BIO FAX!

FLINN SCIENTIFIC, INC
"Your Safer Source for Science"

P.O. Box 219 • Batavia, IL 60510
(800) 452-1261 • Fax (866) 452-1436
www.flinnsci.com • E-mail: flinn@flinnsci.com

Catalog No. FB1442

Publication No. 10267

Lung Model

Student Laboratory Kit

Introduction

We breathe twenty-four hours a day, every day, without consciously thinking about it. What causes air to rush into our lungs and then rush out again?

Concepts

- Differential air pressure
- Inhalation
- Exhalation

Materials

Balloon, large
Balloon, small
Plastic cup with hole, transparent
Rubber stopper, 1-hole
Scissors

Safety Precaution

Wear protective goggles when working with balloons as they may snap off when stretched. Follow all laboratory safety guidelines.

Procedure

1. Place the small balloon over the large end of the one-hole stopper as shown in Figure 1.
2. Insert the rubber stopper securely into the hole from the inside of the plastic cup.
3. Use sharp scissors to cut the large balloon as shown in Figure 2.
4. Have a lab partner hold the cup containing the small balloon. Stretch the large balloon over the end of the cup. Your final model should look like Figure 1.
5. Carefully move the center of the large balloon up and down. Do not pull or push too hard.
6. Answer the questions on the Lung Model Worksheet.

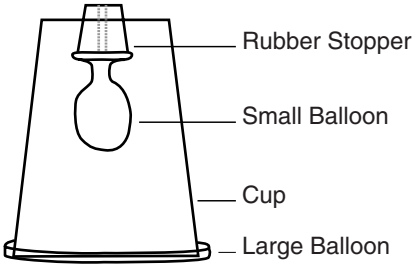


Figure 1. Completed Model

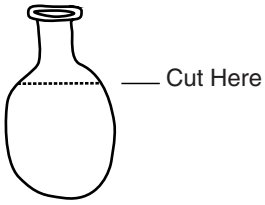


Figure 2. Cutting Large Balloon

IN10267
122115

Name: _____

Lung Model Worksheet

Circle the correct answers or fill in the blanks.

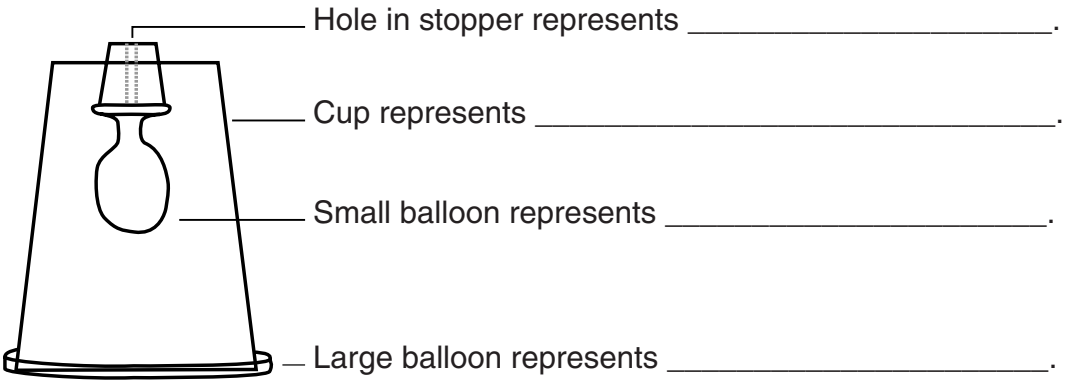
1. When the large balloon is pulled down, it makes the total volume inside the cup chamber (larger, smaller). When this happens the small balloon (inflates, deflates).

2. When the large balloon is pushed up, it makes the total volume inside the cup chamber (larger, smaller). When this happens the small balloon (inflates, deflates).

3. When the cavity inside the cup chamber gets smaller, the air pressure inside the chamber (increases, decreases). This pressure difference between the inside and outside of the chamber causes air to (move into, move out of) the small balloon.

4. When the cavity inside the cup chamber gets larger, the air pressure inside the chamber (increases, decreases). This pressure difference causes air to (move into, move out of) the small balloon.

5. Fill in the blanks.



6. When the diaphragm contracts, the chest cavity gets (larger, smaller), the air pressure inside the lungs (increases, decreases), air (enters, leaves) the lungs and they (inflate, deflate).

