WATER HOLES TO MINI-PONDS KEY

BIO
Controlled Experiment
Physical Factors
Colonization

OVERVIEW

The students observe and compare changes that take place in fertilized and unfertilized water holes. This activity requires regular visits to monitor the water holes for eight to ten weeks.

BACKGROUND

Dig a hole, line it, fill it with fresh water, and you have a water hole: a good place to study colonization. ***Colonization*** is the occupation of an area by a group of organisms that did not previously live there. The process of colonization involves:

- immigration of organisms.
- suitable conditions for survival (sufficient food, proper light and temperature).
- population increase (reproduction, immigration of more organisms).
- population decrease (organisms eating other organisms, emigration of organisms, or death of organisms).

The appearance of life in a water hole transforms the basin of water into a mini-pond.

To provide a fair comparison of the effects of fertilizer on a water hole, two water holes are set up that are identical except for the addition of a handful of fertilizer to one water hole. This fair comparison is called a ***controlled experiment*** because all factors (variables) that can vary (such as location, shade, wind, water level) are controlled or kept the same with the exception of the one factor (fertilizer) under investigation.

CHALLENGE: SET UP TWO WATER HOLES, ONE FERTILIZED AND ONE UNFERTILIZED. THEN MONITOR AND COMPARE THE CHANGES THAT TAKE PLACE IN BOTH WATER HOLES.

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WHAT TO EXPECT

You can expect your water holes to support a number of plants and attract a variety of animals. The major factors affecting the variety and number of organisms are:

- the time of year. (Warm seasons are best.)
- the amount of time the water has been standing. (The longer the better.)
- the proximity of the water holes to a pond, lake, or stream. (Close proximity to established populations speeds colonization.)

The following is a summary of events that occurred in a pair of water holes set up on the West Coast during the spring and summer months. The water holes (a control and one to which one-quarter of a liter of lawn fertilizer had been added) were set up side-by-side in full sunlight near an established pond. Tap water was used to fill the water holes and maintain their water levels.

For the first eight weeks, the life in the fertilized water hole was more varied, more numerous, and grew faster than life in the unfertilized water hole. The fertilized water hole turned green from heavy algae growth between one and two weeks after it was set up. The unfertilized water hole never turned green from excess algae growth. More life probably appeared in the fertilized water hole because the fertilizer added minerals that enabled algae, the basic food source, to grow faster.

In the ninth week, the green algae in the the fertilized water hole suddenly died and settled out as a foul smelling scum. All insects except mosquito wigglers and flower fly larvae disappeared from the fertilized water hole, and tubifex worms colonized the bottom scum. The unfertilized water hole continued to support a variety of pond organisms until the end of the experiment.

MATERIALS

For the water-hole construction:
hoes
shovels
2 children's wading pools (rigid plastic, at least 1 m across and 30 cm deep) or plastic sheeting to line two holes
burlap* (enough to line the bottom and sides of the pools and be tucked under the pool rim)
duct tape or string* to secure edges of burlap under rim of pools
hoses or buckets* for filling pools with water
2 handfuls of lawn fertilizer* for each fertilized water hole

For subsequent meetings:
2 water-hole charts on data boards*
colored marking pens*
Observation Aids*: bug boxes or hand lenses, clear plastic cups, spoons, and aquarium nets (See the "Aquatic Observation Aids" Equipment Card.)
1 thermometer* (See the "Preparation" section.)
30-cm rulers* or meter sticks*
copies of the *OBIS Pond Guide**
1 "Aquatic Observation Aids" Equipment Card*

*Available from Delta Education.

PREPARATION

Group Size. The construction part of this activity works best with small groups. Large or small groups can study the water holes once they have been set up.

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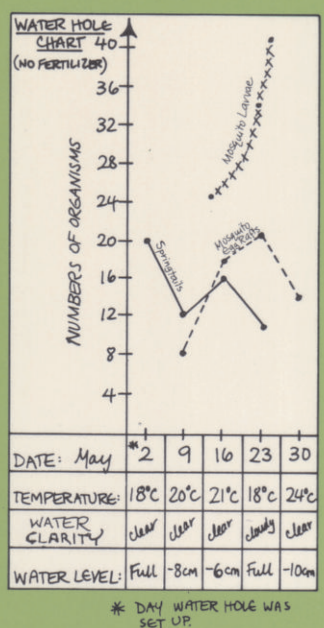
Time. Plan on forty to sixty minutes to set up the water holes and fifteen to twenty minutes for each subsequent visit: twice a week for eight to ten weeks, if possible.

