



The focus of this instructional segment is human impact on the environment.

This segment covers topics pertaining to human population growth and meeting the needs of the human population with natural and energy resources.

Student Science Performance

Grade or course: Environmental Science

Title:

Topic: Support the inhabitants of Earth

Humans on Planet Earth

Performance Expectation for GSE:

SEV3. Obtain, evaluate, and communicate information to evaluate types, availability, allocation and sustainability of energy resources.

- a. Analyze and interpret data to communicate information on the origin and consumption of renewable forms of energy (wind, solar, geothermal, biofuel, and tidal) and non-renewable energy resources (fossil fuels and nuclear energy).
- b. Construct an argument based on data about the risks and benefits of renewable and nonrenewable energy sources.
(Clarification statement: This may include, but is not limited to, the environmental, social, and economic risks and benefits.)
- c. Obtain, evaluate, and communicate data to predict the sustainability potential of renewable and non-renewable energy resources.

SEV4. Obtain, evaluate, and communicate information to analyze human impact on natural resources.

- a. Construct and revise a claim based on evidence on the effects of human activities on natural resources.

Human Activities	Natural Resources
Agriculture	Land
Forestry	Water
Ranching	Air
Mining	Organisms
Urbanization	
Fishing	
Water use	
Pollution	
Desalination	
Wastewater treatment	

- c. Construct an argument to evaluate how human population growth affects food demand and food supply (GMOs, monocultures, desertification, Green Revolution).

SEV5. Obtain, evaluate, and communicate information about the effects of human population growth on global ecosystems.

- a. Construct explanations about the relationship between the quality of life and human impact on the environment in terms of population growth, education, and gross national product.
- b. Analyze and interpret data on global patterns of population growth (fertility and mortality rates) and demographic transitions in developing and developed countries.
- c. Construct an argument from evidence regarding the ecological effects of human innovations (Agricultural, Industrial, Medical, and Technological Revolutions) on global ecosystems.

Performance Expectations for Instruction:

- Students will review data on the short-term and long-term effects of a changing climate.
- Students will review data on the increasing levels of greenhouse gases within the ecosystem.
- Students will construct a claim on the effects of human impact on natural resources.
- Students will design solutions to reduce human impact on the environment.
- Students will construct an argument for the ways that human population growth impacts food supply and demand.
- Students will review data on global patterns of population growth.
- Students will construct explanations for how human impact affects quality of life.
- Students will construct an argument on how human innovations have affected global ecosystems.

[Additional notes on student supports](#)

Materials

Images: pictures of statues (before and after) that have damage due to acid rain and weathering; NASA time lapse video of rainforests.

Demonstrations: (Acid Rain Demo) eyedropper, distilled water, a glass jar with a lid, bromothymol blue, a small clear container (glass or plastic), and matches that have a high sulfur content.

Group Presentations: computers with presentation software, poster board, butcher paper, colored pencils or markers.

Articles provided to students by teacher: A variety of articles regarding the loss of rainforests and the impacts these losses have on climate change, data sets from Wood for Trees website, articles on overfishing and farm-raised fish

Other: graphing paper, colored pencils, butcher paper, computer spreadsheet and graphing software, computers, “Oyster Roast” Simulation (there are many different varieties and sources), a teacher developed debate guideline and rubric, Smithsonian Institute’s Oil Spill Simulation, string, hole punchers, construction paper (variety of colors).

Students will continuously obtain, evaluate, and communicate information. This is not a linear process. Students will communicate through writing and discussions to allow for formative assessment. This benefits the teacher, student, and whole group to guide instruction to clarify misconceptions or extend content.

Engaging Learners

Phenomenon

Provide students with a series of before-and-after images to show how statues have changed over time.

[Statues Damaged Over Time](#)

Students generate questions and facilitate a discussion of their observations

Teacher Notes- Possible Questions for Discussion:

- Why do you see a color difference?
- How do these changes occur?
- How long of a time frame is necessary for this to occur?
- What environmental factors may cause an impact?
- What evidence do you have for this occurring in your own life?
Have you ever seen this occur in your life?

