

Does Air Take Up Space?

Strand	Matter
Topic	Investigating air
Primary SOL	5.4 The student will investigate and understand that matter is anything that has mass and takes up space; and occurs as a solid, liquid, or gas. Key concepts include a) distinguishing properties of each phase of matter;
Related SOL	5.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which b) estimates are made and accurate measurements of length, mass, volume, and temperature are made in metric units using proper tools.

Background Information

Matter is anything that has mass and volume. For example, air has mass and takes up space. In this investigation the teacher will play the part of the nonbeliever, stating that he or she does not believe that air takes up space and asking students to prove that it does. Give the students one class period for planning their experiments and submitting their materials lists to the teacher. Use another class period for students to conduct their experiments, and a third to present them. The last two activities may be combined into one longer class period.

Materials

- Materials as needed for the investigations, to be determined by student lists (e.g., balloons, gram scales, bowls, water, cups, paper towels, etc.)

Vocabulary

matter, mass, volume, scientific method

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

Introduction

1. Begin a whole-class discussion by asking students whether they believe air has mass and volume. If they answer yes, tell them that you don't believe them, and ask them to explain to you the following answers:
 - Why can't you walk through air?
 - Why don't you have to push it out of the way when you walk?
 - Why can't you feel it pushing down on you from above?
 - Why can't you drink a glass of air?
2. At the close of this discussion, tell students that they are to design an experiment to prove that air does take up space and has mass.

Procedure

1. Have students get into small groups to discuss their ideas about whether air takes up space and has mass. They will design an experiment that proves a hypothesis.
2. Each group must research their hypothesis using the Internet, their science textbooks, or materials the teacher has provided from the library. Each group should form a hypothesis before continuing the investigation.
3. Each group must write out the procedure they will follow to do their experiment. They must submit a list to the teacher of the materials they will need.
4. The teacher must approve each group's experimental procedure before groups proceed. The teacher may give suggestions to correct or improve their plans, as necessary.
5. The teacher will collect the necessary materials for each experiment before the next class session.
6. During the next class session, each group will perform their approved experiments, using the materials they listed. They must record their observations and data as they proceed.

Conclusions

1. At the close of this class session or on a subsequent day, each group will present their experiment, their data, and their conclusions to the class and explain how they proved that air takes up space and has mass.
2. The teacher will need to help students recognize that because they have proved that air takes up space and has mass, air is matter.

Assessment

- **Questions**
 - What are the properties of air? Explain each one.
 - How can you prove to a nonbeliever that air is matter?
- **Journal/writing prompts**
 - Explain your experiment and what you may change if you had to do the experiment again.
 - Pretend you are the teacher and convince a student that air has volume and takes up space (or is matter).
- **Other**
 - Evaluate student reports of their experiments to determine whether the conclusion was truly based on the data.
 - Evaluate the groups' presentations.

Extensions and Connections (for all students)

- This is a good opportunity to help students differentiate between weight and mass by holding a discussion about the differences between them, either as students get ready to perform their experiments or after the experiments are completed. The teacher might also wish to include a discussion of volume and introduce the appropriate metric units for volume, weight, and mass.

Strategies for Differentiation

- Create a template for the experimental design such as a scientific method organizer for students who need extra support.
- Put each step of the scientific method on a separate sentence strip: stating the problem, forming a hypothesis, testing the hypothesis, recording and analyzing data, and stating the conclusion with enough repeats for a class set. Tape each sentence strip in a ring to make a headband. Distribute the headbands to each student. When all students have a headband on, they are to get up and move around the room asking each other three questions about their step. The questions students might ask of each other are:
 - “Am I a graph?”
 - “Am I an educated guess?”
 - “Am I at the end of the experiment? Do I summarize?”
 - “Am I a question?”
 - “Am I where all the action takes place?”

The questions can change to meet the needs of the group. Give students enough time to figure out their step. Then, ask individual groups of five to sequence themselves before the class.