

2 Interconnected Earth

Introduction

As Bill McKibben writes in his introduction to Aldo Leopold, “Ecology was the great emergent science of the 20th century, and its central insight was that everything is connected.” Whichever words one chooses to use in service of this concept—*connectedness*, *inter-relatedness*, *interdependence*—the notion that humans and other living organisms are fundamentally linked remains central to biology and environmental science courses. The texts in Unit 2 are meant to comprise a compelling historical complement and context to the science students will learn in such courses. These texts explore the connections between humans, other species, and Earth systems in contexts ranging from individual ecosystems to the entire globe. As students read these texts, encourage them to think about their own place in our interconnected Earth, and the impact of human behavior on its living systems.

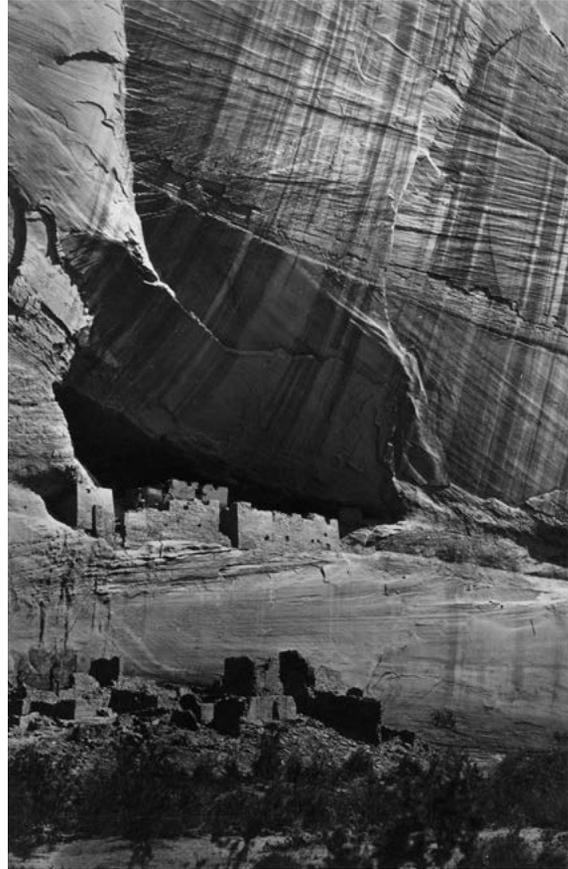
Objectives

1. Students will analyze a variety of acclaimed nonfiction texts to augment their understanding of ecology and its historical context. They will determine what the texts say explicitly, draw inferences, identify points of view and rhetorical strategies, evaluate arguments, and summarize central ideas and conclusions.
2. Students will increase their understanding of how matter and energy flow through ecosystems; of complex interactions between organisms in an ecosystem; of the simultaneous coevolution of Earth’s systems and life on Earth. Students will use several different media to demonstrate their understanding of these connections and to explain them to others.

Core Passages and Images

Close Reading Passage: from *A Sand County Almanac*, by Aldo Leopold (pages 274–276, 278–279, 286–288)

1. from *Only One Earth*, by Friends of the Earth (pages 500–503)
2. “The World’s Biggest Membrane,” by Lewis Thomas (pages 550–553)
3. from “A First American Views His Land,” by N. Scott Momaday (pages 570–575)
4. “Seasons of Want and Plenty,” by William Cronon (pages 635–637)
5. “Planet of Weeds: Tallying the Loss of Earth’s Animals and Plants,” by David Quammen (pages 876–877)
6. from *Ecology of a Cracker Childhood* by Janisse Ray (pages 900–903)
7. Image 2: George Catlin, *Buffalo Hunt, Approaching in a Ravine*
8. Image 14: *Buffalo Skulls at Michigan Carbon Works*



Ancient Ruins in the Cañon de Chelle, N.M. (1873), by Timothy H. O’Sullivan

Standards

Common Core State Standards

RI.9-10.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

RI.9-10.5 Analyze in detail how an author’s ideas or claims are developed and refined by particular sentences, paragraphs, or larger portions of the text (e.g., a section or chapter).

