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Overview

This Delta Science Module introduces students to air and some of its fascinating properties; moreover, it provides hands-on experiments that enable students to see that air takes up space, has weight, exerts constantly changing pressure, and is always in motion.

Activity 1 encourages students to describe an object with which they are familiar by naming its properties. In this activity, students discover that air is indeed something, and they begin to list its properties on a class chart.

In Activity 2, students press an inverted cup full of air underwater and find that it displaces the water—the two substances are too different to mix. Students conclude that quantities of air and water cannot occupy the same space at the same time.

Students investigate the conservation of volume in Activity 3. They measure a trapped volume of air, then split the air into two parts and measure each part. They discover that the total volume is conserved—that is, it does not change.

In Activities 4 and 5, students discover two factors that can change the volume of air. In Activity 4, students alter the temperature of a bottle of air sealed with a balloon. The changing size of the balloon indicates the changing size of the volume of air inside the bottle.

In Activity 5, students gradually increase the pressure on a sealed syringe of air. They observe that the volume of air in the syringe decreases as pressure on it increases. Later, releasing the pressure, they note that the air regains its initial volume.

Activity 6 continues to dispel the myth that air is "nothing" by showing that it has weight. Students use a simple balance to compare identical balloons, one deflated and the other inflated with air. They find the balloon full of air is heavier than the empty balloon.

The concept that air has weight prepares students for the investigation of atmospheric pressure in Activity 7. Team members construct a barometer, monitor the daily changes in its fluid level, and conclude that the air pressure on everything around us is constantly changing.

In Activity 8, students construct a setup with which they alter the air pressure inside a cup containing both water and air. They observe the effects that increasing and decreasing pressure on air can have on another material in contact with it. Students learn two important lessons in this activity: high air pressure pushes; low air pressure pulls.

In Activity 9, students discover that air slows down anything moving through it. They construct simple parachutes and experiment with them to find out how surface area affects air resistance.

The exploration of moving air continues in Activity 10, in which students assemble a simple wind speed indicator and use it to measure and record the speed of wind at various locations on the school property.

In Activity 11, students explore the Bernoulli effect. They construct a device and use it to reveal an unexpected effect of rapidly moving air: its pressure drops when it is squeezed through a narrow space.

In Activity 12, students build two types of gliders with radically different designs. They test and compare them in a contest and note the effects of different aspects of a plane's design on the way it flies.

Materials List

Qty		Description
1		bag, plastic, reclosable, 15 cm × 15 cm
16	c	bags, plastic, 30-gallon
1	c	bags, plastic, with ties, p/35
3	c	balloons, large, p/12
25	c	balloons, small
16		balls, foam
8		bases, foam, for syringes
8		bases, balance
8		beams, balance
9		bottles, plastic
8	c	cardboard, corrugated
1	c	chart, Barometer Data
1	c	chart, Pressure Graph
1	c	chart, Properties of Air
1	c	clay, modeling, 0.25 lb
8		containers, plastic, 6-L
8	c	cups, paper, 10-oz
16		cups, plastic, 10-oz
16		cylinders, graduated, 50-cc
1		Daily Air Pressure
1		Dart Design
2	c	dots, adhesive, blue, p/28
16		eyes, plastic
1	c	food coloring, red, 1 oz
8		measuring tapes
1		paper clips, large, p/100
1	c	paper clips, small, p/100
8		pins, balance
1		rubber bands, p/200
8		rubber stoppers, with hole
1		Slider Design
1	c	string, 75-m
8		syringes

Qty		Description
1	c	tape, duct
1	c	tape, masking
9		thermometers, Celsius
1		transparency, Graduated Cylinder
8		trapezoid pieces
4		tubing, thick, 20-cm, p/4
1		tubing, thin, 50-cm, p/8
32		washers, metal
8		Wind Speed Indicator cards
1		teacher's guide

Teacher provided items

8		bottles, glass, narrow-necked
1		clock or watch, with second hand
8		containers, 2-L or greater
32		crayons
1		funnel
–		ice cubes
1		knife, dull
1		marker, erasable
1		marker, felt-tip
–		newspaper
1		overhead projector
–		paper towels
–		paper, plain
32		pencils
1		pitcher
1		ruler, metric
1		scissors
1		spoon, stirring
–		tape, transparent
32		textbooks
–		water, tap

c = consumable item

Activity 1
Air Is Something

Objectives

Students learn that air is not "nothing" but is a substance with physical properties.

