ECOLOGY Unit Overview

Our **anchor phenomenon** for this ecology unit is: How can we protect and restore ecosystems? And, why is this work important? In this unit we will spend a lot of time discussing the damaging human impacts on ecosystems, and this can be discouraging. We hope that taking a proactive approach where we discuss what can be done (and what has been done) to restore ecosystems will be interesting for students. We will start by asking how you could restore an empty, abandoned lot. Later in the unit, students will read an article about how restoration of urban habitats is providing a great number of ecosystem services (like pollution control, temperature regulation, etc.).

To understand how ecosystems function, we will start analyzing the components of a variety of ecosystems, including abiotic and biotic factors and biodiversity. Students will learn how ecosystems are made up of different species that have specific interactions and of non-living factors that contribute to these interactions. They will move on to learn about the factors that affect populations and how sometimes populations can get out of balance, especially with human disturbances.

Students will consider a case study involving the reintroduction of wolves into Yellowstone National Park. Wolves had intentionally been hunted by humans (European settlers) until extinction in most states. We ask students to come up with solutions to this problem in Yellowstone before we discuss what was actually done, to encourage problem solving. The rest of the lesson then discusses the return of wolves to Yellowstone which highlights the many complex interactions in ecosystems. Not only did the elk and deer populations come under control after wolf reintroduction, but a host of other organisms and interactions were restored as a result. Following this lesson we will look at both human and natural disasters and how they affect ecosystems. Generally, organisms have evolved to survive and will often thrive following natural disturbances. However, human disturbances have not been around as long nor have they been as predictable as natural disturbances, and as a result they cause a lot more problems for ecosystems.

In second half of this unit we will move on to discuss how food webs function and how both matter (nutrients) and energy travel through the food web. Energy is unidirectional (starting with the sun). Living things use energy to fuel their life processes. However, some of the energy is also dissipated to the environment as thermal energy, so that at each step of the food web the amount of energy available decreases. Nutrients, however are cyclic. They move up the food

web starting with plants (and plants get the majority of their mass from CO_2 that they take in through their leaves). Then nutrients move to the animals that eat the plants, and then as these die, they are returned to the soil by way of decomposers. This conservation of matter was also emphasized in the Respiration and Photosynthesis unit and students will diagram this same conservation of matter here in this unit. Then students will conclude the unit by revisiting the **anchor phenomenon;** how can we protect and restore ecosystems (our empty lot). After having designed a project to restore the lot, students will discuss how they can measure the success of this project and will learn about the many ecosystem services that whole, healthy ecosystems (including their project) can provide for people. In addition, they will summarize what they learned in their "Observe an Ecosystem" project.

In conjunction with this unit, it would be beneficial to visit a nature center, or to participate in a habitat restoration project. Or perhaps students could plant some native plants or flowers in an empty part of their school yard. If this is not practical for students, there are online options such as observing live webcams or watching nature documentaries.

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Lessons

Lesson 1: What is an Ecosystem?
Lesson 2: Observe an Ecosystem Project
Lesson 3: Predator - Prey Activity (1-2 days)
Lesson 4: Predator - Prey Cycles (1-2 days)
Lesson 5: Interaction Between Organisms
Lesson 6: Observing Interactions
Lesson 7: Populations
Lesson 8: Balance
Lesson 9: Yellowstone Case Study
Lesson 10: Ecology Review (Quiz)
Lesson 11: Food Webs (2 days)
Lesson 12: Review of "Observe an Ecosystem" Project
Lesson 13: The Flow of Matter in an Ecosystem
Lesson 14: The Flow of Energy in an Ecosystem
Lesson 15: Diagram Energy and Nutrients in Your Project
Lesson 16: Design an Ecosystem (3 days)
Lesson 17: Conservation Biology: Part 1 - Problems
Lesson 18: Conservation Biology: Part 2 - Actions (3 days)
Lesson 19: Review of "Observe an Ecosystem" Project