RI.9-10.6 Determine an author’s point of view or purpose in a text and analyze how an author uses rhetoric to advance that point of view or purpose. **RI.9-10.8** Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient.

RI.11-12.3 Analyze a complex set of ideas or sequence of events and explain how specific individuals, ideas, or events interact over the course of the text.

RI.11-12.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze how an author uses and refines the meaning of a key term or terms over the course of a text (e.g., how Madison defines *faction* in *Federalist* No. 10).

RH.11-12.2 Determine the central ideas or information of a primary or secondary source; provide an accurate summary that makes clear the relationships among the key details and ideas.

RST.9-10.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.

RST.9-10.5 Analyze the structure of the relationships among concepts in the text, including relationships among key terms (e.g., *force*, *friction*, *reaction force*, *energy*).

W.9-10.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

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

W.11-12.2 Write informative/explanatory texts to examine and convey complex ideas, concepts, and information clearly and accurately through the effective selection, organization, and analysis of content.

W.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

W.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Next Generation Science Standards

HS-LS2-3 Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.

HS-LS2-4 Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

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-ESS2-7 Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.



Motivate

Ask students to look at Image 2, **George Catlin's *Buffalo Hunt: Approaching a Ravine***, and Image 14, **Buffalo Skulls at Michigan Carbon Works**. The painting shows buffalo hunting in the 19th century, and the photo shows the effect of such hunts. Invite students to discuss these images in small groups and then share their ideas with the class. Ask students to consider these questions:

- How does the photo show the effects of the kind of hunt portrayed in the painting?
- Based on the photo and the painting, draw conclusions about the effects of buffalo hunting on the larger American landscape, including humans and other species.
- In what ways might the effects of buffalo hunting demonstrate the interconnectedness of humans and other life on Earth?
- Based on their previous knowledge, ask students to share thoughts on how buffalo hunts like those referenced in the two images related to the ways of life, livelihoods, and relationships between different peoples living in 19th century North America.



Explore

Each activity in this section focuses on the work of an individual author. Activities in later sections involve comparing the works of more than one author. Activities marked with an asterisk (*) are more suited to strong readers.

1. For homework or as an in-class activity, have students read and analyze *Only One Earth*, by Friends of the Earth. The text states that within the “web of life . . . the snapping of each thread makes the whole web shudder, and weakens it. Thus in the complex world of living things everything depends on everything else, all life is the same life, every effect is a cause, nothing can happen by itself.” Ask students to write an explanatory essay:



Buffalo Hunt, Approaching in a Ravine (1845), by George Catlin



Buffalo skulls at Michigan Carbon Works, a Detroit charcoal and fertilizer factory (c. 1880)

- Explaining how this idea is developed and refined through particular sentences in the text
- Evaluating whether the reasoning behind this statement is valid and whether it is supported by evidence within the text
- Providing examples from the text that supply evidence for the authors' point of view

(RI.9-10.5; RI.9-10.6; RI.9-10.8; W.9-10.2; W.9-10.9; W.11-12.2)

2. In *The World's Biggest Membrane*, Lewis Thomas discusses the importance of Earth's atmosphere in the development and evolution of life. Have students read and discuss the essay and then work in groups to create a multimedia presentation arguing that the development and evolution of life on Earth depended on atmospheric oxygen. Students should cite specific examples and evidence from the text in support of their arguments; you also may encourage them to do independent research. (RST.9-10.2; HS-ESS2-7; W.11-12.1; W.11-12.6)
3. *In *Seasons of Want and Plenty*, William Cronon describes the tall tales and misconceptions that led many European settlers to be painfully surprised by the conditions they faced upon arrival in North America. Have students read the text and then stage a role-playing exercise in which you have students imagine they are living in the 17th century in a small European community that is considering relocating to New England. Assign equal numbers of students to the following groups: 1) community members considering relocation to New England, specifically the proposition: "Should we move our community to New England?"; 2) ship captains trying to sell passage on their ships to North America; 3) experienced returned settlers who have already made the move from Europe to New England, and decided to return. Give the students time to prepare their roles, arguments, and questions. Then, the ship captains should present to the community compelling reasons why they should move to New England. The returned

settlers should argue against the move. The community members should question both groups and then vote on the proposition. Tell students that their presentations and questions should reference examples from Cronon's text, paying particular attention to the primary sources he quotes. In preparing their comments, students should discuss and prepare rhetoric that will make for a compelling argument. (RH.11-12.2; RI.9-10.6; RI.9-10.8)

