Kansas Apple Earth - Ecosystems

Suggested Grade Level: 9-12

Time: 60 minutes, with additional time needed to complete the assessment

Subject: Matter and Energy in Organisms and Ecosystems, Interdependent Relationships in Ecosystems, Human Sustainability, Language Arts, Mathematics

Overview: Students discover that topsoil is a nonrenewable resource and use an apple to represent how Earth's land resources are used. Through critical thinking, students study agricultural land use, consider the sustainability of current land use practices, including the use of land to feed and graze livestock animals, and review the impact of land use on ecosystems.

Objectives:

1. Explain land use
2. Explain the impact of human activities on ecosystems
3. Identify sustainable agricultural practices that support healthy ecosystems
4. Gather information and write an informed essay on an ecological topic

Background Information:

Earth, the blue planet observed from space, is almost three-quarters (¾ - 75%) of water and one-quarter (¼ - 25%) of land. The land area includes mountains, deserts, snow- and ice-covered polar regions, wetlands, forests, grasslands, and farmlands. These water and land areas are essential to the plants, animals, and microorganisms making up the global ecosystems. Not all land is created equal. Polar regions, deserts, salt flats, and exposed rock comprise one-third of the global land area. These areas are considered inhospitable and unsuitable for people to live or produce food. Two-thirds of our land is habitable. This land is located in climates where people can live and grow food. Half of the world's habitable land is covered in houses, cities, roads, and other developments. The remaining half of all habitable land is used for agriculture (Ritchie & Rosher). So, only a tiny fraction of the total land area has the quality of topsoil, topography, available water, and length of growing season to permit cultivation.

Cultivated land areas provide most of the world's food and fiber for humans. Whether the land is producing food crops, grazing livestock, or producing crops for livestock feed, it must have fertile topsoil. Agriculture depends on good soil. Fertile topsoil produces the highest yields of food per acre. While the world population is growing, the size of our Earth and the natural resources that provide for our needs are not. Farmers work hard to protect their soil. However, erosion, contamination, and other forms of soil loss can be complicated and expensive to address.

To further examine agricultural land use, 25% of agricultural land is used to produce food crops for direct human consumption. This land use includes the production of fruits, vegetables, beans, rice, grains, etc. The remaining 75% of agricultural land is used to feed livestock such as cattle, pigs, poultry, sheep, and goats. Livestock are raised throughout the world for meat, milk, and eggs. Livestock land use includes range and pasturelands used for grazing and croplands used to grow grain commodities fed to livestock (rather than people). Why is there an uneven distribution of agricultural land devoted to foods for direct human consumption compared to the land devoted to feeding livestock? To explore this topic, it is important to understand that cattle, sheep, and goats are ruminants. They have unique digestive systems that allow them to digest and gain nutrients from grasses and other forages that humans (and most other animals) cannot. 86% of global livestock feed intake in dry matter consists of feed materials that are not edible for humans (Mottet et al.) The average life cycle of beef cattle in the United States is 18-22 months ("Exploring"). Cattle generally live and graze on pastures and rangelands until the last four to six months of their life when they are moved to a feedlot where they are fed harvested forages and high concentrate grains until harvest.[4] Grazing animals can convert many otherwise unusable plants and by-products to quality protein. Grazing is especially vital in arid regions of the world where water is insufficient for the growth of other crops "Livestock") These marginal lands can be considered low value due to poor soil, steep terrain, low water availability, or other undesirable characteristics. Could land used to graze livestock be converted to cropland? Yes, but not all. Livestock use 2 billion hectares of land for grazing, of which 700 million hectares (35%) could be used as cropland (Mottet et al.).

In addition to grazing, livestock animals also require feed in the form of cereal grains. Examples include field corn, soybeans, barley, oats, sorghum, and others. Grain-based feeds are fed to beef cattle in the feedlot, to dairy cattle during milk production, and to poultry and pigs that convert their feed into other protein-based foods for humans.

Soil comprises both *living (biotic)* and *nonliving (abiotic)* elements. Soil contains air, water, minerals, and plant and animal matter. The disintegration of rock forms soil under the influence of climate. Events such as temperature fluctuations (freezing and thawing) contribute to rock weathering into the substance we recognize as soil. Organic matter such as leaves, dead plant material, and decaying organisms contribute to the biotic components of soil.

"It is estimated that more than half of all earth species are estimated to live in the soil! From the familiar earthworms to the lesser-known tardigrade and many undiscovered species. One gram of soil (a quarter of a tablespoon) can harbor up to 10 billion organisms - that's more than the number of people living on the planet! 95% of food production relies on the soil – healthy topsoil is vital to our existence on this planet, but we are losing topsoil at an alarming rate - between 10 and 40 times faster than it's formed. Soils store more carbon than the atmosphere, and all of the world's plants and forests combined, which means that soil is one of our most important weapons in the fight against climate change" (10).

