INTRODUCTION

Establishing balanced ecosystems appears to be difficult initially, but biological systems tend to self-organize. For example, as animals in an aquatic ecosystem feed, they reduce the abundance of the algae and the food shortage causes reduced animal reproduction and survival. As animal feeding is reduced, the algal population can increase. Evidence of this relationship can be seen in any nearby lake if one were to look closely. If the system was closed and the animals ate all of the algae, they would also eliminate their oxygen source, however this has not been observed to occur.

The planet earth can be considered a giant space vessel with a functional ecosystem where processes occur on a vast scale in volume, time, and complexity to sustain its various life forms. Earth is essentially closed to mass exchange with its surroundings. Energy is input to the earth as sunlight, which drives physical and biological processes that power nutrient cycling. Life continues by the recycling of carbon, nitrogen, oxygen and other elements through the ecosystem in a self-sustaining manner that passes energy on until it is lost as heat.

GROUPS WILL BE RANDOMLY ASSIGNED TO TERRESTRIAL OR AQUATIC ECOSYSTEMS

I. Self-Sustaining Terrestrial (land) Ecosystem

GOAL

You will be creating a totally closed loop ecosystem that recycles air, oxygen, carbon dioxide, water, nutrients, and micro-organisms. The goal is to sustain the terrestrial population for at least 30 days.

I have some ecosystems that have been going for several YEARS!

BACKGROUND

The energy from the sun will drive the ecosystem in the jar, just like it drives the ecosystems on the earth. This mini ecosystem is totally maintenance free. The water will recycle by evaporating to the top of the jar, condensing, and falling down, just like rain.

The oxygen and carbon dioxide cycle is balanced by the small plants inside the jar. The nutrients will recycle by the plants growing, dying, and being decomposed by the micro-organisms in the soil and water.

Try adding different kinds of plants growing on different kinds of substrates. Different mosses on rocks, branches, twigs, and bark. Or even, try lichen that sources its nutrients from the air!
**MATERIALS**

1. CLEAR, large glass or plastic jar. (No aquariums please!)
2. Stone pebbles
3. 2-3 rocks (with moss on them if possible)
4. Sand
5. Soil
6. Forest moss if possible
7. 1 to 2, 4” potted plant(s)
8. Rotting branch or log
9. Pond water
10. Saran wrap
11. Large rubber band
12. Earth Worms
13. Other plant eating insects.

**Note:** We may be adding more materials as we go along. Please keep track of them!

**PROCEDURES**

1. Obtain a used large glass or plastic jar. Make sure that it is clear.
2. Add one layer of stone pebbles.
3. Then add two or three larger rocks with moss growing on them.
4. Add a thin layer of sand then a thin layer of soil (which contains bacteria), and spread it around the larger rocks, on top of the pebbles.
5. Add small patches of different kinds of moss if possible, and nestle these on top of the soil.
6. Try and find a small rotting branch or log, that has a small fern growing out of it. This is your oxygen maker. Or if not a fern, then one or two small herb plants.
7. Add real stream water, just enough to make all the pebbles on the bottom layer wet. This is your bacteria.
8. Then cover the top of the jar with a layer of air tight saran wrap. This prevents air and moisture escaping from the jar.
9. Finally, secure a rubber band around the film wrap at the neck of the jar, to keep the film wrap securely in place.
10. That's it! You're done! Place this jar under the lamps in the green rack.

*Overall, the space in the jar is divided approximately into one third rocks, soils, and organics, one third plants, and one third air. It is important to keep the eco jar completely sealed from outside influences to obtain the closed loop system effect. If the plastic wrap on top is punctured simply replace it with a new piece of wrap.*

**DATA COLLECTION - TERRESTRIAL AND AQUATIC SYSTEMS**

*It will be your team’s responsibility to collect data on a daily basis (with the exception of Sat. and Sun.). Once a week you will need to take detailed data (conference period), otherwise a brief observation is adequate. Be sure to record both qualitative and quantitative data.*

**Quantitative:** Measure pH, temperature, area, length, width etc. of abiotic and biotic factors in metric units. You will be graphing this data.

**Qualitative:** Note, color, smell, physical changes, Identify your producers and consumers and analyze how they interact. Color diagrams should be created at LEAST once a week in your lab notebook. You may also keep a photo journal IN ADDITION to your sketches.
II. Self-Sustaining Aquatic Ecosystem

GOAL

Create an aquatic ecological community (aquarium) including all of the chemical requirements for photosynthetic organisms to produce food and oxygen and animals to use the food and oxygen and supply carbon dioxide and ammonia as nutrients for the photosynthetic organisms. The goal is to sustain the aquatic population for at least 30 days.

BACKGROUND

The successful closed aquatic ecosystem is an operating ecosystem where all the needs of life are sufficiently met and life grows and thrives in an encapsulated world. All of the parts of the aquatic ecosystem perform vital functions. For example, the gravel layer performs several important functions: It creates a pressure plate, ensuring even water flow throughout the tank. It allows for a microbial community to establish itself and function as a biological filter (these microscopic organisms consume the deadly ammonia that fish excrete, and they convert it to a harmless form of nitrogen). It acts as a mechanical filter, trapping particulate matter as the water is drawn down through the gravel. If small particles of fish feces and excess food were to remain suspended in the water, the gills of the fish could be damaged.

