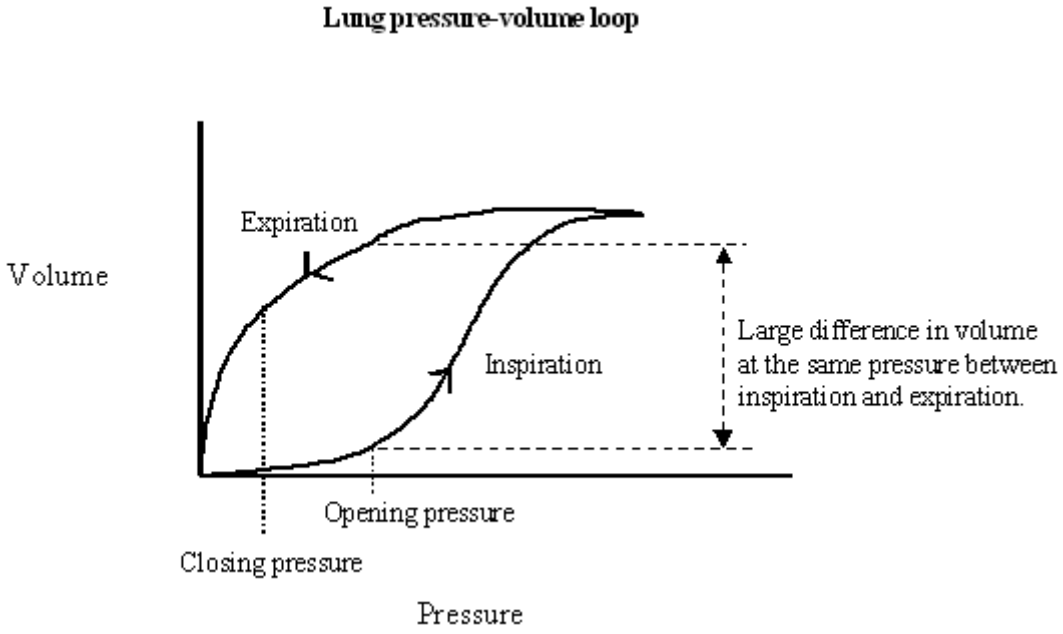
Lung Mechanics

- The change in lung volume that occurs for a given change in pressure is the compliance
- When healthy lungs are inflated from complete collapse to complete inflation and then deflated, their behaviour is similar to that of a new balloon (see figure)



- The slope of the graph at any point is the compliance (volume/pressure)
- The compliance varies according to whether the lungs are appropriately inflated, atelectatic or overdistended
- To begin with, the alveoli have to be opened up and increases in pressure do not get much volume into the lungs
- One the alveoli are opened (opening pressure) they become relatively easy to inflate and large amounts of volume go in for each increase in pressure
- As the alveoli become overinflated it becomes difficult to get any more volume in for each increase in pressure

The lungs behave differently during deflation because of the action of surfactant. This makes the alveoli reluctant to collapse and allows more volume to remain within the lungs at a given pressure than was achieved at the same pressure during inflation.

- The alveoli do not collapse in expiration until the pressure becomes quite low (closing pressure)
- If the alveoli are allowed to collapse, the whole pressure expensive process of re-opening them has to be repeated
- This difference in behaviour between inspiration and expiration is called hysteresis
- As long as end-expiratory collapse is prevented and the alveoli do not have to be repeatedly re-opened then tidal volumes can be exchanged with relatively low additional pressures
- This is the underlying principle behind the use of positive end expiratory pressure (PEEP) and continuous positive airway pressure (CPAP)
- If there is severe surfactant deficiency, the alveoli collapse more easily and higher pressures are required to keep them open. We cannot easily use PEEP at this level in conventional ventilation so we should administer surfactant early
- Lung injury has a similar effect to surfactant deficiency because it results in surfactant inhibition, so it is important to do our best to avoid injury

The pressure required to generate a given gas flow rate through the airways is the resistance. Gas flows rapidly through wide tubes and slowly through narrow tubes because the resistance of narrow tubes is so much higher.

- In RDS, the conducting airways are relatively normal so the resistance is low and tidal volumes are exchanged rapidly. This makes short inspiratory and expiratory times appropriate
- A large part of the problem in chronic lung disease is airway narrowing. This makes resistance high and means that tidal volumes are exchanged slowly so that relatively long inspiration and expiration times are more appropriate