



Springfield Public Schools  
Springfield, New Jersey 07081

Curriculum Guide

**Environmental Science**

2026

This curriculum may be modified through varying materials, techniques, and strategies as per an individual student's IEP.

*Springfield Board of Education  
Approved July 27, 2026*

# Springfield Public Schools

Cultivating compassionate and extraordinary learners!

EXTRACT OF THE MINUTES OF A MEETING OF  
THE BOARD OF EDUCATION OF  
THE TOWNSHIP OF SPRINGFIELD  
COUNTY OF UNION, NEW JERSEY  
AS RECORDED IN THE OFFICIAL MINUTE BOOK

Resolution: 21

Introduced By: Mrs. Gamarekian

Seconded By: Vice President Rinaldi

Adopted: July 27, 2026

## **Curriculum Adoption**

To approve the following new and revised curriculum and courses for the 2026-2027 school year:

### ***1. High School Courses***

- a. AP Cybersecurity (new course)
- b. AP Business with Personal Finance (new course)
- c. AP Biology
- d. AP Chemistry
- e. AP Physics 1
- f. PLTW Robotics and Automation
- g. PLTW Introduction to Engineering Design
- h. PLTW Principles of Engineering
- i. Biology
- j. Biology Honors
- k. Chemistry
- l. Chemistry Honors
- m. Conceptual Physics
- n. Physics
- o. Environmental Science
- p. Forensics
- q. Human Anatomy and Physiology
- r. Oceanography
- s. Science 8
- t. Molecular Biology Research Lab (new course)

### ***2. Middle School Courses***

- a. Science 6
- b. Science 7

### ***3. Elementary School Courses***

- a. Kindergarten Science
- b. Grade 1 Science
- c. Grade 2 Science

(continued)

I, Michelle Calas, School Business Administrator/ Board Secretary of the Springfield Board of Education, hereby certify that the extract from the minutes of a meeting of the Board of Education duly called and held on July 27, 2026 has been compared by me with the original minute book of said Board of Education, and is a true, complete and exact copy thereof, as far as the same relates to the subject matter to on said extract.

In WITNESS THEREOF, I have hereunto set my hand and seal of the Springfield Board of Education, this 28<sup>th</sup> day of July 2026.

SEAL



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Michelle Calas  
School Business Administrator/ Board Secretary



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ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21<sup>ST</sup> CENTURY GLOBAL SKILLS

**Springfield Public Schools  
Springfield, New Jersey**

**Dr. Rachel Goldberg  
Superintendent of Schools**

**Erica Scudero  
Assistant Superintendent**

**Curriculum Developed By:**

**Dr. Normal Francis ~ Principal of Jonathan Dayton High School**

**Gregory Salmon ~ STEM Supervisor**

**Lauren Gettler ~ Chemistry Teacher**



### Unit Overview Template

**Content Area:** Environmental Science      **Grade Level:** 11-12      **Unit Title:** Introduction to the Environment

**Unit Summary:** In this unit, students begin to discover the nature of science and the workings of our environment. This unit includes three chapters of study: Ch1. An Introduction to Environmental Science, Ch2. Economics and Environmental Policy, and Ch3. Earth's Environmental Policy. Within them, students engage in how the scientific process can be applied, what makes the science reliable or trustworthy, and how conflicts of interest can lead to bias and inaccurate results. Students also become familiar with the scope of environmental science as a whole including economic policies in the United States and other countries and Earth's cycles and systems.

**Primary Interdisciplinary Connections:** *Mathematics and ELA*

**21<sup>st</sup> Century Themes**   ☒ Creativity and Innovation   ☒ Critical Thinking and Problem Solving   ☒ ICT Literacy  
☒ Information Literacy   ☒ Life and Career Skills   ☒ Communication and Collaboration   ☒ Media Literacy

**Unit Rationale:** This is the first unit in the Environmental Science curriculum. Students are expected to demonstrate proficiency in using quantitative and qualitative thinking, developing and using models, planning and carrying out investigations, and using data to design and evaluate solutions. They are expected to use these practices to demonstrate understanding of core ideas. This unit introduces students to the scientific process and environmental science as a whole. This unit provides students with the background and tools to build more complex ideas. Students learn real world applications like the lesson behind Easter Island, the fight for clean water, and the impact of "dead zones" on neighboring environments.

**Career Readiness (Standard 9):**

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth
- 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 9.4.12.CT.3: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others
- 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem.
- 9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others.



9.1.12.EG.3: Explain how individuals and businesses influence government policies.

9.1.12.EG.5: Relate a country's economic system of production and consumption to building personal wealth, the mindset of social comparison, and achieving societal responsibilities.

### Learning Targets

**Standards:** 2020 New Jersey Student Learning Standards Science

**Content Statements:** HS-ESS2: Earth's Systems  
HS-ESS3: Earth and Human Activity  
HS-LS1: From Molecules to Organisms: Structures and Processes  
HS-LS2: Ecosystems: Interactions, Energy, and Dynamics  
HS-LS4: Biological Evolution: Unity and Diversity  
HS-ETS1: Engineering Design

| CPI#:     | Cumulative Progress Indicator (CPI):                                                                                                                                                                                                 |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HS-ESS2-1 | Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.                                                              |
| HS-ESS2-2 | Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.                                                                                         |
| HS-ESS2-3 | Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.                                                                                                                       |
| HS-ESS2-4 | Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.                                                                                                           |
| HS-ESS2-6 | Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.                                                                                                          |
| HS-ESS3-1 | Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.                                                          |
| HS-ESS3-2 | Evaluate competing design solutions for developing, conserving, managing, and utilizing energy and mineral resources based on the associated economic, social, environmental, and geopolitical costs and risks, as well as benefits. |
| HS-ESS3-3 | Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.                                                                  |
| HS-ESS3-4 | Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.                                                                                                    |
| 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 to Earth systems.                       |
| 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).                                                  |



|             |                                                                                                                                                                                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HS-LS1-5    | Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.                                                                                                                                                               |
| HS-LS2-7    | Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.                                                                                                                                       |
| HS-LS4-5    | Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.                |
| HS-ETS1-1   | Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.                                                                                                      |
| HS-ETS1-2   | Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.                                                                                                            |
| HS-ETS1-3   | Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. |
| HS-ETS1-4   | Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.                                                  |
| 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.                                                                      |
| 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.                                                                       |
| 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.                                                                   |
| 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.                                                       |
| WHST.9-12.2 | Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.                                                                                                                  |
| MP.2        | Reason abstractly and quantitatively.                                                                                                                                                                                                                           |
| MP.4        | Model with mathematics.                                                                                                                                                                                                                                         |
| N-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.                                     |
| N-Q.A.2     | Define appropriate quantities for the purpose of descriptive modeling.                                                                                                                                                                                          |
| N-Q.A.3     | Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.                                                                                                                                                                 |
| 8.2.12.ED.6 | Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).                                                                                                                         |



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|                  |                                                                                                                                                                                   |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8.2.12.ETW<br>.1 | Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.              |
| 8.2.12.EC.2      | Assess the positive and negative impacts of emerging technologies on developing countries and evaluate how individuals, non-profit organizations, and governments have responded. |



## Science and Engineering Practices

### Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world(s).

- Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-ESS2-1), (HS-ESS2-3), (HS-ESS2-6)
- Use a model to provide mechanistic accounts of phenomena. (HS-ESS2-4)

### Planning and Carrying Out Investigations

Planning and carrying out investigations in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-ESS2-5)

### Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (HS-ESS2-2)

### Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds on 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.

- Construct an oral and written argument or counter-arguments based on data and evidence. (HS-ESS2-7)



## Disciplinary Core Ideas

### ESS1.B: Earth and the Solar System

- Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes. (secondary to HS-ESS2-4)

### ESS2.A: Earth Materials and Systems

- Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. (HS-ESS2-1), (HS-ESS2-2)
- Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior. (HS-ESS2-3)
- The geological record shows that changes to global and regional climate can be caused by interactions among changes in the sun's energy output or Earth's orbit, tectonic events, ocean circulation, volcanic activity, glaciers, vegetation, and human activities. These changes can occur on a variety of time scales from sudden (e.g., volcanic ash clouds) to intermediate (ice ages) to very long-term tectonic cycles. (HS-ESS2-4)

### ESS2.B: Plate Tectonics and Large-Scale System Interactions

- The radioactive decay of unstable isotopes continually generates new energy within Earth's crust and mantle, providing the primary source of the heat that drives mantle convection. Plate tectonics can be viewed as the surface expression of mantle convection. (HS-ESS2-3)
- Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. (HS-ESS2-1)

### ESS2.C: The Roles of Water in Earth's Surface Processes

- The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HS-ESS2-5)

### ESS2.D: Weather and Climate

- The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's reradiation into space. (HS-ESS2-2), (HS-ESS2-4)
- Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen. (HS-ESS2-6), (HS-ESS2-7)



- Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate. (HS-ESS2-6), (HS-ESS2-4)

#### **ESS2.E: Biogeology**

- The many dynamic and delicate feedbacks between the biosphere and other Earth systems cause a continual co-evolution of Earth's surface and the life that exists on it. (HS-ESS2-7)

#### **PS4.A: Wave Properties**

- Geologists use seismic waves and their reflection at interfaces between layers to probe structures deep in the planet.

### **Crosscutting Concepts**

#### **Cause and Effect**

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS2-4)

#### **Energy and Matter**

- The total amount of energy and matter in closed systems is conserved. (HS-ESS2-6)
- Energy drives the cycling of matter within and between systems. (HS-ESS2-3)

#### **Structure and Function**

- The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. (HS-ESS2-5)

#### **Stability and Change**

- Much of science deals with constructing explanations of how things change and how they remain stable. (HS-ESS2-7)
- 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-ESS2-1)
- Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS2-2)

#### **Interdependence of Science, Engineering, and Technology**

- Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise. (HS-ESS2-3)
- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ESS2-2)



### Unit Essential Questions:

- What is environmental science?
- How does science differ from engineering?
- What tools and data do scientists/engineers use and collect?
- Which principles of science apply to environmental science?
- What major environmental challenges do we face as a species and how can we address them?
- Can we reduce the ozone layer?
- How do economic factors influence environmental policy?
- How do “dead zones” affect the environment surrounding them?

### Unit Enduring Understandings:

- Introduction into Environmental Science: studying our Earth, the nature of science, and the community of science.
- Economics and Environmental Policy: studying basic economics, United States environmental policy as well as international environmental policies and approaches.
- Earth’s Environmental Systems: matter and the environment, systems in environmental science, Earth’s spheres, and biogeochemical cycles.

### Unit Learning Targets:

Students will....

- Explain the focus of environmental science.
- Describe the recent trends in human population and resource consumption.
- Explain what science is.
- Describe the process of science.
- Describe the major roles of the scientific community in the process of science.
- Explain the study of environmental ethics.
- Describe two basic concepts of economics.
- Explain the relationship between economics and the environment.
- Describe ways that economies are working toward sustainability.
- Explain the purpose of environmental policy.
- Describe the history of U.S. environmental policy.
- Describe the direction of current U.S. environmental policy.
- Identify major international institutions involved in environmental policy.
- Discuss different approaches to environmental policy.
- List the steps involved in the environmental policy process
- Differentiate among an atom, an element, a molecule, and a compound.
- Discuss how various macromolecules are essential to life.
- Identify some unusual properties of water.
- Describe two major ways that Earth’s systems interact.
- Define Earth’s geosphere, lithosphere, biosphere, atmosphere, and hydrosphere.
- Describe the parts of Earth’s geosphere.
- Describe Earth’s biosphere and atmosphere.
- Discuss the water cycle.



- Explain how the law of conservation of matter applies to the behavior of nutrients in the environment.
- Describe the carbon cycle.
- Describe the events of the phosphorus cycle.
- Explain the importance of bacteria to the nitrogen cycle.



### Evidence of Learning

**Summative Assessment:** 28 days

**Equipment Needed:** Textbook, computer, internet access

**Teacher Resources:** [Savvas Realize](#), [NJCTL environmental science](#), [NASA climate resources](#),

#### Formative Assessments:

Savvas Assessments

- Chapter 1: Lesson 1 Assessment
- Chapter 1: Lesson 2 Assessment
- Chapter 1: Lesson 3 Assessment
- Chapter 1: Chapter Test A
- Chapter 1: Chapter Test B
- Chapter 1: Assessment
- Chapter 2: Lesson 1 Assessment
- Chapter 2: Lesson 2 Assessment
- Chapter 2: Lesson 3 Assessment
- Chapter 2: Chapter Test A
- Chapter 2: Chapter Test B
- Chapter 2: Assessment
- Chapter 3: Lesson 1 Assessment
- Chapter 3: Lesson 2 Assessment
- Chapter 3: Lesson 3 Assessment
- Chapter 3: Lesson 4 Assessment
- Chapter 3: Chapter Test A
- Chapter 3: Chapter Test B
- Chapter 3: Assessment



### Lesson Plans

| Lesson                                                    | Time Frame         |
|-----------------------------------------------------------|--------------------|
| Lesson 1 Lesson 1.2 - The Nature of Science               | 1.5 hours ~ 2 days |
| Lesson 2 Lesson 2.2 - United States Environmental Science | 1.5 hours ~ 2 days |
| Lesson 3 Lesson 3.3 - Earth's Spheres                     | 1.5 hours ~ 2 days |

**Teacher Notes:**

These lessons will introduce students to the key concepts of the units using a group setting. It is recommended that teachers use some technology (socrative.com, Google Forms, or Kahoot) or white boards to have students provide immediate response and feedback. Teachers will base the progress of these lessons on the responses provided by students and groups during each lesson.

**Curriculum Development Resources/Technology Resources:**

*Click the links below to access additional resources used to design this unit:*

[Savvas Realize](#)

[Socrative](#)

[Google Form](#)

[Kahoot](#)

[NJCTL environmental science](#)

[NASA climate resources](#)



### Lesson Plan 1 Template

|                                     |                                           |                                |
|-------------------------------------|-------------------------------------------|--------------------------------|
| Content Area: Environmental Science | Lesson Title: 1.2 - The Nature of Science | Time Frame: 1.5 hours / 2 days |
|-------------------------------------|-------------------------------------------|--------------------------------|

### Lesson Components

#### 21<sup>st</sup> Century Themes

- |                                                      |                                                                                                |
|------------------------------------------------------|------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Global Awareness | <input checked="" type="checkbox"/> Financial, Economic, Business and Entrepreneurial Literacy |
| <input type="checkbox"/> Civic Literacy              | <input type="checkbox"/> Health Literacy                                                       |

#### 21<sup>st</sup> Century Skills

- |                                                               |                                                                     |                                                                                                     |
|---------------------------------------------------------------|---------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Creativity and Innovation | <input type="checkbox"/> Critical Thinking and Problem Solving      | <input checked="" type="checkbox"/> Information Literacy                                            |
| <input checked="" type="checkbox"/> Life and Career Skills    | <input checked="" type="checkbox"/> Communication and Collaboration | <input checked="" type="checkbox"/> Media Literacy <input checked="" type="checkbox"/> ICT Literacy |

#### **Interdisciplinary Connections:**

Mathematics and ELA

#### **Integration of Technology:**

- Students will use technology to access the Savvas resource online and interact with the graphs, data, tables and figures provided on the website.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

**Equipment Needed:** Students will need their computers, whiteboards, dry erase markers, notebooks and access to the Savvas textbook, Lesson 1.2. Additionally students will use poster boards and index cards.

| Goals/Objectives                                                                                                                                                                 | Learning Activities/<br>Instructional Strategies                                                                                                                                                                                                                                                                                        | Formative Assessment Tasks                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Students will: <ul style="list-style-type: none"> <li>• Explain what science is.</li> <li>• Describe the process of science.</li> <li>• Apply the scientific process.</li> </ul> | Lesson Sequence <ol style="list-style-type: none"> <li>1. Anchoring Phenomenon: Scientists from around the world often examine the same environmental problem—such as declining bee populations or climate change—yet may propose different explanations and solutions. How does science allow people to investigate complex</li> </ol> | <ul style="list-style-type: none"> <li>• Call on students to describe the information associated with that heading. Assess students' understanding of the lesson content based on their responses.</li> <li>• Have students complete the Lesson 1.2 Assessment.</li> </ul> |



- environmental questions and build reliable knowledge?
2. Before students read Lesson 1.2, have them preview the lesson assessment questions.
  3. Have students read the information, and brainstorm a list of topics a scientist might study, based on the information.
  4. Record their responses on the board.
  5. Students form small groups and ask each group to select three of the topics on the board.
  6. For each topic a group selects, have them prepare an index card with the following information: the topic, a specific scientific question related to the topic, and a possible way the question could be investigated.

**Differentiation:**

Have students make a graphic organizer that includes each of the lesson vocabulary terms, and shows the relationships. Use Ch1 - Figure 10 to introduce the process of science to the students. Make a copy of this diagram on the board, leaving some blank space in each circle to add information as you cover each topic. At the conclusion of each section, have students come forward to add key words and phrases to the diagram.

