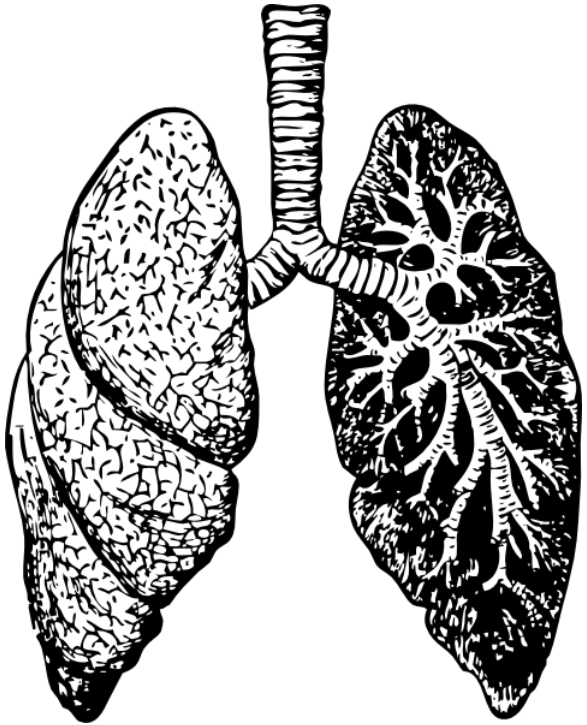
The Respiratory System - 3
Pressure changes and resistance



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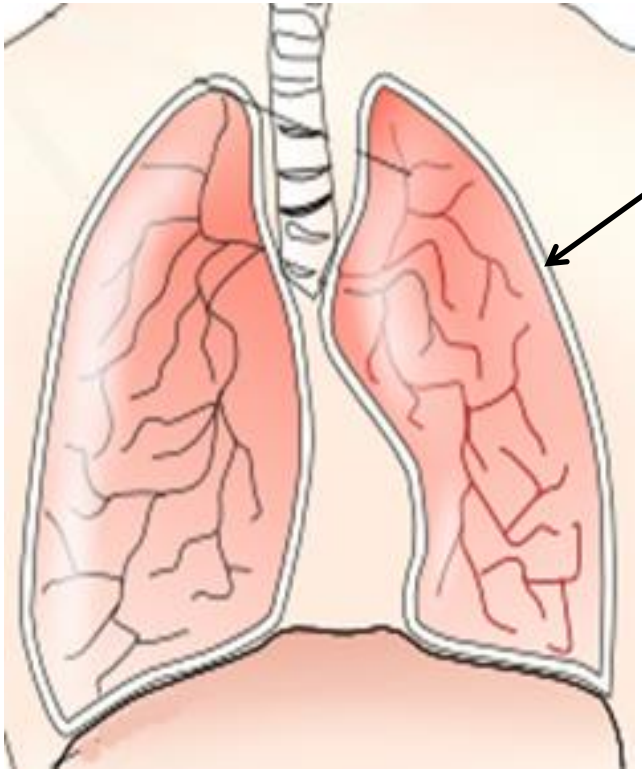
Respiratory System

1. Anatomy and mechanics
2. Lung volumes and compliance
3. Pressure changes and resistance
4. Pulmonary function tests and alveolar ventilation
5. Oxygen transport
6. CO_2 transport and V/Q mismatch
7. Regulation of breathing
8. Exercise and hypoxia

Respiratory System



pleural sac:
inner layer covers lungs
outer layer is attached
to chest wall
fluid in between