Optional videos:

- [Human Migration](#)

	<ul style="list-style-type: none"> • Human Population Through Time <p><i>Obtaining</i> Students do a lab activity or watch a demonstration showing how gases from pollution can dissolve into water or rain. Acid "Rain" Using BTB and Effects on Plants</p> <p><i>Evaluating</i> Students will construct an explanation about the effects of acid rain on plants. <i>Teacher Notes: Help students make a connection to the greenhouse effect and climate change.</i></p> <p><i>Communicating</i> Students will share their explanations with the class through a group presentation based on evidence obtained from a variety of sources (for example, scientific principles, models, or theories) and peer review.</p>
<p>Exploring Developing vs industrialized</p>	<p><i>Obtaining</i> Introduce students to a phenomenon regarding Human Impacts via video. The video shows the effects of deforestation on the Amazon Rainforest, which is home to many endemic species and a vital carbon basin for reducing levels of CO₂ in the atmosphere. This TedTalk discusses world population and resource consumption. Students will individually record their observations, hypothesize about what, why, and how humans may be furthering global warming as well as do research to gather outside sources regarding human impacts on global warming. This video may be useful as a source for students to begin working with.</p> <p>Students will then share their work with a partner and within a small group, and finally, contribute to whole class student-led discussion on topics such as consequences for sustainability of civilizations; CO₂ and climate change; and responsible resource management.</p> <p>It is significant for teachers to draw student attention to deforestation within their own community. Possible questions for a class discussion may include:</p> <ul style="list-style-type: none"> • How have we seen this in our town? Hint: Look for new construction sites and road projects. • Are there regular instances of deforestation that occur? • How do logging companies use reforestation to compensate for the trees they cut down? • How does a growing population contribute to habitat destruction within our community? (look for specific examples)
	<p><i>Communicating</i> Students will read a teacher selected article concerning rainforest loss and the impact the loss may have on global warming in order to examine the global effects from deforestation as a consequence for the sustainability of civilizations. Next, students will examine data sets from the website</p>

	<p>Wood for Trees continuing their exploration of deforestation effects on climate by developing tables and graphs demonstrating the decline of forests in the world while relating the impacts to sustainability of civilization.</p>
	<p><i>Evaluating</i> In groups of 2-3, students will compare and contrast the graphs they made with graphs from data sets provided to the students of tree studies for 10, 20, and 30 years ago. Students will write an explanation of the differences between the data over time gathered when comparing the data sets of trees.</p>
	<p style="text-align: center;"><i>Formative Assessment of Student Learning</i></p> <p>Find out what students know about human impact on global environmental issues</p>
<p><i>Explaining</i></p>	<p>Phenomenon This phenomenon is an image of trawlers overfishing cod. This phenomenon highlights human impact on marine fisheries. <i>Overfishing in the ocean leads to population decline, which depletes the ecosystem of vital resources for other ocean predators. Conversely, this leads to the overabundance of the reduced population's prey species. Overfishing also decimates habitats, which also reduces population sizes of other marine species.</i></p> <p>Students will observe the photo of the fishing trawler while developing explanations on their own of what the picture represents in environmental terms regarding food supplies, population growth, human innovations, human impacts on the environment and quality of life of humans as well as other animals. Have students record their discussion in the Overfishing Thought Organizer</p> <p>Then students will share with a partner their explanations to discover any new ideas or differences and documenting this within their personal explanations. Next, students will share with the class by reading their explanations aloud (word-for-word). Further, the teacher will facilitate a discussion highlighting the information above about the phenomenon.</p> <p>Suggested questions are:</p> <ul style="list-style-type: none"> ● Why are they catching these fish? ● How does the picture represent human impact on fisheries? ● How does overfishing impact ocean populations? ● How have you seen this within your own community? ● Where else do you see these same types of issues in the world? Give examples. ● Why does the Georgia Department of Natural Resources limit the amount of organisms you can remove from the wild? (For example, overhunting does, limits on the number of fish you can keep per season, etc...) ● How does an entire habitat become destroyed by the acts of one? ● How does population size affect natural resources?

