STUDENT ACTIVITY 1

Building A Closed Ecosystem for the Classroom

For this investigation you will need a large bottle or carboy which can be stoppered to be airtight. It should have a capacity of at least 15-20 liters. Alternatively you can use an aquarium sealed with a glass plate.

Materials:

- container
- potting soil
- builders sand
- aquatic plant such as Elodea, Anacharis, Vallisneria or Zostera
- duckweed
- snails
- 2 small fish (algae eater or guppies)
- light source (100-watt light bulbs)
- duct tape or silicone
- ruler
- stiff wire or fondue fork

Procedure:

a) Place about 5 cm of soil in the bottom of the container and cover it completely with a 0.5-cm layer of sand.
b) Place the ruler on the sand leaning against the side of the container. Make certain the ruler is long enough to protrude out the top.
c) Carefully run a trickle of water into the container down the ruler and on to the sand. The water should not disturb the sand and expose the soil underneath.
d) Fill the container almost to the top and let the water dechlorinate for least at 48 hours.
e) Plant a few pieces of aquatic plant by pushing them below the sand into the soil with a piece of wire or long fork.
f) Add a few snails, one or two fish and the duckweed.
g) Seal the container with a stopper or glass plate (use tape or preferably a bead of silicone seal).
h) Position lights to provide adequate illumination. Place the lights so that they do not heat up the container or use a water screen (just a clear jar filled with water that absorbs the heat from the lamp).

Investigate:

a) Observe the sealed or closed ecosystem and manipulate the lighting until the system is in balance. It is possible that the number of plants and animals may need to be changed to reach this steady state.
b) Observe what happens over the course of the year or longer. Mark the top of the sand/soil layer with a permanent marker on the side of the container.

Identify:

a) Is there cycling of materials in this system? List evidence of cycling.
b) What is the role of each of the constituents in the container?
c) Physical factors that affect the closed ecosystem?
d) List evidence that the flow of energy is in one direction?

Determine:

Vary one of the factors listed above and determine the effect on the system. Design an experiment that would allow for this investigation.

Extension:

a) Determine the estimated total mass of consumable materials required to sustain an astronaut on ISS for one year.

b) Research the evolution of the spacesuit from the first spacewalks by cosmonaut Alexei Leonov and astronaut Edward White II to the new generation of Extravehicular Mobility Unit (EMU) used on Space Station. What improvements have been made? Speculate on the design and construction of a spacesuit for use on Mars.

c) Design a closed environment and life support system for the planet Mars or the Moon. Check out the Mars 2030 project at www.mars.2030.net.

Produce a Biomass Production System (BPS), an important element in a regenerative life support system, and using hydroponic principles. Questions that can be studied are similar to those of interest to scientists. This activity uses an hydroponic nutrient plant system constructed from a 2L-pop bottle to analyze biomass production in a number of species. The activity develops students' understanding of hydroponics, nutrient cycling and statistical analysis. This investigation is suitable for upper elementary and secondary students.