

Subject Area: Life Science

Grade Level: 5

Topic: Ecosystems: Interactions, Energy, and Dynamics

NGSS PE: 5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

Building a Biosphere

A. Introduction

Overarching Challenge: Can you make sure the ecosystem in Biosphere 3 has what it needs to keep people alive? In this assessment, students are introduced to the plans that a group of researchers have created for an ecosystem to go in Biosphere 3 on Mars. The Biosphere dome they designed will protect everything inside and will provide the energy that the ecosystem needs. Now the researchers are trying to decide what to put in the ecosystem. Using what they have learned about the flow of matter through ecosystems, student groups will analyze the parts of the ecosystem researchers have included to see if it could keep people alive and identify any parts it is missing for it to function. Student groups will then make a model to show the flow of matter through the ecosystem. Individually, students will use evidence from the model they created to explain how Biosphere 3 will be able to support human life on Mars.

B. Performance Outcomes and Relationship to PEs and Student Evidence

Performance Outcomes	Alignment to PE Dimensions Assessed	Alignment to Prompt for Individual Product
Use a model to describe how the living and non-living components of an ecosystem interact to move matter.	<i>Science Practice</i> – Developing and Using Models <i>Disciplinary Core Idea</i> - LS2.A. Interdependent Relationships in Ecosystems <i>Disciplinary Core Idea</i> - LS2.B. Cycles of Matter and Energy Transfer in Ecosystems <i>Crosscutting Concept</i> - Systems and System Models	How do different parts of the ecosystem interact? Use specific evidence from your group's model to explain how the interactions move matter through the ecosystem.
Describe how different parts of an ecosystem move matter from one part to another using evidence from a model.	<i>Science Practice</i> – Developing and Using Models <i>Disciplinary Core Idea</i> - LS2.A. Interdependent Relationships in Ecosystems <i>Disciplinary Core Idea</i> - LS2.B. Cycles of Matter and Energy Transfer in Ecosystems <i>Crosscutting Concept</i> - Systems and System Models	Explain what each interaction between parts of the ecosystem does to support human life for a long time? Use examples from your model to support your explanation.

Use a model to describe how interactions between each part of an ecosystem contribute to the movement of matter through the whole system.	<i>Science Practice</i> – Developing and Using Models <i>Disciplinary Core Idea</i> - LS2.A. Interdependent Relationships in Ecosystems <i>Disciplinary Core Idea</i> - LS2.B. Cycles of Matter and Energy Transfer in Ecosystems <i>Crosscutting Concept</i> - Systems and System Models	Identify missing part of the original Biosphere 3 plan. Explain why the Biosphere 3 ecosystem would not function well if that part was not included?
Develop an argument about how to improve the function of an ecosystem using evidence from a model.	<i>Science Practice</i> – Making Arguments <i>Science Practice</i> – Developing and Using Models <i>Disciplinary Core Idea</i> - LS2.A. Interdependent Relationships in Ecosystems <i>Disciplinary Core Idea</i> - LS2.B. Cycles of Matter and Energy <i>Crosscutting Concept</i> - Systems and System Models	Add one other thing to your Biosphere 3 plan to help the ecosystem function better for humans. Write an argument to convince the rest of the research team that uses evidence from the model, and is supported by reasoning.

C. Prior Knowledge and Skills Needed

To successfully participate in this assessment, students will need prior understanding of the following concepts or have the following skills:

- Matter is the “stuff” that makes up all objects.
- Matter is conserved, meaning that it can change state or composition but it is never created or destroyed.
- Models are representations used to describe real-world phenomenon.

D. Estimated Time Requirements

Suggested timeline for this assessment:

Class Period	Part of Assessment to be Completed
Day 1	Introduction of assessment Part A: Learn about living on Mars
Day 2	Part B: Step 1. Draw a model
Day 3	Part B. Step 2. Analyze model Part C: Feedback and Revise Model
Day 4	Part D. Explain Model

E. Materials & Resources Needed

Materials needed for this assessment:

- Copies of handouts:
 - *Student IEA Instructions* (1 for each student)
 - *Ecosystem Services* (1 for each student)
 - *Biosphere 3 Ecosystem Plan* (1 per group)
 - *Model Feedback Form* (1 per group)
 - *Individual Student Product Worksheet – Explain the Biosphere 3 Plan* (1 for each student)
- Computer(s) or tablet(s) with Internet connection; or computer and projector
- Poster paper
- Markers/colored pencils/crayons

