Lindenwold Public Schools

Environmental Science Unit 5: Waste

25 instructional days

Content Standards

HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and [changes in] climate change have influenced human activity. [Clarification Statement: Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.]

HS-ESS3-4. HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems. [Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).]

HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts on Earth's systems. [Clarification Statement: Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).] [Assessment Boundary: Assessment is limited to one example of climate change and its associated impacts.]

HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity (i.e., climate change). [Clarification Statement: Examples of Earth systems to be considered are the hydrosphere,

atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.] [Assessment Boundary: Assessment does not include running computational representations but is limited to using the published results of scientific computational models.]

HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Science and Engineering Practices

Analyzing and Interpreting Data

- Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5)

Using Mathematics and Computational Thinking

- Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-ESS3-6)

Constructing Explanations and Designing Solutions

- Construct 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-ESS3-1)
- Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ESS3-4)
- Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations. (HS-ETS1-3)

Disciplinary Core Ideas

ESS3.A: Natural Resources

- Resource availability has guided the development of human society. (HS-ESS3-1)

ESS3.B: Natural Hazards

- Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HS-ESS3-1)

ESS3.C: Human Impacts on Earth Systems

- Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)

ESS3.D: Global Climate Change

- Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts. (HS-ESS3-5)
- Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)

Crosscutting Concepts

Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS3-1)

Systems and System Models

- When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6)

Stability and Change

- Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-5)
- Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS3-4)

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Rationale and Transfer Goals :

This is an overview of our society's waste problems. Society produces many types of solid wastes, and these must be disposed of properly. Producing less waste, recycling, buying recycled products, composting and changing the types of materials that we use can help alleviate the problem.

Enduring Understandings:

- Waste is a byproduct of things that we need and use in daily life.
- As our population continues to increase, the amount of waste is also going to increase.
- The amount of land available is going to continue to decrease, so we need to find more effective ways of dealing with waste.
- We should be separating biodegradable materials from regular waste, and using that in compost binds to supplement agriculture. Next, materials that can be recycled should be separated and collected. Glass and aluminum can be recycled over and over again. Plastic and paper can be recycled, but not indefinitely. The recycled product is generally a lower grade.
- We can buy less, and reuse more of what we already have to reduce waste.
- Some companies convert products that would normally be going into the trash into new and innovative designs. There is a growing market for this.
- We need to shop smarter when we shop. Packaging contributes a great deal of waste. Buying locally will reduce the need for lots of packaging.
- Coming up with better materials for packaging is also something we need to explore. One example would be using packing peanuts made from starch (which biodegrades) instead of styrofoam (which isn't recyclable).
- We have choices in the things that we buy, and we can choose which companies to support, and which not to support. We also have the choice to recycle and compost, since both are available in the Lindenwold Community. To not do these things only reinforces the phrase " Out of sight, out of mind."

Essential Questions:

- How do human activities influence the global ecosystem?
- What are the relationships among earth’s systems and how are those relationships being modified due to human activity?
- What is the current rate of global or regional climate change and what are the associated future impacts to Earth’s systems?
- How can the impacts of human activities on natural systems be reduced?

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***
• Resource vitality has guided the development of human society. • Natural hazards and other geologic events have shaped the course of human history. • Natural hazards and other geologic events have significantly altered the sizes of human populations and have driven human migration. • Empirical evidence is required to differentiate between cause and correlation and make claims about how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activities.	• Describe the difference between biodegradable and non-biodegradable, and give examples for each. • Describe how a modern landfill operates. • Explain 2 environmental problems caused by landfills. • Identify methods that we can use to reduce waste. • Summarize the steps that an item must go through to be recycled. • Make your own recycled paper. • Compost organic materials while in school to reduce the school's waste. Explain the benefit to others. • Correlate waste reduction with consumerism, by explaining how consumers that want	• 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, experts from the community helping with a	• Construct an explanation based on valid and reliable evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. • Use empirical evidence to differentiate between how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. • Use a computational representation to illustrate the relationships among Earth systems and how these relationships are being modified due to human activity. • Describe the boundaries of Earth systems.