	<ul style="list-style-type: none"> • Who is responsible for population control of animals? humans? • How are populations and food supplies related? <p>Lastly, students will re-examine their explanations and rewrite the explanations inferring cause and effect detailing what they understand about populations, food supplies, quality of life, human impact on the environment, and human innovations.</p> <p><i>Obtaining</i> Students will play a simulation game loosely based on the Environmental Science versions of “Go Fish” called "Oyster Roast" and complete data forms (tables) for the different rounds of collecting oysters. After entering oyster data collection into tables, develop a graph detailing the change in population over time. Next, research the fishing/shellfish/mollusk commercial industry regarding over harvesting of sea creatures for food sources and how this affects food supplies as well as global populations as a whole. Prepare an argument for debate with one side explaining why over harvesting of any species is not good for sustaining populations. Students should develop and prepare by writing alternative solutions while the other side argues the need for fishing-type organization's need for less regulation remembering to include economic needs, social customs, and the laws reflecting a “Common” area. <i>Teacher Notes: There are several varieties of the game “Go Fish” online. This is one variety having to do with oysters instead of fish. Also, a reference to the Hardin short story “Tragedy of the Commons” should be introduced here drawing an analogy to the issue of global sustainability through supply and demand and civic responsibility to the ecological environment as well as carrying capacity.</i></p> <p><i>Evaluating</i> Students will complete the Deer Population Simulation Activity. Once completed, students will write an essay on either the fishing or hunting industry and the current regulations addressing either overfishing or overhunting. Students will address new ways to fight either overfishing or overhunting using evidence gathered through research and simulations.</p> <p><i>Communicating</i> Students will be divided into two groups. They will argue using evidence from research and/or simulations about the issue of overfishing in the local coastal waters. Students will address alternative solutions, economic impacts, and the impact on local populations.</p>
<p>Elaborating Applying Model to Solve a Problems</p>	<p>Phenomenon Show students this image of a scientist examining a dead sea otter. Ask students to generate a list of questions they have about this photo. Questions may include things such as:</p> <ul style="list-style-type: none"> • What happened to this sea otter? • Is this an isolated incident? • Are sea otters endangered?

	<ul style="list-style-type: none"> ● Is human pollution, such as the trash islands*, causing an impact on their population? <p>*As our <u>global population expands</u> so too does the amount of trash we produce. A large portion of this trash then ends up in the world's oceans. Due to <u>oceanic currents</u>, much of the trash in the sea is carried to a number of areas where the currents meet. The collections of trash in these locations have recently been referred to as marine trash islands.</p> <p>Have students investigate the major threats to the sea otter populations. Specifically, students should look at human impact on the prevalence and range of the sea otter population. Concepts from ecology (such as predators and limiting factors) are included in their research.</p>
	<p><i>Obtaining</i></p> <p>Investigate the effects of an oil spill on marine species, including the sea otter, by simulating an oil spill. An example of a lab procedure that can be used is this one by the Smithsonian Institute for Education. (https://www.si.edu/Termsofuse)</p> <p>Emphasis is given to the economic impact of an oil spill on society. Have students generate questions and lead a discussion based on them. Questions may include things such as:</p> <ul style="list-style-type: none"> ● Who should be responsible to pay for a cleanup after an oil spill? ● What methods are the most environmentally sustainable for cleaning up an oil spill? ● What kind of impact does an oil spill have on industry (such as fishing)?
	<p><i>Evaluating</i></p> <p>Students will write and illustrate a children's story about sea otters. The story should include population dynamics (range, numbers of organisms, predators, food sources, competition, etc.). The story should include threats to the otter populations, specifically human impact. The story should end with solutions that students generate to help conserve the otter population.</p>
	<p><i>Communicating</i></p> <p>Students will share their children's books either with their classmates or with children in the local elementary grades. They can also facilitate a discussion about the impact that humans have on marine populations and ways that students can personally make a difference.</p>
<p>Evaluation</p>	<p style="text-align: center;"><i>Assessment of Student Learning</i></p> <p>Assessment of student learning should be ongoing throughout the instructional segment. As students record and reflect in the Science Journal, teacher should provide feedback and commentary to guide the student through misconceptions and lack of sufficient evidence or poor-quality sources.</p> <p>Frequent mini checks can be utilized to monitor student understanding at the element level of the standard.</p>