Site. Select a level spot that receives direct sunlight and is near a water tap. Avoid placing the water holes at the base of a slope (runoff can be a problem) or near resinous trees such as pines or eucalyptus. The site should be conveniently located but relatively safe from vandals.

Materials

1. Water-Hole Charts. On a data board, make a large chart like the one illustrated for each water hole. If possible, use a different color pen for recording each kind of organism.



2. Digging Tools. Enlist the help of your group to obtain enough shovels and hoes.

3. Thermometer. An ordinary thermometer can be used to measure air and water temperatures. For safety, choose an alcohol (red indicator) thermometer with a plastic or metal backing.

ACTION

Constructing the Water Holes

1. Describe the water-hole activity to the group, and then divide the group into two teams.

2. Set up the water holes.

a. Give each team a wading pool.
b. Have each team clear an area and dig a hole for their pool deep enough so that the pool rim will be flush with the ground.
c. The teams then line their pools with burlap and place a few rocks on the burlap to keep it down. The burlap edges can be taped or tied under the rims of the pools.
d. Have both teams fill their pools with tap water.
e. Have one team add two handfuls of fertilizer to its pool and stir it up. The other pool remains unfertilized.

3. Set up a schedule for subsequent observations (twice a week if possible), and introduce the water-hole charts.

4. Explain that each team will be responsible for maintaining the water level and monitoring the development of their water hole over the next eight to ten weeks.

Subsequent Meetings

1. State the challenge: Compare the changes that take place in these two water holes. Explain that during each meeting, the teams will measure the physical conditions (temperature, water clarity, and water level) of their water holes and record the results on the water-hole charts.

- **Temperature.** Introduce and demonstrate the use of the thermometer.
- **Water Level.** Measure the meter sticks or rulers.
- **Water Clarity.** Clear, cloudy (can still see bottom), and dirty (can't see bottom) can be used to indicate water clarity.

2. Let the teams use hand lenses and other Observation Aids to monitor biological changes, e.g. appearance or disappearance of life, or evidence of life that they find in and around their water holes. Suggest the hands-and-knees approach for close observation. Copies of the *OBIS Pond Guide* may be helpful for identifying new organisms. Refer to the illustrated water-hole chart to see how to record the date of appearance and number of organisms.

3. End each meeting by asking the teams to compare the development of life in the two water holes. Use information on the water-hole charts and the questions in the "Pondering the Results" section to make this comparison. Also, water samples can be compared in clear, plastic cups. After all comparisons have been made, the teams can add water to their water holes, if necessary.

4. After the group has observed the presence of a population of organisms in a water hole, introduce the term ***colonization*** and its definition. Reinforce understanding of the term by using it in the context of the water holes, e.g. "Were there any new colonizers this week?"

PONDering the RESULTS

(These questions are for discussion during the subsequent observation sessions.)

1. What changes can you see in each water hole?

2. What are the major differences between the two water holes? Do they differ in texture, smell and/or color? What differences has the addition of fertilizer seemed to have made?

3. What terrestrial plants or animals have established themselves around the edges of the water holes?

4. What new plants and animals have appeared in the water?

5. How do you think the appearance of organisms has affected the condition of the water?

6. What organisms have remained in the water hole for a long time? What organisms have increased in numbers? Decreased in numbers?

BRANCHING OUT

After the initial experiment is over, introduce the concept ***controlled experiment.*** (See the "Background" section.) Have the youngsters use other water holes to test the effects of different variables, such as detergent, oil, sugar, or salt. Have the youngsters observe and compare the changes in these water holes. Other experiments to conduct with the water holes are:

- monitoring the dissolved-oxygen content of the water (if you have a test kit available).
- adding predators (fish, crayfish, dragonfly nymphs) to the water holes and watching what happens.
- connecting the ponds with a piece of water hose (filled with water) or a small canal to see if any of the organisms migrate from one pond to the other.

