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Unit Title: Ecology-Interactions and Energy	**Content Area:** Biology	**Grade Level:** 9-12

Unit Summary: The unit aims to have students understand how the study of Ecology helps scientist organize and analyze the interactions among living and non-living parts of ecosystems. In addition, students will be able to identify how the different interactions and/or relationships affect populations of living things as well as the biosphere, and evaluate the impact human development has had on the biosphere by devising solutions to counteract these effects.

Cross Cutting Concepts: Systems and System Models, Energy and Matter, Stability and Change and Patterns.

Science and Engineering Practices: Developing and Using Models, Obtaining, Evaluating and Communicating Information, Analyzing and Interpreting Data, Use Mathematical and Computational Thinking, Planning and Carrying Out Investigations, Constructing Explanations and Designing Solutions

Unit Essential Questions:	**Unit Enduring Understandings:**
• How do the interactions among living and non-living things affect our ecosystem? • How does the relationship among living things influence our ecosystem and the population of life on earth?	• Scientists study the environment at different levels from individual to biosphere including living and nonliving interaction. • Energy is transferred among organisms and is lost into the environment as heat. • Organisms interact with each other in multiple ways forming different types of relationships. • Stability in an ecosystem can be disrupted by natural or human interactions affecting population size.

NJCCCS:5.3.12.B.2, 5.3.12.B.3, 5.3.12.C.1, 5.3.12.C.2

NGSS Performance Expectations: *Students who demonstrate understanding can…*

- HS-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
  HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
- HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*
- HS-LS2-6. Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

Primary CCSS ELA/Literacy Connections: RST. 11-12.7, RST.11-12.8, WHST.9.12-2, WHST.9.12-5, WHST.9.12-7, CCSS.ELA-LITERACY.RI.9-10.1, CCSS.ELA-LITERACY.RI.9-10.2, CCSS.ELA-LITERACY.RI.9-10.4, CCSS.ELA-LITERACY.RI.9-10.10	**Primary CCSS Mathematics Connections:** CCSS.MATH.CONTENT.HSN.Q.A.2

Lesson Pace & Sequence

Lesson Title/Number: Interactions and Interdependence	**Learning Objective(s):** All learners will be able identify the levels of organization that ecologist study and evaluate the interdependence among living things by completing Inquiry Activity and Thinking Visually in groups.	**Lesson Duration:** 80 minutes

Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access	What does interdependence				

students' prior knowledge?	mean? How are living things interdependent?				
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Inquiry Activity: How do organisms affect one another's survival? Students will list all living things they come into contact with daily and create a diagram depicting how those organisms interact with one another. Questions: Which organism provides energy/nutrients?, What would happen if plants on your diagram died? Why is it difficult to make accurate predictions about changes in communities of organisms?	• Chapter 3 pg. 62	Developing and Using Models, Obtaining, Evaluating and Communicating Information	LS2.A: Interdependent Relationships in Ecosystems	Systems and System Models: A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. Energy and Matter: Flows, Cycles, and Conservation: tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.
Explain: How will you help students connect their exploration to the concept/topic under investigation?	Presentation/Discussion. Students will aim to answer individually: How does Ecology help explain the interactions and interdependence between organisms and their environment? What different levels of organization do ecologists study? What methods are used to study ecology?	• Chapter 3 Section 3-1	Obtaining, Evaluating and Communicating Information	LS2.A: Interdependent Relationships in Ecosystems	Patterns: Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Section 3.1 Thinking Visually: Creating a table, Refer to Figure 3-2 which shows the various levels of organization that ecologists study. In a table, provide examples of the ecological levels where you live- individuals, populations, communities, and ecosystems-- that could be studied by ecologists	• Chapter 3 pg. 65			
Extend: How will students deepen their conceptual understanding through use in new context?	Exit ticket: What evidence tells you that people in our society are aware of the interdependence of living things?				
Lesson Pace & Sequence					

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Lesson Title/Number: Energy Flow		**Learning Objective(s):** All learners will be able to identify the source of energy for life's processes and trace the flow of energy through living things.		**Lesson Duration:** 120 minutes	
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Where does the energy needed for living things originate?				
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	In small groups students will separate photocopies of a variety of organisms into 2 piles, producers and consumers, after each group has successfully divided the organisms they will be asked to create a food chain. Teacher will check group food chains for accuracy.		Analyzing and Interpreting Data	LS2.A: Interdependent Relationships in Ecosystems	Energy and Matter: Flows, Cycles, and Conservation: tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.
Explore: What hands-on/minds-on common experience(s) will you provide for students?	You tube videos: Energy flow/ Producers and Consumers. Class Discussion/Presentation: Students will aim to answer individually: Where does the energy for life's process's come from? How does energy flow through living things? How efficient is energy among organisms in an ecosystem.	• Ecosystem Ecology: Links in the Chain Video: http://www.youtube.com/watch?v=v6ubvEJ3KGM&edufilter=E734TCOrjO5qiBrKuK9MDg&safe=active	Obtaining, Evaluating and Communicating Information	LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	Energy and Matter: Flows, Cycles, and Conservation: tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.
Explain: How will you help students connect their exploration to the concept/topic under investigation?	Students will read and create notes based on how each term in the section relates to energy flow in the biosphere. Then they will draw a concept map to show the relationship among the following terms: autotroph, producer, photosynthesis, chemosynthesis, heterotroph, consumer, herbivore, carnivore,	• Chapter 3 section 3-2	Developing and Using Models		Systems and System Models: A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.

	omnivore, detretivore, decomposer, food chain, food web, trophic level, ecological pyramid, biomass				
Extend: How will students deepen their conceptual understanding through use in new context?	Exit ticket: If a food chain consist of grass, human and cow (176 percent of energy), explain what living thing has the most energy and why, and calculate the percent energy for grass and human.		Use Mathematical and Computational Thinking		Energy and Matter: Flows, Cycles, and Conservation: tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.

