



Bottle Biosphere Educational Project Overview 2017

Statement of Need

- Low income community students are falling behind in STEM courses
- Many inner city schools have “paper labs” where there is no equipment, and only a piece of paper that describes what would have happened if the student could see in a microscope or dissect for themselves
- Teachers are extremely busy and don’t always have time to develop new materials to make subject matter hands on and experiential

Who

- Designed for urban students with limited access to outdoor activities, by bringing nature into the classroom in a versatile way
- Also designed to support teachers with hands-on engaging lesson plans to boost existing STEM curriculum with earth science, biology and environmental stewardship classes

What

- 10 week curriculum for 9th graders
- Uses recycled two-liter soda bottles to create low maintenance and self-watering projects
- Creates opportunities for students to consider, design, and implement rules for protecting nature – as represented by their Bottle Biospheres.

Benefits

- Hands-on process-oriented inquiry allows students to establish a direct connection with nature using a hands on approach
- Provides teachers with a flexible format that suits any classroom and class size any time of year, in any weather
- Students will have a new connection to nature, understand the importance of nature’s rights and have practical applications to use in their daily lives
- We expect improved student performance in terms of: engagement, attendance, grades/test scores, and classroom behavior

Curriculum Outline: Weekly Lesson Focus

Observe

1. Laws of Nature¹



Students will be introduced to the concepts of interaction and interdependence between organisms and the environment, in other words – the natural laws. In exploring ecosystems and biodiversity they will learn about Earth’s basic biomes: the abiotic factors or non-living parts of the environment such as water, sunlight, oxygen, soil and weather; and the biotic factors or living parts that affect an organism, such as animals and other organisms. Students will learn how these biotic and abiotic factors interact in the Bottle Biosphere.

2. **Seed Germination**

The students will design and conduct their own experiment based on plant lifecycles and the scientific method. The experiments will focus on seedling germination and plant growth. Students will identify variables to test, then design and conduct their own experiment. They will create a poster presentation of their findings. They will apply what they learn to their Bottle Biosphere.²

Create

3. **Creating the Bottle Biosphere & Monitoring It’s Health**

Students create a model of an ecosystem and will be able to explain how energy flows through their ecosystem, how their ecosystem changes, how the effects of limiting factors on the population dynamics interact, and how different inputs impact the system. Students will build a Bottle Biosphere, fill it with soil, plants and water, and observe and record changes over time. Students will also learn to check plants for signs of stress and troubleshoot problems in their Bottle Biosphere. Students will create a photo story or video of their ecosystem and describe how it changes over time. They will also keep a journal describing how and why their ecosystem changes. For construction: see Sample Bottle Biosphere at the end of this document.³

4. **Phenology & Plant Growth**

Students are introduced to the concept of phenology—the timing of periodic life-cycle events. Students begin by distinguishing between biological and environmental events in an ecosystem (first flower vs. first snow). They place their events on a calendar and then brainstorm what might happen if these biological events didn’t happen one year. Students then break up into small groups and hypothesize about biological and environmental events in their bottle biospheres.⁴⁵

5. **Water Cycle**

Students will first carry out a number of activities that demonstrate the concepts of evaporation, condensation, precipitation, and soil moisture and runoff. The



students will diagram the water cycle for their Bottle Biospheres. Immediately following this, students will use the internet to acquire Real Time Data from their region which they can then use to describe the phases of the water cycle as they occur in their city.⁶

6. Photosynthesis: Carbon & Nitrogen Cycle⁷

Students will learn about carbon dioxide and methane, carbon storage, and the way carbon is exchanged within each Bottle Biosphere. They will learn about the role of photosynthesis in the carbon cycle, which includes both carbon and nitrogen, elements that are the building blocks of life. Class will explore process by which gaseous nitrogen is transformed into proteins used by plants, animals, people, and even bacteria.⁸

Make Laws

7. Creating Rules to Protect Your Biosphere

Students explore the rules they follow: School and home rules. They then create rules to protect their Bottle Biospheres. Guidelines can be provided (e.g. phrase rules in the form of a positive statement, state rules clearly, no more than 5 rules, etc.). The class will discuss potential rules and adopt a set of rules that everyone will follow.⁹

Implement Laws

8. Implementing Rules to Protect Your Biosphere

This activity will raise student awareness of what constitutes appropriate classroom behavior with regards to the Bottle Biosphere. The students will develop strategies around how to enforce the rules made last session. While consequences are often framed as something used only after a rule has failed, they are more accurately viewed as part of the structure that makes rules work. Students can agree what will be communicated up front if someone breaks a rule. This cause and effect relationship teaches students about self-discipline as the best way to achieve long-term goals plus how to implement rules.¹⁰