**Resources Provided:**

- [Savvas Realize](#)
- [Socrative](#)
- [Google Form](#)
- [Kahoot](#)



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### Lesson Plan 2 Template

|               |                       |               |                                          |             |                    |
|---------------|-----------------------|---------------|------------------------------------------|-------------|--------------------|
| Content Area: | Environmental Science | Lesson Title: | 2.2 - United States Environmental Policy | Time Frame: | 1.5 hours / 2 days |
|---------------|-----------------------|---------------|------------------------------------------|-------------|--------------------|

### Lesson Components

#### 21<sup>st</sup> Century Themes

- |                                                      |                                                                                                |
|------------------------------------------------------|------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Global Awareness | <input checked="" type="checkbox"/> Financial, Economic, Business and Entrepreneurial Literacy |
| <input checked="" type="checkbox"/> Civic Literacy   | <input checked="" type="checkbox"/> Health Literacy                                            |

#### 21<sup>st</sup> Century Skills

- |                                                               |                                                                           |                                                                                                     |
|---------------------------------------------------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Creativity and Innovation | <input checked="" type="checkbox"/> Critical Thinking and Problem Solving | <input checked="" type="checkbox"/> Information Literacy                                            |
| <input checked="" type="checkbox"/> Life and Career Skills    | <input checked="" type="checkbox"/> Communication and Collaboration       | <input checked="" type="checkbox"/> Media Literacy <input checked="" type="checkbox"/> ICT Literacy |

**Interdisciplinary Connections:**  
 Mathematics and ELA

#### **Integration of Technology:**

- Students will use technology to access the Savvas resource online and interact with the graphs, data, tables and figures provided on the website.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem.
- 9.1.12.EG.3: Explain how individuals and businesses influence government policies.
- 9.1.12.EG.5: Relate a country's economic system of production and consumption to building personal wealth, the mindset of social comparison, and achieving societal responsibilities.

**Equipment Needed:** Students will be given rolls of paper and reference materials. Students will need their computers, whiteboards, dry erase markers, notebooks and access to the Savvas textbook, lesson 2.2.

| Goals/Objectives                                                                                                                                                              | Learning Activities/<br>Instructional Strategies                                                                                                                                           | Formative Assessment Tasks                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| Students will: <ul style="list-style-type: none"> <li>• Explain the purpose of environmental policy.</li> <li>• Describe the history of U.S. environmental policy.</li> </ul> | Lesson Sequence <ol style="list-style-type: none"> <li>1. Anchoring Phenomenon: Rivers in the United States once caught fire from pollution, and thick smog regularly made city</li> </ol> | <ul style="list-style-type: none"> <li>• Ask and evaluate: Do you think the policies that affect or regulate the issue are effective?</li> </ul> |



- |                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Describe the direction of current U.S. environmental policy.</li><li>• Construct a timeline of milestones in United States environmental policy in the context of historical events.</li><li>• Apply environmental policy to a real, local issue.</li></ul> | <p>air dangerous to breathe. How did environmental conditions become severe enough to change national laws and policies?</p> <ol style="list-style-type: none"><li>2. Students work in small groups.</li><li>3. Distribute a length of paper from a roll to each group.</li><li>4. Students make a timeline that includes all of the information shown in Ch2 - Figure 7.</li><li>5. Challenge each group to research major events in U.S. history that could be added to the timeline, with the goal of putting environmental policies in the context of other events. For example, students might choose to add the dates of the Civil War, the Industrial Revolution, and the Great Depression. Encourage them to add additional environmental policy milestones as well.</li><li>6. Have each group share its timeline with the class.</li><li>7. Groups research a local environmental issue.</li><li>8. Groups investigate some of the environmental policies that affect or regulate this issue.</li><li>9. Discuss each group's research as a class forum.</li></ol> | <ul style="list-style-type: none"><li>• Ask and evaluate: Would you change any policies or suggest new ones?</li><li>• Have students complete the Lesson 2.2 Assessment from the Savvas resource.</li></ul> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Differentiation:**



Have students review the outlines they prepared for the lesson Reading Strategy activity, or have students prepare their outlines at this time. Then, have students form small groups to review the outlines.

**Resources Provided:**

- [Savvas Realize](#)
- [Socrative](#)
- [Google Form](#)
- [Kahoot](#)



### Lesson Plan 3 Template

|                                     |                                     |                                |
|-------------------------------------|-------------------------------------|--------------------------------|
| Content Area: Environmental Science | Lesson Title: 3.3 - Earth's Spheres | Time Frame: 1.5 hours / 2 days |
|-------------------------------------|-------------------------------------|--------------------------------|

### Lesson Components

#### 21<sup>st</sup> Century Themes

- |                                                      |                                                                                                |
|------------------------------------------------------|------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Global Awareness | <input checked="" type="checkbox"/> Financial, Economic, Business and Entrepreneurial Literacy |
| <input checked="" type="checkbox"/> Civic Literacy   | <input checked="" type="checkbox"/> Health Literacy                                            |

#### 21<sup>st</sup> Century Skills

- |                                                               |                                                                           |                                                          |
|---------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------|
| <input checked="" type="checkbox"/> Creativity and Innovation | <input checked="" type="checkbox"/> Critical Thinking and Problem Solving | <input checked="" type="checkbox"/> Information Literacy |
| <input checked="" type="checkbox"/> Life and Career Skills    | <input checked="" type="checkbox"/> Communication and Collaboration       | <input checked="" type="checkbox"/> Media Literacy       |
|                                                               |                                                                           | <input checked="" type="checkbox"/> ICT Literacy         |

#### **Interdisciplinary Connections:**

Mathematics and ELA

#### **Integration of Technology:**

- Students will use technology to access the Savvas resource online and interact with the graphs, data, tables and figures provided on the website.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 9.4.12.CT.3: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

**Equipment Needed:** Ice water with food dye, dropper, beaker of hot water. Map It: Tracing paper  
 Quick Lab: 1-liter plastic bottle, water, large bowl, 3 cups, 25 mL graduated cylinder, waterproof marker

| Goals/Objectives                                                                                                                                                                                                                                                         | Learning Activities/<br>Instructional Strategies                                                                                                                                                                                                                                            | Formative Assessment Tasks                                                                                                                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Students will: <ul style="list-style-type: none"> <li>Describe the parts of Earth's geosphere.</li> <li>Describe Earth's biosphere and atmosphere.</li> <li>Discuss the water cycle.</li> <li>Compare a map of Pangaea to a map of today's continents to help</li> </ul> | Lesson Sequence <ol style="list-style-type: none"> <li>Anchoring Phenomenon: A volcanic eruption can darken skies, alter weather patterns, affect water quality, and disrupt ecosystems around the world. How can one event in a single part of Earth trigger changes across all</li> </ol> | <ul style="list-style-type: none"> <li>Ask and evaluate: How do the consistencies of the lithosphere and asthenosphere differ?</li> <li>Ask and evaluate: How is the process of convection related to plate tectonics?</li> </ul> |



them understand plate tectonics.

- of Earth's interconnected spheres?
2. Students read Lesson 3.3; encourage them to review the location of Earth's spheres as shown in Ch3 - Figure 14
  3. Review with students the components of the geosphere.
  4. Have a student describe the crust, mantle, and core.
  5. Have another student distinguish between the lithosphere and asthenosphere and describe how their interaction results in tectonic processes.
  6. Demonstrate the process of convection for students by placing several drops of ice water (colored with food dye) in a beaker of hot water. Students should note the cold water sinking in the hot water.
  7. Distribute tracing paper to students.
  8. Have students trace the continents as they are today and as they were during pangea - how have they moved?
  9. Tell students that water cycles through the lithosphere, biosphere, and atmosphere. Have students examine Figure 19.
  10. Have students research local weather information to find out how much

- Have students complete the Lesson 3.3 assessment.



precipitation typically occurs in their city or town over the course of a year.

11. Students investigate the distribution of Earth's water to help them understand the scarcity of unfrozen fresh water (Quick lab, lesson 3, page 80).

**Differentiation:**

Create a cluster diagram by writing the word biosphere on the right side of the board and atmosphere on the left. Ask students to read the section The Biosphere and Atmosphere. Then, ask students to verbally supply words and phrases that could be added to the cluster diagram. Make sure the final diagram shows how the systems interact as well as some unique characteristics of each system. Have students work in pairs to make flashcards for each of the lesson vocabulary terms. Then, have pairs use the flashcards for review.

**Resources Provided:**

- [Savvas Realize](#)
- [Socrative](#)
- [Google Form](#)
- [Kahoot](#)



### Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly, Moderately* or *Weakly* meets the criteria below.

| Lesson Activities                                                                                                    | Strongly | Moderately | Weakly |
|----------------------------------------------------------------------------------------------------------------------|----------|------------|--------|
| Are challenging <b>Strongly</b> and require higher order thinking and problem solving skills                         | <b>X</b> |            |        |
| Allow for student choice                                                                                             |          | <b>X</b>   |        |
| Provide scaffolding for acquiring targeted knowledge/skills                                                          | <b>X</b> |            |        |
| Integrate global perspectives                                                                                        | <b>X</b> |            |        |
| Integrate 21st century skills                                                                                        | <b>X</b> |            |        |
| Provide opportunities for interdisciplinary connection and transfer of knowledge and skills                          | <b>X</b> |            |        |
| Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills            | <b>X</b> |            |        |
| Are varied to address different student learning styles and preferences                                              | <b>X</b> |            |        |
| Are differentiated based on student needs                                                                            |          | <b>X</b>   |        |
| Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process    | <b>X</b> |            |        |
| Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives | <b>X</b> |            |        |
| Provide opportunities for student reflection and self- assessment                                                    | <b>X</b> |            |        |
| Provide data to inform and adjust instruction to better meet the varying needs of learners                           |          | <b>X</b>   |        |

### Curriculum Design Template

|                      |                       |                           |           |                    |                                 |
|----------------------|-----------------------|---------------------------|-----------|--------------------|---------------------------------|
| <b>Content Area:</b> | Environmental Science | <b>Grade Level:</b>       | 11-12     | <b>Unit Title:</b> | Introduction to the Environment |
| <b>Created:</b>      | 2023                  | <b>Board Approved on:</b> | Type Here |                    |                                 |



### Unit Overview Template

**Content Area:** Environmental Science      **Grade Level:** 11-12      **Unit Title:** Ecology

**Unit Summary:** In this unit, students study the topic of ecology. This unit includes four chapters of study: Ch4. Population Ecology, Ch5. Evolution and Community Ecology, Ch6. Biomes and Aquatic Ecosystems, and Ch7. Biodiversity and Conservation. Within these chapters, students learn about how population/population growth affects environmental conditions. They also analyze evolution, species interactions and ecological communities in a world with a growing human population. Students also investigate how organisms interact with their environment in different biomes and ecosystems. Lastly, students discover the importance of biodiversity protection as well the impacts of extinction and biodiversity loss.

**Primary Interdisciplinary Connections:** *Mathematics and ELA*

**21<sup>st</sup> Century Themes**   ☒ Creativity and Innovation   ☒ Critical Thinking and Problem Solving   ☒ ICT Literacy  
☒ Information Literacy   ☒ Life and Career Skills   ☒ Communication and Collaboration   ☒ Media Literacy

**Unit Rationale:** This is the second unit in Environmental Science. Students are expected to demonstrate proficiency in using quantitative and qualitative thinking, developing and using models, planning and carrying out investigations, and using data to design and evaluate solutions. They are expected to use these practices to demonstrate understanding of core ideas. Students come across real world applications like the Cloudless Forest, mutualism in Madagascar, biological comebacks, and ecological footprints.

#### Career Readiness (Standard 9):

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 9.4.12.CT.3: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others
- 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem.
- 9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others.
- 9.1.12.EG.3: Explain how individuals and businesses influence government policies.
- 9.1.12.EG.5: Relate a country's economic system of production and consumption to building personal wealth, the mindset of social comparison, and achieving societal responsibilities.



### Learning Targets

**Standards:** 2020 New Jersey Student Learning Standards Science

**Content Statements:** HS-ESS3: Earth and Human Activity  
 HS-LS2: Ecosystems: Interactions, Energy, and Dynamics  
 HS-LS4: Biological Evolution: Unity and Diversity  
 HS-ETS1: Engineering Design

| <b>CPI#:</b> | <b>Cumulative Progress Indicator (CPI):</b>                                                                                                                                                                                          |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HS-ESS3-1    | Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.                                                          |
| HS-ESS3-2    | Evaluate competing design solutions for developing, conserving, managing, and utilizing energy and mineral resources based on the associated economic, social, environmental, and geopolitical costs and risks, as well as benefits. |
| HS-ESS3-3    | Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.                                                                  |
| HS-ESS3-4    | Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.                                                                                                    |
| 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 to Earth systems.                       |
| 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).                                                  |
| 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-LS2-3     | Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.                                                                                              |
| HS-LS2-4     | Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.                                                                                                     |
| HS-LS2-5     | Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.                                                              |
| 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.                                                                                                                                                                                                                                                                                                                   |
| HS-LS4-1  | Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.                                                                                                                                                                                                                                                                                             |
| HS-LS4-2  | Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. |
| HS-LS4-3  | Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.                                                                                                                                                                                                                                            |
| HS-LS4-4  | Construct an explanation based on evidence for how natural selection leads to adaptation of populations.                                                                                                                                                                                                                                                                                                                            |
| HS-LS4-5  | Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.                                                                                                                                                                                    |
| HS-LS4-6  | Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.                                                                                                                                                                                                                                                                                                                     |
| HS-ETS1-1 | Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.                                                                                                                                                                                                                                                                          |
| HS-ETS1-2 | Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.                                                                                                                                                                                                                                                                                |
| HS-ETS1-3 | Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.                                                                                                                                                                     |
| HS-ETS1-4 | Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.                                                                                                                                                                                                                      |



|              |                                                                                                                                                                                                                             |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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.                                  |
| 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.                                   |
| 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.                               |
| 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.                   |
| WHST.9-12.2  | Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.                                                                              |
| MP.2         | Reason abstractly and quantitatively.                                                                                                                                                                                       |
| MP.4         | Model with mathematics.                                                                                                                                                                                                     |
| N-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. |
| N-Q.A.2      | Define appropriate quantities for the purpose of descriptive modeling.                                                                                                                                                      |
| N-Q.A.3      | Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.                                                                                                                             |
| 8.2.12.ED.6  | Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).                                                                                     |
| 8.2.12.ETW.1 | Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.                                                        |
| 8.2.12.EC.2  | Assess the positive and negative impacts of emerging technologies on developing countries and evaluate how individuals, non-profit organizations, and governments have responded.                                           |

## Science and Engineering Practices

### Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

- Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. (HS-LS4-3)

### Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric



functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Create or revise a simulation of a phenomenon, designed device, process, or system. (HS-LS4-6)

### **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.

- 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-LS4-2), (HS-LS4-4)

### **Engaging in Argument from Evidence**

Engaging in argument from evidence in 9–12 builds on 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 or historical episodes in science.

- Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments. (HS-LS4-5)

### **Obtaining, Evaluating, and Communicating Information**

Obtaining, evaluating, and communicating information in 9–12 builds on K–8 experiences and progresses to evaluating the validity and reliability of the claims, methods, and designs.

- Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically). (HS-LS4-1)

### **Disciplinary Core Ideas**

#### **LS4.A: Evidence of Common Ancestry and Diversity**

- Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence. (HS-LS4-1)

#### **LS4.B: Natural Selection**

- Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. (HS-LS4-2), (HS-LS4-3)



- The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3)

#### **LS4.C: Adaptation**

- Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. (HS-LS4-2)
- Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. (HS-LS4-3), (HS-LS4-4)
- Adaptation also means that the distribution of traits in a population can change when conditions change. (HS-LS4-3)
- 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-LS4-5), (HS-LS4-6)
- Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or drastic, the opportunity for the species' evolution is lost. (HS-LS4-5)

#### **LS4.D: Biodiversity and Humans**

- 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. (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 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

### Patterns

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-LS4-1), (HS-LS4-3)

### Cause and Effect

- Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-LS4-2), (HS-LS4-4), (HS-LS4-5), (HS-LS4-6)

### Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future. (HS-LS4-1), (HS-LS4-4)

### Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

- A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence. (HS-LS4-1)

### Unit Essential Questions:

- What is the impact of tourism on the environment?
- How are changes in environmental conditions related to changes in population size?
- How do organisms affect the abiotic and biotic conditions in an environment?
- How do organisms interact with the environment?
- Why is it important to measure and protect biodiversity?

### Unit Enduring Understandings:

- Population Ecology: studying ecology, describing populations, and population growth
- Evolution and Community Ecology: studying evolution, species interactions, ecological communities, and community stability.
- Biomes and Aquatic Ecosystems: defining and studying biomes and aquatic ecosystems
- Biodiversity and Conservation: studying our planets of life, extinction and biodiversity loss, and the importance of protecting biodiversity.

### Unit Learning Targets:

Students will....

- Describe the different levels of organization studied by ecologists.
- Explain the difference between biotic and abiotic factors.
- Discuss how an organism's habitat relates to its survival.
- Explain the usefulness of tracking population size.
- Define population density.
- Describe the three ways populations can be distributed.



