Roles of Cilia and Mucus

I. Location

A. Line the tubes of the respiratory tract

B. The tubes also produce mucus

II. Function

A. Mucus traps bacteria and dust particles

B. Cilia sweep the mucus upward, cleaning the respiratory tubes

C. Smokers lose functionality of this system and must cough to clear mucus (smoker's hack)

Inhalation and Exhalation

I. **Breathing**

A. The taking in of air into the lungs

1. INSPIRATION - breathing air in
2. EXPIRATION - breathing air out

B. Occurs about 14-20 times/min at rest

II. Lung Capacity

A. TIDAL VOLUME

1. Normal breath
2. About 500 mL

B. INSPIRATORY RESERVE VOLUME

1. Amount of air that can be forced in a breath
2. About 3100 mL

C. INSPIRATORY CAPACITY

1. Maximum inhalation
2. inspiratory reserve + tidal volume
3. About 3600 mL

D. EXPIRATORY RESERVE VOLUME

1. After normal exhalation
2. Can expel about 1200 mL more

E. VITAL CAPACITY

1. Maximum amount of air that can be moved in and out during a single breath
2. About 4800 mL

F. RESIDUAL VOLUME

1. Air that remains in the lungs even after very deep breathing
2. About 1200 mL

G. LUNG CAPACITY

1. The total amount of air in the lungs
2. About 6000 mL

III. Sequence of Events

A. Breathing **TED-ED Breathing**

1. Created by "negative pressure" powers breathing

2. Negative pressure is air pressure that is less (756 mm Hg) than the pressure of the surrounding air (760 mm Hg)

3. This negative pressure is created by increasing the volume inside the thoracic cavity

4. Air will naturally move in to fill this partial vacuum

5. The space in the thoracic cavity is made bigger by the contraction of the diaphragm and rib muscles

   a. Diaphragm moves downward and become less dome shaped

   b. When the diaphragm contracts, the space within lungs increases

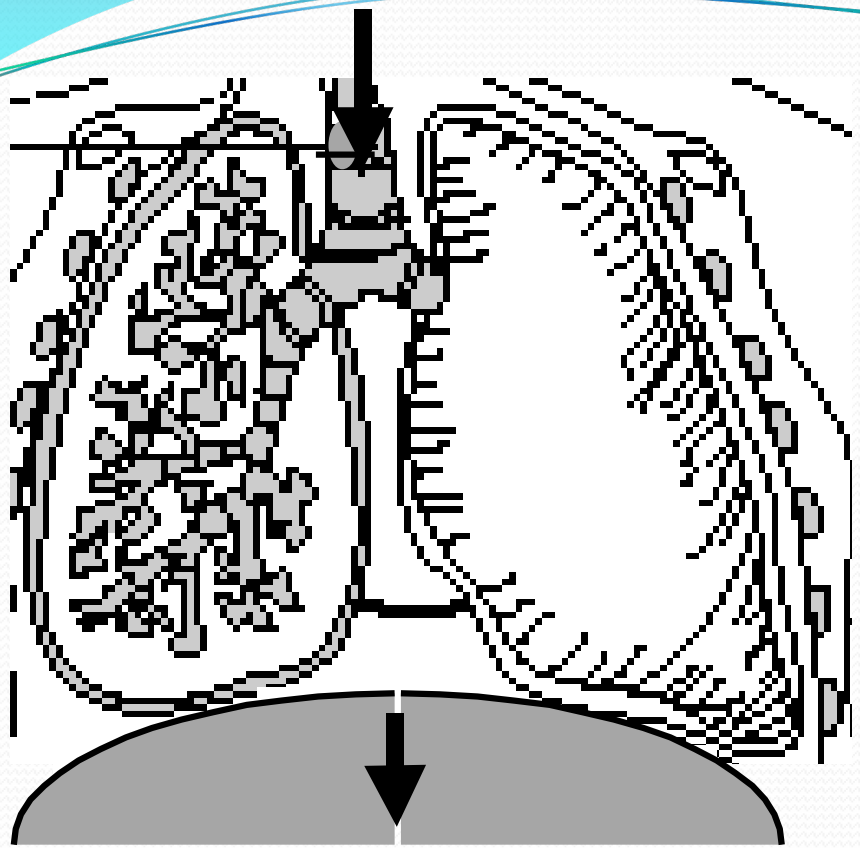
   c. The muscles attached to the ribs, called intercostal muscles, will also contract when you breathe in

   d. This contraction pulls the ribs up and out, further increasing the space within the thoracic cavity