4. *In *Planet of Weeds*, David Quammen explains the concept of mass extinction. He also describes the five major mass extinctions scientists believe have occurred in geological history, and argues that Earth is currently on the brink of a sixth mass extinction. Have students read the text and then work in pairs or small groups to create a poster-sized presentation explaining the concept of mass extinction, showing a timeline of the five major mass extinctions of the past, and the evidence suggesting a sixth is beginning. (HS-LS2-6; HS-ESS2-7)
5. In *Ecology of a Cracker Childhood*, Janisse Ray uses the gopher tortoise as an example in order to explain the concept of "keystone species." Have students read the text independently and then write an explanatory essay explaining the concept using the gopher tortoise and one other species as exemplars. Other species commonly cited as keystone species include: African elephant, sea otter, prairie dog, beaver, and wolf. You may wish to assign students to a species or have them choose from this list. Students will need to research the second species; sufficient information is easily found online. Students should use evidence in Ray's text to support the candidacy of the gopher tortoise as a keystone species as well as their inferences about the additional species they choose. (RI.9-10.1; W.11-12.2; W.11-12.7)



Gopher Tortoise



Close Reading

Aldo Leopold's *A Sand County Almanac* (pages 274–276, 286–288)

 Lexile®: measure = 1120L

Vocabulary

gleanings, *pl n*, things, especially facts, that are gathered or collected from various sources rather than acquired as a whole

tyro, *n*, a beginner or novice

mêlée, *n*, a confused mass (of people or animals)

extirpate, *v*, root out and destroy completely

desuetude, *n*, a state of disuse

defoliated, *v*, removed leaves from (a tree, plant, or area of land), for agricultural purposes or as a military tactic

biotic, *adj*, of, relating to, or resulting from living things, especially in their ecological relations

flora, *n*, the plants of a particular region, habitat, or geological period

fauna, *n*, the animals of a particular region, habitat, or geological period

apex, *n*, the top or highest part of something, especially one forming a point

Close Reading Comprehension Questions

Have students read the Close Reading Text, the passages *Thinking Like a Mountain* and *The Land Pyramid* from **Aldo Leopold's *A Sand County Almanac*** (pages 274–276, 286–288), on their own. Then have the students work in groups to answer the following close reading questions:

1. In the section *Thinking Like a Mountain*, the author discusses how seeing a wolf die changes his views (page 275). What does Leopold learn from watching the wolf die? *He learns that the wolf is important to the mountain ecosystem, and that the death or extermination of the wolf has effects beyond those he can imagine or for which he can hope.* (9RI.11-12.3; HS-LS2-6)
2. How do the details in the section *Thinking Like a Mountain* (pages 274–276) support the idea that all life in an ecosystem is interconnected? *Possible answer: Details in this section describe how the mountain and the other animals react to the presence of wolves, such as the horse whinnying and the deer running away. Other details describe the devastation that deer cause to plant life in the absence of wolves to control their population. The author even suggests that the mountain itself misses the wolves.* (9RI.9-10.5; HS-LS2-6)



