

Where does plant mass come from?

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Grade Levels: 5th

Length of Lesson Sequence: 6-8 weeks, only one hour per week.

Brief Description:

Tracing matter in the gaseous form is difficult to teach and requires carefully planned activities. Plant growth is one way to teach students that most of the mass of the plant comes from somewhere other than the soil, but mostly in carbon dioxide and hydrogen atoms from water. To identify this, students will be planting seeds indoors, weighing the dry pot, soil and seed first and then the dry pot, soil and plant later. The total mass of the soil and pot will be nearly equal before and after the experiment. Students will also measure plant height throughout the experiment. Students will be able use the data from the experiment to make graphs and conclusions, which are important concepts for upper elementary students. After discovering that most of the plant mass does not come from the soil, it will be explained that carbon dioxide is the primary “food” for plants. Students will be assessed based on data collection, graphing and conclusion paragraphs.

Content Statements/Standards Covered:

- V.3.MS.2 (EAW 5) - Describe the composition and characteristics of the atmosphere.
- I.1.MS.2 (C 8) - Design and conduct simple investigations.
- I.1.MS.4 (C 10) - Use measurement devices to provide consistency in an investigation.
- II.1.MS.1 (R 6) - Evaluate the strengths and weaknesses of claims, arguments, or data.

Objectives of Lesson:

At the conclusion of the lesson, students will be able to:

- ◆ Recognize that gases have mass and can be used to make living plant tissue
- ◆ Conduct an experiment to answer a scientific question using data collected
- ◆ Successfully grow different plants in a classroom setting and take accurate measurements

Materials and Resources

- 1 fast growing seed per student, preferable at least 2-4 different species
- 1 plastic pot (4” square) per group of four students
- 1 small paper cup per group with known volume
- 1 ruler per group
- 2 sheets of paper per group
- Trays to hold excess water leached from pots
- 1 bag potting soil

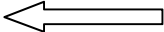
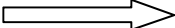
- 1 window or grow light
- 1 electronic scale sensitive to one tenth of a gram

Strategy

- ♦ **Inquiry cycles:** finding and explaining patterns in data (arguments from evidence)
 - Experimental inquiry: predict-explain-observe-explain (**POE**)

Observations, patterns, and explanations

In the chart below, describe the connected observations, patterns, and explanations or models that you will use for your session.

Observations or experiences (examples, phenomena, data)	Patterns (laws, generalizations, graphs, tables, categories)	Explanations (models, theories)
Mass of pot/soil/seeds before and pot/soil/plants after experiment	Tables will be made for the mass gained by the plants and the mass lost by the soil. Students will graph the total mass of the soil + pot + seed vs. soil + pot + plant.	Students will be able to conclude that not very little of the plant nutrition comes from the soil. They will then be told that the plant's mass comes primarily from carbon dioxide and some from water
Measure height of all plants in the class. Groups of four will average all plants in the group to provide group data	Bar graphs will compare plant height between the different groups	Not all plants have the same height or weight. Conclusions will be made about why there is variability in the data
 Application: Model-based Reasoning		
Inquiry: Finding and Explaining Patterns in Experience 		

Introduction/Anticipatory Set

This lesson was designed to complement a unit on the atmosphere and air quality in fifth grade, to help the students understand that the molecules in the air have mass and that that mass is incorporated into living organisms. The plants will be planted before the actual unit is started. A plant that is already growing will be brought into the class and examined for its qualities. Students will be asked exploratory questions such as: “where does the plant get its food” and “what does the plant need to survive and grow?” In groups of two, students will also be prompted to ask their own questions about how plants grow and survive. At the end of the introduction, the students will be told about the activity and expectations. As a class, we will make a hypothesis regarding whether or not the pot with plants growing in it will be heavier, lighter or the same weight at the end of the experiment. It will be made clear to students that they must write down everything they measure and any observations on their data sheet, including the dates that they were measured on.

Activities of the Session

Week 1: Brief introduction to lesson as stated above. Students will be asked to make a data sheet using a blank sheet of paper. The format for the data sheet will be drawn on the board and will include spaces for eight measurements (initial pot/soil/seed weight, initial seed weight, height for weeks 2-5, final pot weight and final plant weight) and the dates of each measurement. For the activity, groups of four students will be given a pot, which they will put their name and date on. They will fill it with dry potting soil and each student will obtain one seed. They will weigh the pot, soil and seeds together and record the weight in grams. They will also weigh the seed. Students will then plant the seeds 1 cm deep in the soil. All pots will be placed into plastic trays that will retain excess water. All students will water their plants in equal amounts, but the amount will be determined based on the pot size and water holding capacity of the soil. Plants will be placed on a shelf near a sunny window to grow.

Week 2-5: Students will water plants 2-3 times per week depending on how much is needed for growth, but all students will water with the same volume. Once per week, students will measure the height of their plants with a ruler and record on their data sheet. Each week when making measurements, students will make observations and compare observations with other students.

Conclusion

Week 6-8: (~Two 1-Hour Lessons) A. At the end of week five, watering will be discontinued so that the soil and plants will dry out. If needed, the plants can be placed in a drying oven to speed up the process. When the soil and plant are completely dry, students will weigh the plant, pot and soil and record on their data sheet. If the roots can be separated from the soil, the students can weigh the plants separately after discarding the soil. After measurements are taken, plants and soil will be placed in one container to be composted, and pots will be stacked for reuse. In groups of four, students will discuss if the weight of the pot became heavier, lighter or stayed the same. In groups, students will make a data table using the initial weight, final weight and the height values for weeks 2-5, providing 6 columns of data.

B. Students can then make bar graphs for their group data with initial and final weight, and line graphs for plant height over time. Each group will display to the class the graph that they created and interpret what their graphs mean. After everyone has talked about their data, the class will together decide if all of the plants food comes from the soil, or if some of it comes from another source. Students may think that a lot of mass comes from water, but the teacher will explain that it is actually coming from the air in the form of carbon dioxide. Each individual student will be asked to write a paragraph about what they learned from the experiment, hopefully using data to explain their observations.

If additional time exists, the teacher can talk about rising carbon dioxide levels in the atmosphere and how that might affect plant growth.

Assessment

Students will be assessed in two ways:

1. How well they kept data and made graphs.

2. The quality of their concluding paragraph about what they learned from the experiment. In this paragraph, they should include some reference to the data they collected in order to make them realize they are learning from data rather than being taught by a teacher.

Modifications and Accommodations (Optional)

Students who seem to be participating less will be called upon to answer questions. Students who are excelling will be asked to help others in their group who are struggling with graphing or writing.

Extensions (Optional)

Groups of students could alter how their plants are treated, including fertilizer, light availability, air availability and water amount.

Students can examine the different morphological characteristics of the plants, such as leaf hairs, leaf to stem ratio

If some students or groups finish early, they can be assigned to collect the data in a table from all of the groups participating.

Extra time could be filled with discussions of:

- a. How rising carbon dioxide levels might affect plant growth
- b. How the different plant species performed and why some grew more than others.

Post-lesson Comments and Reflection

12.11.06

Several problems were encountered while trying to perform this lesson. First, the potting soil that we started with had moisture in it. Therefore, we could not get a good starting weight for the soil. Also, the plants that we used grew very tall and quickly lodged (fell over). Without being in the classroom every day, it was difficult to maintain the plants.

The good part about the lesson is that the students learned a little bit about growing plants in pots and what some of the different plants look like that we tried.