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Ecosystem in a Bottle

Photosynthesis in action. Your final product should be a self-sustaining ecosystem (grant it, everything goes as planned). You'll want to keep your ecosystem in front of a window that provides at least a few hours of direct sunlight at all times. Don't mind if the water starts to look green, that is ok, however murky water is a sign of a problem. You may also notice a soil fungus that develops, plant or fish death. These are all factors that will affect the effectiveness and health of your ecosystem.

This ecosystem is a closed system, meaning nothing will be getting in or out. That makes it a great model for observation. This ecosystem provides a great example of the carbon cycle. Carbon dioxide created by decaying matter will be used by the plants (the wheat, when it grows, & the elodea, in the water) to go through the process of photosynthesis. In turn, these plants will create oxygen, you may actually notice some bubbles near your elodea from time to time. In addition to the carbon cycle you will see the water cycle in action. Water will condense at the top of your ecosystem (from the water below), run down the sides/drip on to the soil (rain), and the cycle continues.

Objectives: Create a model of an ecosystem; observing the relationship between the living and the nonliving components of the ecosystem.

Here's what you'll need:

3 empty and clear 2-liter bottles
clear packing tape
water
rubber band
4-inch square piece of panty hose
a couple dead leaves or small sticks
aquarium gravel
soil
wheat seeds
fish
elodea or other aquarium plants

If you have any green (7-Up/Sprite) bottles use these as the coupler if possible. Ideally, you'll want clear bottles on the top & bottom.

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Step 1: Bottom

Cut the top off of the first clear bottle (make sure the labels are removed, you'll need the bottles clear so the sunlight can get through).

Don't cut it too short, just chop off the spout so you have enough of a bowl left over to fill with lots of water. This will be your "bottom floor."

Step 2: Middle

Cut the top *and* the bottom off of the second clear bottle, making a clear coupler that will eventually link the two other sections together.

Step 3: Top

Cut the bottom off of the third clear bottle but *save it*, you'll reattach the bottom with tape after you fill it with good stuff and it will be your "top floor."

Step 4: Bottom

In the bottom floor (the one you cut up in Step 1) put an inch of aquarium gravel and fill it nearly full with water. Make sure it's treated room temperature, use de-chlorinator if possible.

Step 5: Bottom

Choose your guests! You get to chose one fishy friend, as well as one-two plants. The plants help keep oxygen in the water and filter the water. Secure the plants in the gravel, then add your new fishy friend.

Step 6: Top

Now fill your top floor. Place the piece of panty-hose over the neck of the bottle and secure it with the rubber band. With the bottle upside-down and the bottom off fill with about an inch of gravel then with a couple inches of soil and plant a “sprinkling” of wheat seeds. In addition, add some twigs and dead leaves to this area.

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Step 7: Top

Replace the bottom to your top floor bottle and secure it with packing tape. You might want to have the top edge fit slightly down inside of the bottom edge (and that's when the bottle is upside down and the soil is in the spout) because as moisture collects in the top part it will trickle down the walls and if the seal isn't tight you'll get water on your counter. Fix this problem by putting the edges down inside of the edge they're to join up with.

Step 8:

Slip the taped up bottle down into the coupler, secure it with packing tape and then slip the bottom edge of the coupler down into the top edge of the water-filled bottom floor. Secure it with packing tape.

Step 9:

Place in a well-lit spot where sunlight can get through the clear plastic to do its work. Sunlight will allow photosynthesis which will keep the cycle in motion.

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Ecosystem in a Bottle - Lab Report

Answer the following questions, many of these questions will consider you ecosystem thriving in ideal conditions, or the consequences of it not.

1. Diagram the following cycles as they occur in nature:

Carbon Cycle:

Nitrogen Cycle:

Water Cycle:

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2. Using the same cycles you diagramed in question 1, explain how these cycles will occur within your ecosystem.

3. What would happen to the plants in the bottle if you placed the bottle in a sunny window? What would happen to the temperature inside?

4. Eventually the amount of living plant material inside the bottle reaches a limit, and cannot increase any further. What might limit the amount of plant growth in the bottle?

5. The plants inside the biosphere bottle will grow for a period, and eventually will reach a maximum where plant growth seems to stabilize. The total amount of plant material remains steady, even though the plants appear to be growing new tissues all the time. Why doesn't the bottle fill up with the remains of dead plants?

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6. What would happen to your biosphere bottle if you could increase the concentration of carbon dioxide gas in the air inside the bottle?

7. Predict the sustainability of your ecosystem? What sets your ecosystem apart from the rest in your class? What did you do that should help your ecosystem survive? Did you do anything that may prevent your ecosystem from succeeding?