Industrial Pollution

3. In the final paragraph of the section *Thinking Like a Mountain*, what does Leopold mean by the statement that, “too much safety seems to yield only danger in the long run” (page 276)? *Possible answer: By trying to control dangers such as wolves, humans create new, worse dangers, such as depleted ecosystems.* What actions do his statements in this paragraph suggest people should take? *These statements suggest that people should not only avoid destroying nature but should also take an active role in conserving wildlife.* (RI.9-10.1)
4. In the section *The Land Pyramid*, why does Leopold argue that a pyramid is the best representation of nature’s systems? *The layers of the pyramid accurately show similarities between species with comparable food sources. The pyramid structure also shows the proportion of different elements needed to support the ecosystem.* What does the pyramid structure suggest about the role of the land in an ecosystem? *Because the land is at the base of the pyramid, it supports all the other layers. This suggests that healthy soil and land are crucial elements for a healthy ecosystem.* (RI.9-10.1)
5. Reread the paragraph at the bottom of page 286 and the top of page 287 in the section *The Land Pyramid*. Based on this paragraph, what is a food chain? *A food chain is a line that shows the pattern of dependency for food and other services between Earth and various species.* Give your own example of a food chain. *Possible answer: Soil-grass-deer-wolf.* How does the idea of the food chain fit into the concept of the biotic pyramid? *The food chain demonstrates how energy flows through the different levels of the pyramid.* (RST.9-10.5; HS-LS2-4)



Close Reading Comprehension Questions

1. In the section *Thinking Like a Mountain*, the author discusses how seeing a wolf die changes his views (page 275). What does Leopold learn from watching the wolf die?
2. How do the details in the section *Thinking Like a Mountain* (pages 274–276) support the idea that all life in an ecosystem is interconnected?
3. In the final paragraph of the section *Thinking Like a Mountain*, what does Leopold mean by the statement that “too much safety seems to yield only danger in the long run” (page 276)? What actions do his statements in this paragraph suggest people should take?
4. In the section *The Land Pyramid*, why does Leopold argue that a pyramid is the best representation of nature’s systems? What does the pyramid structure suggest about the role of the land in an ecosystem?
5. Reread the paragraph at the bottom of page 286 and the top of page 287 in the section *The Land Pyramid*. Based on this paragraph, what is a food chain? Give your own example of a food chain. How does the idea of the food chain fit into the concept of the biotic pyramid?



Comparing Texts

Have students write a short comparison of **Aldo Leopold's** point of view on humans' impact on ecosystems with those of one or two other core passage authors. Ask students to explain how, according to each author, people have affected specific ecosystems; the author's opinion of this impact; and any suggestions the author offers to change or lessen humans' impact on the environment. Ninth- and tenth-grade students may compare Leopold's writing with one other core passage text. Eleventh- and twelfth-graders may compare it with two other texts. (RI.9-10.6)



Making Connections to Today

In *A First American Views His Land*, N. Scott Momaday suggests that at the core of the Native American worldview is the concept: "The Earth is our mother. The sky is our father." This concept suggests an intimate relationship and interdependence between humans and the natural world. Have students work in small groups to research and prepare a presentation summarizing Momaday's thesis, and comparing his explanation of the relationship between humans and nature to the way this relationship is viewed in a community to which the students belong. The community each group chooses may be your school, their families, your town or city, or the United States as a whole.

In their presentations, students should choose specific examples from Momaday's text as well as from the community they have chosen. Such examples within their chosen community may include the way nature is featured in popular media and advertising, decisions that have been made about resource use and conservation, and the words and rhetorical approaches politicians representing various constituencies use in their comments on environmental issues. Within their presentations, students should also be sure to reference the interrelations and/or independence of particular species, and to cite specific ways that humans view biotic and abiotic aspects of their natural environment. (RH.11-12.2; RST.9-10.2; W.11-12.7)



Core Passages Assessment Questions

Have students answer these questions individually. Questions are printed on separate pages that can be reproduced for students.

Question #	Correct Answer(s)	Standard(s)
1	D	(RI.11-12.4)
2	D, E, G	(RI.9-10.8, HS-LS2-3)
3	C	(RI.9-10.5)
4	C	(RI.9-10.1, HS-ESS2-7)
5	A	(RI.9-10.8)
6	B	(RH.11-12.2)
7	B	(RST.9-10.2)
8	A	(RST.9-10.4)

UNIT 2



Interconnected Earth

Core Passages Assessment Questions

Answer these questions about the core passages individually.

1. On the first two pages of the section “The Community Concept” in **Aldo Leopold’s *A Sand County Almanac*** (page 278), what does Leopold’s term “land ethic” mean?