Applying to Your Life

9. How to Protect the Biosphere of Earth

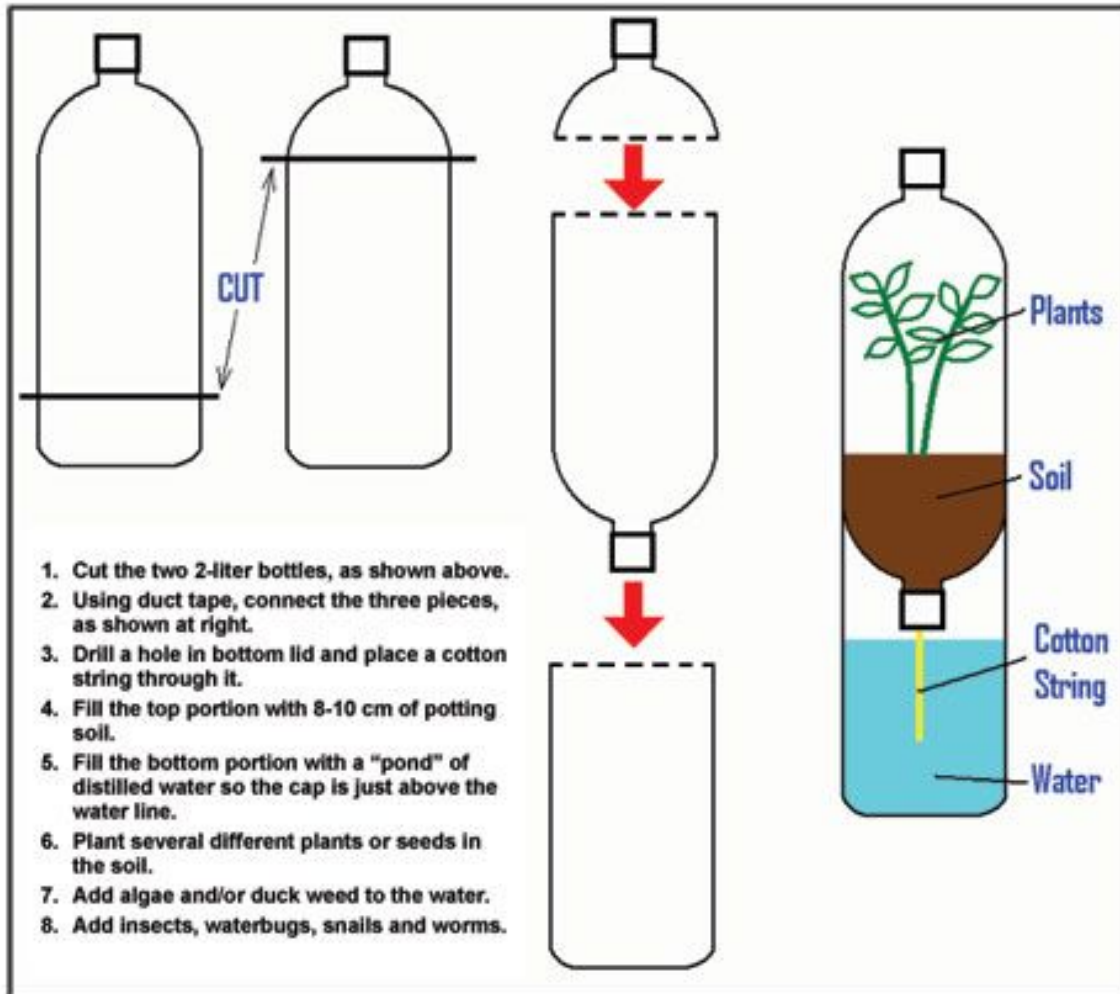
This lesson will build on the rules students have already made for their Bottle Biospheres, and extend that to the larger biosphere of Earth. Students will be introduced to a new form of law, economics and governance (Earth Law). "Earth Law" represents a new form of law, economics and governance that recognizes the inherent rights of the natural world to exist, thrive, and evolve.



10. Rights of Nature

Students learn about real life applications of Earth Law around the world and in the US. Students see examples then brainstorm ways they can personally apply earth law—from day to day life, to projects that they can lead and participate in.

Sample Bottle Biosphere Instructions





About Earth Law Center

ELC works to transform the law to recognize and protect nature's inherent rights to exist, thrive and evolve. Through this work, we envision a future in which humans and nature flourish together.¹¹

Lesson Plan Sources

¹ <https://earthref.org/SCC/lessons/2010/ecology/>

² https://hilo.hawaii.edu/affiliates/prism/documents/Dry_Forest_Lesson_6.pdf

³ <http://www.stemmom.org/2013/04/terrarium-building-with-students.html>

⁴ https://www.chicagobotanic.org/downloads/nasa/Unit_3_Grades_7-9_Activity_3-2_SeasonsOfAPlant.pdf

⁵ <https://www.scholastic.com/teachers/unit-plans/teaching-content/seed-plant/>

⁶ http://delphiboston.org/what-students-can-learn-from-classroom-Bottle_Biospheres/

⁷ <http://www.cpalms.org/Public/PreviewResourceLesson/Preview/75664>

⁸ <https://educators.brainpop.com/bp-topic/nitrogen-cycle/>

⁹ <http://ted.coe.wayne.edu/sse/lesson/law.htm>

¹⁰ http://teachingasleadership.org/sites/default/files/Related-Readings/CMC_Ch2_2011.pdf

¹¹ <https://www.earthlawcenter.org/>