"Soils that support natural, non-agricultural ecosystems usually have the greatest soil biodiversity. In agriculture, soils that receive less manufactured inputs (e.g., chemical fertilizers and pesticides) generally have higher soil biodiversity. Grazing systems that encourage plant diversity usually have higher soil biodiversity due to the greater availability of food resources from roots and litter, which support a greater variety of organisms in the soil. Cropping systems generally have low soil biodiversity unless they increase carbon and nitrogen inputs to the soil, which will increase soil microbial populations. Crop management techniques, developed through sustainable agriculture studies, that increase soil organic matter will also increase soil stability and soil biodiversity. Applying organic matter to the soil, such as crop stubble, supports greater populations of surface-feeding creatures, including earthworms and microbial decomposition. Management techniques such as crop rotation and reduced tillage increase the quantity and quality of organic matter available to soil organisms and develop a more stable environment that encourages more soil biodiversity" (Soil).

Agriculture is an integral part of the economy of the United States. In 2020, 19.7 million full- and part-time jobs were related to the agricultural and food sectors—10.3 percent of the total U.S. employment (USDA). Agricultural exports translated into billions of dollars for United States trade. On poor soil, it costs farmers more to produce good crops; the higher cost is passed on to the consumer—you—in higher prices at the grocery store. Erosion reduces agricultural productivity and washes sediment into rivers, lakes, ocean gulfs, and bays, affecting fisheries and recreation opportunities in these water bodies. Soil loss affects our country's economy and our lives. Soils produce our food, keeping us alive. How do we put a value on soil or land? Many would say it is invaluable, but farmers have to make economic decisions about the soil daily. They cannot spend more to protect the soil than they earn from selling their crops, or they will go out of business. Yet, if farmers don't protect the soil, many years of erosion could destroy the productivity of our valuable agricultural soils. Soil loss affects our country's economy and our lives. The field of sustainable agriculture evaluates problems like this and looks for solutions. Agricultural scientists, policymakers, engineers, and many others are working to help farmers develop techniques that are economically viable, produce the food we need, and protect natural resources like soil and water over the long term.

Kansas Connections:

Kansas Land

"The state is known for its vast plains, but it isn't all flatlands. Gentle hills with pastures and forests can be found in the northeast. This area is called the Dissected Till Plains. The land was cut (or dissected) into hills and valleys by moving glaciers and wind over 400,000 years ago." The Southern Plains include the "Osage Plains, composed of eroded shale and limestone, and the Flint Hills, whose flint ridges stick up because flint doesn't erode (or break down) as other rocks and soil do. Kansas' western half is covered by the Great Plains, which rise in elevation as you continue west toward the Rocky Mountains. Near the Colorado border is Mount Sunflower, the state's highest point" (Kiffel-Alcheh).

“Kansas is the 15th largest state in the U.S., measuring 82,278 square miles, 213,099 square kilometers” (Amend). “The total Kansas land area in 2016 was 52,659,200 acres” (Farmland). “There are 45,759,319 acres of farmland in Kansas, which accounts for 87.5 percent of all Kansas land. More than 21 million acres in Kansas is harvested for crops, and over 14 million is pastureland for grazing animals.” (Kansas).

Kansas Economy

“Agriculture is the largest economic driver in Kansas, with a total contribution of $81 billion to the Kansas economy. The agriculture sector in Kansas supports more than 253,000 jobs through direct, indirect, and induced effect careers or about 13% percent of the entire workforce in the state” (Kansas).

Kansas Agriculture Production

The top five agricultural products grown or raised in Kansas include:

- Cattle and Calves
- Wheat
- Corn
- Sorghum
- Soybeans

Kansas is a recognized leader in agriculture in the United States.

- Kansas is ranked first in grain sorghum production, growing almost 64% of the nation's crop.
- Kansas is ranked second in sorghum for silage production.
- Kansas leads the nation in winter wheat production, growing 24% of the nation’s crop.
- Kansas is ranked third in cattle production and beef processing.
- Kansas is ranked fourth in sunflower production.

Kansas is quickly becoming the new dairy frontier in the United States.

- Kansas is the 16th-ranked dairy state for milk production and is home to 173,000 dairy cows on over 210 dairy farms.
- Milk processing capacity has grown significantly in recent years, with the addition of processing facilities in Rexford, Garden City, and Hugoton.

