Lindenwold Public Schools

Environmental Science Unit 7: Food and Agriculture

25 instructional days

Content Standards

HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation. [Clarification Statement: Emphasis is on the energy transfer mechanisms that allow energy from nuclear fusion in the sun's core to reach Earth. Examples of evidence for the model include observations of the masses and lifetimes of other stars, as well as the ways that the sun's radiation varies due to sudden solar flares ("space weather"), the 11-year sunspot cycle, and non-cyclic variations over centuries.] [*Assessment Boundary: Assessment does not include details of the atomic and sub-atomic processes involved with the sun's nuclear fusion.]*

HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. [Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.] [Assessment Boundary: Assessment does not include specific biochemical steps.]

HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. [Clarification Statement: Emphasis is on using evidence from models and simulations to support explanations.] [Assessment Boundary: Assessment does not include the details of the specific chemical reactions or identification of macromolecules.]

HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy. [Clarification Statement: Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration.] [Assessment Boundary: Assessment should not include identification of the steps or specific processes involved in cellular respiration.]

Lindenwold Public Schools

Science and Engineering Practices

Developing and Using Models

- Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-5),(HS-LS1-7)
- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS1-1)

Constructing Explanations and Designing Solutions

- Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-LS1-6)

Disciplinary Core Ideas

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

- The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5)
- The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells. (HS-LS1-6)
- As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (HS-LS1-6),(HS-LS1-7)
- As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. (HS-LS1-7)

ESS1.A: The Universe and Its Stars

- The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. (HS-ESS1-1)

Crosscutting Concepts

Energy and Matter

- Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-LS1-5), (HS-LS1-6)
- Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems. (HS-LS1-7)

Scale, Proportion, and Quantity

- The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. (HS-ESS1-1)

Rationale and Transfer Goals :

This unit will focus on food production, maintenance of soil productivity and the challenges of feeding the world. In addition, various alternative methods of planting and harvesting crops, raising livestock, and controlling pests will be examined.

Enduring Understandings:

- Grains are the world's largest crops.
- More food is needed each year to feed a growing population.
- Increases in technology may lead to increased efficiency, like the Green Revolution.
- Soil needs to be conserved and maintained properly so that it remains fertile.
- Pests can cause significant crop damage, but chemical pesticides can cause significant damage to the environment.
- Over harvesting aquatic species has reduced populations.

Essential Questions:

- How does the energy from the sun reach the Earth?
- How does photosynthesis transform light energy into stored chemical energy?
- How does cellular respiration result in a net transfer of energy?
- What are some methods that farmers can use to maintain fertile soil over long periods of time?
- How are farmers and others in the food industry increasing the efficiency of food production?

Content/Objectives	Instructional Actions

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Content ***What students will know***	**Skills** ***What students will be able to do***	**Activities/Strategies** ***How we teach content and skills***	**Evidence (Assessments)** ***How we know students have learned***
• Nuclear fusion within the sun's core releases energy that travels to Earth in the form of radiation. • The process of photosynthesis converts light energy to stored energy by converting carbon dioxide plus water into sugars plus released oxygen. • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within a system. • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. • As a result of these chemical reactions,	• Explain the process of nuclear fusion and how energy reaches the Earth in the form of radiation. • ID major causes of malnutrition. • Compare and analyze environmental costs of producing different types of food. • Explain the importance of the green revolution and other new technologies in food production. • Describe the importance of fertile soil. • Explain how soil can be conserved, and what materials can supplement soil to make it more fertile. • Analyze the pros and cons of pesticide use. Examine alternative methods that are available using	• Students will complete a self guided POGIL activity on nuclear fusion. • Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community. • Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling). • Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tools such as SKYPE,	• Provide a mechanistic explanation for how nuclear fusion takes place in the sun's core and how the sun's energy travels to the Earth. • Provide a mechanistic explanation for how photosynthesis transforms light energy into stored chemical energy. • Use their understanding of energy flow and conservation of energy to illustrate the inputs and outputs of matter and the transformation of energy in photosynthesis. • Construct an evidence-based model, to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are

