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Basic Lung Apparatus
#120320

Warning:

- **Not a toy; use only in a laboratory or educational setting.**
- **Contains latex.**
- **California Proposition 65 Warning: This product can expose you to chemicals including styrene, which are known to the State of California to cause cancer, birth defects, or other reproductive harm. For more information go to www.P65Warnings.ca.gov.**

Introduction

Breathing, also known as **respiration**, is something you do every second of every day, so you might not often question how it works. Air moves into the lungs through **inhalation** and out of the body through **exhalation**. To have a grasp on the process of inhalation and exhalation, the most important parts of the respiratory system to understand are the lungs, the diaphragm, the intercostal muscles, and the thoracic cavity.

The **thoracic cavity** is the cavity in the chest that houses the lungs, diaphragm, intercostal muscles, heart, and other structures essential to life. **Lungs** are passive, flexible sacks that provide the surface area needed for oxygenating the blood. They function by responding to changes in the pressure in the thoracic cavity. This pressure is regulated primarily by the diaphragm and intercostal muscles. The **diaphragm** is a flat skeletal muscle that sits below the lungs and divides the thoracic cavity from the abdominal cavity. The **intercostal muscles** are the groups of muscles between your ribs. Together, they serve to manipulate pressure in the thoracic cavity. When these muscles contract, the chest wall expands outwards and the thoracic cavity grows downwards to fill the space taken by the diaphragm when it is relaxed.

The muscle movement and resulting volume changes are small, with the diaphragm moving on an average of about 2/3 of an inch during quiet breathing and nearly 3 inches during deep breathing. This small change in volume causes a decrease in the pressure within the cavity. Since air moves from areas of high pressure to areas of low pressure, this pressure differential in the lungs causes them to become filled by air. It's helpful to keep the **Ideal Gas Law** in mind when conceptualizing this process:

PV=nRT	• **P= Pressure** • **V= Volume** • **n= Molecular Quantity** • **R= Constant** • **T= Temperature**

Components

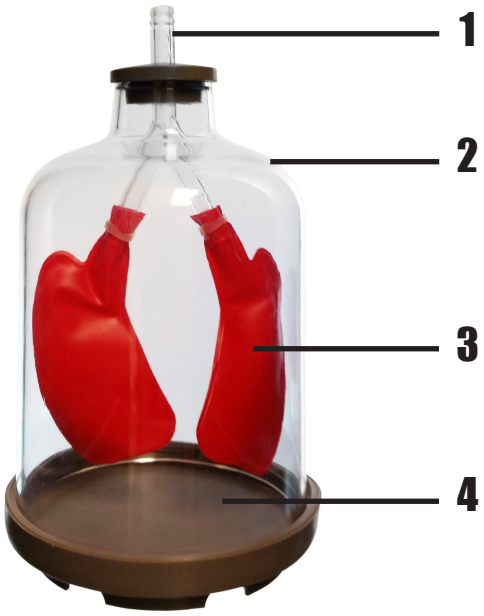
This apparatus simulates essential parts of the respiratory system to demonstrate how lungs function. Learning about this process will also help you to learn about the relationship between volume and pressure. Below are the parts labeled according to which part of the respiratory system that they correspond to:

1. **Airways** – Airways are the paths that air takes to get from outside of your body to inside your lungs. Though your body's airways consist of multiple parts, this apparatus simulates them with a single Y-shaped tube held in place by a rubber stopper. This tube is the only place where air can enter into the system.

2. **Thoracic Cavity** – The plastic dome of this apparatus simulates the thoracic cavity.

3. **Lungs** – The lungs are simulated by two red, lung-shaped balloons, one attached to each fork of the Y-shaped tube simulating the airways.

4. **Respiratory Muscles** – The diaphragm and intercostal muscles which manipulate pressure in the thoracic cavity are simulated by a rubber dam that can by pulled by a knob on the underside of the apparatus. This knob is used to increase volume in the system.



How to Use

1. Set the system up so that the lungs are deflated when the rubber dam is not being pulled on (*ie.* the diaphragm and the intercostal muscles are relaxed). To do so, remove the rubber stopper holding the lungs in place and pull on the knob attached to the rubber dam. With the knob still pulled out, return the stopper and lungs into place. Finally, release the rubber dam. This causes air to be expelled from the lungs.

2. Pull on the rubber dam.

3. Observe how the lungs inflate. This simulates **inhalation**.

4. Release the rubber dam.

5. Observe how the lungs deflate. This simulates **exhalation**.

This process works because air can only enter the system through the airways. When the pressure around the lungs decreases, the system wants to pull in air equalize the pressure. This pressure differential forces the lungs to expand to make room for the air entering the system. The opposite applies to exhalation.