



- 1. Trachea
- 2. Thoracic wall
- 3. Lungs
- 4. Primary bronchi
- 5. Diaphragm

# KEY WORDS TO KNOW

- BOYLE'S LAW
- □ INTERCOSTAL NERVES
- PHRENIC NERVE
- DIAPHRAGM
- EXTERNAL INTERCOSTAL MUSCLES
- THORACIC VOLUME/LUNG VOLUME/LUNG PRESSURE/ATMOSPHERIC PRESSURE/TIDAL VOLUME/EXPERIRATORY RESERVED VOLUME/INSPIRATORY RESERVE VOLUME/VITAL CAPACITY/RESIDUAL VOLUME/TOTAL LUNG VOLUME/
- BELL JAR
- SPIROMETRY

#### Respiration is divided into 4 processes:

- 1. Pulmonary ventilation is the movement of air into/out of the lungs
- 2. External respiration is the movement of O2 from the lungs to the blood and CO2 from the blood to the lungs.
- 3. Internal respiration is the movement of O2 from the blood to the cell interior and CO2 from the cell interior to the blood.
- 4. Cellular respiration is the breakdown of glucose, fatty acids and amino acids that occurs in mitochondria and results in production of ATP. It requires O2 and produces CO2. (Note that this type of cellular respiration, which requires O2, is known as "aerobic metabolism," whereas breakdown of glucose that produces ATP but does not require O2 is "anaerobic metabolism.")















# **INSPIRATORY PROCESS**

- RESPIRATORY CENTERS IN THE MEDULLA BECOME ACTIVE
- □ SIGNALS TRAVEL TO THE INTERCOSTAL AND PHRENIC NERVES
- Diaphragm and intercostal muscles contract
- Thoracic cavity volume expands
- Lung volume expands
- □ Lung pressure decreases, falling below atmospheric pressure
- □ Air flow into the lungs until lung pressure equal atmospheric pressure

# Expiratory process



### **Expiratory process**

- Signal from resp centers via phrenic nerve and intercostal nerves subside
- Diaphragm and external intercostal relax
- Thoracic volume decrease
- Lung volume decreases
- □ Lung pressure increases, rising above atmospheric pressure
- Air flow out the lungs until lungs pressure = atmospheric pressure





| Abbreviation         | Name                                     | Description  |
|----------------------|--|--|
| FVC                  | Forced Vital Capacity                    | This is the total amount of air that can forcibly be blown<br>out after full inspiration, measured in liters.  |
| FEV <sub>1</sub>     | Forced Expiratory Volume in 1 Second     | This is the amount of air that you can forcibly blow out in<br>one second, measured in liters. Along with FVC it is<br>considered one of the primary indicators of lung function.                  |
| FEV1/FVC             | FEV1%                                    | This is the ratio of FEV <sub>1</sub> to FVC. In healthy adults this should be approximately 75–80%.   |
| PEF                  | Peak Expiratory Flow                     | This is the speed of the air moving out of your lungs at the beginning of the expiration, measured in liters per second.   |
| FEF 25–75% or 25–50% | Forced Expiratory Flow 25–75% or 25–50%  | This is the average flow (or speed) of air coming out of<br>the lung during the middle portion of the expiration (also<br>sometimes referred to as the MMEF, for maximal mid-<br>expiratory flow). |
| FIF 25–75% or 25–50% | Forced Inspiratory Flow 25–75% or 25–50% | This is similar to FEF 25–75% or 25–50% except the measurement is taken during inspiration.  |
| FET                  | Forced Expiratory Time                   | This measures the length of the expiration in seconds.   |
| SVC                  | Slow Vital capacity                      |  |
| тv                   | Tidal volume                             | During the respiratory cycle, a specific volume of air is<br>drawn into and then expired out of the lungs. This volume<br>is tidal volume.   |
| MVV                  | Maximum Voluntary Ventilation            | A measure of the maximum amount of air that can be<br>inhaled and exhaled in one minute, measured in<br>liters/minute.   |





Tidal volume (TV) is the volume of air moved in and out of the respiratory tract (breathed) during each ventilatory cycle.

Inspiratory reserve volume (IRV) is the additional volume of air that can be forcibly inhaled following a normal inspiration. It can be accessed simply by inspiring maximally, to the maximal inspiratory level.

Expiratory reserve volume (ERV) is the additional volume of air that can be forcibly exhaled following a normal expiration. It can be accessed simply by expiring maximally to the maximal expiratory level.

Vital capacity (VC) is the maximal volume of air that can be forcibly exhaled after a maximal inspiration. VC = TV + IRV + ERV.

Residual volume (RV) is that volume of air remaining in the lungs after a maximal expiration. It cannot be expired no matter how vigorous or long the effort. RV = FRC - ERV.

Functional residual capacity (FRC) is the volume of air remaining in the lungs at the end of a normal expiration. FRC = RV + ERV.

Total lung capacity (TLC) is the volume of air in the lungs at the end of a maximal inspiration. TLC = FRC + TV + IRV = VC + RV

Minute volume is the volume of air exhaled per minute.

Maximal breathing capacity (also called "maximal voluntary ventilation") is the maximum volume of air that can be exhaled by voluntary effort in a 15 second interval. This volume is multiplied by 4 and expressed as litres per minute.

Forced expiratory volume 1 (FEV,) - the volume of air that is forcefully exhaled in one second.

Forced vital capacity (FVC) - the volume of air that can be maximally forcefully exhaled.

Ratio of FEV<sub>1</sub> to FVC (FEV<sub>1</sub>/FVC) - expressed as a percentage.

Forced expiratory flow (FEF25 - 75) - the average forced expiratory flow during the mid (25 - 75%) portion of the FVC.







| Phrenic | Anterior rami of<br>C3‰C5 nerves | Passes through superior thoracic<br>aperture and runs between<br>mediastinal pleura and | Central portion of diaphragn |
|---------|----------------------------------|---|------------------------------|
|         |                                  | pericardium   |                              |
|         |                                  |   |                              |
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