- Explain what age structure diagrams tell you about a population.
- Describe the factors that influence a population's growth rate.
- Explain exponential growth and logistic growth.
- Explain how limiting factors and biotic potential affect population growth.
- Describe the four primary mechanisms of biological evolution.
- Describe how speciation and extinction affect the diversity of life on Earth.
- Discuss the factors that influence an organism's niche.
- Compare and contrast predation, parasitism, and herbivory.
- Describe mutualism and commensalism.
- Explain the difference between a producer and a consumer.
- Explain the effect of inefficient energy transfer on community structure.
- Describe how feeding relationships can have both direct and indirect effects on community members.
- Describe what happens to a community after a disturbance.
- Explain the conditions necessary for a species to become invasive.
- Explain how biomes are characterized.
- Describe how net primary production varies among biomes
- Explain how organisms are adapted to the conditions of their biomes
- Describe the criteria ecologists use to classify aquatic ecosystems.
- List the major categories of freshwater ecosystems.
- Explain the ecological importance of estuaries.
- List the three major zones of the ocean.



### Evidence of Learning

**Summative Assessment:** 37 days

**Equipment Needed:** Textbook, computer, internet access

**Teacher Resources:** [Savvas Realize](#), [NJCTL environmental science](#), [NASA climate resources](#),

#### Formative Assessments:

Savvas Assessments

- Chapter 4: Lesson 1 Assessment
- Chapter 4: Lesson 2 Assessment
- Chapter 4: Lesson 3 Assessment
- Chapter 4: Chapter Test A
- Chapter 4: Chapter Test B
- Chapter 4: Assessment
- Chapter 5: Lesson 1 Assessment
- Chapter 5: Lesson 2 Assessment
- Chapter 5: Lesson 3 Assessment
- Chapter 5: Lesson 4 Assessment
- Chapter 5: Chapter Test A
- Chapter 5: Chapter Test B
- Chapter 5: Assessment
- Chapter 6: Lesson 1 Assessment
- Chapter 6: Lesson 2 Assessment
- Chapter 6: Lesson 3 Assessment
- Chapter 6: Chapter Test A
- Chapter 6: Chapter Test B
- Chapter 6: Assessment
- Chapter 7: Lesson 1 Assessment
- Chapter 7: Lesson 2 Assessment
- Chapter 7: Lesson 3 Assessment
- Chapter 7: Chapter Test A
- Chapter 7: Chapter Test B
- Chapter 7: Assessment



### Lesson Plans

| Lesson                                                 | Time Frame       |
|--------------------------------------------------------|------------------|
| Lesson 1 Lesson 4.2 - Describing Populations           | 1.5 hours/2 days |
| Lesson 2 Lesson 5.3 - Ecological Communities           | 1.5 hours/2 days |
| Lesson 3 Lesson 7.2 - Extinction and Biodiversity Loss | 1.5 hours/2 days |

**Teacher Notes:**

These lessons will facilitate students learning the key concepts of the units using a group setting. It is recommended that teachers use some technology (socrative.com, Google Forms, or Kahoot) or white boards to have students provide immediate response and feedback. Teachers will base the progress of these lessons on the responses provided by students and groups during each lesson.

**Curriculum Development Resources/Technology Resources:**

*Click the links below to access additional resources used to design this unit:*

[Savvas Realize](#)

[Socrative](#)

[Google Form](#)

[Kahoot](#)

[NJCTL environmental science](#)

[NASA climate resources](#)



### Lesson Plan 1 Template

Content Area: Environmental Science Lesson Title: 4.2 - Describing Populations Time Frame: 1.5 hours / 2 days

### Lesson Components

#### 21<sup>st</sup> Century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy  
☐ Civic Literacy ☒ Health Literacy

#### 21<sup>st</sup> Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy  
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☒ ICT Literacy

#### Interdisciplinary Connections:

Mathematics and ELA

#### Integration of Technology:

- Students will use technology to access the Savvas resource online and interact with the graphs, data, tables and figures provided on the website.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

**Equipment Needed:** Students will be provided with a small paper cup, marbles, and a large glass jar. Students will also use their online Savvas textbook resource.

| Goals/Objectives                                                                                                                                                                                                                                                                               | Learning Activities/<br>Instructional Strategies                                                                                                                                                                                                                                                                      | Formative Assessment Tasks                                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Students will: <ul style="list-style-type: none"><li>Explain the usefulness of tracking population size.</li><li>Define population density.</li><li>Describe the three ways populations can be distributed.</li><li>Explain what age structure diagrams tell you about a population.</li></ul> | Lesson Sequence <ol style="list-style-type: none"><li>Anchoring Phenomenon: Scientists cannot count every fish in an ocean, every tree in a forest, or every deer in a state park, yet they can estimate populations with surprising accuracy. How can scientists determine the size and characteristics of</li></ol> | <ul style="list-style-type: none"><li>Ask and evaluate: Which type of population distribution occurs when individuals are evenly spaced throughout an area?</li><li>Ask and evaluate: How did you model random distribution?</li><li>Call on students to identify and describe the</li></ul> |



- populations they cannot completely count?
2. Before class, count the number of marbles that fit in a small paper cup. Then, use the cup to fill a glass jar with marbles.
  3. Count the number of cupfuls it takes to fill the jar.
  4. In class, show the filled jar to students. Have students guess aloud how many marbles are in the jar. Students will likely note that the guesses have a wide range of values.
  5. Tell students that ecologists face a similar problem when they try to guess the size of a population. Explain that sampling is a technique used to make more-accurate estimates of population size.
  6. Show students the small paper cup. Tell students how many marbles are in an average cupful, and how many cupfuls it took to fill the jar.
  7. Have students use this information to develop a new estimate of the number of marbles in the jar.
  8. Point out how this is similar to sampling.
  9. Use human population density in the students' own environment to clarify the concept of population density.

- ways of describing populations that correspond to the major heads in the lesson.
- Have students explain what can be learned about a population by describing it each way.
  - Have students complete the Lesson 4.2 Assessment.



- Students in an urban setting will have an understanding of high population density; students in a rural area will have experience with low population density.
10. Show pictures or have students discuss experiences visiting areas with different densities of the human population.
  11. Have students work in small groups to use a checkerboard and checkers to model different types of population distribution.
  12. Tell students that each checker represents an organism, and the checkerboard represents the area in which the organisms live.
  13. Encourage students to manipulate the checkers to show each of the three types of population distribution.

**Differentiation:**

Use Ch4 - Figure 6 to help students understand the concept of age structure, or age distribution. Point out the diagram on the left of the figure. Print out the figure and allow students to add notes to the diagram. Have students work in pairs to review the Knowledge and Skills statements. For example, one student in the pair can ask the other to explain the usefulness of tracking population size. For the remaining key concepts, students can swap roles.

**Resources Provided:**

- [Savvas Realize](#)
- [Socrative](#)
- [Google Form](#)
- [Kahoot](#)



## SPRINGFIELD PUBLIC SCHOOLS

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### Lesson Plan 2 Template

Content Area: Environmental Science Lesson Title: 5.3 - Ecological Communities Time Frame: 1.5 hours/2 days

### Lesson Components

#### 21<sup>st</sup> Century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy  
☒ Civic Literacy ☒ Health Literacy

#### 21<sup>st</sup> Century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy  
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☒ ICT Literacy

#### **Interdisciplinary Connections:**

Mathematics and ELA

#### **Integration of Technology:**

- Students will use technology to access the Savvas resource online and interact with the graphs, data, tables and figures provided on the website.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

**Equipment Needed:** Students will be provided with poster board, tape, colored pencils, scissors, and a color printer. Students will also have their computers for access to the Savvas textbook resource.

| Goals/Objectives                                                                                                                                                                                                                                                                        | Learning Activities/ Instructional Strategies                                                                                                                                                                                                                                                                                      | Formative Assessment Tasks                                                                                                                                                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Students will: <ul style="list-style-type: none"><li>Explain the difference between a producer and a consumer.</li><li>Explain the effect of inefficient energy transfer on community structure.</li><li>Describe how feeding relationships can have both direct and indirect</li></ul> | Lesson Sequence <ol style="list-style-type: none"><li>1. Anchoring Phenomenon: A lake that appears crystal clear and free of algae may actually be unhealthy and unable to support diverse aquatic life. Why can removing a single organism from a food web have unintended consequences throughout an entire ecosystem?</li></ol> | <ul style="list-style-type: none"><li>Ask and evaluate: How are producers and consumers similar?</li><li>Ask and evaluate: How are producers and consumers different?</li><li>Call on students to define each of the vocabulary terms in Lesson 5.3, and assess</li></ul> |



effects on community members.

- Calculate energy transfer between trophic levels to reinforce the ten percent rule.

2. Have students form small groups.
3. Distribute to each group a triangular piece of poster board.
4. Have students put this title at the bottom: Pyramid of Numbers and Biomass.
5. Following the example of Ch5 - Figure 23, they should make a pyramid for one of the following environments: pond, ocean, forest, rainforest, or arctic sea ice.
6. They may make copies or print photos of the organisms they choose, then cut them out and tape them to the poster. Or they may choose to draw the organisms.
7. Present students with the following scenario: A tourism bureau for a town with a lake would like to promote tourism by advertising the area's "crystal-clear, algae-free lake." The bureau has proposed treating the lake with a chemical that kills algae to make this a reality.
8. Have students work in small groups to develop a response to the tourism bureau, explaining how its plan would damage the lake's food web.
9. Encourage students to include as many scientific details as possible in their response.
10. Ask groups to share their responses with the class.

students' understanding based on the definitions they provide. Encourage them to

- Students complete the Lesson 5.3 Assessment.

**Differentiation:**



Have students review Ch5 - Figure 26 with a partner. For each organism shown in the figure, have the students explain how it gets energy and how the organism is classified (decomposer, omnivore, carnivore, herbivore, or primary producer).

**Resources Provided:**

- [Savvas Realize](#)
- [Socrative](#)
- [Google Form](#)



### Lesson Plan 3 Template

|               |                       |               |                                        |             |                      |
|---------------|-----------------------|---------------|----------------------------------------|-------------|----------------------|
| Content Area: | Environmental Science | Lesson Title: | 7.2 - Extinction and Biodiversity Loss | Time Frame: | 1.5 hours/<br>2 days |
|---------------|-----------------------|---------------|----------------------------------------|-------------|----------------------|

### Lesson Components

#### 21<sup>st</sup> Century Themes

- |                                                      |                                                                                                |
|------------------------------------------------------|------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Global Awareness | <input checked="" type="checkbox"/> Financial, Economic, Business and Entrepreneurial Literacy |
| <input checked="" type="checkbox"/> Civic Literacy   | <input checked="" type="checkbox"/> Health Literacy                                            |

#### 21<sup>st</sup> Century Skills

- |                                                               |                                                                           |                                                                                                     |
|---------------------------------------------------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Creativity and Innovation | <input checked="" type="checkbox"/> Critical Thinking and Problem Solving | <input checked="" type="checkbox"/> Information Literacy                                            |
| <input checked="" type="checkbox"/> Life and Career Skills    | <input checked="" type="checkbox"/> Communication and Collaboration       | <input checked="" type="checkbox"/> Media Literacy <input checked="" type="checkbox"/> ICT Literacy |

#### **Interdisciplinary Connections:**

Mathematics and ELA

#### **Integration of Technology:**

- Students will use technology to access the Savvas resource online and interact with the graphs, data, tables and figures provided on the website.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

**Equipment Needed:** Students will have access to their online Savvas textbook resource, Lesson 7.2.

| Goals/Objectives                                                                                                                                                                                      | Learning Activities/<br>Instructional Strategies                                                                                                                                                                                                                                       | Formative Assessment Tasks                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Students will: <ul style="list-style-type: none"> <li>Describe how biodiversity is monitored and explain current biodiversity trends.</li> <li>List the major causes of biodiversity loss.</li> </ul> | Lesson Sequence <ol style="list-style-type: none"> <li>Anchoring Phenomenon: The accidental introduction of zebra mussels into North America transformed lakes and rivers, costing billions of dollars and disrupting native ecosystems. How can the loss of one species—or</li> </ol> | <ul style="list-style-type: none"> <li>Have each student write a one or two sentence response to: Why is global biodiversity decreasing?</li> <li>Have several students share their responses with the class.</li> <li>Have students complete the Lesson 7.2 Assessment.</li> </ul> |



- the arrival of another—change biodiversity and ecosystem stability?
2. Divide the class into small groups. Ask - Do you know of any endangered or threatened species in our state?
  3. Have each group research an endangered or threatened species in your state. A good place for students to start their research is with the state's Department of Natural Resources.
  4. Have each group write a paragraph summarizing what they learned, and ask them to share the completed paragraphs with the class.
  5. Analyze a map of the zebra mussel population in the United States to understand how invasive species spread and how they affect biodiversity.

**Differentiation:**

Ask each student to choose one of the five causes, or assign the causes so that all are covered. Assign a stronger reader to Habitat Change and Loss, as it requires the most reading. For their assigned cause, have each student find the associated information in the text, read the information, and summarize the information in a sentence or two that they present orally.

**Resources Provided:**

- [Savvas Realize](#)
- [Socrative](#)
- [Google Form](#)
- [New Jersey Office of Natural Resources](#)



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### Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

| Lesson Activities                                                                                                    | Strongly | Moderately | Weakly |
|----------------------------------------------------------------------------------------------------------------------|----------|------------|--------|
| Are challenging <b>Strongly</b> and require higher order thinking and problem solving skills                         | <b>X</b> |            |        |
| Allow for student choice                                                                                             |          | <b>X</b>   |        |
| Provide scaffolding for acquiring targeted knowledge/skills                                                          | <b>X</b> |            |        |
| Integrate global perspectives                                                                                        | <b>X</b> |            |        |
| Integrate 21st century skills                                                                                        | <b>X</b> |            |        |
| Provide opportunities for interdisciplinary connection and transfer of knowledge and skills                          | <b>X</b> |            |        |
| Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills            | <b>X</b> |            |        |
| Are varied to address different student learning styles and preferences                                              | <b>X</b> |            |        |
| Are differentiated based on student needs                                                                            |          | <b>X</b>   |        |
| Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process    | <b>X</b> |            |        |
| Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives | <b>X</b> |            |        |
| Provide opportunities for student reflection and self- assessment                                                    | <b>X</b> |            |        |
| Provide data to inform and adjust instruction to better meet the varying needs of learners                           |          | <b>X</b>   |        |

### Curriculum Design Template

|                                            |                           |                            |
|--------------------------------------------|---------------------------|----------------------------|
| <b>Content Area:</b> Environmental Science | <b>Grade Level:</b> 11-12 | <b>Unit Title:</b> Ecology |
| <b>Created:</b> 2023                       | <b>Board Approved on:</b> | Type Here                  |



### Unit Overview Template

**Content Area:** Environmental Science      **Grade Level:** 11-12      **Unit Title:** Humans and the Environment

**Unit Summary:** In this unit, students study humans and their relationship with the environment. The unit consists of three chapters: Ch8. Human Population, Ch9. Environmental Health, and Ch10. Urbanization. Within these chapters, students analyze trends in human population to predict future outcomes. Students also study biological hazards, toxic substances and natural disasters and their impacts on environmental health. Lastly, students investigate land usage and urbanization as well as the goals and challenges in developing sustainable cities.

**Primary Interdisciplinary Connections:** *Mathematics and ELA*

**21<sup>st</sup> Century Themes** ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ ICT Literacy  
☒ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy

**Unit Rationale:** This is the third unit in Environmental Science. Students are expected to demonstrate proficiency in using quantitative and qualitative thinking, developing and using models, planning and carrying out investigations, and using data to design and evaluate solutions. They are expected to use these practices to demonstrate understanding of core ideas. Students come across real world applications like the U.S. Census, the regulation of Bisphenol A (BPA), and how geographic information systems are developed and utilized.

#### **Career Readiness (Standard 9):**

- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 9.4.12.CT.3: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others
- 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem.
- 9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others.
- 9.1.12.EG.3: Explain how individuals and businesses influence government policies.
- 9.1.12.EG.5: Relate a country's economic system of production and consumption to building personal wealth, the mindset of social comparison, and achieving societal responsibilities.



### Learning Targets

**Standards:** 2020 New Jersey Student Learning Standards Science

**Content Statements:** HS-ESS3: Earth and Human Activity  
 HS-LS1: From Molecules to Organisms: Structures and Processes  
 HS-LS2: Ecosystems: Interactions, Energy, and Dynamics  
 HS-LS4: Biological Evolution: Unity and Diversity  
 HS-ETS1: Engineering Design

| <b>CPI#:</b> | <b>Cumulative Progress Indicator (CPI):</b>                                                                                                                                                                                          |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HS-ESS3-1    | Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.                                                          |
| HS-ESS3-2    | Evaluate competing design solutions for developing, conserving, managing, and utilizing energy and mineral resources based on the associated economic, social, environmental, and geopolitical costs and risks, as well as benefits. |
| HS-ESS3-3    | Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.                                                                  |
| HS-ESS3-4    | Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.                                                                                                    |
| 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 to Earth systems.                       |
| 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).                                                  |
| 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-LS2-3     | Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.                                                                                              |
| HS-LS2-4     | Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.                                                                                                     |
| HS-LS2-5     | Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.                                                              |



|             |                                                                                                                                                                                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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.                                                                                                                                               |
| HS-LS4-5    | Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.                |
| HS-ETS1-1   | Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.                                                                                                      |
| HS-ETS1-2   | Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.                                                                                                            |
| HS-ETS1-3   | Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. |
| HS-ETS1-4   | Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.                                                  |
| 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.                                                                      |
| 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.                                                                       |
| 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.                                                                   |
| 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.                                                       |
| WHST.9-12.2 | Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.                                                                                                                  |
| MP.2        | Reason abstractly and quantitatively.                                                                                                                                                                                                                           |
| MP.4        | Model with mathematics.                                                                                                                                                                                                                                         |
| N-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.                                     |
| N-Q.A.2     | Define appropriate quantities for the purpose of descriptive modeling.                                                                                                                                                                                          |



|              |                                                                                                                                                                                   |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| N-Q.A.3      | Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.                                                                                   |
| 8.2.12.ED.6  | Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).                                           |
| 8.2.12.ETW.1 | Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.              |
| 8.2.12.EC.2  | Assess the positive and negative impacts of emerging technologies on developing countries and evaluate how individuals, non-profit organizations, and governments have responded. |

### Science and Engineering Practices

#### Analyzing and Interpreting Data

Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data.