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AQUATIC OBSERVATION AIDS:

For Aquatic Activities

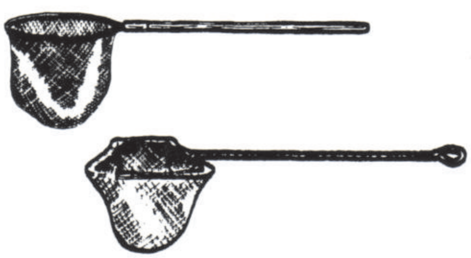
Equipment Card Side 1

Bug Boxes

A bug box is a small, clear plastic box with a magnifying lens for a lid. To use the bug box, place an object or organism in the box and replace the lid to magnify the contents. When exposed to direct sunlight a closed bug box heats up rapidly, so release organisms promptly after observing them. The lid can also be used separately as a magnifying lens.

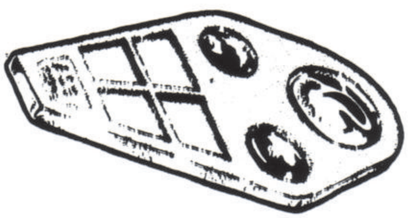
Dip Nets

Nets can either be made or bought. Aquarium nets work fine. You may want to extend the reach of an aquarium net by attaching a dowel, a stick, or a similar extension to the handle. A gradual, gentle scoop of the net is usually more successful and less damaging to organisms than a sudden, violent scooping motion. To prevent eye accidents, ask that the nets never be raised above shoulder level.



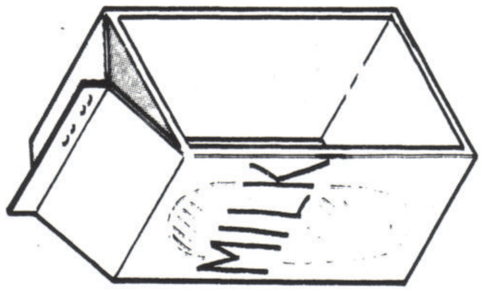
Magnifying Lenses

To use a magnifying lens, hold the lens close to one eye and move either your head or the object back and forth until you can see the object clearly.

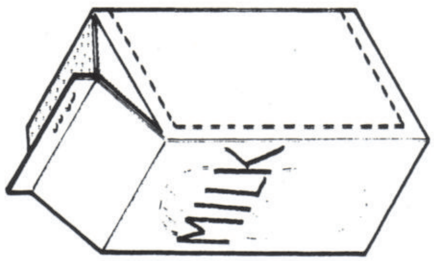


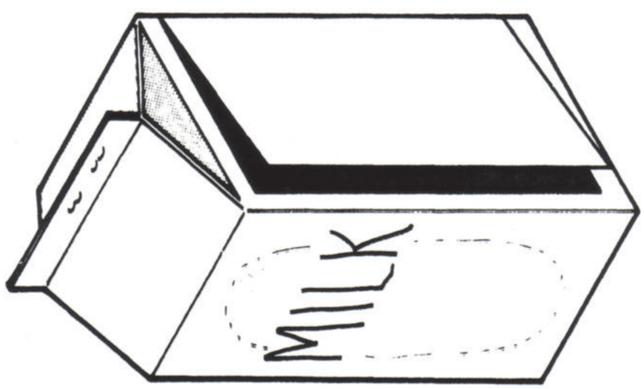
Observation Tray

Any container that will hold water can serve as an observation tray. Containers with light-colored bottoms are best for easy viewing of organisms that have been added. Half-gallon milk cartons can be made into deluxe observation trays. To make one, staple the pouring spout closed and cut out the carton wall on the same side as the stapled pouring spout.



To make a hinged-top observation tray, just cut along three sides (two short and one long) of the carton wall on the same side as the stapled spout.





