The focus of this instructional segment is sustainability of energy sources, choices and human impact.

This segment covers topics pertaining to human impact and sustainability.

Student Science Performance

Grade or course: Environmental Science	**Title:**
Topic: Sustainability of Planet Earth	Sustaining Planet Earth

Performance Expectation for GSE:

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

d. Design and defend a sustainable energy plan based on scientific principles for your location.

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

b. Design, evaluate, and refine solutions to reduce human impact on the environment including, but not limited to, smog, ozone depletion, urbanization, and ocean acidification.

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

d. Design and defend a sustainability plan to reduce your individual contribution to environmental impacts, taking into account how market forces and societal demands (including political, legal, social, and economic) influence personal choices.

Performance Expectations for Instruction:

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 explanations for how human impact affects quality of life.

Students will construct an argument on how human innovations have affected global ecosystems.

Students will design and defend a personal sustainability plan.

Additional notes on student supports

Materials

PowerPoint- water in a clear tub, dirt, leaves, baking soda, vinegar, fishing line, napkins, vegetable oil, other materials for the water pollution demo

Heat Island Article with images

Technology/books for students to do research

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** How the Chattahoochee has changed demo PowerPoint and instructions Discuss changes that students observed in the water in the demo. Discuss with students how pollution impacts waterways in your local area. This might be the Chattahoochee or it could be a local lake or stream. Have students ask questions and make observations about how humans impact the local environment based on their experiences and the demo. Have students obtain information about the major types of human impact on the earth. Some of the big ideas that students should come up with are: Smog, ozone depletion, urbanization, pollution, ocean acidification, ect… Discuss what students have found and create a list of the major human impacts that the students have found.
Exploring	give student groups the images from the following article: Thermal images- heat island effect Have students make observations about the images…. what do they notice? What does it make them wonder? Teacher should lead a class discussion about observations and questions. The students may need to obtain additional information about heat islands, find patterns in how they affect cities of different sizes and strategies to combat them. Have students explain how they think a heat island might exist around your school…. more concrete= more heat trapped

Explaining	Students should design a solution to combat heat islands around their school within their groups. Graphic organizer for designing solutions. Students should share their solutions and then revise or add to solutions as necessary. Students should calculate the approximate cost of their solution and decide how feasible the solution might be. Consider having students present their solutions to administration and have the administrators or other adults evaluate the solutions and give students feedback. This gives the lesson a more real-world appeal if students feel that their solutions could be implemented.
Elaborating Applying Model to Solve a Problems	Have students choose another human impact and design a solution individually. The students can refer back to the list of human impacts created in the engage section. The teacher could choose to have students write this out, make a video, ppt or poster. Graphic organizer for designing solutions. This will require students to obtain information about the human impact they choose. Have students share their human impact, why it's a problem and their solution with the class. Ask students to include cost and potential benefit of their solution. The share format could be a gallery walk, a presentation, viewing each other's videos, etc.
Evaluation	***Assessment of Student Learning***
	Students will be shown a picture of a picturesque piece of land they have recently inherited with a stream or river flowing through the property and told they will be living there in 3 months. The student must design and defend a personal sustainability plan detailing their shelter, food sources, water sources, and long-term sustainability for survival. Some of the details should include ways to reduce the impact on the environment in daily life currently and in the future (such as water usage, recycling, waste, housing development, heating/cooling, spacing allocations of land, food acquisition, food storage, predators, climate adaptation, sewage disposal, recreation and possibly transportation). Students will need to include examples and evidence of how the plan will be put into place as well as how to continually update, evaluate, and follow-up in order to make sure the plan is truly sustainable (take into account natural disasters). Follow this link to find the sample rubric for this assignment.

	An example of a photograph that can be used is: "Mountain Stream as Summer Wanes" by *makelessnoise* is licensed under CC BY 2.0
SEP, CCC, DCI	**Science Essentials**
Science and Engineering Practices	• Constructing explanations and designing solutions • Obtaining, evaluating, and communicating information
Crosscutting Concepts	• Stability and Change • Cause and Effect • Systems and System Models
Disciplinary Core Ideas	From *A Framework for K-12 Science Education:* • Human Impacts on Earth Systems

What happened to the Chattahoochee?