Kansas Specialty Crop - Apples

- Kansas is not a leading producer of apples. The state does not produce enough to be recognized individually for apple production; however, apples are one of the most reliable fruit trees that can be grown in Kansas, and production is increasing (USDA).
- There are several (at least 7) apple orchards in the state, including 86th St. Orchard in Topeka; Cider Hill Family Orchard in Kansas City; Pome On the Range Orchards & Winery in Williamsburg; Sunflower Orchards in Paola; The Orchard in Emporia, KS; Wagon Wheel Orchard in Gardner, KS; and South

Baldwin Farms in Douglas County. According to Kansas State University, the Delicious Golden, Granny Smith, Jonagold, Delicious, Jonathan, Empire, and Gala are the apple varieties that grow well in Kansas. Some of these orchards are called “U pick orchards” and allow people to come to pick fresh fruit directly from the trees.

Materials:

Demonstration

- Apple Land Use Model provided in Lesson Kit
- “Slicing up Earth’s Resources” worksheet found at the bottom of this lesson for each student

Activity

- Paper and pencil for handwriting

Assessment - Writing Assignment

- Computer to conduct research
- Paper and pen or computer for a typed assignment

Instructional Format:

1. Review background information.
2. Conduct engagement exercises.
3. Follow the procedures to conduct the demonstration for students.
4. Lead a class discussion.
5. Complete the activity.
6. Conduct assessment exercise

Engagement:

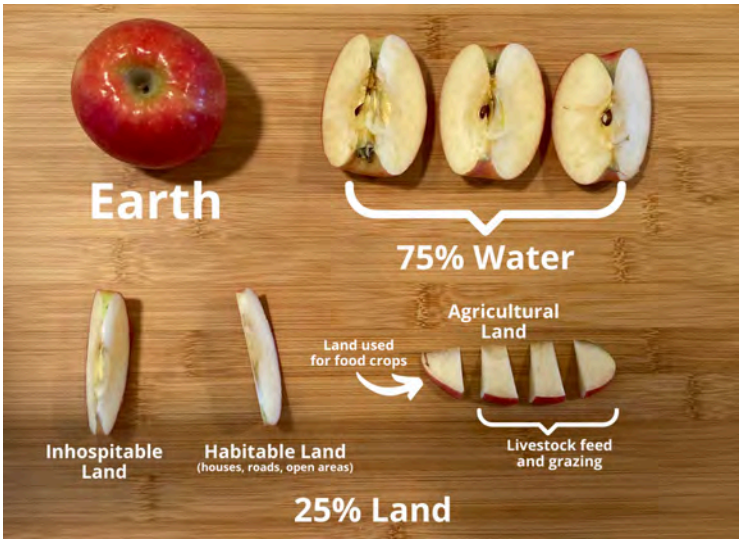
1. Show your students a picture of a rangeland and a cow grazing.
2. Ask students if they see anything in the picture that looks tasty for them to eat.
3. Then, ask them if a sheep or cattle could find anything tasty and nutritious to eat. (Humans do not have an adequate digestive system to obtain sufficient nutrients from grasses and other similar plants. However, cattle and sheep thrive grazing rangelands).
4. Ask students if there are any natural resources in the picture. (Water, air, soil)
5. Are any of the resources nonrenewable?
    a. Water is considered renewable because it circulates in nature in numerous states of matter, including liquid, vapor, and ice. As a result, the water that evaporates returns to Earth as rain or snow.
    b. Air is a renewable resource because it can be restored by natural means faster than it is consumed by humans.
    c. Although renewable, soil takes a very long time to form—up to hundreds of millions of years. So, for human purposes, soil is a nonrenewable resource.

6. Ask students, “How much of the earth is nonrenewable soil? How much of the earth’s soil can be used to grow food?”

Introduce the demonstration activity by letting students know that they will learn about the earth’s surface and the importance of soil as a natural resource to grow our food.

Procedures:

Demonstration
Instructional Video on YouTube
Comparing Apples and...Ear…



1. Hand the “Slicing Up Earth’s Land Resouces” worksheet to students. Instruct students to write on their worksheets and capture information during the demonstration.
2. Hold up the Apple Land Use Model. “This Apple Model represents the planet Earth.” Inform students that they will draw the sections referenced on their handouts during the demonstration.
3. Remove and hold up piece #1 of the Apple Model, that is ¾ of the top layer of the model. “Nearly three-quarters of the Earth is covered in water.” Ask students to draw and label that representation on their worksheets and record the amount of earth that is water on their worksheet. Ask them to think about making four equal pieces before they start drawing.
4. Ask students, “What does the remaining ¼ of the apple represent?” “The remaining quarter represents the area of the earth that is land.” Give students time to mark their worksheets. How much more water than land is there on the earth? (3 times more water than land).
5. Remove and hold up piece #2 of the Apple Model. “This section represents inhospitable land including deserts, mountains, and polar regions that are unsuitable for people to live or grow crops.” Ask students to divide the quarter of the earth into three sections. Label one section inhospitable land. What is inhospitable land?
6. Remove and hold up piece #3 of the Apple Model. "This section represents habitable land. People live on this land, but crops are not grown here as this land includes nature preserves, public lands, and developed areas like roads, schools, houses, etc. Label two sections of the quarter of land as habitable