F. Guide for Implementation: Student Activities and Teacher Instructions

Student Activities and Products	Instructional Steps and Supports
<p>Introduction section (p. 1-2) – Whole class</p>	<ul style="list-style-type: none"> ▪ To warm up and initially engage students, consider showing a video to provide some background on the topic. One possible video is: http://channel.nationalgeographic.com/mars/videos/backing-up-the-biosphere/ ▪ Initiate a discussion about what students already know about Mars ▪ Students also need to be introduced to the story of Biosphere 2. You can do this by showing one of these videos below or by just telling them the main points of the story (possibly with the video playing in the background): Biosphere 2 is a huge dome with a designed ecosystem inside. It was developed to understand more about ecosystems and to learn about what it would mean to create one on another planet. The ecosystem ended up getting low in food and oxygen and many animals and plants died, and it became unsafe for humans. https://www.youtube.com/watch?v=VLroU3PaO3g Or https://www.youtube.com/watch?v=ZKvGfDHFXXU&t=530s ▪ Hand out the <i>Student IEA Instructions</i>. Read over the Student Instructions with the students to orient them to the phenomenon, challenge and overall assessment.
<p>Part A: Individuals and Whole Class - Learn about Living on Mars:</p> <ul style="list-style-type: none"> ○ Students read handout, <i>Ecosystem Services</i>. 	<ul style="list-style-type: none"> ▪ Hand out <i>Ecosystem Services</i> and have students read it individually. ▪ Facilitate a whole group discussion about each

<ul style="list-style-type: none"> ○ Students discuss in pairs or whole class and respond to these questions listed in Part A, and take notes on IEA in box provided ○ Questions include: <ol style="list-style-type: none"> 1. What do ecosystems do to provide each of the services on the handout? 2. What do humans need from their ecosystem to live? 	<p>question in Part A. Allow for pair discussion prior to discussing student thoughts as a whole class.</p> <ul style="list-style-type: none"> ▪ Remind students to record their notes on IEA. ▪ Ask pairs to share out their responses to questions. This will ensure that all students are entering the remaining parts of the assessment with similar background knowledge. ▪ List key information on a class chart if it would prove helpful in supporting group products. <p>NOTE: The main point for this segment is that students understand that Mars is not currently habitable for humans. So, an artificial biosphere would be needed. The specifics characteristics of Mars as a planet are not assessed and do not need to be considered in these activities.</p>
<p>Part B: Group Work Part 1: Develop a Model</p> <ul style="list-style-type: none"> ○ Student groups draw a model to show how each part of the ecosystem depends on matter from the other parts. ○ Model needs to: <ul style="list-style-type: none"> ○ Show and label all the parts (living and non-living) of the ecosystem ○ Include arrows to show how matter moves between each part of the ecosystem. 	<ul style="list-style-type: none"> ▪ Set up small groups and consider reviewing group work norms before the lesson. ▪ Review Part B in the IEA <i>Student Instructions</i> with students. <p>Part 1: Develop a Model</p> <ul style="list-style-type: none"> ▪ Distribute copies of the <i>Biosphere 3 Ecosystem Plan</i> handout to small groups (or have students remove copy from their packet, if you created an IEA packet). This handout shows the plan for the living and non-living things that researchers are considering including in the ecosystem. ▪ After students have reviewed the Biosphere 3 Plan, ask them to read Step 1 (#1) and discuss the questions that follow. Please remind students to take notes on the Student Instructions document. ▪ If this type of modeling is new for students, make sure to review the example in the <i>Student Instructions</i> in detail; depending on students' needs, you may choose to practice this type of modeling with more examples (<i>Emphasize that the direction of the arrow corresponds with the direction in which matter moves</i>). ▪ Optional: Review major ecosystem-related terms and their functions, such as plant, animal, decomposer, air, soil, etc. to ensure all students in the class have access to this content language and some understanding of each concept. ▪ Give students individual think time to plan their models according to the criteria. Remind students to refer back to Part B to help them plan their model. Then students may discuss ideas and begin work within their groups.