	<p>The writing pieces should be given specific feedback and commentary with opportunities to revise. These writing sample could be kept in a folder for students to see the progress they have made as they write throughout the course.</p> <p>Students are assessed how they model resource use and population impacts in the activities of this segment.</p>
<i>SEP, CCC, DCI</i>	Science Essentials
Science and Engineering Practices	<ul style="list-style-type: none"> ● Constructing explanations and designing solutions ● Obtaining, evaluating, and communicating information ● Engaging in argument from evidence ● Analyzing and interpreting data
Crosscutting Concepts	<ul style="list-style-type: none"> ● Stability and Change ● Cause and Effect ● Systems and System Models
Disciplinary Core Ideas	<p>From <i>A Framework for K-12 Science Education</i>:</p> <ul style="list-style-type: none"> ● Ecosystem Dynamics, Functioning, and Resilience ● Biodiversity and Humans ● Earth Materials and Systems ● Weather and Climate ● Natural Resources ● Natural Hazards ● Human Impact on Earth Systems ● Global Climate Change

Additional Supports for struggling learners:

General supports for the following categories:

<p><u>Reading:</u></p> <ol style="list-style-type: none"> 1. Provide reading support by reading aloud or doing partner reads 2. The teacher should read and annotate a text with students so that the students may see what the teacher thinks as they read. 	<p><u>Writing:</u></p> <ol style="list-style-type: none"> 1. The teacher can provide a sentence starter for the students. 2. The teacher can give students an audience to write to (i.e. Write a letter to your sibling explaining this topic). 3. The teacher can provide constructive feedback during the writing process to help students understand the expectations. 	<p><u>Math:</u></p> <ol style="list-style-type: none"> 1. The teacher should model how to create and read a graph including labeling all the parts of the graph. 2. The teacher should provide graph paper so that students do not have to free hand a graph. Many students will get caught up in the drawing and forget basic graphing concepts. 3. The teacher should provide some graph reading practice for students that have trouble constructing the graph.
---	---	--

Supports for this specific lesson if needed:

- Engage:**
1. The teacher should consider providing students with the before and after images in a format that students can write on to record the differences that they see.
 2. The teacher should consider providing students with question stems to assist in generating questions.
 3. Another thing that teachers can do is simplify the language into “what do you notice?” and “what do you wonder?”.
 4. The teacher should consider providing students with an opportunity to formulate answers prior to being asked to provide answers in front of the class.
 5. The teacher should have a set of clear and consistent guidelines for class discussion. These guidelines are to ensure that students feel comfortable and are able to contribute to the discussion.
 6. The teacher may need to show any video more than once to allow students to make adequate observations.
 7. The teacher should consider using closed captioning for any videos that they show in class to assist students in accessing the material in the video.
 8. The teacher should consider providing students with a graphic organizer to organize their thoughts.
 9. The teacher may need to show the demo more than once for students to make observations.
 10. The teacher should have multiple formats for students to share their knowledge. These formats could include writing, drawing, explaining verbally or using technology to make a video.
 11. The teacher should consider having clear and consistent guidelines for students to share their work. This is to help students feel safe and be more likely to participate in the sharing process.
 12. The teacher should ensure that students receive positive, constructive and clear feedback with time to improve their understanding.

