

Mechanism of Breathing

B.Sc Second year Zoology (Honours) Paper - 4

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Mechanism of Breathing

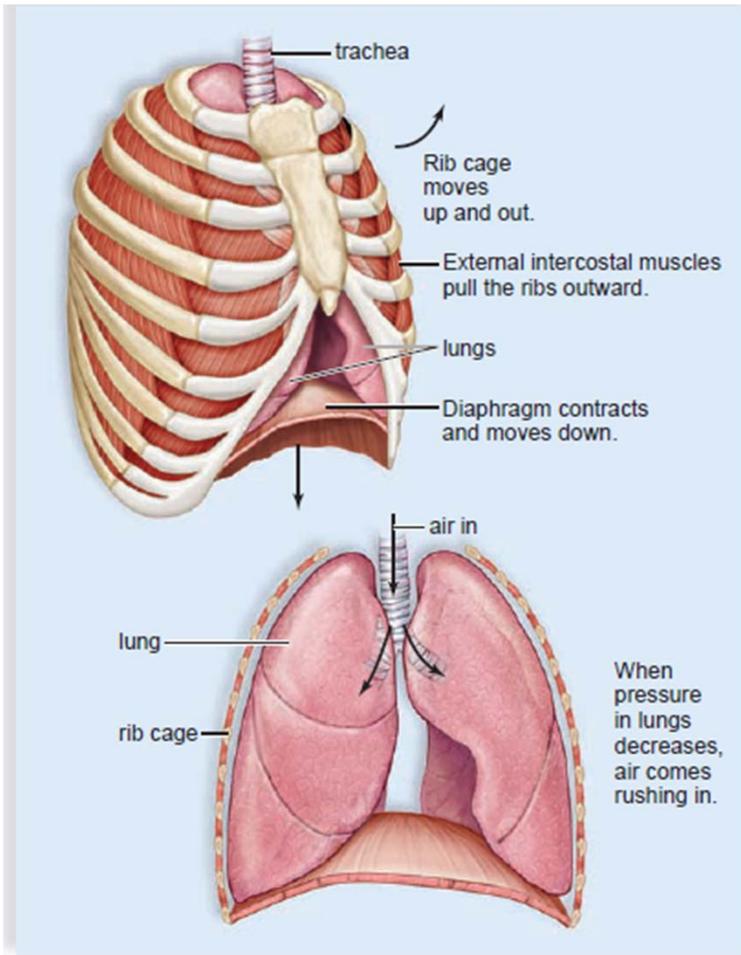
- Ventilation, or breathing, has two phases. The process of inspiration, also called inhalation, moves air into the lungs; the process of expiration, also called exhalation, moves air out of the lungs.
- To understand ventilation (the manner in which air enters and exits the lungs) it is necessary to remember the following facts:
 1. Normally, there is a continuous column of air from the pharynx to the alveoli of the lungs.
 2. The lungs lie within the sealed thoracic cavity. The rib cage, consisting of the ribs joined to the vertebral column posteriorly and to the sternum anteriorly, forms the top and sides of the thoracic cavity. The intercostal muscles lie between the ribs. The diaphragm and connective tissue form the floor of the thoracic cavity.

3. The lungs adhere to the thoracic wall by way of the pleura. Any space between the two pleurae is minimal due to the surface tension of the fluid between them.