<p>Part 2: Analyze the Biosphere 3 Ecosystem Plan</p> <ul style="list-style-type: none"> ○ Student groups analyze their model by answering the following questions provided in the student instructions: <p>2a. Analyze your model. Is there everything else that plants and animals need to survive included in the Biosphere 3 plan? Add one thing that the ecosystem needs to survive and explain the change.</p> <p>2b. Use your model to describe two different ways matter moves from air to humans in this ecosystem.</p> <p>2c. Explain your model. Discuss the ways that one of the following parts (assigned by your teacher) is important to all the other parts of the ecosystem (bacteria, soil or insects).</p> <p>2d. Revise you model if your answers to these questions made you realize that anything is missing from your ecosystem.</p>	<ul style="list-style-type: none"> ▪ Provide student groups with poster paper. Ask students to draw a rough draft of their complete ecosystem model, including arrows and labels. (This might be best done in pencil) ▪ Remind and emphasize that the sketch is a working draft and not a final draft. ▪ Look for: If students are struggling to start creating the model they might not have had enough experience developing a model from a blank page. Consider providing a graphic organizer for students that includes arrows and boxes for labels for students to start with. <p>Part 2: Analyze the Biosphere 3 Model</p> <ul style="list-style-type: none"> ▪ Once groups have completed a draft of their ecosystem, review questions for analysis within Part B - Step 2 (#2a-d) with whole class. Share with students they are to use the facilitating questions provided to help them analyze and begin to explain their model of the ecosystem. ▪ Direct student groups to record responses for each question in the IEA instructions. Encourage each student within the group to record responses for use during the individual product. ▪ Pull whole class together to discuss each question as groups complete them. Have groups share their reasoning as needed or helpful. ▪ ! The purpose of this portion of the task is to analyze ecosystem-related content in a facilitated format that prepares students to provide evidence from their group to explain how the ecosystem works during the individual product. It is recommended that teachers observe student progress and give formative feedback as needed. <p>NOTE: This material should be a review of previously learned content within the PE being assessed.</p>
<p>Part C: Group Work Share Group Models with Peers for Feedback and Revise</p>	<ul style="list-style-type: none"> ▪ Have students hang draft of their ecosystem model posters on the walls around the classroom or place on team tables. ▪ Optional: Begin the gallery walk by having all students circulate the room to see all the groups' models for 3-4 minutes. Ask students to notice one "ideal quality" of a model they see, record it on a post-it provided, and stick it to the corresponding poster.

	<ul style="list-style-type: none"> ▪ Handout and review the “Model Feedback Form.” The feedback form will mirror some of the questions and criteria in the student instruction prompts to be certain groups have addressed all necessary components of the model. ▪ Assign each group to another peer group to give feedback on model. ▪ Assign students a specific amount of time to give feedback (for example: 10 minutes), so student groups are all encouraged to put in the same effort towards their feedback. ▪ Optional: Provide a few minutes for groups to verbally review the feedback they give their peer group. ▪ Student groups revise their models based on feedback and create a final draft, using materials provided (poster paper and markers/colored pencils). ▪ Optional: After all models are complete, you may wish to allow students to briefly view all of the final draft models designed by their class-members in a secondary gallery walk AND/OR You may have students complete a final self-assessment of their model, using the criteria listed.
<p>Part D: Individual Work Explaining your Biosphere 3 Model</p>	<ul style="list-style-type: none"> ▪ Review Part D in the <i>Student Instructions</i> document with students at the start of the class period. Remind them this portion of the assessment is to be completed using all of the information and notes they developed in their group, but here they are to answer the questions individually to show what they have learned. ▪ Provide students access to their group’s model - on their table or on a wall where it is visible as they work on their Individual Product Worksheet. Encourage student to look at and use the model, and refer to it in their answers. ▪ Hand out the <i>Individual Student Product Worksheet</i> or have students turn to it if it is a part of the IEA packet. This worksheet contains four different questions, which will help students explain how all the parts of the ecosystem will work together to support human life on Mars. ▪ Provide structure time for students to complete this work within the classroom and not as homework, so the information gathered about what they know and are able to do will be authentic, accurate and valuable for evaluating individual student progress.

	<ul style="list-style-type: none"> ▪ Optional: Offer sentence starters for the questions. For example, <ul style="list-style-type: none"> ○ In the Biosphere 3 ecosystem, you will find ____, all of which interact in different ways. ○ The living components are __. ○ The nonliving components are __. ○ The living and nonliving components interact by __. For example, ____. ○ One way matter moves through the ecosystem is ____. ○ Another way matter moves through the ecosystem is ____. ○ These interactions help support human life by _____. For example, _____. ○ If one part was missing, then _____. For example, _____. ○ Our Biosphere 3 could function even better if _____. ○ One piece of evidence that supports this is _____. ○ In addition, our model shows that _____. ○ This can be explained by _____.
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I. Scoring

Student products to be assessed:

- 1) Biosphere 3 Model (group) – collect all group models for formative assessment purposes and to reference when evaluating individual student work products.
- 2) Explain Your Biosphere 3 Model (individual) – collect the final versions of the written explanations on the *Individual Student Product Worksheets*.