Exploring:

1. The teacher may need to consider showing the video more than once to allow students to make observations.
2. The teacher should consider providing students with an organizer to record their thoughts and observations on as they view the videos.
3. The teacher should use intentional and flexible grouping to group students.
4. The teacher should have clear and consistent guidelines for group work. This should ensure that all students feel comfortable and have the opportunity to contribute within their groups.
5. The teacher should have clear and consistent guidelines for class discussions. This should ensure that students feel comfortable and be more likely to participate.
6. The teacher should consider providing students with the questions in advance of the class discussion. This allows students to formulate answers in advance so that they feel confident enough to contribute to the class discussion.
7. The teacher should consider providing multiple ways for students to access material. This could include articles, videos, providing text-to-speech or read aloud to best suit the needs of the students.
8. The teacher may need to consider modeling the examination of data process.
9. The teacher may need to provide students with a refresher course of making graphs. This could be done after a formative assessment to provide targeted support to the students that need it.
10. The teacher should provide students with multiple formats to show their knowledge. These formats could include writing, drawing, verbally explaining or using technology to make a video.

Explaining:

1. The teacher should consider providing students with the image to write on. Students could make observations and ask questions on the image.
2. The teacher should consider providing students with multiple formats to show their knowledge. These formats could include writing, drawing, verbally explaining or using technology to make a video.
3. The teacher should consider providing students with the questions in advance to allow students to formulate their answers in advance of the class discussion. This helps students feel more confident and be more likely to participate in the class discussion.
4. The teacher should consider multiple ways for students to share their work. Frequently, it is very anxiety producing for students to share their work with others and the best thing the teacher can do is provide an anonymous way for students to share their work.
5. Students may need additional time to revise their assignment.
6. The teacher should consider providing students with sentence frames to get the students started on their argument.
7. The teacher should consider providing multiple formats to share their knowledge. These formats could include writing, drawing, verbally explaining or using technology to make a video.

Elaborating:

1. The teacher should consider providing students with question stems to get them started developing questions.
2. The teacher should consider providing students with a list of sources that are reliable for students to use in their research.
3. The teacher should have clear and consistent guidelines for class discussions. These guidelines should help students feel comfortable and be more likely to participate in the discussion.
4. The teacher should provide students with multiple formats for students to share their knowledge. These formats could include writing, drawing, verbally explaining or using technology to make a video.

Evaluating:

1. The teacher should provide students with multiple ways to share their knowledge. These formats could include written, verbally explaining, designing a play, drawing or using technology to make a video.
2. The teacher should provide positive, constructive and clear feedback to help students make improvements on their work.

Overfishing --Thought Organizer

1. How does overfishing affect the environment?
2. What long range effects will occur on food supplies?
3. What are the impacts on population growth of the fish? Of humans?
4. Why is there a need for human innovations in the industry?
5. What are ideas for human innovations in the industry?
6. How does this human activity impact the environment?
7. How does this affect the quality of life for humans?
8. How does this affect the quality of life for other animals?

[Return to Instructional Segment](#)



Oyster Roast

Introduction:

People purchase tracts of land and take care of that property as individuals. Our rivers and oceans are not owned by individuals. These areas are considered to be held in “common” and people are able to fish or harvest from those areas according to law. This activity will simulate the use of the “commons” and the sustainable practices that influence the resources available from a common resource.

Materials:

One spoon per student

One paper towel per student

One bowl (river) per group of four

A bell or whistle to begin and end each round

16 oyster crackers for each group of four

Procedure:

Each participant in your group represents the head of household of a hungry family in your town. A large bed of oysters has been found not too far down the river. Each head of household may go out once a month to harvest oysters to feed their family. You will use your spoon to retrieve your oysters, but you may only gather one oyster at a time and place them on your paper towel in front of you. Sorry, you may NOT steal oysters from your neighbor’s paper towel. Oysters that are tossed from the river (bowl) are washed downstream and not eligible to be harvested.

During each month you may harvest for one minute. You must obtain at least two oysters for your family to survive the month. Any extra oyster may be sold at market for a profit. If you harvest less than two oysters during any month, you and your family will starve and you will no longer participate in the remaining monthly harvests.