The students
- describe objects in terms of their properties
- discover that air takes up space
- begin to list the properties of air on a class chart

Schedule

About 40 minutes

Vocabulary

air
properties

Materials

For each student
1 Activity Sheet 1, Parts A and B
1 bag, plastic, with tie
1 *crayon, any color

For each team of four
1 balloon, small
1 syringe

For the class
1 bag, plastic, with tie
1 chart, Properties of Air
1 *marker, felt-tip
4 pc tubing, plastic, thin, 50-cm

*provided by the teacher

Preparation

1. Make a copy of Activity Sheet 1, Parts A and B, for each student.
2. Remove and set aside the protective caps from the tips of the syringes before you distribute them.
3. Use tape or pins to attach the Properties of Air chart to the board or a wall where all students can see it. You may want to leave a felt-tip marker next to the chart for later use.
4. Decide on a familiar object students can describe at the beginning of the activity in order to grasp the concept of *properties.* An object that can be seen, felt, heard, or smelled would serve the purpose best.
5. Each student will need a plastic bag with tie and a crayon. Each team of four will need a small balloon and a syringe.

Background Information

Young students often have difficulty recognizing that air is a substance. This is because it eludes their primary senses: it is invisible, odorless, and except as wind, cannot really be felt.

During the course of the module, students will be asked to describe the properties of air. In order to prepare them for describing such an intangible substance, it is helpful to first encourage them to describe the properties of objects they easily perceive. Good choices are objects that appeal to their

physical senses—objects with strong color, distinctive texture, definite shape, and even a discernible odor or taste, if possible. Such objects will elicit the longest list of descriptive words and phrases.

Such an exercise serves to help students think of an object as a sum of its properties. The more properties of a substance students can name, the better understanding they will have of that substance. As students discover the many properties of air over the course of these activities, they begin to get a picture of what sort of substance it really is.

In this first activity, students experiment with a variety of instruments that focus their attention on the presence of air. In each of these experiments, they observe evidence that air exists. They also begin to identify some of the properties of air.

First, students blow into a bag and seal it off. The inflated bag resists being pressed on and has a shape. Thus, they see that air is a substance that takes up space. Second, by pushing air through a syringe, they are able to feel it as wind. They further explore the movement of air in several ways, from blowing it from their mouths to fanning with their hands. Lastly, by connecting two syringes with a piece of rubber tubing, they are able to see that air pushed out of one syringe will push back the plunger of the other syringe. The lesson in this activity is that air takes up space, and, when pushed on, will in turn push on something else.

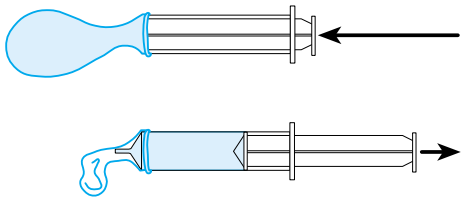
Name _____ Activity Sheet 1, Part A

Air Is Something

1. Blow up your plastic bag until it is full and tie it shut.

What is inside the bag? air

2. In the pictures below, draw the balloon as it looked on the end of the syringe with the plunger pushed in; then draw it as it looked with the plunger pulled out.



3. In each picture above, color the place where air is.

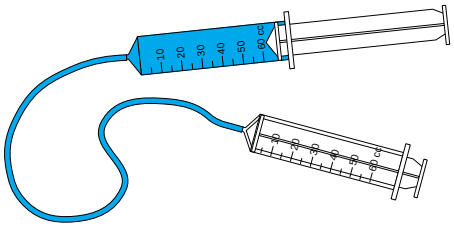
Did the air move when you pulled back the plunger to the end of the syringe? If so, where did it come from, and where did it go?

Yes, it moved. It moved from inside the balloon to inside the syringe.

Name _____ Activity Sheet 1, Part B

Air Is Something

4. With your teammates, connect the two syringes with the piece of tubing, as shown below.



5. In the picture above, color in the place where air is.

What happened when you pushed in the plunger of one syringe?

The second plunger moved out.

Why did the second plunger move out in its syringe when you pushed in the plunger of the first syringe?

The air in the first syringe moved into the tubing and into the second syringe, where it pressed on the plunger and moved it out.

Teaching Suggestions

Additional Information

1

Hold up a familiar object, such as a piece of fruit, a ruler, a marshmallow, or a sheet of construction paper—whatever you have chosen to exhibit—in front of the students and ask, **What is the name of this object?**

Students should call out the name of the object.

Ask, **Now that you have named this object, what words can you think of that would describe it?**

If necessary, elicit responses by asking students questions about the object's color, texture, shape, odor, and so forth.

Make a list of students' descriptions on the board. Tell students that the words they use to describe an object are called its *properties.* Write the word above the list on the board and underline it.