Lesson Pace & Sequence

Lesson Title/Number: Energy Flow		**Learning Objective(s):** All learners will be able to evaluate the efficiency of energy flow that powers life processes by completing Quick Lab Activity.			**Lesson Duration:** 60 minutes
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Explain the relationship in a food chain including omnivores, herbivores and autotrophs.			LS2.A: Interdependent Relationships in Ecosystems	Energy and Matter: Flows, Cycles, and Conservation: tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.

Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Inquiry Lab (Owl Pellet): Observations: How does it look, smell, and feel? How do you think it was formed? What type of consumer do you think this comes from? Be as specific as possible? Why do you think it came from that consumer? Create a possible food web/food chain to illustrate how the object could have been produced		Planning and Carrying Out Investigations		Energy and Matter: Flows, Cycles, and Conservation: tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Owl Pellet Dissection Graphic Organizer	• Owl Pellets Handout: http://www.biologycorner.com/worksheets/owlpellet.html	Obtaining, Evaluating and Communicating Information	LS2.B: Cycles of Matter and Energy Transfer in Ecosystems	Energy and Matter: Flows, Cycles, and Conservation: tracking energy and matter flows, into, out of, and within systems helps one understand their system's behavior.

Lesson Pace & Sequence

Lesson Title/Number: What shapes an ecosystem?		**Learning Objective(s):** All learners will be able to explain how biotic/abiotic factors influence an ecosystem, identify interactions that occur within communities and describe how ecosystems recover from a disturbance.			**Lesson Duration:** 80 minutes
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	What does BIO mean and how does it relate to the meaning of the terms Biotic and Abiotic?				

Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Pick an animal of your choice; provide a description of its biotic and abiotic factors as well as its niche. Share your profile with a partner				
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Students will be asked to review meaning of terms competition, predation, symbiosis, mutualism, commensalism and parasitism. Students will engage in lab rotation in small groups where they are given a variety of visuals and background information describing the interaction between two living things and asked to evaluate the relationship as predation, mutualism, commensalism, symbiosis, parasitism or competition. Class discussion and evaluation of student answers.		Analyzing and Interpreting Data, Obtaining, Evaluating and Communicating Information	LS2.D: Social Interactions and Group Behavior	Patterns: Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them
Extend: How will students deepen their conceptual understanding through use in new context?	Define the following terms in your own words (points off for text-book definitions) Ecological Succession- Primary Succession- Pioneer Species- Secondary Succession- Marine Succession- Choose a method of succession that is best suited for the environment of the animal you chose previously. Provide an explanation of how that succession could affect the niche of the animal.		Constructing Explanations and Designing Solutions	LS2.C: Ecosystem Dynamics, Functioning, and Resilience	Stability and Change: For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.
Lesson Pace & Sequence					

Lesson Title/Number: Factors that affect population		**Learning Objective(s):** All learners will be able to determine and evaluate their understanding of the factors that affect population size.			**Lesson Duration:** 160 minutes
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Think/Pair/Share: Where have you seen the word: carrying capacity? OR What do you think the terms carrying capacity refers to?			LS2.A: Interdependent Relationships in Ecosystems	
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Students share responses during class discussion, misconceptions are addressed				
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Completion of Population Growth Activity	• Population Growth Activity: http://www.crazyteacherlady.com/uploads/5/1/4/8/51486626/objective_2_activities_pop_growth.pdf	Analyzing and Interpreting Data, Using Mathematical and Computational Thinking, Obtaining, Evaluating and Communicating Information.	LS2.C: Ecosystem Dynamics, Functioning, and Resilience	Systems and System Models: A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems. Stability and Change: For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.
Lesson Pace & Sequence					
Lesson Title/Number: Human Impact		**Learning Objective(s):** All learners will be able to describe human activities that can affect the biosphere and propose reasonable solutions.			**Lesson Duration:** 120 minutes

Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	KWL: What human activities do you KNOW affect our Biosphere				
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	KWL: What do you WANT to know about human activities that affect our biosphere?				
Explore: What hands-on/minds-on common experience(s) will you provide for students?	LAB ROTATION: Students will explore different factors that affect the biosphere through a variety of teacher generated readings, illustrations and questions related to the following lab stations: hunting and gathering, agriculture, industrial growth and urban development, habitat alteration, wild life products, pollution, ozone depletion and global climate change		Analyzing and Interpreting Data, Developing and Using Models, Obtaining, Evaluating and Communicating Information.	LS4.D: Biodiversity and Humans	Systems and System Models: A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	KWL: What have you LEARNED about human activities that affect our ecosystem?				
Extend: How will students deepen their conceptual understanding through use in new context?	Research: Identify 3 possible solutions to counteract the detrimental effects of human activities on our biosphere. Explain why the solutions proposed suits the problem.		Constructing Explanations and Designing Solutions	ETS1.B: Developing Possible Solutions	Stability and Change: For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.