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

#### Using Mathematics and Computational Thinking

Mathematical and computational thinking in 9–12 builds on K–8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-ESS3-3) 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

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 knowledge, principles, and theories.

- 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)

#### Engaging in Argument from Evidence

Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and



explanations about natural and designed world(s). Arguments may also come from current scientific or historical episodes in science.

- Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations). (HS-ESS3-2)

## **Disciplinary Core Ideas**

### **ESS2.D: Weather and Climate**

- Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gasses added to the atmosphere each year and by the ways in which these gasses are absorbed by the ocean and biosphere. (secondary to HS-ESS3- 6)

### **ESS3.A: Natural Resources**

- Resource availability has guided the development of human society. (HS-ESS3-1) All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)

### **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**

- The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)
- 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)

### **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 HS-ESS3- 2), (secondary HS-ESS3-4)

## **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-ESS3-3), (HS-ESS3-5)
- Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS3-4)

### **Influence of Engineering, Technology, and Science on Society and the Natural World**

- Modern civilization depends on major technological systems. (HS-ESS3-1), (HS-ESS3-3)
- Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-ESS3-2), (HS-ESS3-4)
- New technologies can have deep impacts on society and the environment, including some that were not anticipated. (HS-ESS3-3)
- Analysis of costs and benefits is a critical aspect of decisions about technology. (HS-ESS3-2)

### **Science is a Human Endeavor**

- Science is a result of human endeavors, imagination, and creativity. (HS-ESS3-3)

### **Science Addresses Questions About the Natural and Material World**

- Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. (HS-ESS3-2)
- Science knowledge indicates what can happen in natural systems— not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. (HS-ESS3-2)
- Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. (HS-ESS3-2)

### **Scientific Investigations Use a Variety of Methods**

- Science investigations use diverse methods and do not always use the same set of procedures to obtain data. (HS-ESS3-5)
- New technologies advance scientific knowledge. (HS-ESS3-5)

### **Scientific Knowledge is Based on Empirical Evidence**

- Science knowledge is based on empirical evidence. (HS-ESS3-5)
- Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS3-5)

**Unit Essential Questions:**

- What is the impact of population size during an environmental hazard, such as a global pandemic?
- How do we balance the relationship between our own health and the health of the environment?
- How can we balance the way we use land with the needs of the environment?

**Unit Enduring Understandings:**

- Human Population: trends in human population growth, predicting population growth, and people and their environments.
- Environmental Health: overview of environmental health, biological and social hazards, toxic substances in the environment, and natural disasters.
- Urbanization: land use and urbanization, sprawl, and sustainable cities.

**Unit Learning Targets:**

Students will....

- Describe how technological advances have contributed to human population growth.
- Explain recent trends in population growth.
- Identify characteristics of human populations that are studied by demographers.
- Describe total fertility rates and replacement fertility.
- Explain how the age structure and sex ratio of a population define its potential for growth.
- Discuss social factors that affect population growth
- Describe how humans impact their environments.
- Discuss the negative and positive impacts of technology
- List the types of environmental health hazards.
- Compare and contrast epidemiology and toxicology.
- Describe the reasons why individuals respond differently to the same environmental hazards.
- Discuss risk assessment.
- Describe how infectious diseases spread.
- Explain why emerging diseases are important to monitor and control.
- Explain what makes chemicals hazardous.
- Discuss how chemical hazards affect human health.
- List some indoor chemical hazards.
- Discuss where chemical hazards can be found in the environment.
- Describe biomagnification.
- Differentiate between social hazards that are lifestyle choices and those that cannot be controlled.
- Discuss how earthquakes affect structures on Earth's surface.
- Discuss how volcanoes affect human lives and property.
- Describe tornadoes, hurricanes, and thunderstorms.
- Discuss the dangers of avalanches.
- Differentiate between land cover and land use, and describe how people affect both.
- Explain how and where urbanization occurs.
- Describe the environmental impacts of urbanization.



- Describe the contributors to sprawl and its patterns.
- Explain the impacts sprawl has on an area.
- Describe four different components of city planning.
- Explain the importance of mass transit options to a city and its residents.
- Explain the importance of open space to a livable city.
- Differentiate green buildings from conventional buildings.
- Discuss the progress toward sustainability some cities have made and its importance to the world.

### Evidence of Learning

**Summative Assessment:** 28 days

**Equipment Needed:** Textbook, computer, internet access

**Teacher Resources:** [Savvas Realize](#), [NJCTL environmental science](#), [NASA climate resources](#),

#### Formative Assessments:

Savvas Assessments

- Chapter 8: Lesson 1 Assessment
- Chapter 8: Lesson 2 Assessment
- Chapter 8: Lesson 3 Assessment
- Chapter 8: Chapter Test A
- Chapter 8: Chapter Test B
- Chapter 8: Assessment
- Chapter 9: Lesson 1 Assessment
- Chapter 9: Lesson 2 Assessment
- Chapter 9: Lesson 3 Assessment
- Chapter 9: Lesson 4 Assessment
- Chapter 9: Chapter Test A
- Chapter 9: Chapter Test B
- Chapter 9: Assessment
- Chapter 10: Lesson 1 Assessment
- Chapter 10: Lesson 2 Assessment
- Chapter 10: Lesson 3 Assessment
- Chapter 10: Chapter Test A
- Chapter 10: Chapter Test B
- Chapter 10: Assessment



### Lesson Plans

| Lesson                                                    | Time Frame       |
|-----------------------------------------------------------|------------------|
| Lesson 1 Lesson 8.3 - People and Their Environments       | 1.5 hours/2 days |
| Lesson 2 Lesson 9.3 - Toxic Substances in the Environment | 0.75 hours/1 day |
| Lesson 3 Lesson 10.3 - Sustainable Cities                 | 1.5 hours/1 day  |

**Teacher Notes:**

These lessons will introduce students to the key concepts of the units using a group setting. It is recommended that teachers use some technology (socrative.com, Google Forms, or Kahoot) or white boards to have students provide immediate response and feedback. Teachers will base the progress of these lessons on the responses provided by students and groups during each lesson.

**Curriculum Development Resources/Technology Resources:**

*Click the links below to access additional resources used to design this unit:*

[Savvas Realize](#)

[Socrative](#)

[Google Form](#)

[Kahoot](#)

[NJCTL environmental science](#)

[NASA climate resources](#)



### Lesson Plan 1 Template

|                                     |                                                   |                               |
|-------------------------------------|---------------------------------------------------|-------------------------------|
| Content Area: Environmental Science | Lesson Title: 8.3 - People and Their Environments | Time Frame: 1.5 hours/ 2 days |
|-------------------------------------|---------------------------------------------------|-------------------------------|

### Lesson Components

#### 21<sup>st</sup> Century Themes

- ☒ Global Awareness    ☐ Financial, Economic, Business and Entrepreneurial Literacy  
☐ Civic Literacy        ☐ Health Literacy

#### 21<sup>st</sup> Century Skills

- ☒ Creativity and Innovation    ☒ Critical Thinking and Problem Solving    ☒ Information Literacy  
☒ Life and Career Skills    ☒ Communication and Collaboration    ☒ Media Literacy    ☒ ICT Literacy

#### **Interdisciplinary Connections:**

Mathematics and ELA

#### **Integration of Technology:**

- Students will use technology to access the Savvas resource online and interact with the graphs, data, tables and figures provided on the website.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

**Equipment Needed:** Students will have access to their online Savvas textbook resource.

| Goals/Objectives                                                                                                                                                                      | Learning Activities/<br>Instructional Strategies                                                                                                                                                                                                                                                                     | Formative Assessment Tasks                                                                                                                                                                                                                                                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Students will: <ul style="list-style-type: none"> <li>• Describe how humans impact their environments.</li> <li>• Discuss the negative and positive impacts of technology.</li> </ul> | Lesson Sequence <ol style="list-style-type: none"> <li>1. Anchoring Phenomenon: A single smartphone contains metals mined on multiple continents, requires enormous amounts of energy to manufacture, and eventually contributes to electronic waste. How do the technologies we use every day affect the</li> </ol> | <ul style="list-style-type: none"> <li>• Have students write a one- or two-sentence summary of the information in Figure 14.</li> <li>• Call on students to share what they have written with the class.</li> <li>• Students complete the Lesson 8.3 Assessment.</li> </ul> |



- environment throughout their entire life cycle?
2. Students work in pairs. Each pair should select one type of technology they frequently use or are familiar with.
  3. Have students research the positive and negative effects this technology has on the environment.
  4. Remind students to focus their research on the environmental impact of the technology, rather than on how the technology affects quality of life.
  5. Have each pair of students write a paragraph summarizing this information.
  6. Hold a “technology fair” where each student pair can showcase its technology. Tell students that the purpose of the fair is to present objective information about how the technology impacts the environment to an audience of consumers who are considering purchasing the items.

**Differentiation:**

Have students make a two-column table with the headings “Impacts of Population” and “Impacts of Technology.” Have students review the lesson and add relevant words or phrases to each column of their tables. Allow students access to this table on assessments.

**Resources Provided:**

- [Savvas Realize](#)
- [Socrative](#)
- [Google Form](#)



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### Lesson Plan 2 Template

|                                     |                                                         |                               |
|-------------------------------------|---------------------------------------------------------|-------------------------------|
| Content Area: Environmental Science | Lesson Title: 9.3 - Toxic Substances in the Environment | Time Frame: 0.75 hours/1 days |
|-------------------------------------|---------------------------------------------------------|-------------------------------|

### Lesson Components

#### 21<sup>st</sup> Century Themes

- |                                                      |                                                                                     |
|------------------------------------------------------|-------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Global Awareness | <input type="checkbox"/> Financial, Economic, Business and Entrepreneurial Literacy |
| <input checked="" type="checkbox"/> Civic Literacy   | <input type="checkbox"/> Health Literacy                                            |

#### 21<sup>st</sup> Century Skills

- |                                                               |                                                                           |                                                          |
|---------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------|
| <input checked="" type="checkbox"/> Creativity and Innovation | <input checked="" type="checkbox"/> Critical Thinking and Problem Solving | <input checked="" type="checkbox"/> Information Literacy |
| <input checked="" type="checkbox"/> Life and Career Skills    | <input checked="" type="checkbox"/> Communication and Collaboration       | <input checked="" type="checkbox"/> Media Literacy       |
|                                                               |                                                                           | <input checked="" type="checkbox"/> ICT Literacy         |

#### **Interdisciplinary Connections:**

Mathematics and ELA

#### **Integration of Technology:**

- Students will use technology to access the Savvas resource online and interact with the graphs, data, tables and figures provided on the website.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

**Equipment Needed:** Air freshener. Students will have access to their online Savvas textbook resource.

| Goals/Objectives                                                                                                                                                                                                                                                                                 | Learning Activities/<br>Instructional Strategies                                                                                                                                                                                                                                                                                         | Formative Assessment Tasks                                                                                                                                                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Students will: <ul style="list-style-type: none"> <li>• Explain what makes chemicals hazardous.</li> <li>• Discuss how chemical hazards affect human health.</li> <li>• List some indoor chemical hazards.</li> <li>• Discuss where chemical hazards can be found in the environment.</li> </ul> | Lesson Sequence <ol style="list-style-type: none"> <li>1. Anchoring Phenomenon: Pollutants released in one location can later be detected thousands of miles away in rain, soil, wildlife, and even human tissues. How can toxic substances move through the environment and affect organisms far from their original source?</li> </ol> | <ul style="list-style-type: none"> <li>• Ask and evaluate: Why are chemical hazards in the air a global problem?</li> <li>• Have students work with a partner to make a concept map that includes at least seven of the eight lesson vocabulary terms.</li> </ul> |



- Describe biomagnification.

2. Have students read the information about chemical hazards. Point out that some naturally occurring substances can be chemical hazards.
3. Have students form small groups. Ask each group to identify at least one example of a chemical hazard in their environment that is a pollutant and another that occurs naturally. Encourage students to think beyond the examples given in the book.
4. Use a quick demonstration to help students understand how chemical hazards move from where they are generated to other areas.
5. Model pesticide drift by spraying a small amount of air freshener at the front of the room. Have students raise their hand as the smell of the air freshener travels to where they are sitting.
6. Discuss that chemical pollutants in the air can travel long distances from where they were produced.

- Have students complete the Lesson 9.3 Assessment.

**Differentiation:**

Help students use the headings in the section and the information in Figure 14 to organize the material describing types of chemical hazards.

**Resources Provided:**

- [Savvas Realize](#)
- [Socrative](#)



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- [Google Form](#)



### Lesson Plan 3 Template

Content Area: Environmental Science    Lesson Title: 10.3 - Sustainable Cities    Time Frame: 1.5 hours/2 days

### Lesson Components

#### 21<sup>st</sup> Century Themes

- ☒ Global Awareness    ☒ Financial, Economic, Business and Entrepreneurial Literacy  
☒ Civic Literacy    ☐ Health Literacy

#### 21<sup>st</sup> Century Skills

- ☒ Creativity and Innovation    ☒ Critical Thinking and Problem Solving    ☒ Information Literacy  
☒ Life and Career Skills    ☒ Communication and Collaboration    ☒ Media Literacy    ☒ ICT Literacy

#### **Interdisciplinary Connections:**

Mathematics and ELA

#### **Integration of Technology:**

- Students will use technology to access the Savvas resource online and interact with the graphs, data, tables and figures provided on the website.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

**Equipment Needed:** Several copies of two maps of Boston, Massachusetts—one current and the other before Boston's Big Dig (1990s). Students will have access to their online Savvas textbook resource.

| Goals/Objectives                                                                                                                                                                                                                                                                  | Learning Activities/<br>Instructional Strategies                                                                                                                                                                                                                                                      | Formative Assessment Tasks                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Students will: <ul style="list-style-type: none"> <li>• Describe four different components of city planning.</li> <li>• Explain the importance of mass transit options to a city and its residents.</li> <li>• Explain the importance of open space to a livable city.</li> </ul> | Lesson Sequence <ol style="list-style-type: none"> <li>1. Anchoring Phenomenon: Some cities have replaced highways with parks, installed green roofs, and redesigned neighborhoods to reduce pollution and improve quality of life. How can cities be redesigned to meet human needs while</li> </ol> | <ul style="list-style-type: none"> <li>• Ask and evaluate: which forms of transportation use the least/most energy per passenger-mile?</li> <li>• Ask and evaluate: how the following can contribute to a city's sustainability: city planning, transportation, open space, and green building design.</li> </ul> |



- |                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Differentiate green buildings from conventional buildings.</li><li>• Discuss the progress toward sustainability some cities have made and its importance to the world.</li></ul> | <p>reducing their environmental impact?</p> <ol style="list-style-type: none"><li>2. Have students form small groups. Have the students in each group imagine that they are city planners, working to design a sustainable city.</li><li>3. Ask each group to select two of the tools or strategies described in this section and develop an explanation of how they as city planners would use them.</li><li>4. Have each group share its results with the class.</li><li>5. Ask students to compare an older map of Boston, Massachusetts with a current map. They should look for the current Rose Kennedy Greenway and note what was in its place on the older map.</li><li>6. Explain that, in a project called the Big Dig, Boston relocated a highway that went through the city to underground tunnels, providing above ground space for the greenway.</li><li>7. Have students tour their school building to look for green building features.</li><li>8. Have students describe any features they find.</li><li>9. If they do not find any, have each student describe one way the building could be changed to make it more “green”.</li></ol> | <ul style="list-style-type: none"><li>• Students will complete the Lesson 10.3 Assessment.</li></ul> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|



**Differentiation:**

Point out that the information in this section describes ways that two very different cities have increased sustainability. Write the name of each city—Curitiba, Brazil and New York City—on the board. Have students come forward to add words and phrases under each city that describe ways that these cities have increased their sustainability. Have students make a flash card for each of the lesson vocabulary terms. Students can then work in pairs to review each of the terms.

