7.5 Ecosystem Dynamics

Content Area: **Science**
Course(s): **Science 7**
Time Period: **Marking Period 4**
Length: **MP4**
Status: **Published**

Essential Questions

Lesson 1 How could buying candy affect orangutan populations in the wild?

Lesson 2 Can we replace palm oil with something else?

Lesson 3 Can we grow oil palm trees somewhere else so we're not cutting down tropical rainforests?

Lesson 4 Why do people cut down tropical rainforests when they know it is harmful to the animals that live there?

Lesson 5 How have changes in our community affected what lives here?

Lesson 6 If palm oil is not going away. how can we design palm farms to support orangutans and farmers?

Lesson 7 How many orangutans typically live in the tropical rainforest?

Lesson 8 Why do orangutans need so much forest space?

Lesson 9 Would planting more rainforest fruit trees help the orangutan population increase?

Lesson 10 How do changes in the amount of resources affect population?

Lesson 11 How does planting oil palm affect other populations?

Lesson 12 What would happen if orangutans go extinct?

Lesson 13 How does an ecosystem change when the plants change?

Lesson 14 Are there ways people can grow food without harming the tropical rainforest?

Lesson 15 How can people benefit from growing food in ways that support plants and animals in the natural ecosystem?

Lesson 16 What approach to growing food works for everyone and why?

Lesson 17 How can we redesign the way land is used in Indonesia to support orangutans and people at the same time?

Lesson 18 How do our designs work for orangutans and people in Indonesia?

Lesson 19 How can we inform others in our community about the palm oi problem and convince them to take action?

Lesson 20 What should we do to take care of our local land, plants and animals?

Big Ideas

Unit Summary

This unit on ecosystem dynamics and biodiversity begins with students reading headlines that claim that the future of orangutans is in peril and that the purchasing of chocolate may be the cause. Students then examine the ingredients in popular chocolate candies and learn that one of these ingredients--palm oil--is grown on farms near the rainforest where orangutans live. This prompts students to develop initial models to explain how buying candy could impact orangutans.

Students spend the first lesson set better understanding the complexity of the problem, which cannot be solved with simple solutions. They will figure out that palm oil is derived from the oil palm trees that grow near the equator, and that these trees are both land-efficient and provide stable income for farmers, factors that make finding a solution to the palm oil problem more challenging. Students will establish the need for a better design for oil palm farms, which will support both orangutans and farmers. The final set of lessons engage students in investigations of alternative approaches to growing food compared to large-scale monocrop farms. Students work to design an oil palm farm that simultaneously supports orangutan populations and the income of farmers and community members.

Enduring Understandings

This unit builds toward the following NGSS Performance Expectations (PEs):

- MS-LS1-6: Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms.
- 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-PS1-3: Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

Partial NGSS Performance Expectations (PEs) addressed by this unit:

- MS-LS1-2: Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function. (Specifically, chloroplasts and mitochondria.)

Disciplinary Core Ideas

LS1.C: Organization for Matter and Energy Flow in Organisms

- Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use.

LS2.B: Cycle of Matter and Energy Transfer in Ecosystems

- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem.

- Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments.
- The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.

PS1.A: Structure and Properties of Matter

- Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.

PS1.B: Chemical Reactions

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.

PS3.D: Energy in Chemical Processes and Everyday Life

- The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary)

Crosscutting Concepts

- Systems and System Models
- Energy and Matter

Science and Engineering Practices

- Developing and Using Models
- Constructing Explanations and Design Solutions
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communication Information

Cross-Curricular Integration

Integration Area: Language Arts

W.AW.7.1. Write arguments on discipline-specific content (e.g., social studies, science, technical subjects, English/Language Arts) to support claims with clear reasons and relevant evidence.

A. Introduce claim(s) about a topic or issue, acknowledge alternate or opposing claims, and organize the reasons and evidence logically.

B. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

C. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), reasons, and evidence.

D. Establish and maintain a formal style/academic style, approach, and form.

E. Provide a concluding statement or section that follows from and supports the argument presented.

RL.TS.7.4. Analyze the structure an author uses to organize a text and how it contributes to the text as a whole, including how a drama's or poem's form or structure (e.g., soliloquy, sonnet) contributes to its meaning.