Ask them to name some properties of any object they can think of, indoors or out, to confirm that they understand what is meant by a *property* of something.

Students may describe such things as a piece of clothing, a rock, a tree, rain, clouds, and so on.

2

Write *air* on the board. Ask, **What is air?**

Answers will vary, but most students will probably say that air is the stuff all around us that we breathe.

Ask, **Can you think of any properties of air?**

Accept all reasonable responses. Write them on the board and allow for discussion.

Tell students that in the following activities they will be doing experiments to find out whether air has properties and, if so, what they are. Point out the chart, Properties of Air, and tell them that every time they discover a new property, you will add it to the chart.

3

Give each student a copy of Activity Sheet 1, Part A, an empty plastic bag with a tie, and a crayon. Ask, **Is there anything inside the bag?**

Students will probably say that the bag is empty.

Next, take a plastic bag and demonstrate how to inflate it by blowing into it. Show students how to twist the open end closed and tie it tightly. Ask students to do the same with their plastic bags. When all students have done so, ask, **Is your bag still empty? What is now inside?**

Students will probably say that the bag is no longer empty because their breath is in the bag.

Explain that their breath is air, like the air around them in the classroom. Have students answer the first question on Part A of their activity sheets.

Have students feel their bag of air. Ask, **Why is the bag no longer flat? Why does it take up more space than it did before?**

Encourage students to conclude that the bag is no longer flat because the air inside it takes up space.

Ask students to hold up their bags and show each other how much space their air takes up.

Point out that they have just identified a property of air and write *Air takes up space* on the Properties of Air chart. Tell students that next they will do another experiment that shows how air takes up space.

4

Distribute a small balloon and a syringe to each team of four.

Borrow a syringe from one of the teams and show the class how to pull back on the plunger and then push it in.

Tell students when they are told to pull the plunger outward, they should pull it back only until it stops at the end of the syringe. Caution them not to remove the plunger from the syringe because that might damage it.

Have one student from each team take the syringe and pull back the plunger. Then, while pointing the tip down, a few inches from a second student's hand, have him or her quickly push in the plunger. Ask the second students what they felt on their hands.

Students should say that they felt wind, or moving air.

Ask, **What made the air move out of the syringe?**

Students should suggest that the plunger pushed the air out of the syringe.

Point out to students that by pushing on air, they can create wind. Lead them to conclude that wind is just moving air. Discuss with students how, although we cannot see air, we can feel it when it moves against our skin.

Allow each student in the team to take a turn blowing on a teammate's hand with the syringe. Then ask, **Can you make air move by using your bodies instead of a syringe?**

Students may fan air with their hands or blow it from their mouths. Ask them if they can feel their stomachs pressing the air out when they blow, as the plunger pressed the air out of the syringe.

Tell one student from each team to pull out the syringe's plunger again. Have another student fit the balloon over the end without pressing in the plunger. Then have a third student press in the plunger while the others watch. Ask, **What happened?**

5

Students should point out that the balloon filled up with air.

Ask, **Where did the air that filled up the balloon come from?**

It came from inside the syringe.

Have the fourth student in each team pull the balloon off the end of the syringe, press the plunger in and put the balloon back on the end. Ask, **What do you think will happen if you pull the plunger out?**

6

Accept all reasonable answers.

Have each team pass the syringe back to the first student and let him or her pull out the plunger.

Ask, **What happened?**

The balloon collapsed.