7. When the diaphragm relaxes, the chest cavity gets (larger, smaller), the air pressure inside the lungs (increases, decreases), air (enters, leaves) the lungs and they (inflate, deflate).

8. In the model the chest cavity cannot expand. In our body the chest cavity expands and contracts. How is this expansion and contraction coordinated with diaphragm movements?

IN10267

Teacher's Notes

Lung Model

Materials Included in Kit

Balloons, large, 32
Balloons, small, 32
Plastic cups, transparent, 32
Rubber stoppers, 1-hole, 30
Lung Model Worksheet Master
Cork borer

Additional Materials Needed (for each lab group)

Scissors

Pre-Lab Preparation

Use the cork borer provided in the kit to cut a hole in the center of the bottom of each cup. Place each cup on a piece of wood or cardboard and cut the hole from the inside of the cup. Apply an even, twisting motion to cut a hole through the bottom of the cup. A glove might be worn to protect your hand. *Be careful,* the cork borer is a potentially dangerous cutting device. **Do not** let students cut the holes. *Note:* upon difficulty cutting, gently heat the sharp edge of the cork borer using a bunsen burner or safety lighter.

Safety Precautions

Be sure precautions are given about working with balloons.

Disposal

Students can take their models home and teach family members about lung functioning or you can reuse all the materials for additional classes.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation
Form and function
Content Standards: Grades 5–8
Content Standard C: Life Science, structure and function in living systems
Content Standard F: Science in Personal and Social Perspectives; personal health
Content Standards: Grades 9–12
Content Standard C: Life Science, matter, energy, and organization in living systems
Content Standard F: Science in Personal and Social Perspectives; personal and community health

Tips

- Enough materials are provided in the kit to make 30 models. Several extra cups and balloons are provided in case of breakage or poor hole cutting. The activity can easily be completed in one class period with discussion.
- You may want to have students assemble their models and then have the class manipulate their models simultaneously. This way you can complete the worksheet as an all-class discussion. Alternatively, all students can work individually.
- If you are unfamiliar with cutting objects with a cork borer, practice on some paper or cardboard prior to cutting the tougher plastic cup.
- Make one of the models prior to the class operation. Practice stretching the large balloon over the bottom of the cup. Students might need assistance at this step. Be sure to cut the balloon just below the neck of the balloon. If the balloon is cut too close to the center, it will rip easily.

- This model, like any model, has its limitations. The real breathing mechanism, as described in the discussion section, points out the multiple contractions involved in breathing. Be sure students realize that, even though this model is fun to operate and does illustrate the general principle of breathing, it doesn't show all of the muscles involved in breathing. Be sure to read the discussion carefully and augment your class discussion as appropriate for your students and your class goals.

Discussion

The human breathing mechanism is, in principle, a simple concept. The nervous/muscular coordination, however, is complex. The basic principle is that muscular contractions alter the size of the internal chest cavity and create an air pressure differential between the inside of the chest cavity and the atmospheric air pressure outside the body. When the atmospheric air pressure outside the body is greater than inside the lungs, air enters the lungs. When the pressure is greater inside the lungs than outside the body, air leaves the lungs.

Two sets of muscles are basically involved in breathing. Intercostal muscles between the ribs and certain thoracic muscles can contract and relax which results in the raising and lowering of the rib cage. The contraction of the rib cage muscles causes the rib cage to be raised and the chest cavity to enlarge. (See Figure 2A — Inspiration.) While this is happening, the diaphragm (a very strong muscle) simultaneously contracts. This contraction lowers the diaphragm making the internal chest cavity even larger. Because of this chest cavity expansion, the air pressure inside the chest cavity is reduced and becomes less than the outside atmospheric pressure — air rushes into the lungs. These muscle contractions are alternately followed by a relaxation of the diaphragm and rib cage muscles which results in a decrease in the chest cavity size and an increase in air pressure inside the lung cavity. This increased pressure results in air being expelled from the lungs. (See Figure 2B — Expiration.)

In summary, changes in the size of the chest cavity affect the air pressure in the lungs. When the chest expands, the pressure within the chest falls. Because of this reduced air pressure, air is forced in from the outside, where it is under greater atmospheric pressure. When the chest cavity is reduced, the internal pressure becomes greater than the atmospheric pressure and air is forced out of the breathing passages. The autonomically controlled, rhythmic increase and decrease in the chest cavity's volume is the mechanical "pump" that drives air into and out of the lungs.