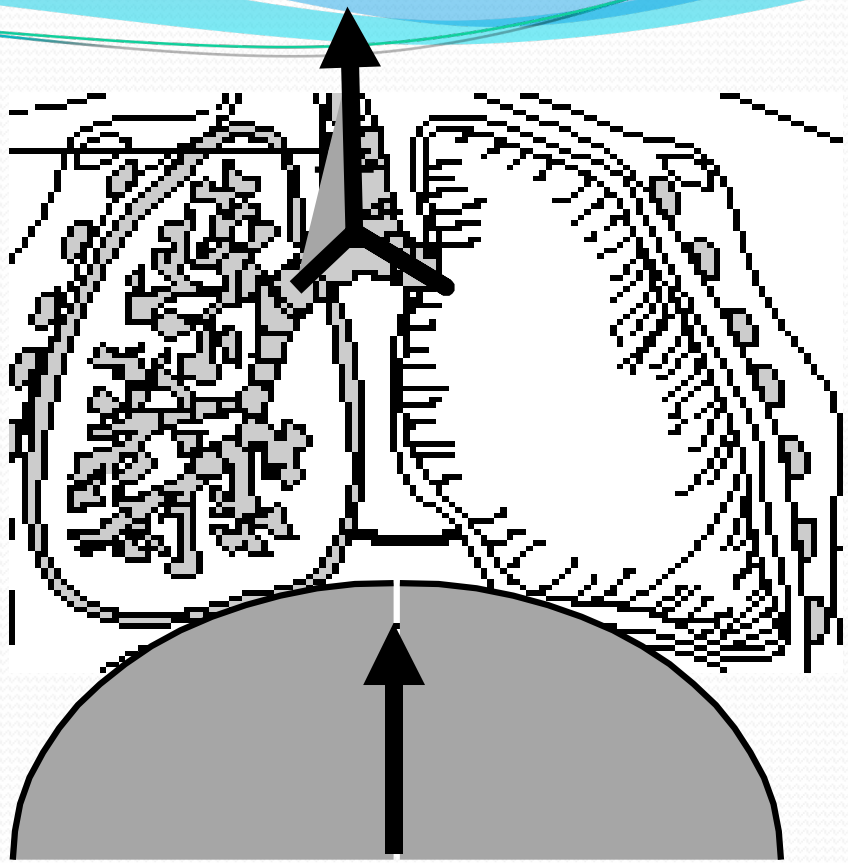
6. The decrease in the volume of the thoracic cavity forces air out of the lungs

   a. The diaphragm relaxes and moves upwards

   b. The intercostal muscles relax and the ribs move down and inward



INSPIRATION



EXPIRATION

B. Inspiration – breathing air IN

1. Diaphragm contracts
2. Rib muscles contract
3. These actions EXPAND the thoracic cavity
4. Create low pressure
5. Air is "sucked" or pulled in
6. An ACTIVE process (requires energy)

C. Expiration – breathing air OUT

1. Diaphragm relaxes
2. Ribs relax
3. Thoracic cavity relaxes
4. These actions CONTRACT the thoracic cavity
5. Air is forced out
6. A PASSIVE process