land. Mark one of the two sections of habitable land as non-agriculture to represent habitable land where people live but crops are not grown.

7. Remove and hold up piece #4. “A tiny portion of the Earth’s surface has the potential to grow crops. This section of the model represents arable land.” Ask students to label the section on their worksheets. Ask students to divide the arable land into four sections. Explain that three of the four sections represent land used for livestock to graze or produce forages for livestock feed. Ask students to label those sections for animal use.
8. The remaining section on your worksheet is the 1/48th of the Earth used to produce human food. Ask students to label the section for human use.
9. Ask students to compare the size of the section for human use to the area of the earth that serves other purposes.
10. Ask students to complete the worksheet by filling in percentages or fractions for the terms at the bottom.
11. Talk through the fractions/percentages for the worksheet. Ask students what equations they had to create to find the answers to the questions.
    a. Water 75%
    b. Land 25%
    c. Inhospitable land - ⅓ of 25% = 8.32%
    d. Habitable land ⅔ of 25% = 16.65%
    e. Habitable land - non agriculture -⅓ of 25% = 8.32%
    f. Agriculture land for livestock ¾ of ⅓ of 25%= 6.2 %
    g. Agriculture land for Food Crops ¼ of ⅓ of 25% = 2.08 % or 1/48th

Class Discussion

1. Why can’t we grow food on all of the land on Earth? (Climate. Average temperatures, seasons, and rainfall determine what crops (if any) can be grown in a given place. Some land is inhospitable.)
2. How does urbanization impact agricultural land use? (Urbanization takes place in habitable land. It decreases the amount of land available for agriculture while simultaneously creating more demand for food and other agricultural products as populations grow.)
3. Can you think of any food not accounted for in this activity? (Most of our food comes from agricultural land, but food like fish and shellfish come from water like oceans, rivers, and lakes. Our food can also be grown in home gardens and greenhouses.)
4. What can we learn from the demonstration? (Answers will vary. Direct discussion to conclude that the amount of habitable land where we can live and produce our food is extremely limited. We need to use it wisely and protect it.)

Activity

1. Post the vocabulary words.
2. Have students write a paragraph (minimum of 5 sentences) about their observations from the demonstration and the effects and/or benefits of land grazing animals. Ask them to include as many vocabulary words as possible and facts from their worksheets.
3. Have students share and discuss their paragraphs with a partner. Have partners check facts and offer suggestions for revisions and editing.

Vocabulary:

- **conservation tillage**: farming methods that reduce the intensity or frequency of tilling to maintain some ground cover throughout the year and disturb the soil as little as possible while still providing the conditions needed to grow a productive crop
- **nonrenewable resource**: a limited natural resource that cannot be replaced or reproduced within a generation and cannot be managed for renewal; examples include oil, soil, and mineral resources (lead, iron, cobalt, zinc, etc.)
- **sustainable agriculture:** an approach to agriculture that focuses on producing food while improving the economic viability of farms, protecting natural resources, and enhancing quality of life for farmers and society as a whole
- **marginal land:** is land that has little or no agricultural or industrial value. Marginal land has little potential for profit and often has poor soil or other undesirable characteristics. This type of land is often located at the edge of deserts or other desolate areas.
- **carbon:** an element that takes the solid form of either graphite or diamond. Carbon is one of the basic elements of any living thing. Carbon is known as the most essential element for life, and it's the second most abundant — after oxygen — in the human body
- **climate change:** long-term shifts in temperatures and weather patterns
- **ecosystem:** a system that environments and their organisms form through their interaction

Assessment:

- Allow students 30 minutes (or more as desired) to research ecosystems or related topics such as sustainability and human impact on ecosystems.
- Ask students to develop a graph or chart depicting the capacity of ecosystems.
- Ask students to identify two good resources for writing a research paper. Have students write a two-sentence summary of each article and identify one quote from each source they will use in their research paper.
- Write a one-page research paper explaining the graph or chart and cite at least two sources.

