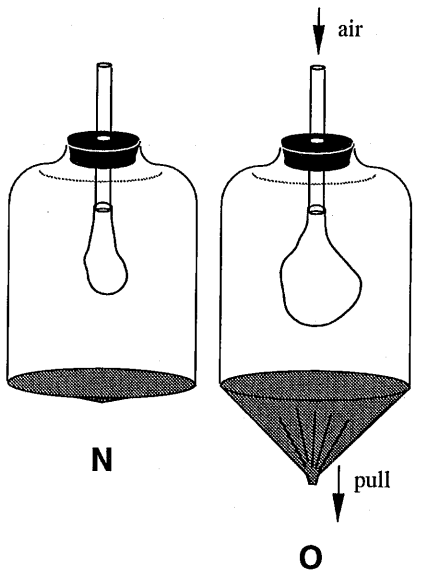
4.1.5 Air Pressure and Breathing

Concepts to Investigate: "Negative pressure," breathing, pressure differentials.

Materials: Bell jar, balloons, glass tubing, one-holed stopper, twine.

Principles and Procedures: Inhalation is the process whereby air is delivered to the lungs, where it is then absorbed into the blood. In mammals, inhalation is dependent upon a pressure gradient that pushes air into the lungs. When inhaling, the diaphragm (a muscular membrane at the bottom of the chest cavity) is pulled down while the rib cage is pulled up and out. As a result of such movement, the lungs expand like a bellows. As a result of this expansion, a partial vacuum is created inside the lungs and air from the outside is pushed in.

The action of lungs can be demonstrated using the apparatus illustrated in Figure N. To simulate the lungs, place a balloon over the ends of a glass tubing fitted into a rubber stopper. Stretch a sheet of rubber from a large balloon over the base of the bell jar to simulate the diaphragm. Secure the rubber diaphragm with heavy tape or twine so it will not slip off when pulled. Carefully pull the rubber diaphragm down, as shown in Figure O, and observe the inflation of the balloon (lungs).



Questions

(1) Some textbooks state that mammalian lungs operate on the principle of "negative pressure." Is this statement accurate? Explain.

(2) Frogs use a "positive pressure" pump to inflate their lungs after using a "negative pressure pump" to draw air into their mouths. Describe how this might work.

(3) Explain how a drinking straw works. Draw a diagram and indicate regions of higher and lower pressure.