

Investigation: Ecosystem in a Bottle In Class Project Overview

Overview: Students will create an ecosystem simulation using 2-Liter bottles to explore the cycling of the essential elements carbon, hydrogen, oxygen, and nitrogen through biotic and abiotic components of an ecosystem. Students will need a minimum of two 2-Liter bottles for this project – one to represent an aquatic ecosystem and one to represent a terrestrial ecosystem. Students will work with a partner to design a way to connect these two bottle ecosystems so that nutrients can cycle appropriately and life can be sustained for a month-long period. They will assemble their ecosystems in class and collect daily observations throughout this month. At the completion of their observation month, students will write a report of their findings, relating their observations back to what they know about the cycling of nutrients and the interrelationships of organisms.

Biology Standards:

HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

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-LS2-1. Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

Materials that will be provided to you:

- For the Aquatic ecosystem:
 - o Dechlorinated water
 - o Goldfish (1 per group)
 - o Aquatic plant
- For the Terrestrial ecosystem:
 - o Flowering plant
 - o Cricket (1 per group)
 - o Superworm (1 per group)
 - o Grass seeds
 - o Soil
- For the overall assembly:
 - o Duct tape
 - o Clear packaging tape
 - o Scissors

Materials that you must provide:

- Two empty and clean 2-Liter bottles (one for each ecosystem)
- Any materials not on the list above you want for your design (*Note: I must approve these!!*)

How you will be graded: At the completion of this project you will submit a detailed report of your investigation with all required components.

Ecosystem in a Bottle In Class Project Checklist

Use this list to make sure you have completed every aspect of the report before you turn it in. You may also use the rubric I will be using as a reference tool.

Introduction (10 points)

- Drawings of each cycle including abiotic and biotic factors are included
- Examples of ecological interactions between living organisms in these drawings are highlighted
- The importance of the cycling of these nutrients is explained

Hypothesis (20 points)

- Design sketch is clear, complete, and detailed enough to replicate
- Table is complete and each organism has a specific way to obtain each essential nutrient in the designed set-up

Materials (5 points)

- All materials used are included in a bulleted list
- List is specific and includes amounts of each material used

Procedures (5 points)

- An overview of how the bottles are connected is included
- The reasoning for connecting the bottles this way is explained
- This is in paragraph form and not a step-by-step numbered list

Results: (20 points)

- All daily observations are included from the data collection month
- Includes a visual timeline that summarizes key events from the month

Analysis (20 points)

All of the following questions are answered thoughtfully, in detail and in paragraph form:

- Describe at least three ecological interactions you observed between the living organisms in your aquatic and terrestrial ecosystems.
- What happened to your ecosystem that was out of your control and not something you anticipated in your design? What was its effect? How could you potentially have prevented this?
- How could you have modified your set-up in order to collect quantitative data and not just qualitative data? Be specific about what data you would collect, how you would do it, and why this would be beneficial data to analyze.
- If you were to do this investigation again with what was originally provided, how would you modify your design in order to increase the odds of survival of all your living organisms?
- If you were to do this investigation again but were not limited by materials, time or living things, what would you create and why? (Be creative and dream big but remember – you are still trying to achieve the goal of creating a sustainable ecosystem in a bottle)

Conclusion (20 points)

All of the following questions are answered thoughtfully, in detail and in paragraph form:

- Describe three ways in which nutrients did cycle as you predicted in your hypothesis.
- Describe three ways in which nutrients did not cycle as you predicted in your hypothesis.
- Overall, how is this project like a real ecosystem?
- How is this project different from a real ecosystem and what are its limitations?
- What did you learn about the nutrient cycles and ecological interactions from this investigation?

Ecosystem in a Bottle Project Rough Draft Outline

Introduction:

Drawing of Hydrologic Cycle:

List of ecological interactions:

Drawing of Carbon Cycle:

List of ecological interactions:

Drawing of Nitrogen Cycle:

List of ecological interactions:

Importance of the cycling of nutrients: _____

Hypothesis:

Drawing:

Table:

| | Hydrogen and Oxygen (water) | Carbon | Nitrogen |
|------------------------------|--|---------------|-----------------|
| Goldfish | | | |
| Aquatic plant | | | |
| Cricket | | | |
| Worm | | | |
| Terrestrial plant | | | |

Analysis:

All of the following questions are answered thoughtfully, in detail and in paragraph form:

1. Describe at least three ecological interactions you observed between the living organisms in your aquatic and terrestrial ecosystems.

2. What happened to your ecosystem that was out of your control and not something you anticipated in your design? What was its effect? How could you potentially have prevented this?

3. How could you have modified your set-up in order to collect quantitative data and not just qualitative data? Be specific about what data you would collect, how you would do it, and why this would be beneficial data to analyze.

4. If you were to do this investigation again with what was originally provided, how would you modify your design in order to increase the odds of survival of all your living organisms?

5. If you were to do this investigation again but were not limited by materials, time or living things, what would you create and why? (Be creative and dream big but remember – you are still trying to achieve the goal of creating a sustainable ecosystem in a bottle)

Conclusion:

All of the following questions are answered thoughtfully, in detail and in paragraph form:

1. Describe three ways in which nutrients did cycle as you predicted in your hypothesis.

2. Describe three ways in which nutrients did not cycle as you predicted in your hypothesis.

3. Overall, how is this project like a real ecosystem?

4. How is this project different from a real ecosystem and what are its limitations?

5. What did you learn about the nutrient cycles and ecological interactions from this investigation?
