B. A program in Physical Education (Semester 2)
College: Raniganj Girls College (K.N.U)
Department: Physical Education

Respiratory System

Introduction: -

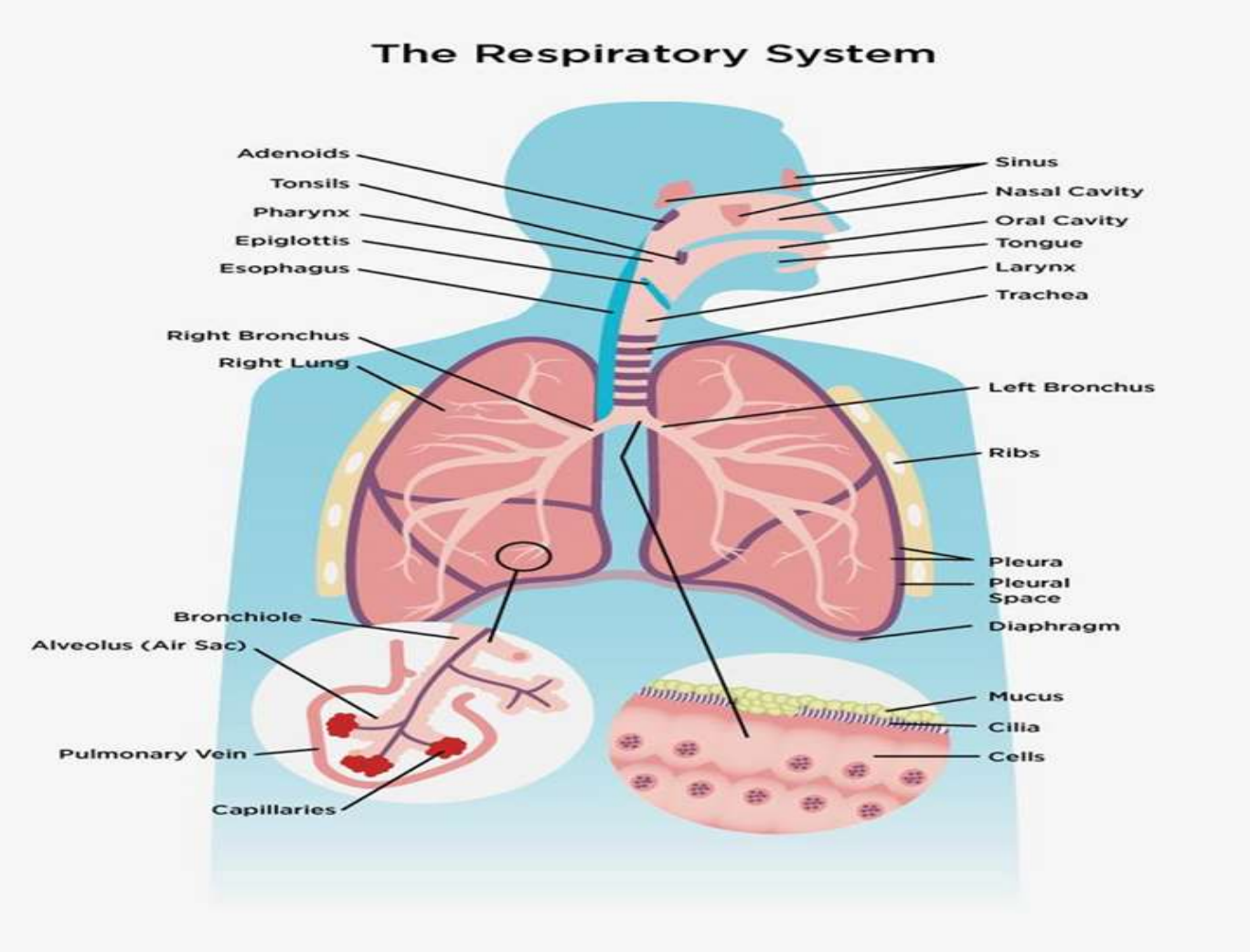
The respiratory system is the organs and other parts of your body involved in breathing, when you exchange oxygen and carbon dioxide.