MATERIALS

1. Large clear glass jar (please do NOT bring in aquariums)
2. Aquarium gravel
3. Aquarium plant (2-3)
4. Snails
5. Soil
6. Rocks
7. Sand
8. Driftwood
9. Pond water
10. Fish. Guppies do best in these tanks. Please bring these during week TWO.

Note: We will be adding more materials as we go along. Please keep track of them!

PROCEDURES

1. Rinse jar thoroughly using tap water. Do not use detergent (the chemical residue is harmful to fish).
2. Once rinsed, add a layer of soil to the bottom of the jar.
3. Rinse your aquatic plant.
4. Add your aquatic plants at this time. Be sure that the plants are firmly anchored in the soil.
5. Next add a layer of sand. Be careful to cover all exposed soil, but do not crush your plant.
6. Then add a layer of aquarium gravel. Again cover all exposed sand, but do NOT crush your plant.
7. Driftwood may also be added to the jar. Remember to rinse the driftwood before placing it in the aquarium.
8. Add 1-3 small rocks. Be sure to rinse these rocks before placing them in the tank. These rocks will provide a hiding place for the fish.
9. Fill the aquarium with tap water and allow the aquarium to set for at least 1-3 days. This is to allow the chlorine in the tap water to dissipate and the environment to settle. We will then add fish.

DATA COLLECTION

It will be your team’s responsibility to collect data on a daily basis (with the exception of Sat. and Sun.). Once a week you will need to take detailed data (conference period), otherwise a brief observation is adequate. Be sure to record both qualitative and quantitative data.

Quantitative: Measure pH, temperature, area, length, width etc. of abiotic and biotic factors in metric units. You will be graphing this data.

Qualitative: Note, color, smell, physical changes. Identify your producers and consumers and analyze how they interact. Color diagrams should be created at LEAST once a week in your lab notebook. You may also keep a photo journal IN ADDITION to your sketches.
Before you have assembled the ecosystem:

1. Decide on the design of your ecosystem.
2. Decide on the materials to include in your ecosystem and how much of each to include.
   a. 1/3 abiotic solids and water, 1/3 air, & 1/3 biotic factors.
3. Write out your group’s plan in your lab notebook. Include the following things:
   a. How will each organism get food?
   b. How will each organism get nutrients (ex. Oxygen, carbon dioxide, sunlight, suitable moisture and temperature levels…)
   c. How will each organism change the environment, over time?
   d. Are all the needs of all the organisms being met?

   **HINT: Keep It Simple! There are a lot of biotic and abiotic factors to consider, but you will NOT be able to use all of them in your ecosystem.**

4. In your lab notebook, sketch a web showing cycling in your planned ecosystem.
5. Include food cycling, nitrogen cycling, water cycling, and carbon cycling.
6. Label the cycles or use different colors for each cycle’s arrows. (Make a key!)
7. Once you have planned your ecosystem, sketch your idea in your lab notebook. Mrs. Robson will need to initial steps 2-6 prior to building your ecosystem.
8. Bring supplies ahead of time!!!! We will build on January 21st.
9. Some supplies will be provided…see list below.

Provided Supplies:
1. Large rubber bands
2. Scissors
3. Sand
4. Saran wrap
5. Masking tape
6. Pond water
7. Soil
8. Aquatic Snails

Supplies your group needs to bring in for terrestrial ecosystems:
1. A large clear jar - glass or plastic (pretzel jars work great!)
   Do not wait until construction day. Obtain a jar/container ASAP…Label it!
2. An indoor plant, Not a weed from your front yard! Something that likes a moist environment! (a small plant…Think about the size of your container and the fact that it should grow!) Bring the plant in ahead of time!!! Home Depot has small cheap indoor plants in the area right before you go out to the garden area.
3. Aquarium rocks (allows for a reservoir of water to remain below the soil.)
4. Larger rocks with debris, insects, and/or bacteria on them from out in the local desert.
5. Rotting bark, cholla (or other wood) other biotic item from the local desert or mountain. Example: Rotting log or rock with moss, or fern or lichen, a rotting piece of bark with beetles etc…
6. Earthworms and other herbivore insects.

Supplies your group needs to bring in for aquatic ecosystems:
1. A large clear jar - glass or plastic (pretzel jars work great!)
   Do not wait until construction day. Obtain a jar/container ASAP…Label it!
2. 2-3 aquatic plants. Some of the elodea has survived from the previous lab, but the more you have in your ecosystem the better.
3. Aquarium gravel rocks (allows for a reservoir of water to remain below the soil.)
4. Gently washed (with no soap!) larger rocks.
5. Driftwood (if possible)
6. Guppies. You may bring these in ahead of time, but we will be adding them 1-7 days after setting up the ecosystem.

**Note: If you are having trouble getting supplies for ANY reason, please let me know as soon as possible so that I can purchase your supplies for you. Please do NOT wait until the day of the lab to notify me of problems. I realize that times are tough and totally understand if you need help - we will keep it confidential.**

After you have assembled the ecosystem:
1. Record your predictions and initial observations in your lab notebook.
   a. You should do a sketch and make qualitative AND quantitative data tables.
   b. **You will record observations throughout the next 30 days, possibly longer.**

Note: This will end in a major 100 point lab report. This lab is comprised of mostly descriptive research and therefore it is critical that you take very detailed data! DO NOT rely on your partners to do this for you. You have two conference periods a week to take data. Make sure you come in and do it at least once a week!