

Building a Biosphere

Introduction

You already learned about Biosphere 2 and some of its problems. You are now going to use what you know about ecosystems on Earth to think about what humans would need to live on another planet so you can help design Biosphere 3.

A group of researchers are creating plans for an ecosystem to go in Biosphere 3 on Mars. The dome they designed will protect everything inside and will provide the energy that the ecosystem needs. Now the researchers are trying to decide what will need to be inside the dome to create an ecosystem that will help the humans survive. You are ecologists who have been asked to analyze their plan to figure out if it could support humans, and what else the system might need to be healthy. After you complete your analysis, you will explain your findings to the rest of the team – the researchers and the people who will live inside Biosphere 3.



Overarching Challenge: Can you make sure the ecosystem in Biosphere 3 has what it needs to keep people alive?

In your groups, you will do the following two activities:

1. Develop a model to show how the parts of the ecosystem interact, and
2. Use the model to analyze whether
 - a. the ecosystem could support humans, and
 - b. what could be added to the ecosystem to strengthen it

Individually, each of you will use evidence from the model your group created to explain how Biosphere 3 would be able to support humans on another planet.

What Is Assessed

In this assessment, you will show that you can:

- Develop a model that shows how interactions between the living and non-living parts of an ecosystem cause matter to move through the system.
- Use a model to describe how interactions move matter through a whole ecosystem.
- Identify whether an important part of the ecosystem is missing and explain what happens to the function of ecosystem if that part is not included.

Products to be assessed:

- 1) Biosphere III model and plan (group)
- 2) Biosphere III explanation (individual)

Instructions

Part A: Learn about Living in an Ecosystem (Pairs and whole class)

1. Read the handout: *Ecosystem Services*
2. Discuss what ecosystems do to provide each of the services on the handout.
3. Discuss the question, What do humans need from their ecosystem to live? Take notes below.

Part B: Analyze the Biosphere 3 Plan (Group work)

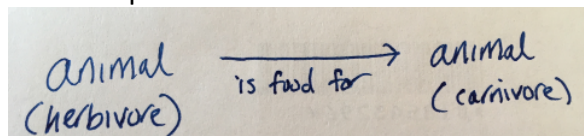
To make sure Biosphere 3 has a healthy ecosystem, you need to think carefully about all of the ways parts of the ecosystem interact.

1. **Develop a model.** Your teacher will give you a DRAFT *Biosphere 3 Ecosystem Plan* and a blank piece of paper. This plan shows the things that researchers are thinking about including in Biosphere 3. **Develop a model to show how each part of the ecosystem depends on matter from the other parts.**

Your model needs to:

- 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 (living and non-living).

For example:



2. Use your model and what you know about ecosystems to discuss the following questions with your group. You might find that you need to add information to your model as you answer the questions.

- a. **Analyze your model.** The biosphere will provide energy that plants need to survive. Is 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 here.

- b. **Use your model.** Use your model to describe two different ways matter moves from air to humans in this ecosystem.

- c. **Explain your model.** Your teacher will assign you one of the parts of the ecosystem from the list below. Discuss the ways that this part is important to all of the other parts of the ecosystem.

- Bacteria
- Soil
- Insects

Your teacher will assign you a partner group. Your group will explain to your partner group why this part is important for keeping the whole ecosystem healthy. Each member of your group should explain how matter moves between this part and at least one other part of the ecosystem.

- d. **Revise your model.** If your answers to any of these questions made you realize that anything is missing from your ecosystem model, revise your model before you continue.

Part C: Peer Feedback (Group work)

Directions: Each group will give feedback to one other group. Your group will use the *Model Feedback Form* to write your feedback to the other group.