Control of Breathing

I. **Can be Controlled Consciously**

II. **Mainly by Carbon Dioxide**

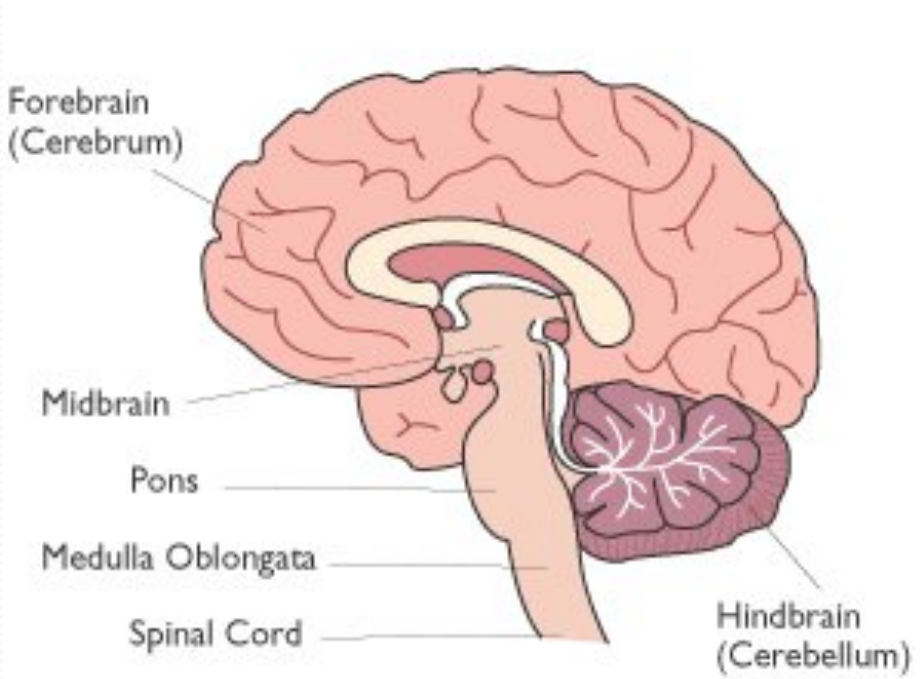
A. The urge to breathe is brought about primarily by CO_2 and H^+ ions in the blood

1. **CO_2 levels in the blood will increase as cells continue to produce it**
2. **The concentration of CO_2 will increase until they reach a threshold level**
3. **High CO_2 stimulates breathing center which stimulates diaphragm and rib muscles to contract**

B. Chemoreceptors in arteries detect the increased CO_2 and H^+ levels

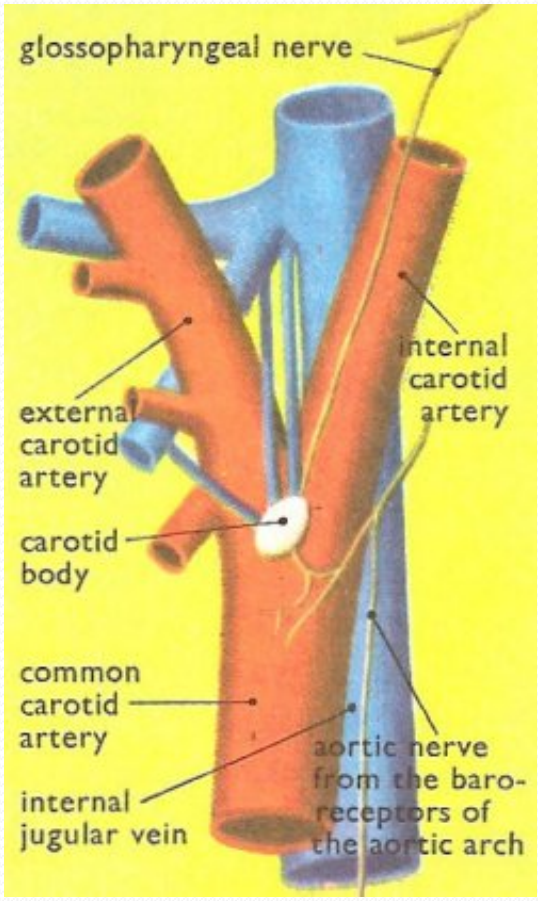
C. The chemoreceptors send a signal to a breathing center in the MEDULLA OBLONGATA of the brain

1. **It detects the rising levels of CO_2 and H^+.**
2. **This center is not affected by low oxygen levels.**



D. There are also chemoreceptors in the carotid bodies

1. Located in the carotid arteries and in the aortic bodies, located in the aorta
2. Respond primarily to H^+ concentration
3. Also to the level of carbon dioxide and oxygen in the blood
4. These bodies communicate with the respiratory center



E. The medulla oblongata sends a nerve impulse to the diaphragm and muscles in the rib cage

F. The diaphragm contracts and lowers, while the rib cage moves up

G. Air flows into alveoli, and the alveolar walls expand and stretch

H. STRETCH RECEPTORS in the alveoli walls detect this stretching

I. Nerves in alveoli send signal to brain to inhibit the medulla oblongata from sending its message to the diaphragm and rib muscles to contract

J. They therefore stop contracting

K. The diaphragm relaxes, and moves upward, resuming its original shape

L The rib cage relaxes and moves downward and inward

M. Air is forced out the lungs