**Resources Provided:**

- [Savvas Realize](#)
- [Socrative](#)
- [Google Form](#)



### Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

| Lesson Activities                                                                                                    | Strongly | Moderately | Weakly |
|----------------------------------------------------------------------------------------------------------------------|----------|------------|--------|
| Are challenging <b>Strongly</b> and require higher order thinking and problem solving skills                         | <b>X</b> |            |        |
| Allow for student choice                                                                                             |          | <b>X</b>   |        |
| Provide scaffolding for acquiring targeted knowledge/skills                                                          | <b>X</b> |            |        |
| Integrate global perspectives                                                                                        | <b>X</b> |            |        |
| Integrate 21st century skills                                                                                        | <b>X</b> |            |        |
| Provide opportunities for interdisciplinary connection and transfer of knowledge and skills                          | <b>X</b> |            |        |
| Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills            | <b>X</b> |            |        |
| Are varied to address different student learning styles and preferences                                              | <b>X</b> |            |        |
| Are differentiated based on student needs                                                                            |          | <b>X</b>   |        |
| Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process    | <b>X</b> |            |        |
| Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives | <b>X</b> |            |        |
| Provide opportunities for student reflection and self- assessment                                                    | <b>X</b> |            |        |
| Provide data to inform and adjust instruction to better meet the varying needs of learners                           |          | <b>X</b>   |        |

### Curriculum Design Template

|                                            |                           |                                               |
|--------------------------------------------|---------------------------|-----------------------------------------------|
| <b>Content Area:</b> Environmental Science | <b>Grade Level:</b> 11-12 | <b>Unit Title:</b> Humans and the Environment |
| <b>Created:</b> 2023                       | <b>Board Approved on:</b> | Type Here                                     |



### Unit Overview Template

**Content Area:** Environmental Science      **Grade Level:** 11-12      **Unit Title:** Earth's Resources

**Unit Summary:** In this unit, students study the topic of Earth's Resources. This unit includes five chapters of study: Ch11. Forestry and Resource Management, Ch12. Soil and Agriculture, Ch13. Mineral Resources and Mining, Ch14. Water Resources, and Ch15. The Atmosphere. With these chapters, students learn about resource/forest management, soil, agriculture, food production, and conservation. Additionally students investigate minerals, rocks, as well as mining and its impacts and regulations. Lastly, students study water and the atmosphere including the use and scarcity of fresh water, and importance controlling atmospheric and water pollution.

**Primary Interdisciplinary Connections:** *Mathematics and ELA*

**21<sup>st</sup> Century Themes**   ☒ Creativity and Innovation   ☒ Critical Thinking and Problem Solving   ☒ ICT Literacy  
☒ Information Literacy   ☒ Life and Career Skills   ☒ Communication and Collaboration   ☒ Media Literacy

**Unit Rationale:** This is the fourth unit in Environmental Science. Students are expected to demonstrate proficiency in using quantitative and qualitative thinking, developing and using models, planning and carrying out investigations, and using data to design and evaluate solutions. They are expected to use these practices to demonstrate understanding of core ideas. Students come across real world applications like the challenge of reforesting Africa and the Amazon, salt mining in Retsof New York, wastewater treatment, acid rain and the Clean Air Act.

#### Career Readiness (Standard 9):

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth
- 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 9.4.12.CT.3: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others
- 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem.
- 9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others.
- 9.1.12.EG.3: Explain how individuals and businesses influence government policies.



9.1.12.EG.5: Relate a country's economic system of production and consumption to building personal wealth, the mindset of social comparison, and achieving societal responsibilities.

### Learning Targets

**Standards:** 2020 New Jersey Student Learning Standards Science

**Content Statements:** HS-ESS2: Earth's Systems  
 HS-ESS3: Earth and Human Activity  
 HS-LS2: Ecosystems: Interactions, Energy, and Dynamics  
 HS-LS4: Biological Evolution: Unity and Diversity  
 HS-ETS1: Engineering Design

| <b>CPI#:</b> | <b>Cumulative Progress Indicator (CPI):</b>                                                                                                                                                                                          |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HS-ESS2-1    | Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.                                                              |
| HS-ESS2-2    | Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.                                                                                         |
| HS-ESS2-3    | Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.                                                                                                                       |
| HS-ESS2-4    | Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.                                                                                                           |
| HS-ESS2-5    | Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes                                                                                                                |
| HS-ESS2-6    | Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.                                                                                                          |
| HS-ESS3-1    | Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.                                                          |
| HS-ESS3-2    | Evaluate competing design solutions for developing, conserving, managing, and utilizing energy and mineral resources based on the associated economic, social, environmental, and geopolitical costs and risks, as well as benefits. |
| HS-ESS3-3    | Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.                                                                  |
| HS-ESS3-4    | Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.                                                                                                    |
| 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 to Earth systems.                       |



|           |                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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).                                                                                                                                                                                                                                                 |
| 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-LS2-3  | Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.                                                                                                                                                                                                                                                                                             |
| HS-LS2-4  | Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.                                                                                                                                                                                                                                                                                                    |
| HS-LS2-5  | Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.                                                                                                                                                                                                                                                             |
| 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.                                                                                                                                                                                                                                                                                                                   |
| HS-LS4-1  | Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.                                                                                                                                                                                                                                                                                             |
| HS-LS4-2  | Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. |
| HS-LS4-3  | Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.                                                                                                                                                                                                                                            |



|             |                                                                                                                                                                                                                                                                 |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HS-LS4-4    | Construct an explanation based on evidence for how natural selection leads to adaptation of populations.                                                                                                                                                        |
| HS-LS4-5    | Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.                |
| HS-LS4-6    | Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.                                                                                                                                                 |
| HS-ETS1-1   | Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.                                                                                                      |
| HS-ETS1-2   | Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.                                                                                                            |
| HS-ETS1-3   | Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. |
| HS-ETS1-4   | Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.                                                  |
| 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.                                                                      |
| 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.                                                                       |
| 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.                                                                   |
| 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.                                                       |
| WHST.9-12.2 | Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.                                                                                                                  |
| MP.2        | Reason abstractly and quantitatively.                                                                                                                                                                                                                           |
| MP.4        | Model with mathematics.                                                                                                                                                                                                                                         |
| N-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.                                     |
| N-Q.A.2     | Define appropriate quantities for the purpose of descriptive modeling.                                                                                                                                                                                          |



|              |                                                                                                                                                                                   |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| N-Q.A.3      | Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.                                                                                   |
| 8.2.12.ED.6  | Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).                                           |
| 8.2.12.ETW.1 | Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.              |
| 8.2.12.EC.2  | Assess the positive and negative impacts of emerging technologies on developing countries and evaluate how individuals, non-profit organizations, and governments have responded. |

### Science and Engineering Practices

#### Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2)
- Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-4), (HS-LS1-5), (HS-LS1-7)

#### Planning and Carrying Out Investigations

Planning and carrying out in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-LS1-3)

#### 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.

- 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-LS1-1)
- 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.A: Structure and Function



- Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1) All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)
- Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)

#### **LS1.B: Growth and Development of Organisms**

- In multicellular organisms, individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (HS-LS1-4)

#### **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)

#### **Crosscutting Concepts**

##### **Systems and System Models**

- Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-2), (HS-LS1-4)

##### **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)

### **Structure and Function**

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-LS1-1)

### **Stability and Change**

- Feedback (negative or positive) can stabilize or destabilize a system. (HS-LS1-3)

### **Scientific Investigations Use a Variety of Methods**

- Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. (HS-LS1-3)

### **Unit Essential Questions:**

- Why do we need to conserve Earth's resources?
- Why is it important to manage Earth's resources sustainably?
- How can we balance our growing demand for food with our need to protect the environment?
- Can we make the benefits of mining outweigh the costs?
- Why is the level of water in the Colorado River so low?
- Does congestion charging work to reduce air pollution?

### **Unit Enduring Understandings:**

- Forestry and Resource Management: resource management, forest management, forests and their resources.
- Soil and Agriculture: soil degradation and conservation, agriculture, and food production.
- Mineral Resources and Mining: minerals, rocks, mining, mining impacts and regulation.
- Water Resources: the water planet (Earth), uses of fresh water, and water pollution.
- The Atmosphere: studying Earth's atmosphere, pollution of the atmosphere, and controlling air pollution.

### **Unit Learning Targets:**

Students will....

- Explain the importance of managing specific renewable resources.
- Describe three resource management approaches.
- List some of the ecological and economic values of forest resources.
- Describe the costs and benefits of the different methods of timber harvesting.
- Discuss the current levels of deforestation in the United States and in developing nations.
- Explain how logging is managed in U.S. national forests.
- Describe where most logging in the United States takes place.
- Discuss the potential effects of fire suppression on an ecosystem and on future fires.



- Describe how consumer demand is important to sustainable forestry.
- Explain three processes by which soil forms.
- Describe the horizons that make up a soil profile.
- List the four characteristics used to classify soil.
- Describe some practices that can lead to soil erosion and some that can prevent it.
- Identify the causes and effects of desertification.
- Discuss the activities of U.S. and international agricultural organizations.
- Explain how irrigation and pesticide use can cause soil pollution.
- Discuss the beginnings of agriculture.
- Explain the importance of industrial agriculture and the green revolution.
- Identify different types of pest control.
- Explain the importance of pollinators to agriculture.
- Explain why the world needs to grow more food and to grow it sustainably.
- Discuss genetically modified food.
- Describe the advantages and disadvantages of industrial food production.
- Discuss sustainable agriculture.
- Explain what a mineral is.
- Describe how minerals form.
- Identify types of rocks and the stages of the rock cycle.
- Identify the types of resources that are mined.
- Describe different methods used for mining
- Explain how metals are processed.
- Describe the negative impacts of mining on the environment and society.
- Explain how mining is regulated.
- Describe ways that mineral use can become more responsible.
- Discuss how fresh water can be both renewable and limited.
- Explain the significance of a watershed.
- Explain how most groundwater is accessed.
- List the three primary categories of freshwater use.
- Relate the causes of surface water depletion to their effects.
- Explain the major causes and effects of groundwater depletion.
- Describe strategies for addressing water depletion.
- Discuss the main categories of water pollution.
- Explain why groundwater pollution is difficult to clean up.
- Discuss the sources and effects of major pollutants found in the ocean.
- Describe how water is regulated and treated.
- Describe the properties of the atmosphere.
- Identify the four main layers of the atmosphere.
- Explain heat transfer and the interaction of air masses in the troposphere.
- Explain how both natural processes and human activities can cause air pollution.
- Describe how air pollutants affect human health.
- Explain what causes smog and how temperature inversions affect it and other forms of air pollution.
- Explain how acid deposition occurs and describe its effects.
- Explain how the provisions of the Clean Air Act have reduced air pollution in the United States.



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- Describe international efforts to reduce the ozone hole.



### Evidence of Learning

**Summative Assessment:** 47 days

**Equipment Needed:** Textbook, computer, internet access

**Teacher Resources:** [Savvas Realize](#), [NJCTL environmental science](#), [NASA climate resources](#),

**Resources:**

#### Formative Assessments:

Savvas Assessments

- Chapter 11: Lesson 1 Assessment
- Chapter 11: Lesson 2 Assessment
- Chapter 11: Lesson 3 Assessment
- Chapter 11: Chapter Test A
- Chapter 11: Chapter Test B
- Chapter 11: Assessment
- Chapter 12: Lesson 1 Assessment
- Chapter 12: Lesson 2 Assessment
- Chapter 12: Lesson 3 Assessment
- Chapter 12: Lesson 4 Assessment
- Chapter 12: Chapter Test A
- Chapter 12: Chapter Test B
- Chapter 12: Assessment
- Chapter 13: Lesson 1 Assessment
- Chapter 13: Lesson 2 Assessment
- Chapter 13: Lesson 3 Assessment
- Chapter 13: Chapter Test A
- Chapter 13: Chapter Test B
- Chapter 13: Assessment
- Chapter 14: Lesson 1 Assessment
- Chapter 14: Lesson 2 Assessment
- Chapter 14: Lesson 3 Assessment
- Chapter 14: Chapter Test A
- Chapter 14: Chapter Test B
- Chapter 14: Assessment
- Chapter 15: Lesson 1 Assessment
- Chapter 15: Lesson 2 Assessment
- Chapter 15: Lesson 3 Assessment
- Chapter 15: Chapter Test A
- Chapter 15: Chapter Test B
- Chapter 15: Assessment



### Lesson Plans

| Lesson                                                   | Time Frame       |
|----------------------------------------------------------|------------------|
| Lesson 1 Lesson 12.2 - Soil Degradation and Conservation | 1.5 hours/2 days |
| Lesson 2 Lesson 13.1 - Minerals and Rocks                | 1.5 hours/2 days |
| Lesson 3 Lesson 14.2 - Uses of Fresh Water               | 1.5 hours/2 days |

#### Teacher Notes:

These lessons will facilitate students learning the key concepts of the units using a group setting. It is recommended that teachers use some technology (socrative.com, Google Forms, or Kahoot) or white boards to have students provide immediate response and feedback. Teachers will base the progress of these lessons on the responses provided by students and groups during each lesson.

#### Curriculum Development Resources/Technology Resources:

*Click the links below to access additional resources used to design this unit:*

[Savvas Realize](#)

[Socrative](#)

[Google Form](#)

[Kahoot](#)

[NJCTL environmental science](#)

[NASA climate resources](#)



### Lesson Plan 1 Template

|                                     |                                                        |                               |
|-------------------------------------|--------------------------------------------------------|-------------------------------|
| Content Area: Environmental Science | Lesson Title: 12.2 - Soil Degradation and Conservation | Time Frame: 1.5 hours/ 2 days |
|-------------------------------------|--------------------------------------------------------|-------------------------------|

### Lesson Components

#### 21<sup>st</sup> Century Themes

- |                                                      |                                                                                     |
|------------------------------------------------------|-------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Global Awareness | <input type="checkbox"/> Financial, Economic, Business and Entrepreneurial Literacy |
| <input type="checkbox"/> Civic Literacy              | <input checked="" type="checkbox"/> Health Literacy                                 |

#### 21<sup>st</sup> Century Skills

- |                                                               |                                                                           |                                                                               |
|---------------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Creativity and Innovation | <input checked="" type="checkbox"/> Critical Thinking and Problem Solving | <input checked="" type="checkbox"/> Information Literacy                      |
| <input checked="" type="checkbox"/> Life and Career Skills    | <input checked="" type="checkbox"/> Communication and Collaboration       | <input type="checkbox"/> Media Literacy <input type="checkbox"/> ICT Literacy |

#### **Interdisciplinary Connections:**

Mathematics and ELA

#### **Integration of Technology:**

- Students will use technology to access the Savvas resource online and interact with the graphs, data, tables and figures provided on the website.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

**Equipment Needed:** 500-milliliter beaker, saturated salt solution, dropper, black construction paper. Students will also use their online Savvas textbook resource.

| Goals/Objectives                                                                                                                                                                                                                                                                                        | Learning Activities/<br>Instructional Strategies                                                                                                                                                                                                                                                                                              | Formative Assessment Tasks                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Students will: <ul style="list-style-type: none"> <li>Describe some practices that can lead to soil erosion and some that can prevent it.</li> <li>Identify the causes and effects of desertification.</li> <li>Discuss the activities of U.S. and international agricultural organizations.</li> </ul> | Lesson Sequence <ol style="list-style-type: none"> <li>Anchoring Phenomenon: Productive farmland around the world is gradually becoming less fertile and, in some regions, is turning into desert. How can the degradation of soil in one part of the world ultimately affect food supplies, economies, and ecosystems everywhere?</li> </ol> | <ul style="list-style-type: none"> <li>Have students complete a vocabulary assessment for terms in this unit.</li> <li>Have students complete the Lesson 12.2 Assessment.</li> </ul> |



- |                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <ul style="list-style-type: none"><li>• Explain how irrigation and pesticide use can cause soil pollution.</li></ul> | <ol style="list-style-type: none"><li>2. Have students read the information about</li><li>3. desertification and address: Why is global desertification a problem that Dayton students should be concerned about?</li><li>4. Have students form small groups, discuss the question within their groups, and write a short response that can be shared with the class.</li><li>5. During the class discussion, emphasize that desertification knows no national boundaries; changes to the ecosystem in one region can have major impacts on ecosystems in other regions far away.</li><li>6. Prepare in advance a saturated solution of salt water in a 500-milliliter beaker. Have students use a dropper to obtain and place several drops of the salt water on a piece of black construction paper. When the water has completely evaporated, students should notice a white, salty residue on the paper. Have students explain how this activity models salinization of soil.</li></ol> |  |
|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

**Differentiation:**

Have students make notecards of the vocabulary terms: intercropping, shelterbelts, tilling, terracing, and contour farming.



