

Martian habitats in the classroom: testing *Artemia*

Activity 2 worksheet: From Earth to Mars – creating a self-sustaining ecosystem in a bottle

Materials

- Transparent plastic bottle (1–2 l)
- Clean sand (washed and dried)
- Crushed shells of marine animals
- Aged/dechlorinated tap water
- Sea salt or non-iodized coarse salt
- 6 Brine shrimps of different sizes (and ages)
- Liquid plant fertiliser
- Pipette
- Spoon
- Sieve
- Funnel

Procedure

Constructing a bottle ecosystem for Martian life-support studies

1. Wash the bottle (1.5 l) with tap water. Do not use detergent.
2. Add 1.2 l of tap water to the bottle and mark the water level. Empty the bottle afterwards. This mark will help maintain a stable water volume.
3. Add a thin layer (2 cm) of clean sand and crushed seashells (e.g., oyster shells) in a 3:1 ratio to the bottom of the bottle to simulate the sediment of a shallow aquatic habitat.
4. Prepare the seawater by dissolving 30 g of sea salt per litre (36 g for 1.2 l). Pour the solution into the bottle up to the marked level.
5. Add 2 drops of liquid plant fertiliser.
6. Place it in a sunny spot (20–25°C), such as a south-facing window or near a light source during the winter.
7. Observe the system weekly for 2–8 weeks. Check for algal growth by looking for green areas. Once green zones are present, the ecosystem is ready to receive the brine shrimp.

Maintaining a Martian life-support System

8. Add 6 brine shrimp of different sizes into the bottle.
9. During the first two weeks, add one drop of liquid fertiliser per week. After this period, reduce the dosage to one drop every two weeks.
10. Leave the bottle uncapped, or only lightly secure the cap.
11. Once a week, screw on the cap and roll the bottle gently.
12. Monitor the water level regularly. If evaporation occurs, add dechlorinated fresh water (without salt) to restore the original level.
13. Observe the *Artemia* regularly and record their behaviour, abundance and distribution within the bottle. Note where they swim, how they interact with the sediment, and whether the population changes over time.

Discussion

- Why is the bottle washed before the experiment, and why is detergent avoided during cleaning?
- What is the purpose of adding sand and crushed shells?
- Why do we use sea salt?
- Why are algae essential in both the bottle ecosystem and a future 'Martian habitat'?
- Why must water levels and environmental conditions be carefully monitored in this model ecosystem, and how does this relate to future habitats on Mars?
- Why do we add liquid fertiliser at the beginning of the experiment, and why can the dose be reduced later?
- Why is the cap left loose or off?
- Why do we roll the bottle once a week?
- Why are different sizes of brine shrimp added?
- How do the geosphere, atmosphere, biosphere, and hydrosphere interact in the bottle ecosystem?
- Can a bottle ecosystem be considered a model of a Martian life-support system? Why or why not?