You will harvest oysters for up to five months. At the end of each month’s harvest, your teacher will add more oyster crackers to simulate oyster reproduction. Fill out the Data Table after each month’s harvest.

Data Table

Round 1:

Month #	# of oysters at the beginning of the round	# of oysters taken by 1 st harvester	# of oysters taken by 2 nd harvester	# of oysters taken by 3 rd harvester	# of oysters taken by 4 th harvester	Total number of oysters at the end of the round
1	16					
2						
3						
4						
5						
Total						

We will discuss the results of round one as a class. As a group “town” quietly discuss the results of round one and create 2 questions you feel either need to be answered to survive or you feel have demonstrated your knowledge of sustainability gathered from the first round of the activity. Each person will create questions on their own piece of paper to be turned in at the end of each round. The teacher will select 10 questions from the one’s submitted for all students to answer at end of activity.

Round 2:

Month #	# of oysters at the beginning of the round	# of oysters taken by 1 st harvester	# of oysters taken by 2 nd harvester	# of oysters taken by 3 rd harvester	# of oysters taken by 4 th harvester	Total number of oysters at the end of the round
1	16					
2						
3						
4						
5						
Total						

Analysis:

Evaluate the results of your trials and answer the following questions on a separate sheet of paper. Attach the answers to your data tables.

1. How did the harvesting practices of your neighbors affect you? How did that make you feel?
2. What are the impacts of overharvesting or exploiting a natural resource?
3. Obviously you need your neighbors for the town to survive. Devise a plan that will change your harvesting activity to sustain your town. Write the details of your plan.
4. How can we establish and maintain the sustainability of a resource?
5. How can we apply what we learned in this lesson to global ecology?



Deer Population Activity

Students model a population of deer and graph changes in population size as the deer population experiences the pressures of density-dependent factors.

Materials:

- A place to run with a distance of at least 35 meters
- Nice weather for the students to run

Procedure:

1. The class is going to mimic a population of deer.
2. On a grass field, outside, two students will stand on one side and face students about 35 meters away. The side with two students will represent deer and the other side will represent resources in the environment. The teacher will stand on the side and designate the decomposing area.
3. Tell the deer to face away from the resources and the resources to face away from the deer. The teacher will then tell all the students in the environment area to choose which resource they want to be, and the deer which resource they want to find.
 - Students choose their resource by making a triangle over their head for shelter, a “W” in front of their mouth for water, and their hands over their stomach for food.
 - Once the students have chosen their resource they cannot change it.
4. The teacher will then tell the environment group to turn around and face the deer and the deer to turn around and go after the resource they wish to choose. The deer must run straight to their resource and tag it.
 - If a deer tags a resource, the deer survives and reproduces one offspring.
 - The tagged environmental person will become a deer in the next generation.
 - If a deer does not tag the resource they were looking for, they die and go to the decomposer section.
 - Decomposers go to the resource environment after one generation.
 - If a resource is not tagged they stay where they are at for the next generation.
5. The students will repeat this procedure for 5 generations. Count the number of deer, environment before you say, “go” and record in the data table.
6. On the 6th generation, introduce a hunter. Have one student from the decomposers become a hunter. The hunter stands where the teacher stands and begins hunting a deer at the same time the teacher tells the deer to go. The hunter runs and tries to tag a deer. If the hunter tags a deer the deer becomes a hunter in the next round. At first, the hunter may only tag one deer in each round. Then, allow students to change from decomposers to additional hunters. Increase the number of hunters each round until the deer population is unable to survive. If the hunter fails to tag a deer, he becomes a decomposer in the next round. Record the number of hunters in each round.

Data Table

Generation	Deer	Environment	Lion
1	2		0
2			0
3			0
4			0
5			0
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			

Use graph paper to make a line graph of the deer, environment, and lion populations. Graph all three lines on the same graph and include a key to differentiate between the lines. Be sure to include a title for your graph and label the y-axis “population size” and the x-axis “generations”.