Pond in a Jar

David W. Allard

I have found microcosm laboratory exercises to be quite successful with my students, especially in introductory biology and environmental biology courses. Initially described by Taub (1969) as a means for observing and manipulating single natural phenomena, simulations allow students to investigate important principles of ecology such as succession, predator-prey relationships, population dynamics, and the effects of manipulating various environmental factors, in a laboratory situation. Investigations with microcosms are also becoming an important area of sophisticated research in modern ecology (Odum & Deyers 1992). There is a growing body of research literature using microcosm techniques (e.g. Larsen et al. 1986 and Taylor et al. 1990). Ecologists are using very elaborate microcosms to simulate natural environments (Adey 1992). The studies are limited in that whole ecosystem responses cannot be observed, but still provide valuable insights into ecosystem processes. These techniques are also being used in the classroom (Corner 1992; Jones 1992; and Murphy et al. 1992) to give students hands-on experiences.

I have tried a number of different types of microcosms, such as hay infusions and bottle biology projects. One of the most successful activities is what I call a "pond in a jar." I modified this activity from Taylor and Kaufman (unpublished). It is an easy way to set up a self-sustaining ecosystem and it is very versatile. The simple and inexpensive exercise works for students at almost any level, elementary school to graduate school. It can be used as a simple observation activity or to perform a variety of experiments. Field trips can be combined with a long-term indoor activity or the "pond in a jar" can be a substitute when field trips are impractical.

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Materials

The following materials are needed to assemble the microcosm:

- Glass or plastic wide-mouthed quart jar (Jars with plastic lids work best as they do not rust; bigger jars are okay, but smaller sizes do not work very well).
- Plankton nets (I use commercial plankton nets, but handmade nets of stocking or other material could substitute).
- Water samplers (I use a Van Dorn Sampler, but homemade equipment could substitute).
- Small hand trowel.
- Bottom sampler (I use a Peterson Dredge, but a shovel will suffice if that is all that is available).
- A light setup or a well-lighted window.

Procedure

I take my classes on a field trip to a local park that has a pond in it; however, if field trips are impossible, the instructor can do the collecting and bring the materials to campus. The students then assemble their microcosms in the classroom. I have my students bring their own jar and I supply the sampling equipment. I teach the students how to use the various samplers. Students then prepare their "pond in a jar."

Preparing the Microcosm

- Take a sample of bottom mud with the dredge.
- Place an inch or two of mud in the bottom of the jar (There should be some benthic organisms in this mud).
- Take plankton samples and add them to the jar (This provides a nice group of microcrustaceans—cladocerans, copepods, etc.—and algae).
- Place some sticks, rooted aquatic plants, filamentous algae, duckweed, etc. into the jar.
- Fill the jar up with pond water and cap it.
- Return the jars to the lab for further observation and experimentation.

It is not a good idea to place larger organisms, such as fish and insects, in the jar. I have had students ignore this and place small minnows in their jars. The minnows have survived an entire semester. The jar should be kept closed. The ecosystem will remain functioning for a very long period, given adequate light. I have a light setup and keep the jars under fluorescent lights. The lights are on a timer and stay on 14 hours per day. These ecosystems can be stored in the dark and brought out at a later time. They rejuvenate when placed in light.

Investigations

Students may pursue a variety of investigations using their microcosms. The following is a list of some of the possibilities.

- Measuring pH and other physicochemical parameters over time.
- Successional studies done by keeping records on the organisms they find in their jars over time. My students have found leeches, hydra, amphipods, copepods, cladocerans, ostracods, midge larvae, various types of algae, snails, etc.
- Controlled investigations using paired jars (experimental and control) to determine the effects of:

1. Different lighting conditions
2. Fertilization with inorganic nutrients
3. Organic enrichment, such as adding sucrose
4. Inorganic and organic pollution.

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Conclusion

The "pond in a jar" is a simple and inexpensive way to bring ecology into the classroom. It is very versatile and can be adapted for life science courses at all levels.

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