serve as a organizing concepts for the disciplinary core ideas. Students also use the science and engineering practices to demonstrate understanding of the disciplinary core ideas.

Enduring Understanding:

- Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not.
- Empirical evidence is required to differentiate between cause and correlation and make claims about how specific biotic and abiotic differences in ecosystems contribute to change in gene frequency over time, leading to adaptation of populations.
- Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals.
- The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. Adaptation also means that the distribution of traits in a population can change when conditions change.
- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- Changes in the physical environment, whether naturally occurring or human induced, have contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline, and sometimes the extinction, of some species.
- Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost.
- Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.

Essential Questions:

How does natural selection lead to adaptations of populations?
Why is it so important to take all of the antibiotics in a prescription if I feel better?
How are species affected by changing environmental conditions?
Why do some species live in groups and others are solitary?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit.
Unit 7 Test, Quarterly Exam

Resources: Biology Textbook, NJ Center for Teaching and Learning, other teacher created resources as appropriate.,

Topic/ Selection	Suggested Timeline per topic	General Objectives	Instructional Activities	Suggested Benchmarks/ Assessments	NJSLS
Natural Selection	5 days	Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review), and on the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future, for how natural selection leads to adaptation of populations. Use data to differentiate between cause and correlation and to make	Peppered Moth Simulation	Peppered Moth Graphing	LS 4.C, HS- LS 2-8, HS-LS 4-3, HS-LS 4-4, HS-LS 4-5, MA.9-12.S-MD.A.1

		claims about how specific biotic and abiotic differences in ecosystems contribute to change in gene frequency over time, leading to adaptation of populations.			
Advantageous heritable trait increase in proportion to Organisms	5 days	Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. Analyze shifts in numerical distribution of traits and, using these shifts as evidence, support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. Observe patterns at each of the scales at which a system is studied to provide evidence for causality in explanations that organisms with an advantageous heritable trait	Human Hand Adaptation Lab	Post Lab questions	LS 4.C, HS- LS 2-8, HS-LS 4-3, HS-LS 4-4, HS-LS 4-5

		tend to increase in proportion to organisms lacking this trait.			
Environmental Changes affect Evolution	5 days	Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. Determine cause-and-effect relationships for how changes to the environment affect distribution or disappearance of traits in species. Use empirical evidence to differentiate between cause and correlation and to make claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.	Who Wants to Live a Million Years Activity	Who Wants to Live a Million Years Quiz	LS 4.C, HS- LS 2-8, HS-LS 4-3, HS-LS 4-4, HS-LS 4-5
Group or individual Behavior	5 days	Evaluate the evidence for the role of group behavior on individual and species'	Beak Lab Survival of the Fittest Lab	Graphing and analysis of group vs. individual behavior	LS 4.C, HS- LS 2-8, HS-LS 4-3, HS-LS 4-4, HS-LS 4-5, MA.9-12.S-MD.A.1

		chances to survive and reproduce. Distinguish between group and individual behavior. Identify evidence supporting the outcome of group behavior. Develop logical and reasonable arguments based on evidence to evaluate the role of group behavior on individual and species' chances to survive and reproduce. Use empirical evidence to differentiate between cause and correlation and to make claims about the role of group behavior on individual and species' chances to survive and reproduce.			
Review and Assess	2 – 3 days	Students will review information gained throughout the unit in preparation for a summative assessment	Review assignment, review game or activity,	Biology summative assessment	LS 4.C, HS- LS 2-8, HS-LS 4-3, HS-LS 4-4, HS-LS 4-5
Suggested Modifications for Special Education, English Language Learners and Gifted Students: Restructure lesson using UDL principals (http://www.cast.org/our-work/about-udl.html#.VXmoXcfD_UA); Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.; Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).; Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool					

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Unit 8: Evolution

Summary of the Unit: Students construct explanations for the processes of natural selection and evolution and then communicate how multiple lines of evidence support these explanations. Students evaluate evidence of the conditions that may result in new species and understand the role of genetic variation in natural selection. Additionally, students can apply concepts of probability to explain trends in population as those trends relate to advantageous heritable traits in a specific environment. Students demonstrate an understanding of these concepts by obtaining, evaluating, and communicating information and constructing explanations and designing solutions. The crosscutting concepts of patterns and cause and effect support the development of a deeper understanding.

Enduring Understanding:

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment, and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.
- Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.
- Different patterns in multiple lines of empirical evidence may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of common ancestry and biological evolution.
- Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information— that is, trait variation—that leads to differences in performance among individuals.
- Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.
- Empirical evidence is required to differentiate between cause and correlation and make claims about the process of evolution.

Essential Questions:

How can someone prove that birds and dinosaurs are related?
What is the relationship between natural selection and evolution?

Summative Assessment and/ or Summative Criteria to demonstrate mastery of the Unit. Unit 8 Test, Quarterly Exam					
Resources: Biology Textbook, NJ Center for Teaching and Learning, other teacher created resources as appropriate.,					
Topic/ Selection	**Suggested Timeline per topic**	**General Objectives**	**Instructional Activities**	**Suggested Benchmarks/ Assessments**	**NJSLS**
Biological Evolution	10 days	Communicate scientific information in multiple forms that common ancestry and biological evolution are supported by multiple lines of empirical evidence. Understand the role each line of evidence has relating to common ancestry and biological evolution. Observe patterns in multiple lines of empirical evidence at different scales and provide evidence for causality in explanations of common ancestry and biological evolution.	Bone of Contention Lab Sex and the Single Guppy Lab	Bone of Contention Assessment	LS 4.A, HS-LS 4-1, HS-LS 4-2
Theories and Laws of Natural World	10 days	Construct an explanation, based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the	Homologous, Analogous, and Vestigial Structures Activity	Evolution Test	LS 4.A, HS-LS 4-1, HS-LS 4-2

		assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future, that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. Use empirical evidence to explain the influences of: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce			

		in the environment, on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species.			
Review and Assess	2 – 3 days	Students will review information gained throughout the unit in preparation for a summative assessment	Review assignment, review game or activity,	Biology summative assessment	LS 4.A, HS-LS 4-1, HS-LS 4-2

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