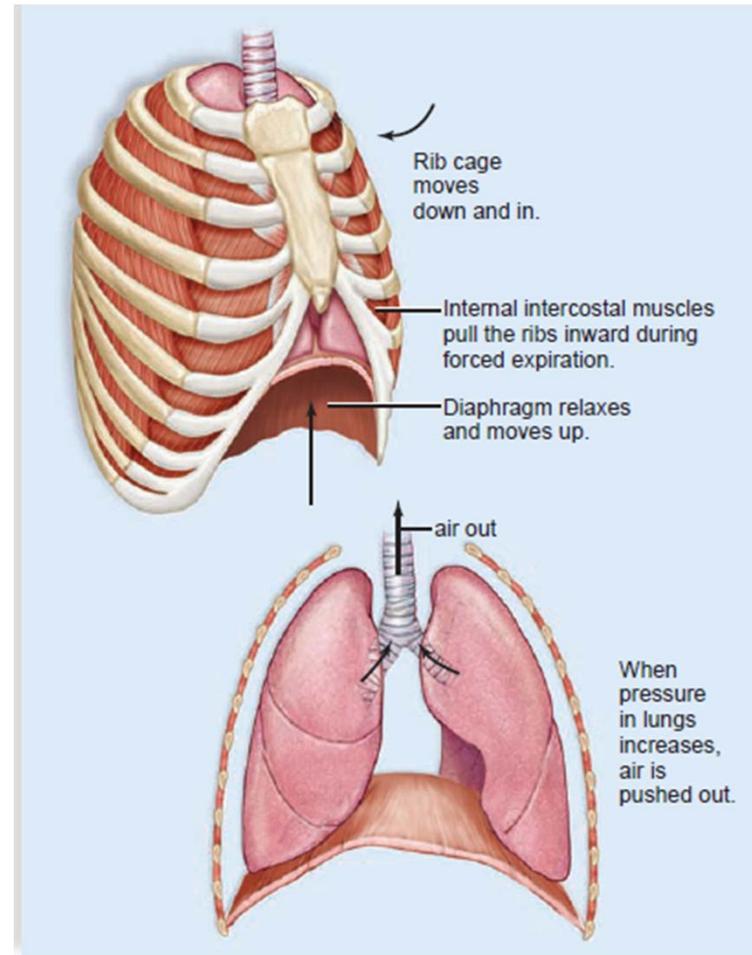
Inspiration

- Inspiration is the active phase of ventilation because this is the phase in which the diaphragm and the external intercostal muscles contract.
- In its relaxed state, **the diaphragm** is dome-shaped. During inspiration, it contracts and becomes a flattened sheet of muscle.
- Also, the external intercostal muscles contract, causing the rib cage to move upward and outward.
- Following contraction of the diaphragm and the external intercostal muscles, the volume of the thoracic cavity is larger than it was before.
- As the thoracic volume increases, the lungs increase in volume as well because the lung adheres to the wall of the thoracic cavity.

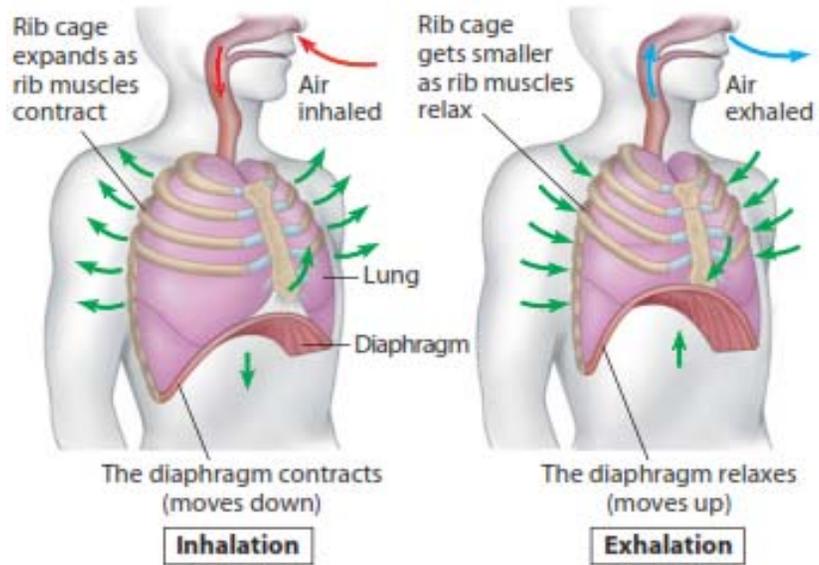
- As the lung volume increases, the air pressure within the alveoli decreases, creating a partial vacuum .
- In other words, alveolar pressure is now less than atmospheric pressure (air pressure outside the lungs).
- Air will naturally flow from outside the body into the respiratory passages and into the alveoli, because a continuous column of air reaches into the lungs.
- Air comes into the lungs because they have already opened up; air does not force the lungs open.
- This is why it is sometimes said that *humans inhale by negative pressure*.
- The creation of a partial vacuum in the alveoli causes air to enter the lungs.
- Whereas inspiration is the active phase of breathing, the actual flow of air into the alveoli is passive.



a. Inspiration



b. Expiration



Expiration

- Usually, expiration is the passive phase of breathing, and no effort is required to bring it about.
- During expiration, the diaphragm and external intercostal muscles relax.
- The rib cage returns to its resting position, moving down and inward.
- The elastic properties of the thoracic wall and lung tissue help them to recoil .