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**Resources Provided:**

- [Savvas Realize](#)
- [Socrative](#)



### Lesson Plan 2 Template

Content Area: Environmental Science    Lesson Title: 13.1 - Minerals and Rocks    Time Frame: 1.5 hours/ 2 days

### Lesson Components

#### 21<sup>st</sup> Century Themes

- ☒ Global Awareness    ☐ Financial, Economic, Business and Entrepreneurial Literacy  
☐ Civic Literacy    ☒ Health Literacy

#### 21<sup>st</sup> Century Skills

- ☒ Creativity and Innovation    ☒ Critical Thinking and Problem Solving    ☒ Information Literacy  
☒ Life and Career Skills    ☒ Communication and Collaboration    ☐ Media Literacy    ☐ ICT Literacy

#### **Interdisciplinary Connections:**

Mathematics and ELA

#### **Integration of Technology:**

- Students will use technology to access the Savvas resource online and interact with the graphs, data, tables and figures provided on the website.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

**Equipment Needed:** Mineral Formation: 100-mL beaker, water, salt, spoon or stirring rod Go Outside: rock samples, camera. Students also have access to the online Savvas textbook.

| Goals/Objectives                                                                                                                                                                                          | Learning Activities/<br>Instructional Strategies                                                                                                                                                                                                                                                                                             | Formative Assessment Tasks                                                                                                                           |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Students will: <ul style="list-style-type: none"> <li>• Explain what a mineral is.</li> <li>• Describe how minerals form.</li> <li>• Identify types of rocks and the stages of the rock cycle.</li> </ul> | Lesson Sequence <ol style="list-style-type: none"> <li>1. Anchoring Phenomenon: The stone used to build monuments, roads, and buildings may have formed hundreds of millions of years ago deep within Earth before eventually reaching the surface. How do Earth's processes continually create, transform, and recycle rocks and</li> </ol> | <ul style="list-style-type: none"> <li>• Exit ticket on rocks and minerals.</li> <li>• Have students complete the Lesson 13.1 Assessment.</li> </ul> |



- minerals over geologic time?
2. Discuss the difference between minerals in food and minerals found and Earth related to their molecular structure and how supplements are elements produced in labs.
  3. Create a checklist of five specific criteria a substance must meet to be considered a true mineral (inorganic, solid, chemical structure, naturally occurring, crystalline structure).
  4. Have students pour 50 milliliters of warm water into a 100-mL beaker. Have students mix salt into the water until no more salt can be stirred into solution. Then, have students place their beakers in a sunny or warm location in the room.
  5. Have students observe what happens over several days as the water evaporates. Students should note that the water evaporates, but the salt remains.
  6. Students investigate local rocks to explore the differences between sedimentary, igneous, and metamorphic rocks.
  7. Students complete an exit ticket about minerals and rock categorization and the rock cycle.



**Differentiation:**

Have students write each of the lesson vocabulary terms on a sticky note. Then, have them write the definition of each term on another set of sticky notes. Then, students can spread the sticky notes out on a desk or wall and match the terms with their definitions.

**Resources Provided:**

- [Savvas Realize](#)
- [Socrative](#)
- [Google Form](#)
- [Kahoot](#)



### Lesson Plan 3 Template

|                                     |                                         |                               |
|-------------------------------------|-----------------------------------------|-------------------------------|
| Content Area: Environmental Science | Lesson Title: 14.2 - Uses of Freshwater | Time Frame: 1.5 hours/ 2 days |
|-------------------------------------|-----------------------------------------|-------------------------------|

### Lesson Components

#### 21<sup>st</sup> Century Themes

- |                                                      |                                                                                     |
|------------------------------------------------------|-------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Global Awareness | <input type="checkbox"/> Financial, Economic, Business and Entrepreneurial Literacy |
| <input type="checkbox"/> Civic Literacy              | <input checked="" type="checkbox"/> Health Literacy                                 |

#### 21<sup>st</sup> Century Skills

- |                                                               |                                                                           |                                                                               |
|---------------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Creativity and Innovation | <input checked="" type="checkbox"/> Critical Thinking and Problem Solving | <input checked="" type="checkbox"/> Information Literacy                      |
| <input checked="" type="checkbox"/> Life and Career Skills    | <input checked="" type="checkbox"/> Communication and Collaboration       | <input type="checkbox"/> Media Literacy <input type="checkbox"/> ICT Literacy |

#### **Interdisciplinary Connections:**

Mathematics and ELA

#### **Integration of Technology:**

- Students will use technology to access the Savvas resource online and interact with the graphs, data, tables and figures provided on the website.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

**Equipment Needed:** Water, drinking glass, straw or pipette. Students will also access their online Savvas textbook.

| Goals/Objectives                                                                                                                                                                                                                                                                                                                   | Learning Activities/<br>Instructional Strategies                                                                                                                                                                                                                                                                                                              | Formative Assessment Tasks                                                                                                                                                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Students will: <ul style="list-style-type: none"> <li>List the three primary categories of freshwater use.</li> <li>Relate the causes of surface water depletion to their effects.</li> <li>Explain the major causes and effects of groundwater depletion.</li> <li>Describe strategies for addressing water depletion.</li> </ul> | Lesson Sequence <ol style="list-style-type: none"> <li><b>Anchoring Phenomenon:</b> Communities often depend on the same river for drinking water, agriculture, recreation, hydroelectric power, and wildlife habitat, leading to difficult management decisions. How should societies balance competing demands for limited freshwater resources?</li> </ol> | <ul style="list-style-type: none"> <li>Ask and evaluate: List the three main uses of fresh water.</li> <li>Ask and evaluate: What are ways to conserve water?</li> <li>Have students complete Lesson 14.2 Assessment</li> </ul> |



2. Present students with the following scenario: *A local dam needs expensive repairs and the owners want to take it down. The dam, however, regulates the flow of the river for irrigation. The regulated flow also makes the river a popular kayaking spot.*
3. Divide your class into groups and assign them stakeholder roles such as a wildlife biologist, a dam owner, a farmer, and a kayaking club organizer.
4. Have them debate whether the dam should be dismantled or repaired.
5. Model the process of groundwater mining: Fill a glass half-full of water, tell students it represents an aquifer. Insert a straw into the water to represent a well. Add a few drops of water and explain that this represents the water that recharges the aquifer in one year. Withdraw a substantial amount of water with the straw.
6. Explain that it represents the water humans withdraw in a year.
7. Continue modeling the process to show how groundwater mining can deplete an aquifer over time.
8. Students calculate how the Colorado River Compact affects water gains and losses in Lake Powell.

Differentiation:



Allow vocabulary notecards and assign the Math Worksheet page in their Study Workbook. Have students rewrite the lesson's knowledge and skills statements in their own words.

**Resources Provided:**

- [Savvas Realize](#)
- [Socrative](#)
- [Google Form](#)



### Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

| Lesson Activities                                                                                                    | Strongly | Moderately | Weakly |
|----------------------------------------------------------------------------------------------------------------------|----------|------------|--------|
| Are challenging <b>Strongly</b> and require higher order thinking and problem solving skills                         | <b>X</b> |            |        |
| Allow for student choice                                                                                             |          | <b>X</b>   |        |
| Provide scaffolding for acquiring targeted knowledge/skills                                                          | <b>X</b> |            |        |
| Integrate global perspectives                                                                                        | <b>X</b> |            |        |
| Integrate 21st century skills                                                                                        | <b>X</b> |            |        |
| Provide opportunities for interdisciplinary connection and transfer of knowledge and skills                          | <b>X</b> |            |        |
| Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills            | <b>X</b> |            |        |
| Are varied to address different student learning styles and preferences                                              | <b>X</b> |            |        |
| Are differentiated based on student needs                                                                            |          | <b>X</b>   |        |
| Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process    | <b>X</b> |            |        |
| Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives | <b>X</b> |            |        |
| Provide opportunities for student reflection and self- assessment                                                    | <b>X</b> |            |        |
| Provide data to inform and adjust instruction to better meet the varying needs of learners                           |          | <b>X</b>   |        |

### Curriculum Design Template

|                                            |                           |                                      |
|--------------------------------------------|---------------------------|--------------------------------------|
| <b>Content Area:</b> Environmental Science | <b>Grade Level:</b> 11-12 | <b>Unit Title:</b> Earth's Resources |
| <b>Created:</b> 2023                       | <b>Board Approved on:</b> | Type Here                            |



### Unit Overview Template

**Content Area:** Environmental Science      **Grade Level:** 11-12      **Unit Title:** Toward a Sustainable Future

**Unit Summary:** In this unit, students study the topic of ecology. This unit includes four chapters of study: Ch16. Global Climate Change, Ch17. Nonrenewable Energy, Ch18. Renewable Energy Alternatives, and Ch19. Waste management. Within these chapters, students study rising seas and the climate change cycles including the effects of climate change and the way that humans are responding to climate change. Students also study nonrenewable energy like fossil fuels and nuclear power, and investigate the benefits and consequences of these energy sources. After nonrenewable energy, students turn to renewable energy alternatives exploring like biomass/geothermal, hydropower, solar, wind and energy from hydrogen. Lastly students will study waste management including topics in municipal/industrial waste, how to minimize waste, and identifying hazardous waste.

**Primary Interdisciplinary Connections:** *Mathematics and ELA*

**21<sup>st</sup> Century Themes** ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ ICT Literacy  
☒ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy

**Unit Rationale:** This is the fifth and final unit in Environmental Science. Students are expected to demonstrate proficiency in using quantitative and qualitative thinking, developing and using models, planning and carrying out investigations, and using data to design and evaluate solutions. They are expected to use these practices to demonstrate understanding of core ideas. Students make real world applications of the unit related to ice core analysis, biofuels, recycling and the generation of energy/electricity.

#### Career Readiness (Standard 9):

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth
- 9.2.12.CAP.5: Assess and modify a personal plan to support current interests and postsecondary plans.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
- 9.4.12.CT.3: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others
- 9.4.12.DC.8: Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem.
- 9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others.



9.1.12.EG.3: Explain how individuals and businesses influence government policies.

9.1.12.EG.5: Relate a country's economic system of production and consumption to building personal wealth, the mindset of social comparison, and achieving societal responsibilities.

### Learning Targets

**Standards:** 2020 New Jersey Student Learning Standards Science

**Content Statements:** IIS-PS3: Energy  
HS-ESS3: Earth and Human Activity  
HS-LS2: Ecosystems: Interactions, Energy, and Dynamics  
HS-LS4: Biological Evolution: Unity and Diversity  
HS-ETS1: Engineering Design

**CPI#:** **Cumulative Progress Indicator (CPI):**

HS-PS3-1 Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).

HS-PS3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS-PS3-4 Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

HS-PS3-5 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

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



|           |                                                                                                                                                                                                                                                  |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HS-ESS3-2 | Evaluate competing design solutions for developing, conserving, managing, and utilizing energy and mineral resources based on the associated economic, social, environmental, and geopolitical costs and risks, as well as benefits.             |
| HS-ESS3-3 | Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.                                                                              |
| HS-ESS3-4 | Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.                                                                                                                |
| 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 to Earth systems.                                   |
| 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).                                                              |
| 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-LS2-3  | Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.                                                                                                          |
| HS-LS2-4  | Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.                                                                                                                 |
| HS-LS2-5  | Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.                                                                          |
| 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.                                                                                                                                |
| HS-LS4-5  | Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species. |
| HS-LS4-6  | Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.                                                                                                                                  |



|              |                                                                                                                                                                                                                                                                 |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HS-ETS1-1    | Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.                                                                                                      |
| HS-ETS1-2    | Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.                                                                                                            |
| HS-ETS1-3    | Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. |
| IIS-ETS1-4   | Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.                                                  |
| 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.                                                                      |
| 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.                                                                       |
| 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.                                                                   |
| 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.                                                       |
| WHST.9-12.2  | Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.                                                                                                                  |
| MP.2         | Reason abstractly and quantitatively.                                                                                                                                                                                                                           |
| MP.4         | Model with mathematics.                                                                                                                                                                                                                                         |
| N-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.                                     |
| N-Q.A.2      | Define appropriate quantities for the purpose of descriptive modeling.                                                                                                                                                                                          |
| N-Q.A.3      | Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.                                                                                                                                                                 |
| 8.2.12.ED.6  | Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).                                                                                                                         |
| 8.2.12.ETW.1 | Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.                                                                                            |
| 8.2.12.EC.2  | Assess the positive and negative impacts of emerging technologies on developing countries and evaluate how individuals, non-profit organizations, and governments have responded.                                                                               |

**Science and Engineering Practices**



### **Developing and Using Models**

Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-2), (HS-PS3-5)

### **Planning and Carrying Out Investigations**

Planning and carrying out investigations to answer questions or test solutions to problems in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS3-4)

### **Using Mathematics and Computational Thinking**

Mathematical and computational thinking at the 9–12 builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.

- Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-PS3-1)

### **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/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. (HS-PS3-3)

## **Disciplinary Core Ideas**

### **PS3.A: Definitions of Energy**

- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-1), (HS-PS3-2)
- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy. (HS-PS3-2) (HS-PS3-3)



- These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)

### **PS3.B: Conservation of Energy and Energy Transfer**

- Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system. (HS-PS3-1)
- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems. (HS-PS3-1), (HS-PS3-4)
- Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior. (HS-PS3-1)
- The availability of energy limits what can occur in any system. (HS-PS3-1)
- Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). (HS-PS3-4)

### **PS3.C: Relationship Between Energy and Forces**

- When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5)

### **PS3.D: Energy in Chemical Processes**

- Although energy cannot be destroyed, it can be converted to less useful forms—for example, to thermal energy in the surrounding environment. (HS-PS3-3), (HS-PS3-4)

### **ETS1.A: Defining and Delimiting Engineering Problems**

- Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (secondary to HS-PS3-3)

## **Crosscutting Concepts**

### **Cause and Effect**

- Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS3-5)

### **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-PS3-4)



- Models can be used to predict the behavior of a system, but these predictions have limited precision and reliability due to the assumptions and approximations inherent in models. (HS-PS3-1)

#### **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-PS3-3)
- Energy cannot be created or destroyed—only moves between one place and another place, between objects and/or fields, or between systems. (HS-PS3-2)

#### **Influence of Science, Engineering, and Technology on Society and the Natural World**

- Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks. (HS-PS3-3)

#### **Scientific Knowledge Assumes an Order and Consistency in Natural Systems**

- Science assumes the universe is a vast single system in which basic laws are consistent. (HS-PS3-1)

#### **Unit Essential Questions:**

- How can you support a sustainable future?
- How does climate change impact low-lying areas?
- What effect nonrenewable energy resources have on the environment?
- Do the benefits of renewable energy outweigh the costs?
- What can we do with old landfills?

#### **Unit Enduring Understandings:**

- Global Climate Change: studying climate change, effects of climate change and responding to climate change.
- Nonrenewable Energy: overview of energy, fossil fuels and their consequences, and nuclear power.
- Renewable Energy Alternatives: biomass and geothermal energies, hydropower and ocean energies, solar and wind energies, and energy from hydrogen.
- Waste Management: municipal and industrial waste, minimizing solid waste, and hazardous waste.

#### **Unit Learning Targets:**

Students will....

- Describe factors that affect how the sun warms Earth.
- Discuss the role of wind patterns in determining climate.
- Explain how the oceans affect climate.
- Describe how climate is affected by topography, volcanoes, regional vegetation, and periodic changes in Earth's orbit.



- Identify evidence of global warming.
- Explain three methods used to study climate change.
- State the probable cause of global climate change.
- State ways in which the warming atmosphere affects ecosystems and organisms.
- Explain how climate change is affecting people now.
- Predict future effects of climate change on people.
- Define energy and differentiate between kinetic and potential energy.
- Identify different forms of energy.
- Describe how human society uses energy resources.
- Explain how fossil fuels formed.
- Describe the uses of coal and how it is removed from the ground.
- Describe the uses of oil and how it is extracted.
- Explain the characteristics and uses of natural gas.
- Predict the future of fossil fuels.
- Explain how pollutants released by fossil fuels damage health and the environment.
- Describe the environmental and health effects of mining and drilling.
- Explain the implications of dependence on foreign countries for fossil fuels.
- Explain why energy conservation is important.
- Relate nuclear fission to the production of energy.
- Describe how a nuclear power plant generates electricity.
- Identify the advantages and disadvantages of nuclear power.
- Contrast nuclear fusion with nuclear fission, and explain the issues related to nuclear fusion.
- Explain the benefits and current status of renewable energy resources.
- Define biomass energy and explain how it is used.
- Describe how geothermal energy is harnessed and used.
- Explain how river water can be used to generate electricity.
- Identify benefits and costs of hydropower.
- Describe how energy from the ocean can generate electricity.
- Describe techniques for using solar energy to heat buildings and generate electricity.
- Analyze the benefits and costs of solar energy.
- Explain how wind energy can be used to produce electricity.
- Analyze the benefits and costs of wind energy.
- Describe how hydrogen fuel can be produced.
- Explain the way fuel cells work and how they are used.
- Identify the three categories of waste.
- Describe conventional waste disposal methods.
- Discuss the importance of reducing waste.
- Describe how composting and recycling help reduce the amount of waste.
- Define hazardous waste.
- Describe some of the sources of hazardous wastes.
- Describe current methods for hazardous waste disposal.
- Describe the danger of radioactive wastes.
- Identify agencies that regulate hazardous waste.



