

Ecosystem in a Bottle

Real World Ecosystems
Activity
Grade Level: 5-8



Main Objectives

This activity encourages learners to observe an ecosystem by having them observe and investigate a class bottle biosphere. The investigation will allow learners to make connections between the bottle and the Earth as a whole unit and ecosystem. The lesson is not dependent upon success in creating a thriving bottle, as a dying bottle may create more discussion than a successful one.

Learning Outcomes

By the end of this activity, learners will:

- Assist in building or observe a pre-made biosphere bottle
- Understand the connection between ecosystem of the bottle and ecosystem of the earth
- Define ecosystem
- Gain an appreciation of our Earth and the complexity of our planet
- Begin to understand how changes made in one area of a closed system may have consequences in a balanced environment

Length of Activity

1.5 hours to build
3 weeks to observe

Materials List

Ecosystem in a Bottle Backgrounder
Ecosystem in a Bottle Worksheet
Ecosystem in a Bottle Learner Worksheet Answer Key
One large, fully-enclosed glass or plastic container

(Note: one of the best containers to use is a 20-litre plastic or glass water bottle, used by purified water companies. Check with your local distributor.)

Pea-sized gravel (3L)
Activated charcoal (1L)
Sterilized potting soil (4-6 L)
Natural twigs and tree bark
3 or 4 humidity-loving plants
Mister or sprayer
Long wooden dowel to reach bottom of the bottle
Newspaper
Large mouth funnel

Procedure

Step 1: Backgrounder

- a. Provide the learners with copies of the Ecosystem in a Bottle Backgrounder. Allow the class to read the backgrounder individually or in groups.
- b. As learners are finishing up their reading, be sure to remind them to discuss amongst themselves the “Think About” questions at the end of the backgrounder.

Step 2: Introduction and demonstration

- a. Ask the learners to imagine that they lived in a city under a large glass dome. The glass is sealed so that nothing gets in and nothing gets out, except light and heat. Everything they need is within that glass dome. Discuss what elements they would be needed. Ask how they would handle oxygen, food, and waste concerns.

- b. The following activity will serve as an educator demonstration for the class. You could make one or two or even three bottles, varying the conditions for each bottle.

Step 3: Making the biosphere bottle

- a. Spread newspaper over your workspace.
- b. Mix the activated charcoal and gravel and pour into the bottom of the container, using the funnel. You will need a layer about 3 cm deep.
- c. Add dry sterilized soil to the container to form a layer about 8 cm deep on top of the gravel.
- d. Spray the soil down with about 500 mL of water. Moisten but do not saturate.

Step 4: Inserting the plants

- a. Remove 3 or 4 young plants from their plastic pots and gently shake some of the soil from the roots.
- b. Use the dowel to dig a small hole in dirt in the bottle.
- c. Squeeze each plant through the mouth of the bottle and drop the plant into place.
- d. Arrange the plants; smallest near the outside and largest near the middle.
- e. Using the dowel, gently push the soil to cover the plant roots.
- f. Plant all mosses last.

Step 5: Maintenance

- a. Keep the bottle sealed. Do not water or fertilize. The plants inside will adjust to the amount of water and nutrients and will not be helped by adding more water.
- b. If you added too much water in the beginning it is likely that you will get a moldy fungus that will ultimately kill all the plants.
- c. Place the bottle near a window where it can grow, but out of direct sunlight. If the bottle gets too hot the plants can die. Place the bottle near a grow light or near a north-facing window for indirect sunlight.

Step 6: Life or death

- a. If the bottle survives and thrives for three weeks, you have probably established a balanced ecosystem. If the bottle doesn't do well and the plants die, have the learners write up an "autopsy" report stating why they think the plants died.



Photo: D Mussell, GreenLearning

Tips and Extensions

- Use only sterilized soil.
- Plants should come only from greenhouses and indoor sites.
- Do not choose plants that will grow too tall. Small plants are best suited, rather than seeds.
- Low growing humidity-loving plants will work best (E.g. ferns, spider plants and ivy).
- Too little water is better than too much water. Spray no more than 200 mL at a time. If you get a fungus growing in the bottle, start the whole procedure over again, but wash the gravel and the bottle with a mild bleach solution. Use fresh soil and fresh plants.

- Change only one variable per bottle of setting up more than one:
 - Use soil taken from the outside garden.
 - Add more water than recommended.
 - Add more plants than recommended.
 - Place the bottle in direct hot sunlight.
 - Place the bottle in a cold area.
 - Place the bottle in a dark place.
 - Introduce some plant-eating beetles
- Power and water
 - Have learners make drawings of the energy flow within the bottle.
 - Have learners make drawing of the water flow within the bottle.
- Imagine you had to seal your house from outside influences. How would you do it? Describe what materials you would use. How would you get air and water and what would you do with waste?
- Create the following scenario: You have to design and build a biosphere that can hold 10 people because there is serious concern about the survival of the Earth. You need to house and feed these people and systems within your biosphere need to be self-reliant. Consider how the biosphere would keep these people alive for three years. How can you allow for a quality of life within your biosphere? What kind of people would you like to inhabit your biosphere and what types of skills should they have?

Comprehension

- When the learners have observed the biosphere bottle for a few weeks, allow time for completion of the worksheet and then discuss answers with them.
- Take note of the numbers, sizes, and types of plants inside each.
- Discuss the growing conditions each bottle was kept in (the light, temperature, etc.)