



Curriculum Connections



Photo courtesy of Ginter Park Elementary

And Around it Goes: The Water Cycle

Since water formed on the planet, it's been traveling endlessly through the processes of evaporation, precipitation, and runoff. Observations of your pond's fluctuating water levels due to rain or evaporation offer the opportunity for students to puzzle out and understand that all water on Earth is connected through the water cycle. Ask, *The water we used to fill our pond: where did it come from, and where did it go?* List and talk about their answers, then introduce an illustration of the water cycle for discussion. Once you've assessed that students understand the general cycle, challenge them to make a connection between it and the source water for your school pond. If you filled it with water from a spigot or hydrant, you might invite a worker from the town's water utility to come in to field questions from students, or have a

hydrologist come in and talk about how the school's artesian well draws water from an underground reservoir. Ultimately, they should be able to see how their pond is part of the cycle, and that the water there is constantly in motion, even when it looks like it's just sitting there!

Water Cycle Diagrams:

[Third Grade Web Quest](#) (animated diagram)

[USGS: Water Science for Schools](#)

Biosphere in a Bottle

Observations of a humble jar of pondwater can help students appreciate the role of plants in transforming light energy from the sun into the food energy that sustains all life on Earth. Water containing producers (mainly algae and higher plants), consumers (tiny animals) and decomposers (bacteria and fungi), and placed under a light source, can act as a model of any living system! Carbon, oxygen, and other important elements cycle through the minibiosphere, as in the larger world, through processes of photosynthesis, respiration, and decomposition.

This project is easily accessible to a range of grade levels. Younger kids may simply observe and describe changes over time and wonder at the diversity of emerging life. Older students can do more quantitative measuring and identification of life forms.

Minibiospheres can provide an engaging focus for long term observations; an understanding that systems cycle and change over time; and a glimpse into the tremendous diversity of life teeming in even a small jarful of pondwater. Making observations for at least six weeks gives students a sense of the pace and type of changes that occur over a season. You might want to keep one or two of your biospheres indefinitely: many can reach some state of equilibrium and remain healthy for months or even years.

Consider breaking into small groups, with each group of students setting up several minibiosphere jars.



Photo courtesy of Austin Independent School District

Biosphere Setup

Step 1. For each minibiosphere, obtain a clean pint or quart jar with a screw-top lid. Because too much organic matter in the jars can cause a gas buildup and potential explosion, use a nail to poke a hole in each lid and seal the hole with melted wax. This will act as a pressure-release valve.

Step 2. Collect pondwater and mud. Add mud to the jar, providing a 1/2- to 1-1/2-inch-deep base; add pondwater to fill the jar 2/3 to 3/4 full. Make a point of collecting some visible primary producers (algae and plants) and consumers (snails and insects). Don't include large animals or plants since it's such a small habitat.

(Make your pondwater collections at any time of the year. One instructor reports that her students were awestruck as



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tiny green plants and baby snails "hatched" from seemingly lifeless mud and water collected during the winter.)

Step 3. Before sealing the jars, have students make careful observations of the contents. Use hand lenses and microscopes, if available, to explore the pondwater. Suggest that students also observe and use crayons or pencils to record the color of the water, or the amount of light passing through. The density of the green color is an indicator of the quantity of producers present, which will change during the experiments.

Step 4. Allow the biospheres to sit for a week in a brightly lit room out of direct sun, or under growlights, before beginning experiments. Have students repeat and record observations, noting changes in the abundance of different organisms, color changes, odor, and so on. Although, ideally, these systems should remain closed once they've been set up, student interest will be higher if they can open them briefly on a regular basis and remove a small quantity of water for closer observation.

Simulating Environmental Changes

Minibiospheres also provide an opportunity to set up experiments to test the effects of simulated environmental changes on the system. To spur inquiry, ask your students to hypothesize what might happen if something in the environment stimulated changes in their school pond. *What if we let a tree grow up and shade the pond? What if salt used to melt ice on the sidewalk, or fertilizer used on the playground turf washed into it?* Have students use their imaginations to come up with their own ideas. Compile their ideas and ask how they would set up an experiment to test such changes in the pondwater biospheres.