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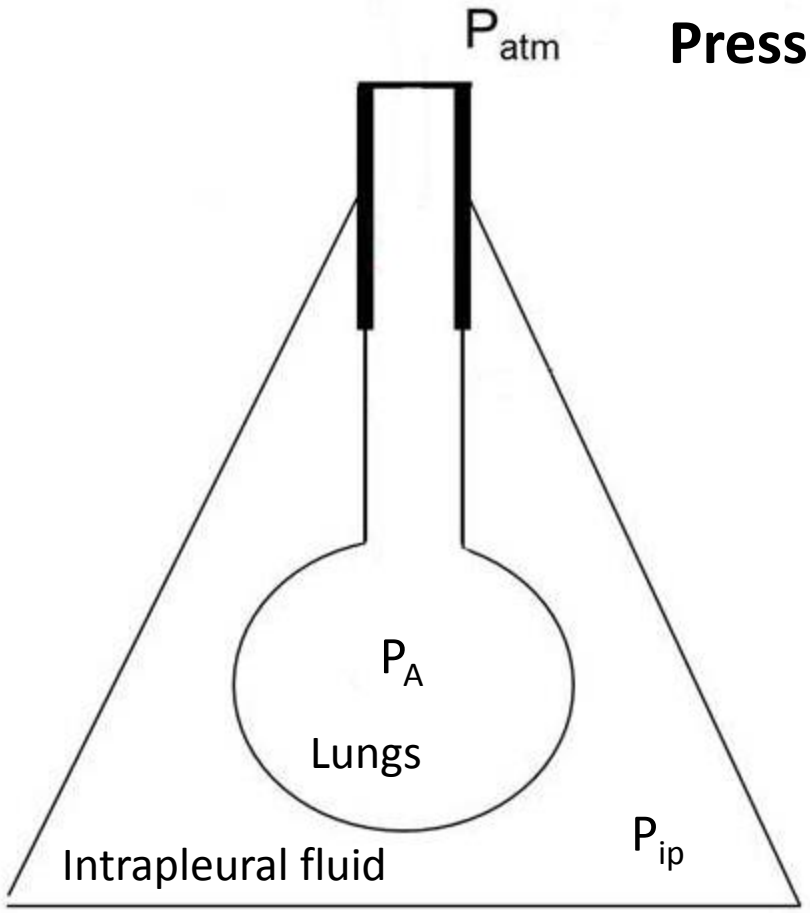
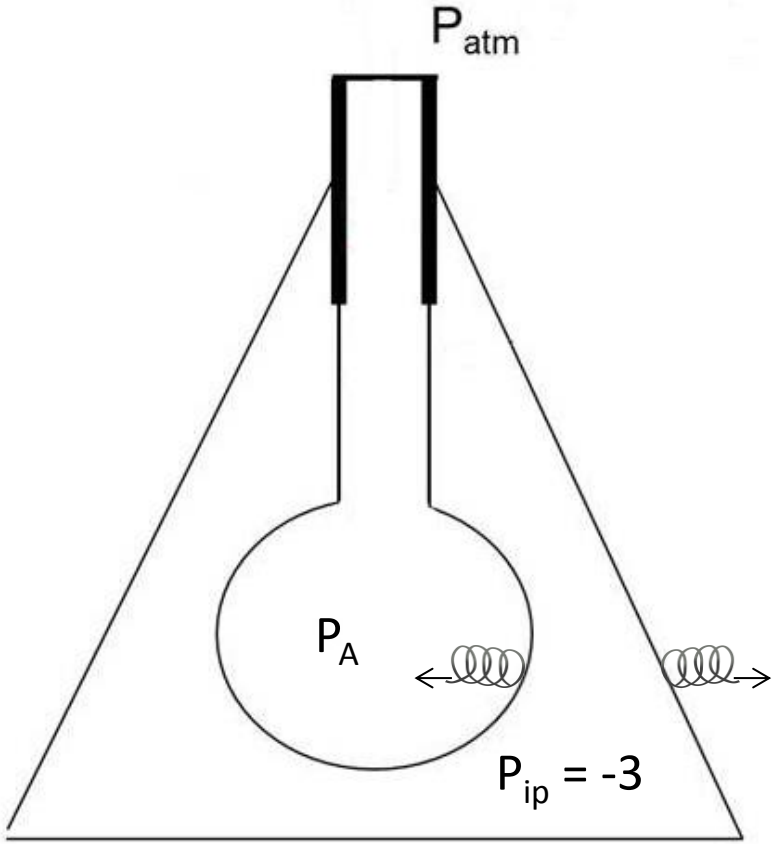
Pressure & Lung Volumes