Materials:

9 cups	Vinegar	Napkins/ plastic
Leaves	Vegetable oil	Fishing line
Red dirt	Dish soap	Baking soda
Syrup	Clear water	A clear plastic tub

Directions:

1. Put the clean water into the clear plastic tub
2. Set up 9 cups in the following way:
    a. 1 cup with leaves (slide 3)
    b. 1 cup with red dirt (slide 4)
    c. 1 cup with Baking soda (Slide 5)
    d. 1 cup with Vinegar (Slide 6)
    e. 1 cup with syrup (slide 7)
    f. 1 cup with dish soap (slide 8)
    g. 1 cup with vegetable oil (slide 9)
    h. 1 cup with napkins or plastic (slide 10)
    i. 1 cup with fishing line (slide 11)
3. Have volunteers come up and grab a cup (you can label them with slide number to make this easier)
4. As you go through the story have the students with the appropriate cups come up and dump in the plastic bucket containing the water
5. As the water changes you should pause and discuss.
6. When all items have been put into the water discuss the following:
    a. Is this how they see the waterways around the state? Justify.
    b. Ask the students if there are other things that end up in our water in Georgia.
    c. What do all these things do to the wildlife in and around the waterways? Justify.
    d. How does the water pollution impact humans? Justify.
7. Split into groups and come up with ideas to reduce human impact on our waterways.

Slide 1:

Hundreds of years ago the land was very wild and had few inhabitants that were native. These native people believed in living off the land and did not change their natural surroundings. They fished, hunted and used nature for the things that they needed.

Slide 2

One day a boat brought over some explorers. After that more and more people traveled to this land. They were very excited to find land for building and farming, wildlife and fish for hunting and a river that provided clean water

Pause to ask students how they see the Chattahoochee River or another local river. Use their feedback to have them draw some conclusions of what has changed since this time long ago.

The river has changed since then and here is the story behind the changes.

Slide 3

As time went on natural things like storms continued to blow normal things like leaves into the river.

Slide 4

Over time more and more people moved to the area. This caused many construction sites to be used to build housing, schools, roads, hospitals and many other necessary buildings. This has caused many trees to be cut down leaving nothing to hold the soil in place and so the soil is washing into the river.

Slide 5

When the city was small it was easy to keep food supplies available. However, as the population grows it requires that the farmer start using fertilizer to help crops grow faster. Rainwater is washing this fertilizer and the waste from the animals into the river.

Slide 6

Now the city is huge. It is one of the largest cities in the southeast. Many people live and work around the city. This has led many factories to build in the area. These factories make necessary thing such as cars and technology, but they end up leaking things into the River.

Slide 7

Many people who work in the city live far away. Driving is very necessary in the city and traffic can be very difficult to avoid.

Cars contain a lot of fluids that can leak if the car is not in good repair or if someone has an accident. All of this could end up in the river.

Slide 8

People value their cars and therefore things like car washes are used frequently. The runoff from car washes frequently ends up in the river.

Slide 9

One of the best places to go for a break from the city is one of the parks on the river. Many people have boats that they use to have fun on nice days. This can lead to boat oil or fuel being in the water. This causes major problems for the wildlife in the river.

Slide 10

Also, at these parks many people are having picnics. Picnics are a lot of fun for the residents but sometimes people get distracted and forget to pick up their trash. This trash ends up in the river.

Slide 11

One of the best past times is to go fishing on the river as well. You can frequently see a few people standing on the riverbank or on a boat fishing in the river. This is not a big deal until the hook snags on a branch and the fisherman cuts the line and leaves the hook and line in the river.

Slide 12

The river is no longer the same. It looks very different.

Have the students describe what has changed? Ask them why and what could be done differently.

Return to Instructional Segment

Designing a Solution Graphic Organizer

Research Problem or Question:

Why is a solution needed?

What is the evidence of the problem?

Proposed solution:

Impact? Cost? Time frame?

