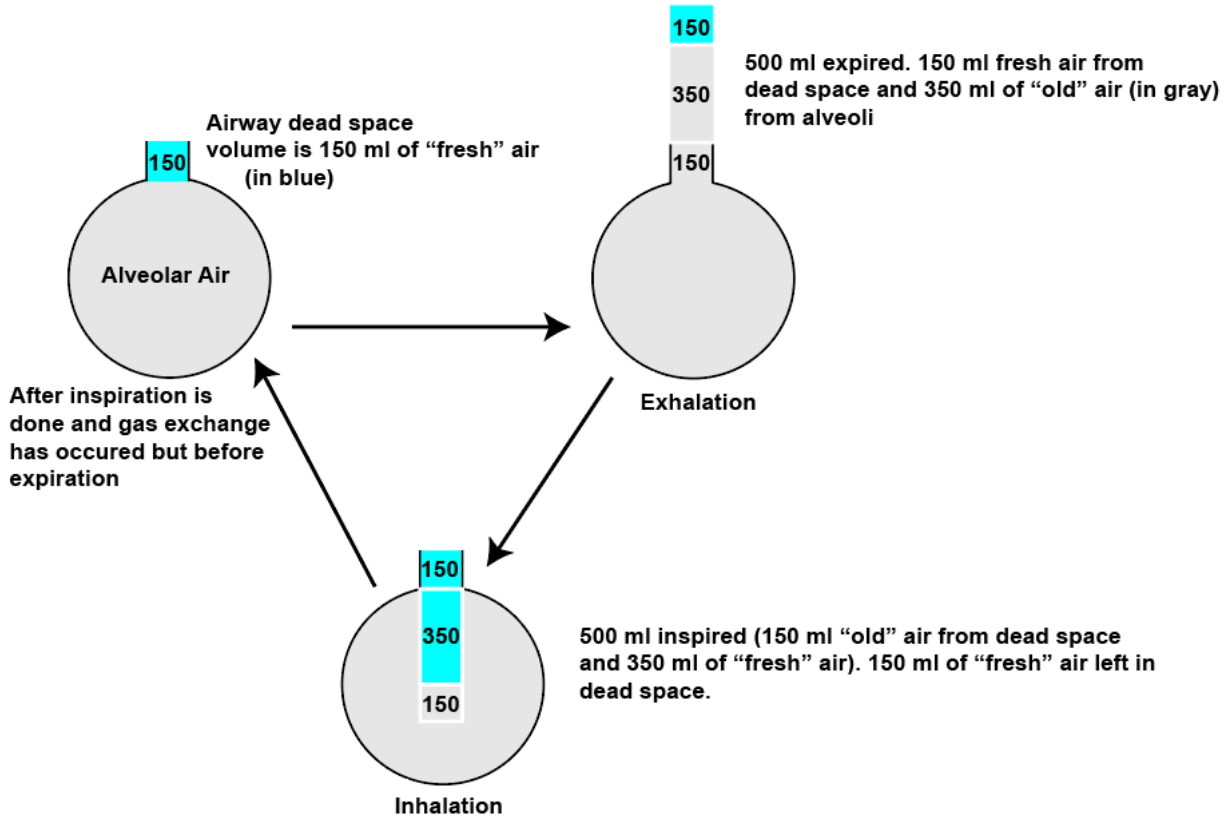
4.5.5

Alveolar Ventilation

PAO_2 is also dependent on sufficient alveolar ventilation. In order to understand alveolar ventilation, it might be helpful to first introduce total pulmonary ventilation. Total pulmonary ventilation is the amount of air moved into and out of the respiratory passages per minute. This is generally calculated by taking the volume of air moved in and out of the lungs in a single breath (tidal volume) and then multiplying this by the breathing rate per minute. It is assumed of course that the volume of each breath remains the same for each minute.

Total Pulmonary Ventilation = Breaths/min * Tidal Volume

Alveolar ventilation is similar but considers only the fresh oxygenated air that reaches the alveoli. The larger respiratory branches, bronchi and trachea contain air that does not reach the alveoli. This air is called **Anatomical Dead Space** because it does not participate in gas exchange. Try not to confuse this with **Alveolar Dead Space** which is alveolar air that does not contribute to gas exchange (usually because of a lung pathology that interferes with gas crossing the respiratory membrane. There is a third term called **Physiologic Dead Space** which is the total of anatomical and alveolar dead space. Because of “dead space”, only a portion of air entering the alveoli is fresh oxygenated air which can participate in gas exchange. The image below and the following table help explain how we calculate total pulmonary and alveolar ventilation differently.



Alveolar Ventilation

Drawn by J. Shaw at BYU-Idaho Winter 2014

Tidal Volume (ml)	Ventilation Rate (breaths / min)	Total Pulmonary Ventilation (ml/min)	Fresh Air Entering the Alveoli per Breath (ml/breath)	Alveolar Ventilation ml/min)
500 (normal)	12 (normal)	6000	350	4200
300 (shallow)	20 (rapid)	6000	150	3000
750 (deep)	8 (slow)	6000	600	4800

In the table above, notice how total pulmonary ventilation can be the same with normal, shallow and deep breaths. However, alveolar ventilation is highest when the breaths are slower and deeper. Higher alveolar ventilation maximizes PAO_2. This is why we tell people to breathe deeply and more slowly when they are hypoxic.