The respiratory system, which includes air passages, pulmonary vessels, the lungs, and breathing muscles, aids the body in the exchange of gases between the air and blood, and between the blood and the body's billions of cells. Most of the organs of the respiratory system help to distribute air, but only the tiny, grape-like alveoli and the alveolar ducts are responsible for actual gas exchange.

In addition to air distribution and gas exchange, the respiratory system filters, warms, and humidifies the air you breathe. Organs in the respiratory system also play a role in speech and the sense of smell.

The respiratory system also helps the body maintain homeostasis, or balance among the many elements of the body's internal environment.

Organs of Respiratory System:



The respiratory system is divided into two main components:

Upper respiratory tract: Composed of the nose, the pharynx, and the larynx, the organs of the upper respiratory tract are located outside the chest cavity.

Nasal cavity: Inside the nose, the sticky mucous membrane lining the nasal cavity traps dust particles, and tiny hairs called cilia help move them to the nose to be sneezed or blown out.

Sinuses: The sinuses are a connected system of hollow cavities in the skull. The largest sinus cavities are about an inch across. Others are much smaller. Your cheekbones hold your maxillary sinuses (the largest). The low-center of your forehead is where your frontal sinuses are located. These air-filled spaces alongside the nose help make the skull lighter.

Pharynx: Both food and air pass through the pharynx before reaching their appropriate destinations. The pharynx also plays a role in speech.

Larynx: The larynx is essential to human speech.

Lower respiratory tract: Composed of the trachea, the lungs, and all segments of the bronchial tree (including the alveoli), the organs of the lower respiratory tract are located inside the chest cavity.

Trachea: Located just below the larynx, the trachea is the main airway to the lungs.

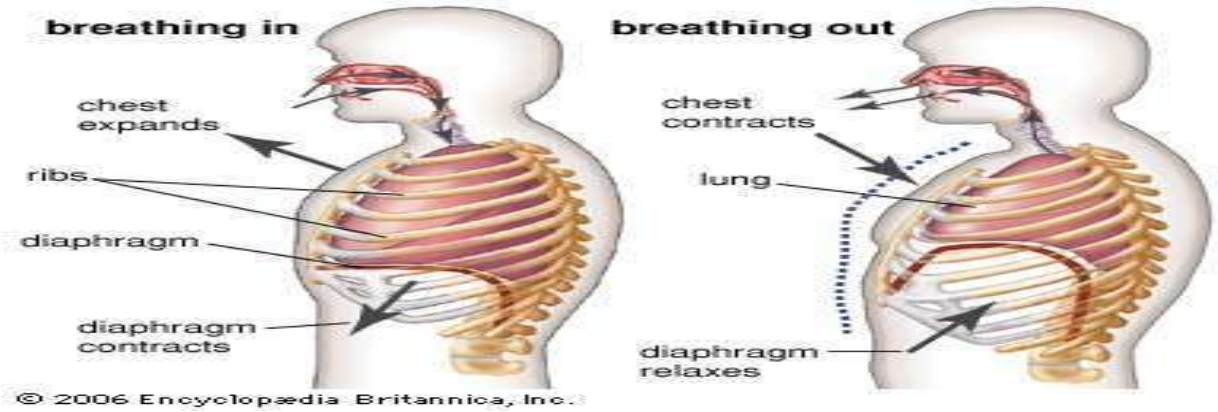
Lungs: Together the lungs form one of the body's largest organs. They're responsible for providing oxygen to capillaries and exhaling carbon dioxide.

Bronchi: The bronchi branch from the trachea into each lung and create the network of intricate passages that supply the lungs with air.

Diaphragm: The diaphragm is the main respiratory muscle that contracts and relaxes to allow air into the lungs.