Return to Instructional Segment

Sustainability Plan Rubric

	Beginning	Developing	Proficient	Exemplary
Sustainability plan	The personal sustainability plan details shelter, food sources, water sources, and long-term sustainability for survival. The plan lacks specific details that are needed to ensure that the plan is adequate for survival and sustainability.	The personal sustainability plan details shelter, food sources, water sources, and long-term sustainability for survival. Minimal details are included about the parts of the plan that would lead it to be adequate for survival or sustainable.	The personal sustainability plan details shelter, food sources, water sources, and long-term sustainability for survival. Some of the following details are included: water usage, recycling, waste, housing development, heating/cooling, spacing allocations of land, food acquisition, food storage, predators, climate adaptation, sewage disposal, recreation and possibly transportation. The plan is adequate for survival and sustainable.	The personal sustainability plan details shelter, food sources, water sources, and long-term sustainability for survival. Most of the following details are included: water usage, recycling, waste, housing development, heating/cooling, spacing allocations of land, food acquisition, food storage, predators, climate adaptation, sewage disposal, recreation and transportation. The plan is adequate for survival and sustainable.
Evidence	No evidence is presented as to the sustainability of the plan. No examples are provided that show how the plan would function.	Minimal evidence is presented as to the sustainability of the plan. Minimal examples are provided that show how the plan would function.	Some evidence is presented as to the sustainability of the plan. Some examples are provided that show how the plan would function.	Much evidence is presented as to the sustainability of the plan. Many examples are provided that show how the plan would function. This evidence and the examples point to the plan being sustainable long term.
Realistic	The plan is not realistic. This plan would not be able to be implemented.	The plan has some realistic pieces. This plan would be difficult to implement and not able to be used long term.	This plan is mostly realistic and could be implemented for the short term.	This plan is completely realistic and could be implemented easily for the long term.
Organization	The organization of the plan makes it difficult to follow. There is no introduction or conclusion.	The organization of the plan is minimal. There is a basic format, but the ideas are jumbled an difficult to follow.	There is logical organization but some of the ideas should be more well developed to give the plan depth.	There is logical organization and the plan is fleshed out to provide a clear plan of how this sustainability plan should be implemented.

Return to Instructional Segment

Additional Supports for struggling learners:

General supports for the following categories:

Reading:

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.

Writing:

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.

Math:

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 may need to show the demo more than once to allow students to make observations.
2. The teacher should have clear and consistent guidelines for class discussions. These guidelines should help students feel more comfortable and be more likely to participate in the discussion.
3. The teacher should consider providing students with question stems to assist students in generating questions.
4. Teachers can also consider changing the format to be “what do you notice?” and “what do you wonder?”.
5. The teacher should consider providing students with an organizer to record their thoughts, observations and research.
6. The teacher should consider providing students with some sources that they can use in their research.
7. The teacher can, also, assist students in determining what sources are reliable and why.
8. The teacher should consider posting a list of the major human impacts somewhere the students can see as they work.

Exploring:

1. The teacher should consider providing students with the images that they can write on. This way the students can write as they think about the images.
2. The teacher should have clear and consistent guidelines for class discussions. These guidelines should help students feel more comfortable and be more likely to participate.
3. The teacher should consider providing students with sources that they can use in their research.
4. The teacher can also help students determine which sources are reliable and why those sources are more reliable than others.
5. The teacher should consider providing multiple formats for students to show their knowledge. These formats could include writing, drawing, verbally explaining or using technology to make a video.

Explaining:

1. The teacher may need to repeat direction as needed for students.
2. The teacher should have multiple formats for students to share their knowledge. These formats could include writing, drawing, verbally explaining or using technology to make a video.
3. The teacher may need to consider providing students with an example of a solution might be to a human impact.
4. The teacher should consider having students go outside to examine their school's area for heat islands.
5. The teacher may need to help students calculate the cost of their solution.
6. The teacher should consider multiple share formats for students. It is best to choose options or give students options that reduce anxiety.

Elaborating:

1. The teacher should refer back to the list of human impacts to help students choose.
2. The teacher should consider having multiple options for students to show their knowledge. This could include writing, drawing, verbally explain or using technology.
3. The teacher should consider providing students with some sources that students can use to obtain information.
4. The teacher should consider helping students decide which sources are reliable and why those sources are more reliable.
5. The teacher should consider having multiple share formats so that students can choose a way to share that does not create anxiety.

Evaluating:

1. The teacher may need to repeat directions multiple times to assist students in understanding the expectations.
2. 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.
3. The teacher should provide positive, constructive and clear feedback to help students make improvements on their work.

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