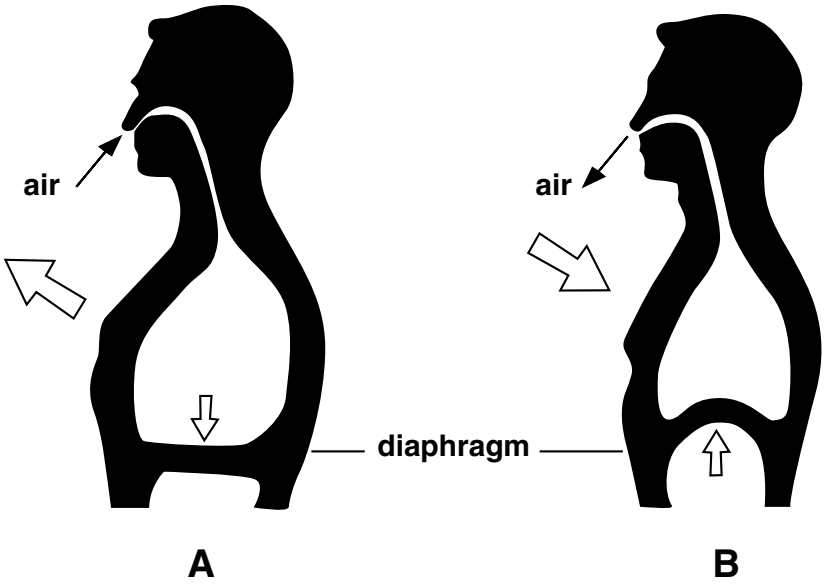


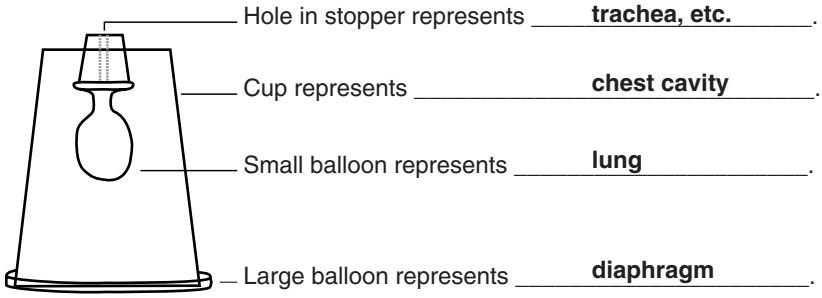
Figure 2 A. Inspiration — diaphragm contracted and chest muscles contracted raising rib cage causing increased volume and decreased air pressure.

Figure 2 B. Expiration — diaphragm relaxed and chest muscles relaxed lowering rib cage and causing decreased volume and increased air pressure.

Answers to Lung Model Worksheet

Circle the correct answers or fill in the blanks. **(Answers in bold.)**

1. When the large balloon is pulled down, it makes the total volume inside the cup chamber (**larger**, smaller). When this happens the small balloon (**inflates**, deflates).
2. When the large balloon is pushed up, it makes the total volume inside the cup chamber (larger, **smaller**). When this happens the small balloon (inflates, **deflates**).
3. When the cavity inside the cup chamber gets smaller, the air pressure inside the chamber (**increases**, decreases). This pressure difference between the inside and outside of the chamber causes air to (move into, **move out of**) the small balloon.
4. When the cavity inside the cup chamber gets larger, the air pressure inside the chamber (increases, **decreases**). This pressure difference causes air to (**move into**, move out of) the small balloon.
5. Fill in the blanks.



6. When the diaphragm contracts, the chest cavity gets (**larger**, smaller), the air pressure inside the lungs (increases, **decreases**), air (**enters**, leaves) the lungs and they (**inflate**, deflate).
7. When the diaphragm relaxes, the chest cavity gets (larger, **smaller**), the air pressure inside the lungs (**increases**, decreases), air (enters, **leaves**) the lungs and they (inflate, **deflate**).
8. In the model the chest cavity cannot expand. In our body the chest cavity expands and contracts. How is this expansion and contraction coordinated with diaphragm movements?

   The chest cavity expands up and outward (muscles contract) when the diaphram contracts.

The *Lung Model—Student Laboratory Kit* is available from Flinn Scientific, Inc.

Catalog No.	Description
FB1442	Lung Model—Student Laboratory Kit
FB1110	Functioning Lung Model

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.

