



Lesson: Self-sustaining Ecosystem

Name:

Teacher:

Date:



Building a Self-Sustaining Ecosystem in a Jar

Creating a self-sustaining ecosystem in a jar offers an insightful glimpse into the intricate web of life present within ecosystems, even on a miniature scale. This simple, contained environment serves as a model to help us understand fundamental ecological processes such as the cycling of matter, flow of energy, and the balance required to sustain life. By sealing a glass jar filled with plants, soil, and water, students can observe how plants perform photosynthesis, how water circulates, and how gases are exchanged—revealing complex interactions between living and non-living components of an ecosystem.

The Science Behind a Jar Ecosystem

A closed ecosystem in a jar replicates the delicate dynamics of larger ecosystems. When plants, soil, water, and air are sealed in a jar, they create a self-contained environment that sustains life without external resources. This ecosystem demonstrates essential ecological principles and underscores the importance of balance. Students gain hands-on experience in understanding how ecosystems function at a basic level.

Photosynthesis and Respiration: The Oxygen-Carbon Dioxide Cycle

Plants play a central role in sustaining the ecosystem within the jar through **photosynthesis and respiration**. **Photosynthesis is the process by which plants use sunlight to convert carbon dioxide and water into glucose (a type of sugar) and oxygen.** This process provides energy for the plant and produces oxygen as a byproduct, maintaining the balance of gases within the jar.



In **cellular respiration**, plants consume oxygen to break down glucose for energy, releasing carbon dioxide back into the air. This exchange of gases is crucial for ecosystem balance, mirroring the continuous oxygen-carbon dioxide cycle in all ecosystems on Earth. Observing this process in a jar allows students to appreciate the delicate balance of gases required for life and the vital role plants play in sustaining breathable air.

The Water Cycle in a Closed System

The water cycle also functions within a closed jar ecosystem. Water evaporates from the soil and plant surfaces, condenses on the glass walls, and eventually drips back into the soil. This constant cycle of **evaporation and condensation** keeps plants hydrated without additional water, mimicking the hydrological cycle in natural environments.

This miniature water cycle demonstrates principles of **closed systems and sustainability**, emphasizing how natural ecosystems recycle resources without external input. Students can observe firsthand how Earth's ecosystems conserve resources and maintain balance.

Nutrient Cycling and Decomposition

Nutrient cycling is another critical aspect of ecosystems that students can observe in a jar ecosystem. As organic material, such as plant matter, decomposes, it enriches the soil with essential nutrients for plant growth. Even if decomposition is slower in a jar than in an open ecosystem, the process demonstrates how resources are recycled.

This small-scale nutrient cycling reflects broader principles of **ecosystem sustainability**, where resources are reused and conserved over time. Observing this process helps students understand how even small ecosystems maintain balance that supports life.

The Importance of Balance and Sustainability

A jar ecosystem vividly illustrates the interdependence of living and non-living components in an environment. It shows that ecosystems require a careful balance of light, air, water, and nutrients to sustain life. Disrupting any one of these elements can destabilize the system, teaching students important lessons about the fragility and resilience of natural environments.

Sustainability is a key lesson learned from observing closed ecosystems. Because the jar ecosystem operates without additional resources, it demonstrates how essential resources like water, air, and nutrients can be recycled within a system. By studying this model, students gain a deeper understanding of how ecosystems function and why preserving natural resources is critical.



Conclusion

The “Ecosystem in a Jar” experiment is more than a hands-on activity; it provides valuable insight into the processes that sustain life on Earth. By observing a self-contained environment, students learn about **photosynthesis, respiration, the water cycle, and nutrient cycling**, all of which contribute to maintaining balance within an ecosystem. This small-scale model offers an accessible way to appreciate the interconnected web of life and the principles of sustainability essential for all ecosystems.

References:

- Greenfield, T., & Karbler, L. (2021). *Experiential Learning in the Science Classroom: Enhancing Understanding through Hands-on Activities*. Science Education Journal, 34(2), 67–83.
- Johnson, R. (2020). *The Microcosm Approach: Teaching Complex Ecological Interactions through Miniature Environments*. Environmental Education Press, 12(5), 145–152.
- Miller, K., & Levine, J. (2019). *Biology: Exploring Life and Ecosystems*. Pearson Education.
- NGSS Lead States. (2013). *Next Generation Science Standards: For States, By States*.

Blog about the topic is available on the STEM Blog page. PDF downloadable resources are down below, and PowerPoint presentations and reference videos are found on the PPT/Video page.