Activity:

Populations & Ecosystems: Using the text as your primary source, read and analyze factors that affect animal populations. Based on your research, form an opinion on how ecosystems affect the populations that exist within the ecosystem. Construct an argument in the form of an essay that is supported by valid and credible evidence that defends the claim that a change to this physical or biological component of an ecosystem will affect its populations. Make sure to use relevant vocabulary and create a clear and coherent position on which factor is the most important.

Integration Area: Pre-Algebra

Chapter 8: Geometric Figures

7.G.B.5 Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.

Chapter 9/5: Measurement and Geometry

7.G.A.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

7.G.A.2 Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.

7.G.A.3 Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.

7.G.B.4 Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle

7.G.B.6 Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.

Chapter 7: Collecting, Displaying and Analyzing Data

7.SP.A.1 Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.

7.SP.A.2 Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. *For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.*

7.SP.B.3 Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. *For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.*

7.SP.B.4 Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. *For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.*

Chapter 10: Probability

7.SP.C.5 Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.

7.SP.C.6 Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.*

7.SP.C.7 Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.

7.SP.C.8 Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation.

Algebra Prerequisites

8.NS.A.1 Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.

8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, $3^2 \times 3^{-5} = 3^{-3} = 1/3^3 = 1/27$.

8.EE.A.3 Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. *For example, estimate the population of the United States as 3 times 10^8 and the population of the world as 7 times 10^9, and determine that the world population is more than 20 times larger.*

8.F.A.3 Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. *For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are* *not on a straight line*.

8.F.B.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

8.G.B.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

CRLLKS- Career Education

9.2.8.B.3 Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.

9.2.8.B.4 Evaluate how traditional and nontraditional careers have evolved regionally, nationally, and globally.

9.2.8.B.5 Analyze labor market trends using state and federal labor market information and other resources available online.

Connection:

Explore the variety of scientific careers that revolve around animals and their survival. Discuss how different types of scientists communicate and collaborate to gain even more information pertinent to their careers.

Science and Society

Carolus Linnaeus

He devised the formal two-part naming system we use to classify all lifeforms.

Anton von Leeuwenhoek

Van Leeuwenhoek is best known for his pioneering work in microscopy and for his contributions toward the establishment of microbiology as a scientific discipline.

Charles Darwin

Charles Darwin is often cited as the greatest biologist in history. His most famous work, On the Origin of

Species, explains the theory of evolution by natural selection, providing numerous supporting examples.

Louis Pasteur

Pasteur revolutionized chemistry and biology with his discovery of mirror-image organic molecules, then founded microbiology with his work on fermentation, his discovery of anaerobic bacteria, and his establishment of the germ theory of disease. The process he invented to stop foodstuffs going bad, pasteurization, is still in use worldwide today.

Ivan Pavlov

Ivan Petrovich Pavlov was an eminent Russian physiologist and psychologist who devised the concept of the conditioned reflex. He conducted a legendary experiment in which he trained a hungry dog to drool at the sound of a bell, which had previously been related to the presentation of food to the animal.

CSDT Technology Integration

8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools.

8.1.8.A.4 Graph and calculate data within a spreadsheet and present a summary of the results

8.1.8.A.3 Use and/or develop a simulation that provides an environment to solve a real world problem or theory.

Activity:

Students will graph data that they collected on an assignment based on resource availability in an ecosystem. The students will use a simulation to find test results. They will make a spreadsheet with the data and present a graph based on the results. They will report the findings.

Climate Change

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

- Activity: Students will be able to develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Students will be assessed through a project/activity where they will create a visual model showcasing the cycling of matter and flow of energy in a chosen ecosystem. They will also provide a written explanation of their model.

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

- Activity: Students will be able to develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. Students will be assessed through a project/activity where they will create a visual model showcasing the cycling of matter and flow of energy in a chosen ecosystem. They will also provide a written explanation of their model.

Resources

Savvas Interactive Science - The Diversity of Life 2016

Scientific Inquiry

MS-LS2-3 (5.3.8.B.1) *Nitrogen Cycle activity*
MS-LS2-4 *Changes to Ecosystem Lab*