Kansas Curricular Standards:

Next Generation Science Standards

High School

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-LS2-8. Evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Science and Engineering Practices

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-LS2-7) Engaging in Argument from Evidence Engaging in argument from evidence in 9–12 builds from K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about the natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-6) Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS2-8)

Disciplinary Core Ideas

LS2.A: Interdependent Relationships in Ecosystems Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem. (HS-LS2- 1),(HS-LS2-2)
LS2.C: Ecosystem Dynamics, Functioning, and Resilience A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. (HS-LS2-2),(HS-LS2-6) Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species. (HS-LS2-7)
LS2.D: Social Interactions and Group Behavior Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives. (HS-LS2-8)
LS4.C: Adaptation Changes in the physical environment, whether naturally occurring or human induced, have thus 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. (HS-LS4-6)
LS4.D: Biodiversity and Humans Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). (secondary to HS-LS2-7) 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. Thus sustaining biodiversity so that ecosystem

functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. (secondary to HS-LS2-7), (HS-LS4-6) ETS1.B: Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to HSLS2-7),(secondary to HS-LS4-6) Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different 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. (secondary to HS-LS4-6)

Crosscutting Concepts

Cause and Effect

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS2-8),(HS-LS4-6)

Stability and Change

Much of science deals with constructing explanations of how things change and how they remain stable. (HS-LS2-6),(HSLS2-7)

HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

Language Arts

Grades 9-10

W.9-10.2 Write informative/ explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

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

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

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

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

W.9-10.10 Demonstrate command of the conventions of standard English grammar and usage when writing.

W.9-10.11 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.

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.9-10.2 Determine a central idea of a text and analyze its development over the course of the text; provide an objective summary of the text.

RI.9-10.3 Analyze how the author unfolds an analysis or series of ideas or events, including the order in which the points are made, how they are introduced and developed, and the connections that are drawn between them.

RI.9-10.4 Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the cumulative impact of specific word choices on meaning and tone.

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 a text.

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.9-10.13 Read and comprehend high quality informational text of appropriate quantitative and qualitative complexity for Grades 9-10.

Grades 11 -12
W.11-12.1 Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.
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.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
W.11-12.7 Conduct short as well as more sustained research projects to answer a question (including 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.
W.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
W.11-12.9 Draw evidence from grades 11-12 literary or informational texts, to support analysis, reflection, and research.
W.11-12.10 Demonstrate command of the conventions of standard English grammar and usage when writing.
W.11-12.11 Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
RI.11-12.1 Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.
RI.11-12.2 Determine two or more central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to provide a complex analysis; provide an objective summary of the text.
RI.11-12.3 Analyze a complex set of ideas or sequence of events and explain how specific individuals, ideas, or events interact and develop 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.
RI.11-12.5 Analyze and evaluate the effectiveness of the structure an author uses in his or her exposition or argument, including whether the structure makes points clear, convincing, and engaging.
RI.11-12.6 Determine an author's point of view or purpose in a text in which the rhetoric is particularly effective, analyzing how style and content contribute to the power, persuasiveness or beauty of the text.
RI.11-12.13 Read and comprehend grade-level appropriate nonfiction literature.

National Ag Literacy Outcomes:
Agriculture and the Environment
Describe resource and conservation management practices used in agricultural systems (e.g., riparian management, rotational grazing, no-till farming, crop and variety selection, wildlife management, timber harvesting techniques) (T1.9-12.b)

Discuss the value of agricultural land (T1.9-12.d)

Companion Resources: (supplemental documents)
Apple Earth, YouTube https://www.youtube.com/watch?v=v9WXCAwk4_c
Earth: The Apple of our Eye
https://populationeducation.org/video-transcript/earth-the-apple-of-our-eye/
Journey 2050 Lesson 5: Land Use (grades 9-12) https://agclassroom.org/matrix/lesson/587/
How America Uses its Land (a series of interactive maps illustrating how land is used in America) https://agclassroom.org/matrix/resource/1027/

Book: *Cows Save the Planet: And Other Improbable Ways of Restoring Soil to Heal the Earth* by Judith D. Schwartz

Book: *Food and Agriculture*, Spilsbury

KFAC Topsoil in Our Food System poster

Author: Adapted by Nancy Zenger-Beneda from the NAITCO lesson plan "Earth's Land and Soil Resources" https://agclassroom.org/matrix/lesson/551/ by Debra Speilmaker and Andrea Gardner.

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Name:_____

Slicing Up Earth's Resources

Draw the divisions of the globe that represents what percentage of the earth is used for each resource. Fill in the lines below with what the resources are and the percentage of the earth they represent.

_____ % _____

_____ % _____

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