energy is transferred from one system of interacting molecules to another. ● Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. ● Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. ● Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.	Integrated Pest Management. ● Describe how composting and hydroponics gardening can lead to increased efficiency. ● Predict how over harvesting aquatic species affects the supply used for food, and how it affects cost. ● Explain how aquaculture is one method to reduce over harvesting. ● Describe the importance of livestock. ● Examine ways to eat a healthier diet, using locally grown foods. ● Explore how we can raise livestock for consumption, but do so in a way that is humane for the animals and mindful of the environment. ● Create a recipe that uses all natural and local ingredients.	experts from the community helping with a project, journal articles, and biographies). ● Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences). ● Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understanding. ● Use project-based science learning to connect science with observable phenomena. ● Structure the learning around explaining or solving a social or community-based issue.	broken and the bonds in new compounds are formed, resulting in a net transfer of energy. ● Use their understanding of energy flow and conservation of energy to illustrate the inputs and outputs of the process of cellular respiration. ● Environmental Benchmark #4

	• Design a recipe book based on recipes from classmates, using all recycled materials and scraps for the book. • Create a meal with the class using all natural and local products.	• Provide ELL students with multiple literacy strategies. • Collaborate with after-school programs or clubs to extend learning opportunities.	

Spiraling for Mastery		
Content or Skill for this Unit	**Spiral Focus from Previous Unit**	**Instructional Activity**
• The process of photosynthesis converts light energy to stored energy by converting carbon dioxide plus water into sugars plus released oxygen. • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. • Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within a system. • Energy cannot be created or destroyed—it only moves between one place and another place,	• 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. • Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new	• Resources from the Holt Environmental Science Text: ○ Using the Figure: Meat Consumption ○ MathPractice: Extra Calories ○ Interpreting Skills: Production vs. Population ○ Student Opportunities: Soil Surveys ○ Career: Agricultural Specialist ○ Student Opportunities: Community Gardens and Farmer's Markets ○ Using the Figure: Engineering Plant Resistance ○ Points of View: Genetically Engineered Food ○ Maps Skills: U.S. Crops

between objects and/or fields, or between systems. ● Compare and analyze environmental costs of producing different types of food.	molecules, to support growth, or to release energy. ● Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. ● Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere	

	and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved. ● Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes.	

Key resources:

· National Earth Science Teachers Association: *http://www.nestanet.org/php/index.php*
· National Science Digital Library: *https://nsdl.oercommons.org/*
· National Science Teachers Association: http://ngss.nsta.org/Classroom-Resources.aspx
· North American Association for Environmental Education: *http://www.naaee.net/*

21st Century Life & Careers:

9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.

9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.

9.2.12.CAP.4: Evaluate different careers and develop various plans (e.g., costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.

Lindenwold Public Schools

Career Readiness, Life Literacies, & Key Skills:

9.4.12.CT.3: Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).

9.4.12.CT.4: Participate in online strategy and planning sessions for course-based, school-based, or other projects and determine the strategies that contribute to effective outcomes.

9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others.

9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.

9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.

9.4.12.IML.4: Assess and critique the appropriateness and impact of existing data visualizations for an intended audience.

9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately.

9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity.

9.4.12.IML.7: Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change.

Interdisciplinary Connections/Companion Standards:

NJSLS Mathematics

HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-ESS1-1)

HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS1-1)

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS1-1)

HSA-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. (HS-ESS1-1)

HSA-CED.A.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (HS-ESS1-1)

HSA-CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (HS-ESS1-1)

NJSLS ELA

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-ESS1-1), (HS-LS1-6)

WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-LS1-6)

WHST.9-12.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-LS1-6)

WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-LS1-6)

SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-LS1-5), (HS-LS1-7)

Companion Standards for ELA in Science and Technical Subjects: Reading

Key Ideas and Details RST.11-12.1. Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.

Companion Standards for ELA in Science and Technical Subjects: Writing

WHST.11-12.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.