Part D: Explain How Your Biosphere 3 Model Works (Individual work)

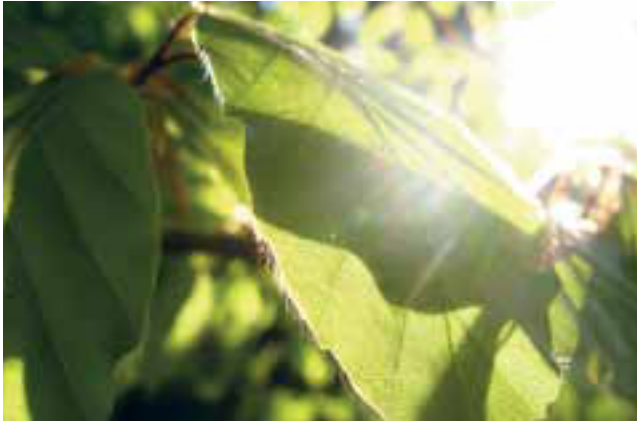
Directions: Now that you have analyzed the draft ecosystem plan, you will need to explain your findings to the rest of the team. All of the people who will live in Biosphere 3 need to know that the ecosystem will support them for a long time on another planet. In order to do that, it needs to work as a system—its parts have to work together so that living things have what they need to survive.

Answer the questions on the worksheet *Explain the Biosphere 3 Plan* to explain to the team how all the parts of the ecosystem will help the whole system work to allow them to eat, drink, and breathe for a long time.

Photo of Biosphere II by [DrStarbuck](https://www.flickr.com/photos/drstarbuck/3783804640/sizes/o/) <https://www.flickr.com/photos/drstarbuck/3783804640/sizes/o/>

ECOSYSTEM SERVICES

From the World Wildlife Handbook: Nature's Services, a guide for primary school



Ecosystem services support the rest of the ecosystem

Supporting services are:

- Photosynthesis
- Soil Formation
- Nutrition in nature
- The water cycle
- Habitats for different species
- Biodiversity



Ecosystem services help humans survive

Ecosystems provide:

- Drinking water
- Food
- Fuel
- Medicine and health resources
- Raw materials for building



Ecosystems services protect humans and the environment

Ecosystems protect by:

- Control of erosion
- Water purification
- Protection against disease
- Protection against pests
- Protection against natural disasters
- Better climate
- Purification of the air
- Pollination



Ecosystems services provide natural beauty.

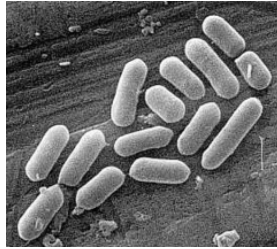
Ecosystems provide places for:

- Outdoor activities
- Health and relaxation

DRAFT Biosphere 3 Ecosystem Plan



Plants/trees



bacteria



insects



animals - birds (omnivore)



animals – mammals (carnivore)



animals (herbivore)



soil



air



Humans

Model Feedback Form

Part 1: Place a checkmark in the box for each part of the ecosystem you see in the model you are reviewing.

Parts of the Ecosystem	Is each part shown and labeled?
Plants/trees	
Bacteria	
Insects	
Birds (omnivore)	
Animals (herbivore)	
Soil	
Air	
Animals (carnivore)	
Humans	
Ecosystem parts added?	

Part 2: Analyze the interactions you see in the model and answer the questions below.

1. Are there arrows between the living and non-living parts of the ecosystem? Do the arrows show accurately how interactions move matter between each part of the ecosystem?
2. Are there are any arrows you think might be missing or drawn incorrectly? Write suggestions for how to improve the model below:
3. Do the labels describe clearly and accurately all the ways that matter moves between the living and non-living parts of the ecosystem? Write suggestions for how to improve the model below:

Biosphere IEA
Model Feedback Form

Part 3: Give your partner group some positive and constructive feedback.

1. What is one thing this group did well on their model?
2. What is one thing this group can do to improve their model?

Explain How the Biosphere 3 Ecosystem Will Work

1. What did your group decide that the original Biosphere 3 plan was missing? Explain to the researchers why the whole Biosphere 3 ecosystem would not function well if that part was not included.

2. Explain to the people who will live in Biosphere 3 how the ecosystem works. Choose one part of the ecosystem and describe how it supports the movement of matter for all other parts of the system.

3. The Biosphere 3 ecosystem needs to be designed to support human life for a long time. Explain why bacteria are very important for making sure the ecosystem can support human life for many years. Use examples from your model to support your explanation.

4. The team does not want to add too many things to the ecosystem. But if you could convince them to add one more thing to the ecosystem to make it even stronger for the humans in Biosphere, 3, what would you add?

Write an argument to convince the rest of the research team why they should add this part. Make sure your argument has a claim, is supported by evidence from your model, and reasoning.