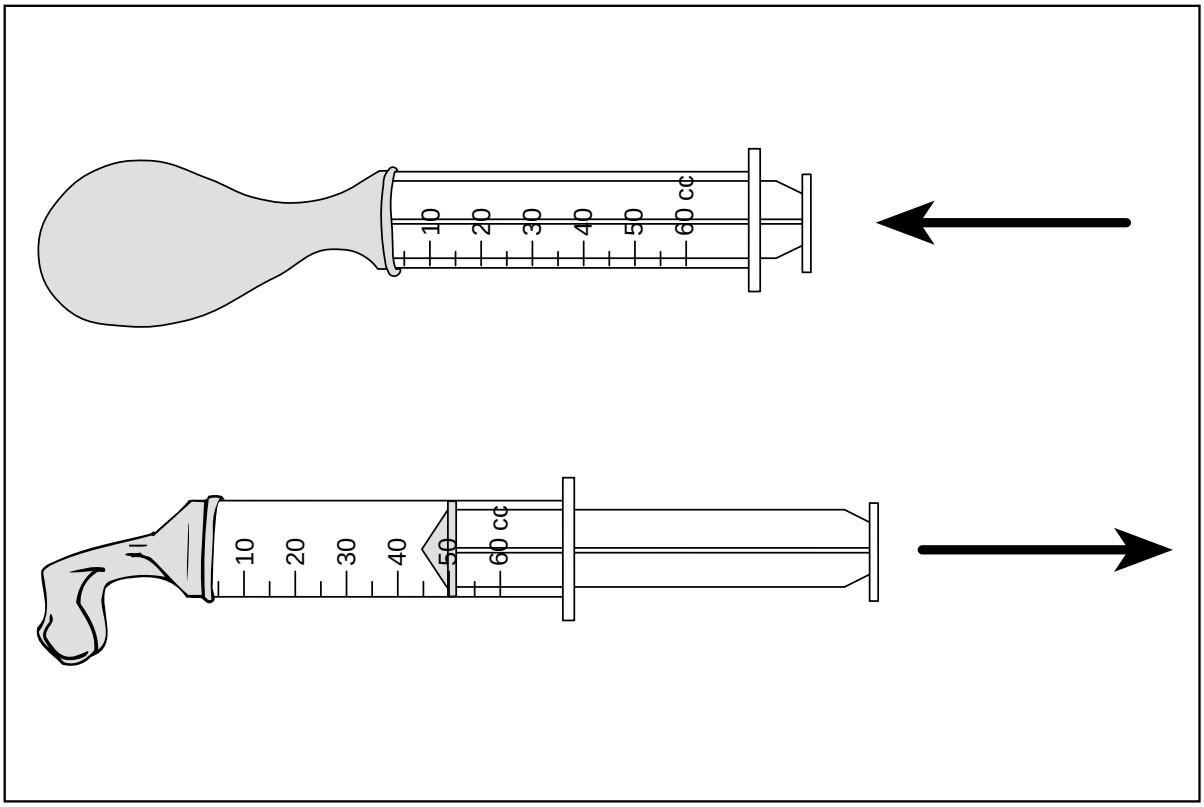


Figure 1-1. Pushing in the plunger on the syringe fills the balloon with air. Pulling outward on the plunger removes the air and collapses the balloon.

Lead students to conclude that in order for the balloon to have collapsed the air must have gone out of it. Ask, **Where do you think the air went?**

Students may say that the air that was inside the balloon was pulled into the syringe.

Ask students to complete Part A of the activity sheet.

7

Have teams pair up to make teams of eight students each and give each team a 50-cm piece of tubing. Give each student a copy of Activity Sheet 1, Part B, and ask all the students to take a few moments to study the illustration in Step 4 before proceeding with the next experiment.

Tell students they will now take turns assembling the setup shown on the activity sheet. Ask one student in each group to pick up a syringe and press the plunger all the way in. Ask another student to take the other syringe and pull the plunger back to the end. Then have a third student push the tubing onto the tip of one syringe and a fourth student attach the free end of the tubing to the tip of the other syringe.

Students may find it difficult to fit the tubing over the tip of the syringe. Offer help as needed.

Allow a fifth student to press in the plunger of the open syringe and ask students to describe what happened.

The other plunger was pushed outward in its syringe.