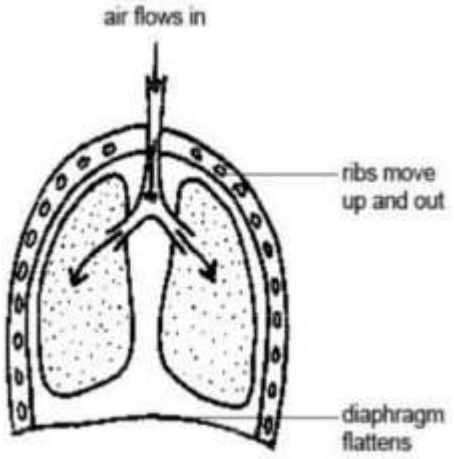
Mechanism of Respiratory System: -

The respiratory system goes through two stages – **Inspiration and Expiration**. Let's understand what happens during these two stages. During inspiration, atmospheric air is drawn in while during expiration, air is expelled out. This movement of air in and out of the lungs is due to a pressure gradient between the atmosphere and the lungs.



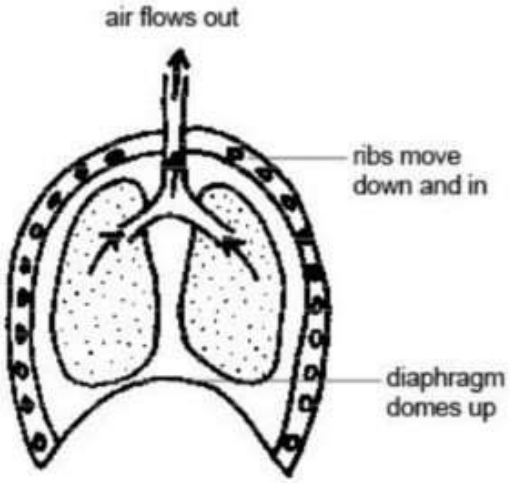
Inspiration

The contraction of the diaphragm increases the volume of the thoracic chamber in the front and back. This volume is further increased by the contraction of external intercostal muscles which lifts up the ribs and sternum. Increase in the thoracic volume increases the pulmonary volume such that the intrapulmonary pressure is less than the atmospheric pressure. This forces the air to move from outside into the lungs i.e. inspiration.



Expiration

When the diaphragm and the intercostal muscles relax, the ribs and sternum return to their normal positions. This reduces the thoracic volume and consequently, the pulmonary volume. This makes the intra-pulmonary pressure higher than the atmospheric pressure causing the release of air from the lungs i.e. expiration.



Additional muscles in the abdomen help to increase the strength of inspiration and expiration. The average rate of respiration of a healthy human is **12-16 breaths/minute.** We can estimate the volume of air during breathing movements using a Spirometer. It helps to clinically assess pulmonary function.

Respiratory Volumes and Capacities

During clinical assessments, the following terms are used to describe respiratory volumes and capacities.

Tidal Volume (TV): It is the volume of air inspired or expired during normal breathing. A healthy human can inspire or expire approximately 6000 to 8000 ml of air/minute. Therefore, the tidal volume is approximately 500 ml per inspiration.

Inspiratory Reserve Volume (IRV): This refers to the additional volume of air a person can forcefully inspire. It is approximately 2500-3000 ml.

Expiratory Reserve Volume (ERV): This refers to the additional volume of air a person can forcefully expire. It is approximately 1000-1100 ml.

Residual Volume (RV): This is the volume of air that remains in the lungs even after a forcible expiration. This is approximately 1100-1200 ml.

The pulmonary capacities used in clinical assessment are derived by adding a few respiratory volumes described above.

Inspiratory Capacity (IC): This is the volume of air a person can inspire after a normal expiration. It is the sum of tidal volume and inspiratory reserve volume **(TV+IRV).**

Expiratory Capacity (EC): This refers to the volume of air a person can expire after a normal inspiration. It is the sum of tidal volume and expiratory reserve volume **(TV+ERV).**

Functional Residual Capacity (FRC): This is the volume of air that remains in the lungs following a normal expiration. It is the sum of expiratory reserve volume and residual volume **(ERV+RV).**

Vital Capacity (VC): It is the maximum volume of air a person can breathe out, following a forced inspiration. It is the sum of inspiratory and expiratory reserve volume and tidal volume **(IRV+ERV+TV).**

Total Lung Capacity: It refers to the total volume of air the lungs can accommodate after a maximal inspiration. It is the sum of all the lung volumes **(TV+RV+IRV+ERV)** or vital capacity + residual volume **(VC+RV).**