• Modern civilization depends on major technological systems. • Changes in climate can affect population or drive mass migration. • Current models predict that, although future regional climate changes will be complex and will vary, average global temperatures will continue to rise. • The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. • Through computer simulations and other studies, important discoveries are still being made about how the	reduced waste are willing to pay for it by buying recycled products. • Help your community by assisting in our school wide recycling program. Track the data for the school. • Give an item that would be heading to the trash a different look or a different use. • Assist in our "Santa's Workshop," which is in place to sell gently used items to families in our community. • Create a new look for someone by using donated clothes from Goodwill or a consignment shop. • Encourage our school to drop the bottled water habit by buying an LHS thermos, which can be filled with tap water. • Examine ways that our school could reduce	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. • Provide ELL students with multiple literacy strategies.	• Analyze and describe the inputs and outputs of Earth systems. • Analyze geosciences data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. • Quantify and model change and rates of change in geosciences data and rates of global or regional climate change and associated impacts to Earth systems. • Evaluate or refine a technological solution that reduces impacts of human activities on natural systems based on scientific knowledge and student-generated sources of evidence; prioritize criteria and tradeoff considerations.

ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. ● When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. ● Criteria may need to be broken down into similar ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. ● Human activities can modify the relationships among Earth systems. ● Although the magnitude of human impacts are greater than they have ever been, so too are	waste. Create a written plan to address the problem, and then present it for approval. ● Describe the characteristics of hazardous waste. ● Explain methods in place to treat hazardous waste safely. ● Encourage the 3R's into your life: at home, at work and at school. Get your family and friends on board.	● Collaborate with after-school programs or clubs to extend learning opportunities.	● Environmental Benchmark #3

human abilities to model, predict, and manage current and future impacts. ● Change in rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. ● Science investigations use diverse methods and do not always use the same set of procedures to obtain data. ● Science knowledge is based on empirical evidence. ● Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. ● Engineers continuously modify these systems to increase benefits while			

decreasing costs and risks. ● Feedback (negative or positive) can stabilize or destabilize natural systems. ● When evaluating solutions, it is important to take into account a range of constraints, including costs, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. ● New technologies can have deep impacts on society and the environment, including some that are not anticipated. ● Analysis of costs and benefits is a critical aspect of decisions about technology.			

Spiraling for Mastery		
Content or Skill for this Unit	**Spiral Focus from Previous Unit**	**Instructional Activity**

• Empirical evidence is required to differentiate between cause and correlation and make claims about how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activities.
• When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models.
• Although the magnitude of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts.
• Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities.
• Engineers continuously modify these systems to increase benefits while decreasing costs and risks.
• When evaluating solutions, it is important to take into account a range of constraints, including costs,
	• All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and the matter that cycles produce chemical and physical changes in Earth's materials and living organisms.
	• The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.
	• Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet
		• Resources from the Holt Environmental Science Text:
		  ○ Using the Figure: NIMBY
		  ○ Interpreting Statistics: Municipal Solid Waste
		  ○ Career: The Wide World of Waste
		  ○ MathPractice: Municipal Solid Waste
		  ○ Skill Builder: Graphing
		  ○ Using the Figure: The Recycling Center
		  ○ Case Study: Paper of Plastic?
		  ○ Graphic Organizer: Chain-of-Events Chart
		  ○ Case Study: Green Chemistry
		  ○ Points of View: Should Nuclear Waste be Stored at Yucca Mountain?
		  ○ Map Skills: Recycling Centers

safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. ● Identify methods that we can use to reduce waste. ● The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere. ● Current models predict that, although future regional climate changes will be complex and will vary, average global temperatures will continue to rise.	as a result of past geologic processes. ● Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces, can help forecast the locations and likelihoods of future events. ● The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns. ● Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.	

	• Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. • Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior, and on applying that knowledge wisely in decisions and activities.	

	• Because these patterns are so complex, weather can only be predicted probabilistically. • The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents.	

Key resources:

Climate Change Impacts: NOAA Education Resources that can be used to teach climate science.

Digital Library for Earth System Education: DLESE is the Digital Library for Earth System Education, a free resource that supports teaching and learning about the Earth system. DLESE's development was funded by the National Science Foundation and continues to be built by a distributed community of educators, students, and scientists to support Earth system education at all levels. DLESE is operated by the National Center for Atmospheric Research (NCAR) Computational and Information Systems Laboratory and the NCAR Library on behalf of the education community.

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.

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-ESS3-1), (HS-ESS3-4), (HS-ESS3-5), (HS-ESS3-6)

HSN-Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS3-1), (HS-ESS3-4), (HS-ESS3-5), (HS-ESS3-6)

HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS3-1), (HS-ESS3-4), (HS-ESS3-5), (HS-ESS3-6)

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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-ESS3-1), (HS-ESS3-4), (HS-ESS3-5)

RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. (HS-ESS3-5)

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ESS3-5)
RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ESS3-4)

WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-ESS3-1)

Companion Standards for ELA in Science and Technical Subjects: Reading

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.

RST.11-12.2. Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

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.