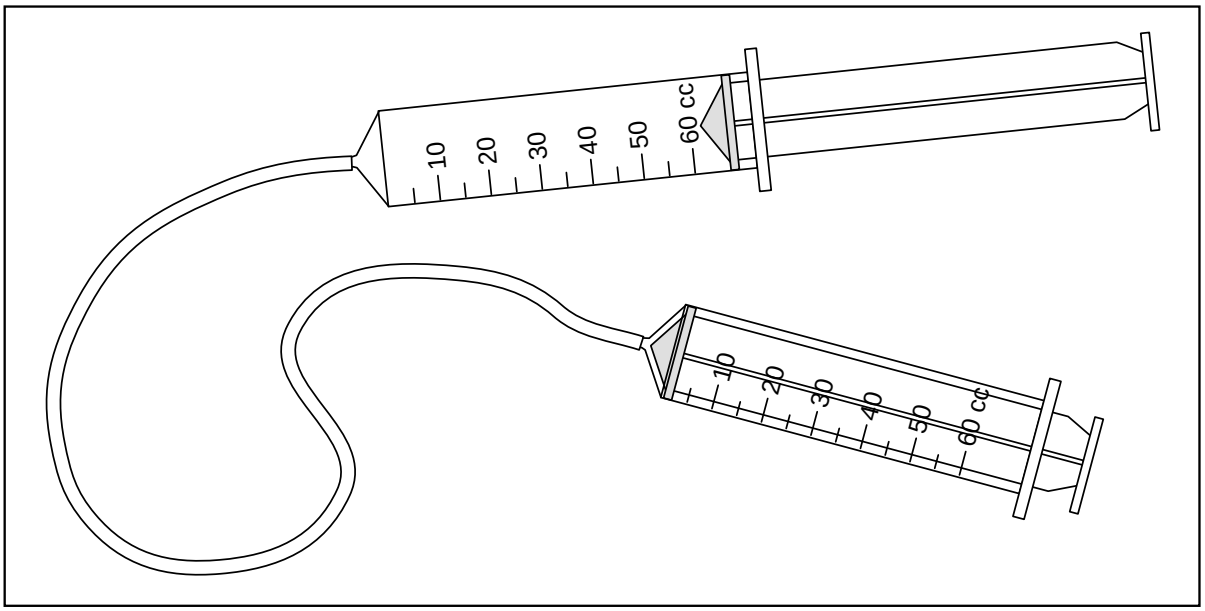


Figure 1-2. Connecting two syringes with tubing.

When each team member has had a chance to push in the plunger of one of the syringes, ask, **When you pushed in the plunger on one syringe, what made the plunger on the second syringe move outward?**

Students should say that air pushed it outward.

Lead students to conclude that when the first plunger was pressed in, it forced the air out of the first syringe, through the tubing, and into the second syringe, where it pressed against the plunger and moved it outward in the syringe.

Ask, **If air did not take up space, would the second plunger have moved outward?**

Students should conclude that it would not.

Have students complete Part B of their activity sheets.

Tell students they have discovered one of the properties of air (that it takes up space). Tell them they will discover even more properties in the following activities.

Reinforcement

Make a list of examples students can offer of objects they are familiar with in which air takes up space. It may be helpful to phrase the question thus: **How many objects can you think of that are useful because they have air inside them?** Students might mention various kinds of balls, tires, or even blimps.

Cleanup

Dispose of the plastic bags and ties. Have students disconnect the tubing from the syringes. Replace the protective caps on the tips of the syringes and return them, along with the tubing and balloons, to the kit. Leave the Properties of Air chart posted throughout all the following activities.

Science at Home

Ask students to look for inflatable toys and other items at home. Tell them to notice the difference in the amount of space they take up when they are full of air (inflated) and when they are empty of air (deflated).

Connections

Science Extension

To give students additional practice describing the properties of objects, play a game of "I Spy." Model the procedure by choosing an object without revealing what it is and describing its properties—"I spy something long, thin, hard, yellow, and pointed on one end," for a pencil, for example—and let students guess the object. Once they have the idea, let them take turns choosing and describing objects.

Do the following activity as a demonstration. Put a clear plastic funnel into the top of a clear jar and mold clay around the jar's rim, making sure there are no holes or gaps. Show students the jar and ask them whether there is anything in it. (They will probably say no.) Pour tinted water into the funnel. (The water will stay in the funnel.) Then poke a small hole through the clay. The water will flow from the funnel into the jar. Ask students to explain this observation. (The jar was not empty but was filled with air. The water could not flow into the jar while there was air in it, but when you made a hole in the clay, the air was pushed out of the jar and the water flowed in.)

Science and Careers

Invite a professional or hobbyist clown who entertains at children's parties to visit the class and show students how to make animals with inflated balloons. (Look in the Yellow Pages under the heading *Clowns*.) Ask the visitor to demonstrate the air pump or oxygen tank used to inflate the balloons and to describe how it works. Provide an ample supply of balloons so students can try their hand at making balloon creatures. Also ask the visitor to explain how he or she learned to be a clown and what is involved in creating a unique clown character.

Science and Language Arts

Provide library books about air to read aloud to small groups or to make available for students to read on their own if they are capable. Three good choices are described below.

Air by David Bennett (Bantam, 1989): Easy-to-read text and simple illustrations make this book appropriate for younger readers; covers many aspects of air in simple terms.

Air by David Lloyd (Dial, 1982): Text is appropriate for mature readers, but the dramatic and captivating illustrations by Peter Visscher could simply be used as a basis for discussion with beginning readers.

The Air I Breathe by Bobbie Kalman and Janine Schaub (Crabtree, 1993): For more capable readers; covers a wider range of topics and more detail than the Bennett book described above.

Science, Technology, and Society

Let students use a bicycle pump to blow puffs of air at their hands or at objects that will move when air hits them. If you can trust students not to blow up balloons to the point of bursting (or if you do not mind the noise of popping balloons), let students attach a balloon to the end of the tube and blow it up. Ask students whether the pump pulls air back out of the balloon when they pull the plunger back. (No; the pump draws air through a separate intake hole, so it does not pull air from the balloon or from a tire being inflated.) Save the pump for use again in Science, Technology, and Society for Activities 5 and 8.