Have small groups of students set up several minibiosphere jars. Be sure to keep one jar as the control and experiment with the others. Groups might each test the same variables, or different concentrations or degrees of a single variable. Here are some suggestions:

- 24 hours of light vs. natural (12-14 hours)
- low pH versus actual pond pH (simulated acid rainfall)
- no light (cover with black paper)
- addition of small quantities of fertilizer (simulated fertilizer runoff)
- cold versus warmer temperatures
- addition of salt (simulated road salt runoff)
- addition of commercial phosphate detergent (simulated pollution)
- colored cellophane around jars (growth under different light colors)

Once you've recorded results from some of these experiments, extend them into a discussion or study of how human activities stimulate analogous environmental changes in your region (e.g., eutrophication in local water bodies from nutrient pollution; sterilization of lakes and waterways due to acid rain; salinization of water supplies) and what is being done to help restore health to these bodies of water.

Oh, the Webs They Weave



Photo courtesy of Austin Independent School District

Have your eager observers take stock of the species that live in and around their pond, on both the macro (and, if appropriate), the micro scale. Since water is a key element of all habitats, they likely have seen animals drinking or birds hunting pond insects. Create a master list from this survey, and assign small groups to each sort the plants and creatures into different categories of their choosing. For younger students, there might be just two — plants and animals — but older kids might recall the three types of plants required for a healthy pond, and classify plants as emergent, submergent, or floating, and sort animals into lists of amphibian, insect, and so on.

Using their lists, have groups draw simple food chains, beginning with the sun, using arrows to indicate how each plant or animal provides energy to the next in line. Next, have them re-draw two or more chains and consider how they connect to one another to form food webs. They might use different colored pencils or crayons to indicate the different relationships — predator-prey, producer-consumer (plant-animal), producer-decomposer, consumer-decomposer. This will help you assess students' grasp of the concepts they have explored.

To celebrate their new understanding, have students combine their webs into a colorful poster bulletin board display, complete with drawings, photos, or images cut from magazines. As observations reveal more inhabitants, or a shifting of species over the seasons, adapt the poster to reflect the current residents of the habitat.



NGA's latest book for educators, *Growing Ventures*, features stories of 18 student-run business projects, as well as step-by-step guidelines, activities, and worksheets for engaging students in planning and implementing a plant- or garden-related business that meets your curriculum goals. You'll find more details at our [Gardening with Kids Store](#).

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More Pond Investigations

- Challenge students to figure out how to determine their pond's volume (in milliliters, liters, and/or gallons).
- Estimate population numbers of selected plants and animals, then create a graph. Note population changes over time.
- Explore pond organisms up close using hand lenses or microscopes. Have students draw and describe them, noting their methods of movement (or how they are rooted), food sources, life cycle changes, and so on. What types of features might help pond life adapt, compete, or survive?
- Write a story of the life history of a pond, following the process of succession. Helpful links: [Four Stages of Pond Succession](#) and [descriptive images](#).
- Spend some quiet observation time at your pond, then have students write, draw, or paint freely about something that inspired them during that period.
- Learn about invasive exotic water plants in your area, such as Eurasian milfoil, hydrilla, and purple loosestrife. Explore the problems they cause, what is being done to combat them, and how your class can help.
- Get to know the insect species considered indicators of water quality in your area, keep track of what shows up in your pond, and consider what this says about the purity of the water. For a sample list of insects, visit the Hamilton Heights Elementary School [Web site](#).
- Use ponds and other waterways as a means of studying the geography and history of your region. Were waterways important travel routes for native people and early explorers, for commercial fishing or transport, or for wartime naval activity?

Pick with Caution!

Never collect or disturb any plant or animal species that may be endangered or protected. Learn your state laws by contacting a natural resources agency. It's a good idea even with non-protected plants to use the following rule of thumb: never collect a plant/creature unless you can see at least six in the area. Also, always get permission from the owner of any property on which you intend to collect plants.



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