### Evidence of Learning

**Summative Assessment:** 37 days

**Equipment Needed:** Textbook, computer, internet access

**Teacher Resources:** [Savvas Realize](#), [NJCTL environmental science](#), [NASA climate resources](#),

#### Formative Assessments:

Savvas Assessments

- Chapter 16: Lesson 1 Assessment
- Chapter 16: Lesson 2 Assessment
- Chapter 16: Lesson 3 Assessment
- Chapter 16: Lesson 4 Assessment
- Chapter 16: Chapter Test A
- Chapter 16: Chapter Test B
- Chapter 16: Assessment
- Chapter 17: Lesson 1 Assessment
- Chapter 17: Lesson 2 Assessment
- Chapter 17: Lesson 3 Assessment
- Chapter 17: Lesson 4 Assessment
- Chapter 17: Chapter Test A
- Chapter 17: Chapter Test B
- Chapter 17: Assessment
- Chapter 18: Lesson 1 Assessment
- Chapter 18: Lesson 2 Assessment
- Chapter 18: Lesson 3 Assessment
- Chapter 18: Lesson 4 Assessment
- Chapter 18: Chapter Test A
- Chapter 18: Chapter Test B
- Chapter 18: Assessment
- Chapter 19: Lesson 1 Assessment
- Chapter 19: Lesson 2 Assessment
- Chapter 19: Lesson 3 Assessment
- Chapter 19: Chapter Test A
- Chapter 19: Chapter Test B
- Chapter 19: Assessment



### Lesson Plans

| Lesson                                              | Time Frame       |
|-----------------------------------------------------|------------------|
| Lesson 1 Lesson 16.2 - Climate Change Investigation | 1.5 hours/2 days |
| Lesson 2 Lesson 17.2 - Fossil Fuels                 | 1.5 hours/2 days |
| Lesson 3 Lesson 18.3 - Solar and Wind Energy        | 1.5 hours/2 days |

**Teacher Notes:**

These lessons will facilitate students learning the key concepts of the units using a group setting. It is recommended that teachers use some technology (socrative.com, Google Forms, or Kahoot) or white boards to have students provide immediate response and feedback. Teachers will base the progress of these lessons on the responses provided by students and groups during each lesson.

**Curriculum Development Resources/Technology Resources:**

*Click the links below to access additional resources used to design this unit:*

[Savvas Realize](#)

[Socrative](#)

[Google Form](#)

[Kahoot](#)

[NJCTL environmental science](#)

[NASA climate resources](#)

[World Energy Statistics](#)



### Lesson Plan 1 Template

|                                     |                                                   |                               |
|-------------------------------------|---------------------------------------------------|-------------------------------|
| Content Area: Environmental Science | Lesson Title: 16.2 - Climate Change Investigation | Time Frame: 1.5 hours/ 2 days |
|-------------------------------------|---------------------------------------------------|-------------------------------|

### Lesson Components

#### 21<sup>st</sup> Century Themes

- |                                                      |                                                                                     |
|------------------------------------------------------|-------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Global Awareness | <input type="checkbox"/> Financial, Economic, Business and Entrepreneurial Literacy |
| <input type="checkbox"/> Civic Literacy              | <input checked="" type="checkbox"/> Health Literacy                                 |

#### 21<sup>st</sup> Century Skills

- |                                                               |                                                                           |                                                                               |
|---------------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Creativity and Innovation | <input checked="" type="checkbox"/> Critical Thinking and Problem Solving | <input checked="" type="checkbox"/> Information Literacy                      |
| <input checked="" type="checkbox"/> Life and Career Skills    | <input checked="" type="checkbox"/> Communication and Collaboration       | <input type="checkbox"/> Media Literacy <input type="checkbox"/> ICT Literacy |

#### **Interdisciplinary Connections:**

Mathematics and ELA

#### **Integration of Technology:**

- Students will use technology to access the Savvas resource online and interact with the graphs, data, tables and figures provided on the website.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

**Equipment Needed:** Students will have access to their online Savvas textbook resource.

| Goals/Objectives                                                                                                                                                                                                        | Learning Activities/<br>Instructional Strategies                                                                                                                                                                                                                                                                               | Formative Assessment Tasks                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Students will: <ul style="list-style-type: none"> <li>Identify evidence of global warming.</li> <li>Explain three methods used to study climate change.</li> <li>State the probable cause of global warming.</li> </ul> | Lesson Sequence <ol style="list-style-type: none"> <li>Anchoring Phenomenon: Glaciers are retreating, sea levels are rising, and the ten warmest years on record have all occurred within recent history. How do scientists know Earth's climate is changing, and how can they distinguish long-term climate trends</li> </ol> | <ul style="list-style-type: none"> <li>Ask and evaluate: What is the effect of increased burning of fossil fuels?</li> <li>Ask and evaluate: What is the effect of increased carbon dioxide in the atmosphere?</li> <li>Have students take the Lesson 16.2 Assessment.</li> </ul> |



- from normal weather variation?
2. Have students research specific examples of evidence for climate change using NASA.gov climate resources.
  3. Have a class symposium where students share their ideas and create a joint list of evidence.
  4. Discuss with students the following ways to study climate change: using direct measurement, proxy indicators, and computer models.
  5. Have students turn back to the Quick Lab in Lesson 11.2. Point out that tree rings are one type of proxy indicator.
  6. Students analyze how atmospheric temperature has changed between 1880 and 2018.
  7. Then, have them work in pairs to list methods of studying climate.

**Differentiation:**

Help students understand some of the cause-and-effect relationships identified in this section of text. Draw two cause-and-effect diagrams on the board (each with one box labeled "Cause," one box labeled "Effect," and an arrow pointing from the Cause box to the Effect box). In the first diagram add the following to the Cause box: "Increased burning of fossil fuels."

**Resources Provided:**

- [Savvas Realize](#)
- [Socrative](#)
- [Google Form](#)
- [NASA climate resources](#)



### Lesson Plan 2 Template

Content Area: Environmental Science      Lesson Title: 17.2 - Fossil Fuels      Time Frame: 1.5 hours/2 days

### Lesson Components

#### 21<sup>st</sup> Century Themes

- ☒ Global Awareness    ☐ Financial, Economic, Business and Entrepreneurial Literacy  
☐ Civic Literacy        ☒ Health Literacy

#### 21<sup>st</sup> Century Skills

- ☒ Creativity and Innovation    ☒ Critical Thinking and Problem Solving    ☒ Information Literacy  
☒ Life and Career Skills    ☒ Communication and Collaboration    ☐ Media Literacy    ☐ ICT Literacy

#### **Interdisciplinary Connections:**

Mathematics and ELA

#### **Integration of Technology:**

- Students will use technology to access the Savvas resource online and interact with the graphs, data, tables and figures provided on the website.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

**Equipment Needed:** Students will have access to their online Savvas textbook resource.

| Goals/Objectives                                                                                                                                                                                                                                                                                                                                            | Learning Activities/<br>Instructional Strategies                                                                                                                                                                                                                                                                               | Formative Assessment Tasks                                                                                                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Students will: <ul style="list-style-type: none"> <li>• Explain how fossil fuels formed.</li> <li>• Describe the uses of coal and how it is removed from the ground.</li> <li>• Describe the uses of oil and how it is extracted.</li> <li>• Explain the characteristics and uses of natural gas.</li> <li>• Predict the future of fossil fuels.</li> </ul> | Lesson Sequence <ol style="list-style-type: none"> <li>1. Anchoring Phenomenon: Modern society depends heavily on coal, oil, and natural gas for transportation, electricity, and manufacturing, yet these resources formed over millions of years and exist in limited quantities. Why have fossil fuels become so</li> </ol> | <ul style="list-style-type: none"> <li>• Ask and evaluate: Is natural gas a gas?</li> <li>• Have students complete the Lesson 17.2 Assessment.</li> </ul> |



essential to human civilization, and what challenges arise from our dependence on them?

2. Have students investigate the different ways people around the world have used coal throughout history. Divide your class into groups and have each group study a different fossil fuel: oil, coal, and natural gas.
3. Have the groups prepare presentations of their findings, and volunteer to share those findings with the class.
4. Evaluate which products in use today are made of petroleum? What are the modern uses of coal, oil and natural gas?
5. Have students access the Global Energy Yearbook to evaluate the consumption, production and trade by country of coal, oil and natural gas. Have students form trends and patterns from the data.

**Differentiation:**

Allow students to work in pairs to develop notecards and graphic organizers for the terms and concepts in the lesson.

**Resources Provided:**

- [Savvas Realize](#)
- [Socrative](#)
- [Google Form](#)
- [World Energy Statistics](#)
- [NASA climate resources](#)



### Lesson Plan 3 Template

|                                     |                                            |                               |
|-------------------------------------|--------------------------------------------|-------------------------------|
| Content Area: Environmental Science | Lesson Title: 18.3 - Solar Wind and Energy | Time Frame: 1.5 hours/ 2 days |
|-------------------------------------|--------------------------------------------|-------------------------------|

### Lesson Components

#### 21<sup>st</sup> Century Themes

- |                                                      |                                                                                     |
|------------------------------------------------------|-------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Global Awareness | <input type="checkbox"/> Financial, Economic, Business and Entrepreneurial Literacy |
| <input type="checkbox"/> Civic Literacy              | <input checked="" type="checkbox"/> Health Literacy                                 |

#### 21<sup>st</sup> Century Skills

- |                                                               |                                                                           |                                                                               |
|---------------------------------------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Creativity and Innovation | <input checked="" type="checkbox"/> Critical Thinking and Problem Solving | <input checked="" type="checkbox"/> Information Literacy                      |
| <input checked="" type="checkbox"/> Life and Career Skills    | <input checked="" type="checkbox"/> Communication and Collaboration       | <input type="checkbox"/> Media Literacy <input type="checkbox"/> ICT Literacy |

#### **Interdisciplinary Connections:**

Mathematics and ELA

#### **Integration of Technology:**

- Students will use technology to access the Savvas resource online and interact with the graphs, data, tables and figures provided on the website.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

**Equipment Needed:** Students will have access to their online Savvas textbook resource. For each student: two clear, resealable bags; water (500 mL); thermometer, pinwheels.

| Goals/Objectives                                                                                                                                                                                                                                                                                                                              | Learning Activities/<br>Instructional Strategies                                                                                                                                                                                                                                                                                                 | Formative Assessment<br>Tasks                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Students will: <ul style="list-style-type: none"> <li>Describe techniques for using solar energy to heat buildings and generate electricity.</li> <li>Analyze the benefits and costs of solar energy.</li> <li>Explain how wind energy can be used to produce electricity.</li> <li>Analyze the benefits and costs of wind energy.</li> </ul> | Lesson Sequence <ol style="list-style-type: none"> <li><b>Anchoring Phenomenon:</b> Some regions can generate large amounts of electricity from sunlight or wind, while others cannot efficiently rely on these same energy sources. Why are renewable energy resources abundant in some places but limited in others, and how should</li> </ol> | <ul style="list-style-type: none"> <li>Ask and evaluate: How does a rotating pinwheel generate electricity?</li> <li>Ask and evaluate: What are the pros and cons of solar power? How is it generated?</li> <li>Have students complete Lesson 18.3 Assessment.</li> </ul> |



- communities decide which energy sources to develop?
2. Distribute for each student: two clear resealable bags, 500 mL of water, and a thermometer.
  3. Choose an appropriate outside location for students to place their bags of water.
  4. Students investigate the effect of solar energy on the temperature of water.
  5. Have students review the benefits and costs of solar power. Point out that generation of solar energy is dependent upon weather. Have students locate about where their city is in Ch18-Figure 16.
  6. Have students use the information in the map to draw a conclusion about how feasible it would be for their city to rely on solar power.
  7. Have students use pinwheels to introduce the concept of wind power. Distribute to each group of students one or more pinwheels. Have an electric fan available for students to use to investigate how changing airflow can affect the speed at which the pinwheel turns.
  8. Students examine a map of wind patterns to understand why different areas of the U.S. are better suited for wind farms.
  9. Have students access the Global Energy Yearbook to



|  |                                                                                                                                           |  |
|--|-------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | evaluate the consumption, production and trade by country of solar and wind energy. Have students form trends and patterns from the data. |  |
|--|-------------------------------------------------------------------------------------------------------------------------------------------|--|

**Differentiation:**

Have students make two index cards: one for solar energy and one for wind energy. Have students review the chapter, and write on their index cards short summaries of what they learned about each topic. Allow access to cards for some period of time during the lesson 18.3 assessment.

**Resources Provided:**

- [Savvas Realize](#)
- [Socrative](#)
- [Google Form](#)
- [World Energy Statistics](#)
- [NASA climate resources](#)



### Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

| Lesson Activities                                                                                                    | Strongly | Moderately | Weakly |
|----------------------------------------------------------------------------------------------------------------------|----------|------------|--------|
| Are challenging <b>Strongly</b> and require higher order thinking and problem solving skills                         | <b>X</b> |            |        |
| Allow for student choice                                                                                             |          | <b>X</b>   |        |
| Provide scaffolding for acquiring targeted knowledge/skills                                                          | <b>X</b> |            |        |
| Integrate global perspectives                                                                                        | <b>X</b> |            |        |
| Integrate 21st century skills                                                                                        | <b>X</b> |            |        |
| Provide opportunities for interdisciplinary connection and transfer of knowledge and skills                          | <b>X</b> |            |        |
| Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills            | <b>X</b> |            |        |
| Are varied to address different student learning styles and preferences                                              | <b>X</b> |            |        |
| Are differentiated based on student needs                                                                            |          | <b>X</b>   |        |
| Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process    | <b>X</b> |            |        |
| Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives | <b>X</b> |            |        |
| Provide opportunities for student reflection and self- assessment                                                    | <b>X</b> |            |        |
| Provide data to inform and adjust instruction to better meet the varying needs of learners                           |          | <b>X</b>   |        |

### Curriculum Design Template

|                      |                       |                           |           |                    |                             |
|----------------------|-----------------------|---------------------------|-----------|--------------------|-----------------------------|
| <b>Content Area:</b> | Environmental Science | <b>Grade Level:</b>       | 11-12     | <b>Unit Title:</b> | Toward a Sustainable Future |
| <b>Created:</b>      | 2023                  | <b>Board Approved on:</b> | Type Here |                    |                             |



## SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21<sup>ST</sup> CENTURY  
GLOBAL SKILLS

### IEP AND 504 ACCOMMODATIONS AND MODIFICATIONS FOR EARLY CHILDHOOD AND ELEMENTARY SCHOOL STUDENTS:

Large print textbooks  
Textbooks for at-home use  
Additional time for assignments  
Review of directions  
Use of mnemonics  
Have student restate information  
Concrete examples  
Adaptive writing utensils  
Support auditory presentations with visuals  
Use of a study carrel  
Assistance in maintaining uncluttered space  
Weekly home-school communication tools (notebook, daily log, phone calls or email messages)  
Space for movement or breaks  
Study sheets and teacher outlines  
Extra visual and verbal cues and prompts  
Math sheets with highlighted instructions  
Graph paper to assist in organizing or lining up math problems  
Use of computers and calculators  
Books on tape  
Graphic organizers  
Quiet corner or room to calm down and relax when anxious  
Preferential seating  
Alteration of the classroom arrangement  
Reduction of distractions  
Answers to be dictated  
Hands-on activities  
Use of manipulatives  
No penalty for spelling errors or sloppy handwriting  
Follow a routine/schedule  
Alternate quiet and active time  
Teach time management skills  
Rest breaks  
Verbal and visual cues regarding directions and staying on task  
Agenda book and checklists  
Adjusted assignment timelines  
Visual daily schedule



## SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21<sup>ST</sup> CENTURY  
GLOBAL SKILLS

Varied reinforcement procedures  
Immediate feedback  
Work-in-progress check  
Personalized examples

### **TESTING AND ASSESSMENT ACCOMMODATIONS AND MODIFICATIONS:**

Answers to be dictated  
Frequent rest breaks  
Additional time  
Oral testing  
Untimed tests  
Choice of test format (multiple-choice, essay, true-false)  
Alternate ways to evaluate (projects or oral presentations instead of written tests)  
Accept short answers  
Open-book tests  
Read test and directions to student  
Provide study outline prior to tests  
Highlight key directions  
Test in alternative site  
Use of calculator  
Extra credit option  
Preview test procedures  
Simplified test wording; rephrased test questions and/or directions

### **GENERAL ACCOMMODATIONS AND MODIFICATIONS:**

Use of alternative books or materials on the topic being studied  
Computerized spell-check support  
Word bank of choices for answers to test questions  
Provision of calculator and/or number line for math tests  
Reworded questions in simpler language  
Projects instead of written reports  
Highlighting important words or phrases in reading assignments  
Modified workload or length of assignments/tests  
Modified time demands  
Modified grades based on IEP

### **BEHAVIOR ACCOMMODATIONS MODIFICATIONS:**



## SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21<sup>ST</sup> CENTURY  
GLOBAL SKILLS

Breaks between tasks  
Cue expected behavior  
Daily feedback to student  
Have contingency plans  
Use de-escalating strategies  
Use positive reinforcement  
Use proximity/touch control  
Use peer supports and mentoring  
Model expected behavior by adults  
Have parent sign homework  
Have parent sign behavior chart  
Set and post class rules  
Chart progress and maintain data



## SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21<sup>ST</sup> CENTURY  
GLOBAL SKILLS

### IEP AND 504 ACCOMMODATIONS AND MODIFICATIONS FOR MIDDLE AND HIGH SCHOOL STUDENTS:

- Large print textbooks
- Textbooks for at-home use
- Additional time for assignments
- A locker with adapted lock
- Review of directions
- Review sessions
- Use of mnemonics
- Have student restate information
- Provision of notes or outlines
- Concrete examples
- Adaptive writing utensils
- Support auditory presentations with visuals
- Weekly or bi-weekly home-school communication
- Space for movement or breaks
- Study sheets and teacher outlines
- Extra visual and verbal cues and prompts
- Lab and math sheets with highlighted instructions
- Graph paper to assist in organizing or lining up math problems
- Use of tape recorder for lectures
- Use of Interactive notebook
- Use of a scribe
- Use of computers and calculators
- Books on tape
- Graphic organizers
- Quiet corner or room to calm down and relax when anxious
- Preferential seating
- Alteration of the classroom arrangement
- Reduction of distractions
- Answers to be dictated
- Hands-on activities
- Ability to type all assignments
- Follow a routine/schedule
- Teach time management and organizational skills
- Rest breaks
- Verbal and visual cues regarding directions and staying on task
- Agenda book and checklists
- Daily check-in with case manager or special education teacher
- Adjusted assignment timelines
- Visual daily schedule



## SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21<sup>ST</sup> CENTURY  
GLOBAL SKILLS

Varied reinforcement procedures  
Immediate feedback  
Work-in-progress check  
Personalized examples

### **TESTING AND ASSESSMENT ACCOMMODATIONS AND MODIFICATIONS:**

Answers to be dictated  
Frequent rest breaks  
Additional time  
Oral testing  
Choice of test format (multiple-choice, essay, true-false)  
Alternate ways to evaluate (projects or oral presentations instead of written tests)  
Accept short answers  
Open-book or open-note tests  
Read test and directions to student  
Provide study guides prior to tests  
Highlight key directions  
Test in alternative site  
Use of calculator  
Extra credit option  
Pace long-term projects  
Preview test procedures  
Simplified test wording; rephrased test questions and/or directions

### **GENERAL ACCOMMODATIONS AND MODIFICATIONS:**

Allow outlining, instead of writing for an essay or major project  
Use of alternative books or materials on the topic being studied  
Computerized spell-check support  
Word bank of choices for answers to test questions  
Provision of calculator for math tests  
Film or video supplements in place of reading text  
Reworded questions in simpler language  
Projects instead of written reports  
Highlighting important words or phrases in reading assignments  
Modified workload or length of assignments/tests  
Modified time demands



## **SPRINGFIELD PUBLIC SCHOOLS**

**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21<sup>ST</sup> CENTURY  
GLOBAL SKILLS**

Pass/no pass option  
Modified grades based on IEP

### **BEHAVIOR ACCOMMODATIONS FOR STUDENTS:**

Breaks between tasks  
Cue expected behavior  
Daily feedback to student  
Have contingency plans  
Use de-escalating strategies  
Use positive reinforcement  
Use proximity/touch control  
Use peer supports and mentoring  
Model expected behavior by adults  
Have parent sign homework  
Set and post class rules  
Chart progress and maintain data



## SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21<sup>ST</sup> CENTURY  
GLOBAL SKILLS

### Accommodations and Modifications for ESL Students

- Give tests orally
- Give instructions/directions in writing and orally
- Assign a peer tutor, same language or English speaking
- Allow use of bilingual/translation dictionary
- Provide summaries of text or study guides of particular chapters
- Allow errors in speaking
- Allow errors in writing
- Accept writing in first language
- Highlight key vocabulary
- Reduce amount of work required
- Assess comprehension through demonstration or other alternative means (gestures, drawings)
- Rephrase questions, directions, and explanations
- Reduce multiple choices on assessments
- Provide study guides and/ or outlines
- Shorten reading assignments
- Allow extended time for test/project completion
- Use of audio books
- Use of graphic organizers
- Use reduced text, so that print is not dense
- Use visuals/pictures throughout lesson/unit/assignment
- Adapt homework to reflect language proficiency/home support
- Adapt homework to reflect home support
- Provide hands-on activities and explanations
- Allow extended time to answer questions, and permit drawing, as an explanation
- Use of translation dictionaries to locate words in the native language
- Use anecdotal records and portfolio of work as forms of assessment
- Use story retellings to assess comprehension

## **What Does the Gifted and Talented Experience Look Like?** *Springfield Public Schools*

### **Mission Statement**

The Gifted and Talented Program of the Springfield Public Schools aims to provide a meaningful and rigorous education that instills the value of lifelong learning and empowers all students to reach their full potential and become self-fulfilled creative leaders in accordance with the comprehensive standards of our state. We accomplish this by offering challenging, real-world experiences in a student-centered environment.

We recognize that students come from diverse socioeconomic, cultural, and ethnic backgrounds, and the mission of the gifted and talented program is to provide opportunities for students to explore their intellectual, creative, and artistic gifts and talents within the classroom and with beyond-the-classroom experiences. It is essential to provide diverse, appropriate, and ongoing learning experiences and environments that incorporate students' academic, psychological, and social needs. Our responsibility is to provide students with educational alternatives that teach, challenge, and expand their knowledge, while simultaneously stressing the development of independent and self-directed learners who continuously generate questions, analyze, synthesize, and evaluate information and ideas.

New Jersey Administrative Code 6A:8-3.1 defines students who are gifted and talented as those students who possess or demonstrate high levels of ability in one or more content areas when compared to their chronological peers in the local district and who require modification of their educational program if they are to achieve in accordance with their capabilities.

## Goals:

To support our mission, we have established the following goals to guide our work:

- To infuse into the general education program a broad range of activities for high-level learning that will challenge all students to perform at advanced levels, and provide extended opportunities, resources, and support in particular areas where student interest or talent is demonstrated.
- To provide a continuum of gifted education services that will strengthen the total school program, offer enriching and challenging learning opportunities for all students, and provide specialized learning experiences
- To promote achievement of students' best potentials and increased ability.

Through a productive and collaborative relationship among the building principals, classroom teachers, and the Gifted and Talented teacher, our schools can create programming that will enhance the learning experience for every student and serve the unique and specialized needs of students currently demonstrating gifted behaviors.

Elements of the Schoolwide Enrichment Model, W.I.N (What I Need), differentiated instruction, advanced classes, or individual programs into a student's regular instruction program are integral to this overarching framework for gifted education in the Springfield School District.

*Reference Board Policy and Regulation 2464 – Gifted and Talented Pupils (M)*

### **Early Childhood Center** **Edward V. Walton**

#### Schoolwide Virtual Enrichment

All first and second grade students have access to the [Gifted and Talented Virtual Classroom](#). This virtual classroom is a space for students to complete various challenges and enrichment opportunities at their own pace. Students can receive feedback and additional adaptable resources to meet their individual learning needs. The virtual classroom design expands accessibility to enrichment resources and allows students to choose learning activities according to their unique interests and abilities. The purpose of the activities is to encourage problem-solving, develop critical thinking

skills, and expand curiosity and imagination. Activities are aligned to the New Jersey Student Learning Standards.

#### Gifted and Talented Teacher as a Resource

The Gifted and Talented teacher serves as a resource to all teachers within Edward V. Walton School. Teachers seeking resources for their high-ability learners will receive additional support from the Gifted and Talented teacher in various ways. This support may include additional units of study, challenging resources, and student projects.

### **Elementary Schools**

**James Caldwell**

**Thelma L. Sandmeier**

The goal is to engage small groups of students in intensive learning experiences through standards-based, rigorous, and relevant units of study that supplement, not supplant, the grade-level curriculum and support students' unique learning needs.

#### Enrichment Experience Grade 3

Beginning in third grade, the G&T teacher will cycle through all classrooms to work on problem-solving and enrichment tasks with students. Driven by assessment data, academic performance, student interest, and teacher observation, small groups of students will meet with the G&T teacher during W.I.N. (What I Need) periods throughout the week that the teacher is assigned to their classroom teacher. Groupings will be flexible and monitored to best meet each student's needs throughout the school year. Activities will include brain teasers, puzzles, strategic thinking, problem-solving, and STEM challenges.

#### Targeted Gifted and Talented Programing Grades 4-5

Students may become identified as Gifted and Talented in fourth grade. Students that are identified may receive support from the G&T Teacher for up to five periods (200 minutes) a week during W.I.N. (What I Need) periods. Identified students will meet to explore grade-level content while incorporating depth and complexity in a student-centered, problem-based environment. The Gifted and Talented Program aims to provide students with various advanced and challenging learning experiences across content areas to promote independent thinking skills, refine critical thinking and communication skills, cultivate joy in learning, and expand student interests through problem-solving. The instruction that students receive incorporates 21st Century Skills and advanced content that is challenging, hands-on, and relevant to the real world.

### *Strategies and Practices that Support Gifted and Talented Students*

- Adjusted Pace of Lessons
- Inquiry-Based Instruction
- Higher-Order Thinking Activities
- Interest-Based Content
- Real World Problem Solving/Problem Based Learning
- Independent Study/Passion Projects
- Units of Study with Like-Minded Peers

### Schoolwide Virtual Enrichment

All JCS and TLS students have access to grade level-specific [Gifted and Talented Virtual Classrooms](#). These virtual classrooms are a space for students to complete various challenges and enrichment opportunities at their own pace. Students are able to receive feedback and additional opportunities based on their needs. The virtual classrooms have expanded the accessibility of enrichment resources directly to the students and allows for students to choose opportunities according to their interests and abilities. The purpose of the activities is to encourage problem solving, develop critical thinking skills, and expand curiosity and imagination in conjunction with the New Jersey Student Learning Standards.

### Gifted and Talented Teacher as a Resource

In addition to classroom support, the Gifted and Talented teacher also serves as a resource to all teachers in the building. Teachers that are seeking resources for their high ability learners will receive additional support from the Gifted and Talented teacher in various ways. This may include additional units of study, challenging resources, student projects, and meeting with the G&T teacher as needed.

### Additional Enrichment Opportunities

Across all grade levels 3-5, as recommended by the classroom teacher, students exhibiting a need for additional enrichment may have the opportunity to meet with the G&T teacher as the schedule allows. Groupings will be flexible and monitored to best meet the students' needs throughout the school year. Activities will include, brain teasers, puzzles, strategic thinking activities, problem-solving challenges, and STEM challenges. Students engage in an extended process of asking questions, using resources, and developing answers that lead to thinking about what and how they are learning. Students are held accountable for how they work and use their time by demonstrating their learning through products or presentations.

Students self-select to participate in individual and/or group projects based on interest and commitment. The classroom teacher and/or the enrichment teacher will help guide and monitor student exploration of chosen topics, facilitating their learning with resources and teaching of needed skills.

**Secondary Schools**  
**Florence M. Gaudineer Middle School**  
**Jonathan Dayton High School**

Grades 6-12: Access to specific content programs with higher levels of academic challenges (i.e. Pre-Algebra, Accelerated Communication Arts, and Advanced Placement Classes)

Dual Credit Courses provide students the opportunity to obtain high school credit, and college credit, simultaneously through partnerships with several institutions.

Project Lead the Way (PLTW) students become builders of technology by engaging in real world activities. Students are empowered as design thinkers collaborating on real world projects.

**Gifted and Talented Identification Criteria**

The Springfield Schools Gifted and Talented Program recognizes that students require differentiated learning experiences beyond the core curriculum being taught because of their advanced abilities in one or more content areas. These students may also have other cognitive qualities such as curiosity, creativity, motivation, leadership, and passion that require modifications to their academic experience.

**Multiple Measures of Eligibility**

Kindergarten through grade twelve identification process for gifted and talented students includes multiple measures. Multiple measures may include but are not limited to: achievement test scores; grades; student performance or products; intelligence testing; parent, student, and/or teacher recommendation; and other appropriate measures. The identification methodology is developmentally appropriate, non-discriminatory, and related to the programs and services offered by the Springfield School District. The identification procedures are reviewed annually.

*According to N.J.A.C. 6A:8-3.1, all public school districts must have a board-approved gifted and talented identification process and provide services for identified students enrolled in the grades of that school district. The regulations require that identification and services be made available to students in grades K-12.*

When students are recommended for the Gifted and Talented Program there are multiple measures that are considered to determine if services are necessary and appropriate. The assessments used are as follows:

- Cognitive Abilities Test (CogAT)
- Classroom Performance/Student Portfolios
- DRA2 Level
- iReady Diagnostic Scores
- Gifted Indicators Checklist
- Start Strong/NJSLA Assessment Data

*The N.J.A.C. requires that students be compared to their chronological peers in the local school district. The New Jersey Department of Education has not established state-level criteria for identifying students who are gifted, such as mandated tests or assessments, grade point averages, or IQ scores. Local school districts must use multiple measures to identify students.*

#### Procedures

<https://www.straussesmay.com/seportal/Public/DistrictPolicy.aspx?policyid=2464&id=b8a33a9f505e4998a6db3fb8e1de778b>

### Gifted and Talented Program Identification Matrix

**Minimum Score Required for Consideration: 14 Points**

| 1 Point                                                     | 2 Points                                          | 3 Points                                                    |
|-------------------------------------------------------------|---------------------------------------------------|-------------------------------------------------------------|
| Cogat Assessment<br>Overall Stanine Score of a 7            | Cogat Assessment<br>Overall Stanine Score of an 8 | Cogat Assessment<br>Overall Stanine Score of a 9            |
| iReady Math Assessment<br>Just Below Current Grade<br>Level | iReady Math Assessment<br>On Grade Level          | iReady Math Assessment<br>½ Year + Above Current<br>Level   |
| iReady ELA<br>On Grade Level                                | iReady ELA<br>½ Year Above Current Level          | iReady ELA<br>One Full Grade Level +<br>Above Current Level |
| NJSLA Math<br>Approaching Expectations                      | NJSLA Math<br>Met Expectations                    | NJSLA Math<br>Exceed Expectations                           |
| NJSLA ELA<br>Approaching Expectations                       | NJSLA ELA<br>Met Expectations                     | NJSLA ELA<br>Exceed Expectations                            |
| HOPE Teacher Rating Scale<br>Raw Score: 11 - 29             | HOPE Teacher Rating Scale<br>Raw Score: 30 - 49   | HOPE Teacher Rating Scale<br>Raw Score: 50-66               |

Team meetings present the opportunity to review data and assess the educational needs of all students. Teacher provides examples of student work exhibiting above and beyond grade level expectations, creativity, leadership, critical and abstract thinking. Programs for gifted and talented students will be periodically evaluated for their continuing efficacy and adjusted accordingly. The parent of any student identified as gifted or talented shall be consulted regarding any program designed to address the student's particular needs.

#### Resource Links

[https://riversideinsights.com/cognitive\\_abilities\\_test](https://riversideinsights.com/cognitive_abilities_test)

<https://www.curriculumassociates.com/programs/i-ready-learning>

<https://www.nj.gov/education/assessment/resources/>

<https://www.routledge.com/HOPE-Teacher-Rating-Scale-Involving-Teachers-in-Equitable-Identification/Gentry-Pereira-Peters-McIntosh-Fugate/p/book/9781618214522#:~:text=The%20HOPE%20Teacher%20Rating%20Scale.making%20it%20easy%20to%20use.>

Gifted and talented student: The "[\*Strengthening Gifted and Talented Education Act\*](#)" defines a gifted and talented student as a "student who possesses or demonstrates a high level of ability in one or more content areas when compared to their chronological peers in the school district and who require modifications of their educational program if they are to achieve in accordance with their capabilities."

Twice-exceptional (2E) students: A twice-exceptional (2E) student is defined as "a student who is both gifted and a student with a disability. These students may also be referred to as having dual exceptionalities or as being gifted with learning disabilities (GT/LD). This also applies to students who are gifted with ADHD or gifted with autism" (New Jersey Association for Gifted Children, [www.nagc.org](http://www.nagc.org)).

Instructional adaptation: An adjustment or modification to instruction enabling a student who is gifted and talented to participate in, benefit from, and demonstrate knowledge and application of the New Jersey Student Learning Standards in one or more content areas at the instructional level of the student, not just the student's grade level.

Identifying gifted and talented students: The focus of identification is to provide programming and services in which students' specific learning needs and potential are appropriately addressed and met. In every New Jersey school district, there are students who require modifications to the general education curriculum if they are to achieve in accordance with their abilities. By identifying a student's general intellectual ability, creativity, or specific academic area aptitudes, we are acknowledging that they need programming and services outside of the general education/grade level curriculum to advance their learning.

## NJDOE Fast Facts

<https://www.nj.gov/education/standards/gifted/>

<https://www.nj.gov/education/standards/gifted/legislation.shtml>

## **Supplemental Resources/Programming for Gifted Students**

### Edward V. Walton

- PETS Program – Primary Education Thinking Skills
- Group Solutions/Group Solutions 2 – Cooperative Logic Activities
- Lollipop Logic
- Beginning Thinking Skills
- AIMS Education Programming

### James Caldwell and Thelma L. Sandmeier

#### *Math/ELA*

- Project M3: Mentoring Mathematical Minds
- Junior Great Books
- AIMS Education Programming
- Borenson Hands on Equations
- BizWorld
- Perplexors
- Advanced Math Explorations grade 3-5
- Challenging Units for Gifted Learners (ELA and Math)
- Creative Curriculum Extenders
- Differentiated Lessons & Projects
- Challenge Math Grades 4+
- Differentiating Instruction with Menus (All Content Areas)
- Jacob's Ladder
- Genius Hour/Passion Project
- Spatial Reasoning
- Logic Puzzles, Brain Games, Analogies

#### *STEM*

- Engineering is Elementary
- Engineer Throughout the Year
- PBS Design Squad
- DefinedSTEM
- Project Lead the Way (PLTW)

### Enrichment Events

Experience for all students to be enriched through events related to the curricular or extracurricular activities. Examples include after school clubs, PTA-sponsored events, leadership opportunities, visual and performing arts, and community service opportunities.