- A the declaration of love for and obligation to the land
- B the alteration, management, and use of plant and mineral resources
- C the individual’s struggle between conflict and competition in human society
- D the understanding of humans as part of a community of soil, water, plants, and animals

2. In the passage from **Friends of the Earth’s *Only One Earth*** (pages 500–503), the authors claim that life on Earth is so intertwined that changes to any life on Earth will affect all life on Earth. Which three pieces of evidence from the text support this claim?

- A “The mixing of dead atoms in some strange swamp or ocean made by chance a new kind of matter.”
- B “Patterns of atoms have come together to make cells, and cells to make tissues, and tissues to make organs, and organs to make redwoods and bees and sharks and hawks and men.”
- C “Life is never still, always trying to become something else, something more efficient and stable and strong.”
- D “All the matter and energy needed for life moves in great closed circles from which nothing escapes and to which only the driving force of the sun is added.”

- E** “Nearly everything is used by life, used and reused in thousands of complex ways, moved through vast chains of plants and animals and back to the beginning.”
- F** “The web of life has so many threads that a few can be broken without making it all unravel.”
- G** “In the complex world of living things everything depends on everything else, all life is the same life, every effect is a cause, nothing can happen by itself.”
- H** “For the first time in his short history, man is now facing the limits of the earth that he likes to call his.”
- 3.** In the passage from **Friends of the Earth’s *Only One Earth***, the section “Getting It in Proportion” (pages 502–503) considers Earth’s history as one week. How does this section help develop the authors’ ideas about life on Earth?
- A** It demonstrates that Earth has limited resources to sustain life.
- B** It shows that all forms of life depend on one another to survive.
- C** It highlights what a short time humans and human civilization have existed.
- D** It emphasizes the role of evolution in the development of plant and animal life.
- 4.** According to **Lewis Thomas’s *The World’s Biggest Membrane*** (pages 550–553), which crucial step led to the continued development of life on Earth?
- A** Living things began to catch and hold energy.
- B** Water began to create a shield against ultraviolet radiation.

- C** Photosynthesis began to breathe oxygen into the atmosphere.
 - D** A drop in carbon dioxide began to decrease the atmosphere’s ability to hold in solar heat.
- 5.** In Lewis Thomas’s *The World’s Biggest Membrane* (pages 550–553), Thomas describes Earth’s atmosphere as having “perfection of function.” Which detail from the text supports this claim?
- A** Earth’s atmosphere destroys meteorites that would otherwise hit Earth.
 - B** Earth’s atmosphere’s “breathing” would be damaged by a nuclear explosion.
 - C** Earth’s atmosphere was first formed from gases that were released when Earth cooled.
 - D** Earth’s atmosphere goes through cycles related to levels of oxygen and carbon dioxide.
- 6.** Which best summarizes the European colonists’ and the Indians’ relationship to the New England environment as described in **William Cronon’s** *Seasons of Want and Plenty* (pages 635–637)?
- A** Colonists feared poor harvests, and Indians were confident that the land would provide for them.
 - B** Colonists expected continual plenty, and Indians knew they had to adapt to the cycles of the seasons.
 - C** Colonists viewed the land as more fertile than Europe, and Indians wanted to tame and cultivate the land.
 - D** Colonists believed that the area would support farming, and Indians thought it was a better place for hunting.

7. What is the main issue that **David Quammen** identifies on page 877 of *Planet of Weeds*?
- A The collective impact of the *Homo sapiens* species is destroying the world.
 - B Biologists believe that Earth is headed into a sixth period of mass extinction.
 - C Humans are causing so much global wreckage that it will result in their own extinction.
 - D Polluted air and water, acid rain, greenhouse gases, and toxic waste have caused irreversible contamination.
8. Which sentence from the passage from **Janisse Ray's** *Ecology of a Cracker Childhood* (pages 900–903) best explains why the gopher tortoise is described as a “keystone”?
- A “The tortoise is central in holding the ecosystem together.”
 - B “A gopher tortoise can live for up to fifty years, although they take a long time to mature.”
 - C “The life of a gopher tortoise revolves around its burrow, although it can occupy more than one.”
 - D “Their ancestors were one of at least twenty-three species of land tortoises that originated in North America some sixty million years ago.”