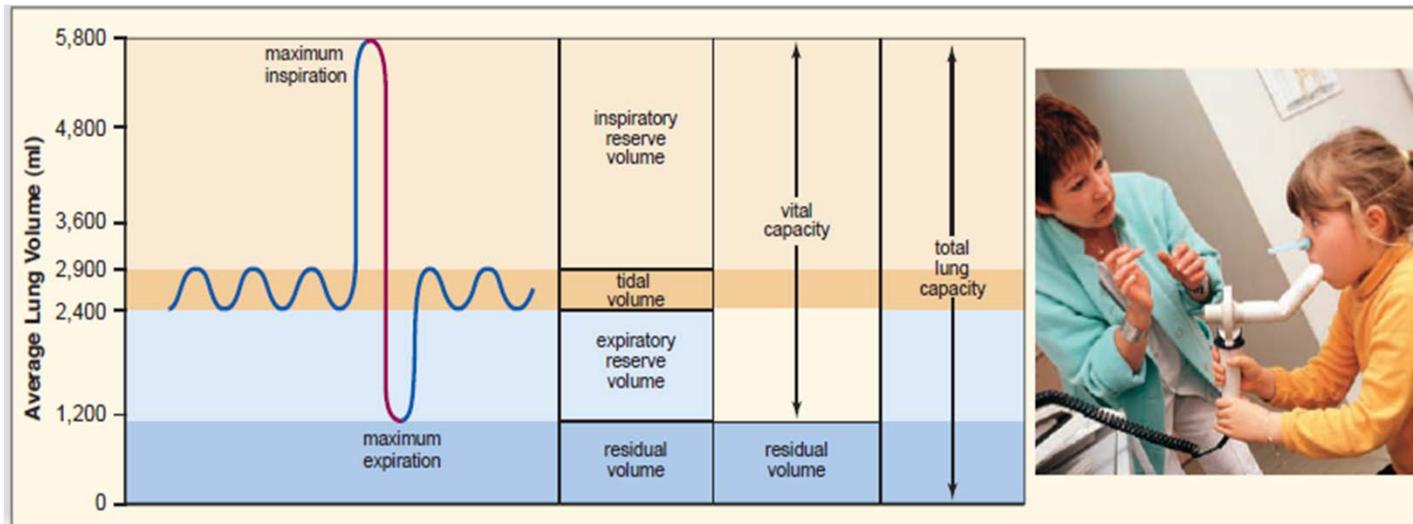
Volumes of Air Exchanged During Ventilation

- As ventilation occurs, air moves into the lungs from the nose or mouth during inspiration and then moves out of the lungs during expiration.
- A free flow of air to and from the lungs is vitally important. Therefore, a technique has been developed that allows physicians to determine if there is a medical problem that prevents the lungs from filling with air upon inspiration and releasing it from the body upon expiration

Tidal Volume

- Normally, when we are relaxed, only a small amount of air moves in and out with each breath, similar, perhaps, to the tide at the beach.
- This amount of air, called the tidal volume, is only about 500 ml.

Vital Capacity



- The maximum volume of air that can be moved in plus the maximum amount that can be moved out during a single breath is called the vital capacity.

Inspiratory and Expiratory Reserve Volume

- As noted previously, we can increase inspiration by expanding the chest and also by lowering the diaphragm to the maximum extent possible.
- Forced inspiration (inspiratory reserve volume) usually adds another 2,900 mL of inhaled air, and that's quite a bit more than a tidal volume of only 500 mL.
- We can increase expiration by contracting the abdominal and thoracic muscles. This so-called expiratory reserve volume is usually about 1,400 ml of air.

Residual Volume

- It is a curious fact that some of the inhaled air never reaches the lungs; instead, it fills the nasal cavities, trachea, bronchi, and bronchioles.

- These passages are not used for gas exchange; therefore, they are said to contain **dead air space**.
- To ensure that newly inhaled air reaches the lungs, it is better to breathe slowly and deeply.
- Also, note in Figure that even after a very deep exhalation, some air (about 1,000 mL) remains in the lungs. This is called the **residual volume**. The residual volume is the amount of air that can't be exhaled from the lungs.