Ecology Unit
Next Generation Science Standards

Next Generation Science Standards - Performance Expectations

MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

MS-LS2-5. Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Analyzing and Interpreting Data Constructing Explanations and Designing Solutions Engaging in Argument from Evidence --- ***Connections to Nature of Science*** Scientific Knowledge is Based on Empirical Evidence	**LS2.A:** Interdependent Relationships in Ecosystems **LS2.B:** Cycle of Matter and Energy Transfer in Ecosystems **LS2.C:** Ecosystem Dynamics, Functioning, and Resilience **LS4.D:** Biodiversity and Humans **ETS1.B:** Developing Possible Solutions	Patterns Cause and Effect Energy and Matter Stability and Change --- ***Connections to Engineering, Technology, and Applications of Science*** Influence of Science, Engineering, and Technology on Society and the Natural World --- ***Connections to Nature of Science*** Scientific Knowledge Assumes an Order and

		Consistency in Natural Systems Science Addresses Questions About the Natural and Material World

California Common Core State Standards Connections:

ELA/Literacy –

RST.6–8.1	Cite specific textual evidence to support analysis of science and technical texts.
RST.6–8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
RST.6–8.8	Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
RI.8.8	Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims.
WHST.6–8.1.a–e	Write arguments focused on discipline-specific content.
WHST.6–8.2.a–f	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
WHST.6–8.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
SL.8.1.a–d	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
SL.8.4	Present claims and findings (e.g., argument, narrative, response to literature presentations), emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation. **a.** Plan and present a narrative that: establishes a context and point of view, presents a logical sequence, uses narrative techniques (e.g., dialogue, pacing, description, sensory language), uses a variety of transitions, and provides a conclusion that reflects the experience.
SL.8.5	Integrate multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

Mathematics –

MP.4	Model with mathematics.
6.RP.-3.a-d	Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.
6.EE.9	Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.
6.SP.5.a-d	Summarize numerical data sets in relation to their context.

Materials **(for a breakdown of materials by lesson, see the Unit Planning Chart)**

- ★ 4 ecosystems photos and descriptions to project for students (provided); or color copies (Lesson 1)
- ★ poster paper (optional, for sample KWL chart and concept map; Lesson 1)
- ★ white boards (for concept map activity; Lesson 2)
- ★ stopwatch or clock with second hand
- ★ Interaction Cards (optional, Lesson 6)

Per group:

- ★ 1 piece of cloth with multicolored patterned designs, at least 1 meter square. (Per student group; Lesson 3)
- ★ 3 small vials, envelopes, or resealable plastic bags to hold the hole punches (Per group; Lesson 3)
- ★ 3 colors of hole punches, approximately 50 per vial (each vial should have a different color of hole punch; Per group; Lesson 3)
- ★ Lesson 10 resource: Review Cards (1 set per group)

Other Supplies

- ★ graph paper (1 sheet per student)
- ★ rulers
- ★ colored pencils
- ★ markers
- ★ plain paper

Per group:

- ★ large poster board (1 for each group of 4 students; Lesson 16 & 18)

Advance Preparation

- ★ Lesson 2-19: “Observe an Ecosystem” Project Packet
- ★ Lesson 6: Find nature video(s) showing many different types of interactions in an ecosystem. Students will try to spot different interactions and think about the role of these interactions in the ecosystem. For example, predators often keep prey numbers down, and this is highlighted in many nature documentaries. There are also webcams that might work well for this.
- ★ Optional, Lesson 6: If a video or webcam is not available, or if you think your students would benefit from more practice, make a set of Interaction Cards for each group to sort. See separate file. Copy and cut apart. Laminate for more durability.
- ★ Lesson 8: Disaster cards (see separate file). One set per group (recommended, or groups can pass around and share). Copy and cut out. Laminate these for more durability.
- ★ Lesson 10: Make a set of index cards with the terms we learned in class for the Opener. Make a set for each group, or photocopy the set of cards onto card stock and cut apart (provided in a separate file, i.e., abiotic, biotic, consumer, producer, decomposer,

population, pollination, mutualism, competition, parasite, predator, ecosystem, biodiversity)

★ Lesson 18: Could look for a local non-profit group that is working on restoration where the students can go to participate in an active restoration project

Tech option

★ nature video(s) that shows many different types of interactions in an ecosystem
★ video about the wolves in Yellowstone (Lesson 9)

Vocabulary

abiotic factors
biotic factors
ecosystem
system, system components
producers
consumers
species
photosynthesis
population
predator/predation
reproduction
camouflage
predator-prey cycle
interaction
mutualism
competition
parasite-host
pollination/ pollinator
population size
balance
invasive species
food web
consumer (herbivore)
consumer (carnivore)
decomposer
biodiversity
sustainable
biodiversity hotspots
ecosystem services