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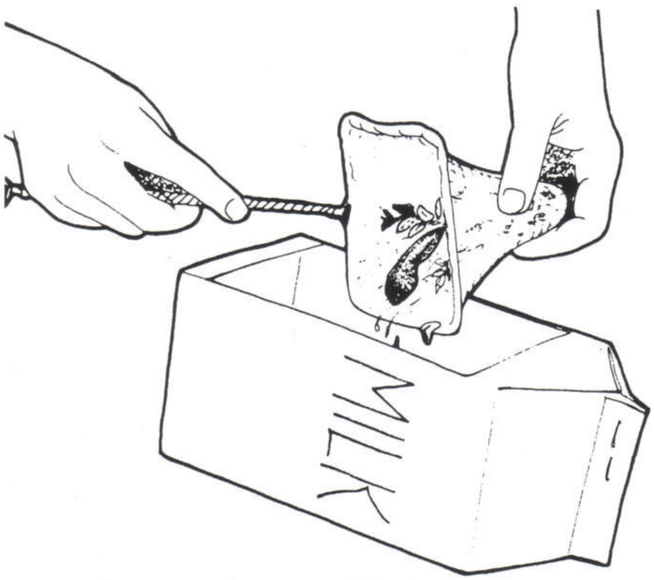
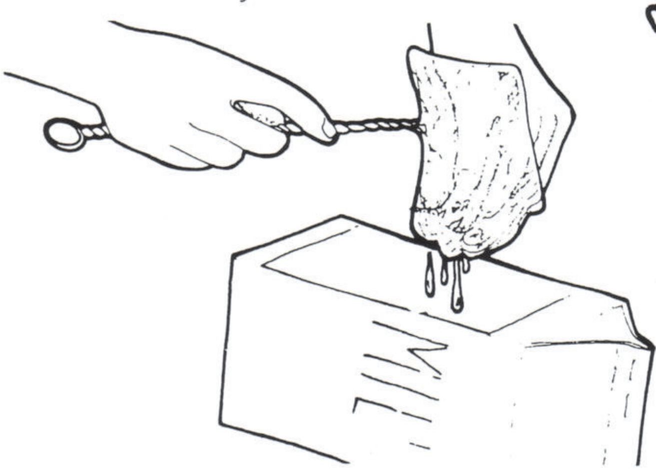
AQUATIC OBSERVATION AIDS:
For Aquatic Activities
Equipment Card Side 2

Transferring critters to observation trays. When using a net to transfer critters, first swish the net through the water without releasing the organisms. (You can use the pond or stream you are investigating.) The rinsing removes any sediment you may have netted. Fill your observation tray about one-half full of water (preferably water from the organism site). Hold the net hoop over the tray,



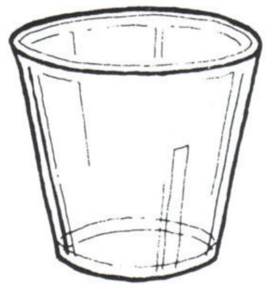
turn the net inside out, and dip the net bag into the water in the tray.



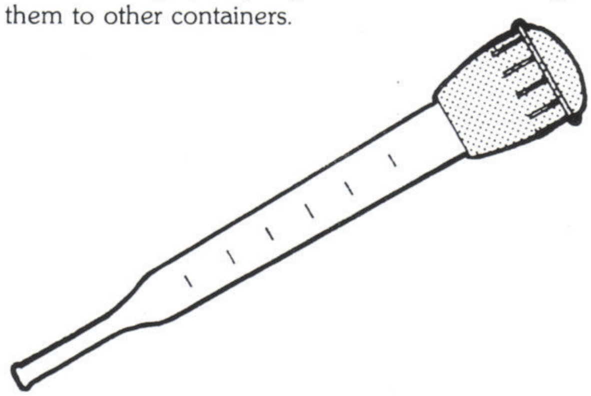
This will release netted organisms into the tray.

Spoons and Clear Plastic Cups

Spoons and cups are useful for transporting tiny organisms and observing them at a close range.



Simply dip up tiny organisms with a spoon or cup and place the organisms in a container partially filled with clear water. Turkey basters are also useful for sucking up tiny organisms and transferring them to other containers.



Note: All of these aids áre available from Delta Education.

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