



Sample Lesson: “Plant Filtration”

Objective

Discuss the concerns dealing with human life environmental systems, including topics such as the inability to control environmental contaminants, solid waste processing, plant growth, food processing, creation of water, radiation, use of lunar resources, etc.

National Standards Met

NCSS 3—People, Places and Environments

NSES 3—Life Sciences

NSES 2—Physical Science

Plant Filtration

Objectives

- To review the transpiration process.
- To have students identify the process of filtration used in plants.
- To explore possible uses of such a finding in space exploration.

Suggested Grade Level

10-12

Subject Area(s)

Biology or Space Biology

Timeline

60 to 90-minute period

Background

In this lesson students will explore how plants hold water and their role as a purifying agent for water in future space exploration.

Materials

Glass tube (hollow; the smaller the diameter, the better)

Celery Stalks (with leaves; about 10 stalks for every 25 students)

Microscopes, slides, and cover-slips

Food coloring

2 glass containers

2 razor blades per group for making a plant cross-section.

2 pots or cans for planting the seeds in per group.

2 seeds (Lima beans have worked best for me)

Sharpie Pen per group

Masking Tape

Growing lights or natural source of UV rays

4 watering cans or pouring devices for the water supply

Waste water (from doing dishes and such)

Water

Plastic baggies with twist ties at least one per group.

Lesson

Preparation: mix several drops of blue food coloring with water in the glass container. Place the celery stalks in the container 4 days prior to the date the class will be using the celery. After mixing food coloring and water in the second container, insert the glass tube (the water should creep up the tube, but will not reach the top.)

1. PART 1: Have the students observe the water in the tube. Ask them why the water is creeping up the glass rod, apparently defying gravity. After discussing how the forces of adhesion and cohesion are responsible for the ascending water, have them compare the celery and the glass tube in terms of how high the water ascended. Students should notice that the water in the celery has risen to the tips of the leaves, while the water in the glass tube is much lower. Then ask the following question: "Why did the water rise so high in the leaves but not in the glass tube?" Following their responses, explain the Adhesion/cohesion/transpiration theory (include how the gradient of water potential moves water from cell to cell to cell to stomata.) Have the students view a thin cross section of celery under the microscope to discover the location of the xylem cells, which are stained blue.
2. PART 2: Once the students have completed and understand transpiration theory discuss with them how knowing that plants up take water and transpire it out into the environment again could be useful. Have students set up and begin their group project below.
3. PROJECT: Tell the students that they must design an experiment using the materials given that will test to see what differences, if any, there will be if two different watering sources are used (like waste water and tap water).
4. The groups will develop a portfolio which will contain the following sections:
 - a. Experiment Design-give out a copy of a lab report format to help them fill in the blanks here if needed.
 - b. Timeline of growth including pictures
 - c. Future uses of this information
 - d. Presentation to the class of the findings
 - e. A lab design is included to help differentiate for each class.
5. Place potting soil in pots loosely.
6. Plant one seed approximately 5 cm deep in the soil.
7. Label one plant A and the other plant B. Water one plant with tap water and the other plant with waste water. Remind the kids that it is important to write down and keep track of which is which so the data is kept accurate.
8. Over the next 1-2 weeks have students in each group come in and water the plants daily and log observations of height, # of leaves, date of observation, and the date when it sprouted in their data logs.
9. Once the plants have grown the students can place a bag over the leaves and place a twist tie around the stem. (As the experiment goes on the students will see water begin to collect in the baggies through transpiration.)
10. Have students compare the two water samples w/their original source water to see if the water has changed in any way.
11. Write up the lab report and prepare the presentation.

12. FYI: If time is an issue, use pre-grown plants or germinate the plants early so the kids do not have to wait as long.

Extensions

1. How would this be useful in space?
2. How many plants would it take to support a shuttle crew?

Evaluation

- Students will be evaluated using the attached rubric on their presentations and will be evaluated during the research using teacher observation.

Resources

Biological and Physical research course through the Space Discovery program.
Gus Koerner (guest lecturer at space discovery course).

Lab Report: Plant filtration project

Teacher Name: _____

Student Name: _____

CATEGORY	4	3	2	1
Data	Professional looking and accurate representation of the data in tables and/or graphs. Graphs and tables are labeled and titled.	Accurate representation of the data in tables and/or graphs. Graphs and tables are labeled and titled.	Accurate representation of the data in written form, but no graphs or tables are presented.	Data are not shown OR are inaccurate.
Experimental Design	Experimental design is a well-constructed test of the stated hypothesis.	Experimental design is adequate to test the hypothesis, but leaves some unanswered questions.	Experimental design is relevant to the hypothesis, but is not a complete test.	Experimental design is not relevant to the hypothesis.
Drawings/Diagrams	Clear, accurate diagrams are included and make the experiment easier to understand. Diagrams are labeled neatly and accurately.	Diagrams are included and are labeled neatly and accurately.	Diagrams are included and are labeled.	Needed diagrams are missing OR are missing important labels.

Conclusion	Conclusion includes whether the findings supported the hypothesis, possible sources of error, and what was learned from the experiment.	Conclusion includes whether the findings supported the hypothesis and what was learned from the experiment.	Conclusion includes what was learned from the experiment.	No conclusion was included in the report OR shows little effort and reflection.
Appearance/Organization	Lab report is typed and uses headings and subheadings to visually organize the material.	Lab report is neatly handwritten and uses headings and subheadings to visually organize the material.	Lab report is neatly written or typed, but formatting does not help visually organize the material.	Lab report is handwritten and looks sloppy with cross-outs, multiple erasures and/or tears and creases.