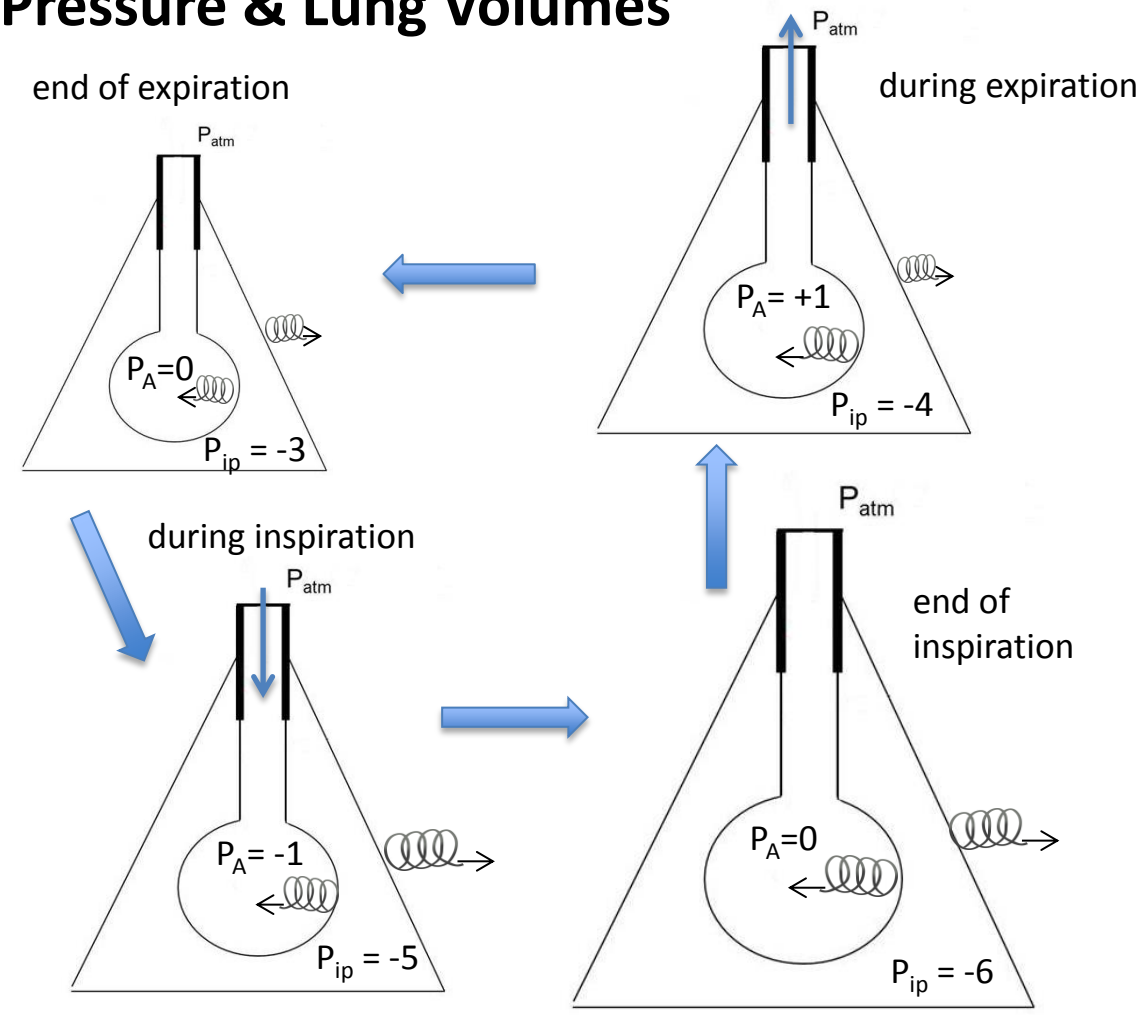
P_{atm} = 0 mm Hg = 760 mm Hg

Pressure & Lung Volumes



$P_A - P_{ip}$ determines lung size and $P_A - P_{atm}$ determines air flow

Pressure & Lung Volumes



$P_A - P_{ip}$ determines lung size and
$P_A - P_{atm}$ determines air flow

$$F = (P_A - P_{atm}) / R$$

$P_1V_1 = P_2V_2$ – Boyles Law

Resistance & Air Flow

$$F = (P_A - P_{atm}) / R$$

Factors that influence resistance:

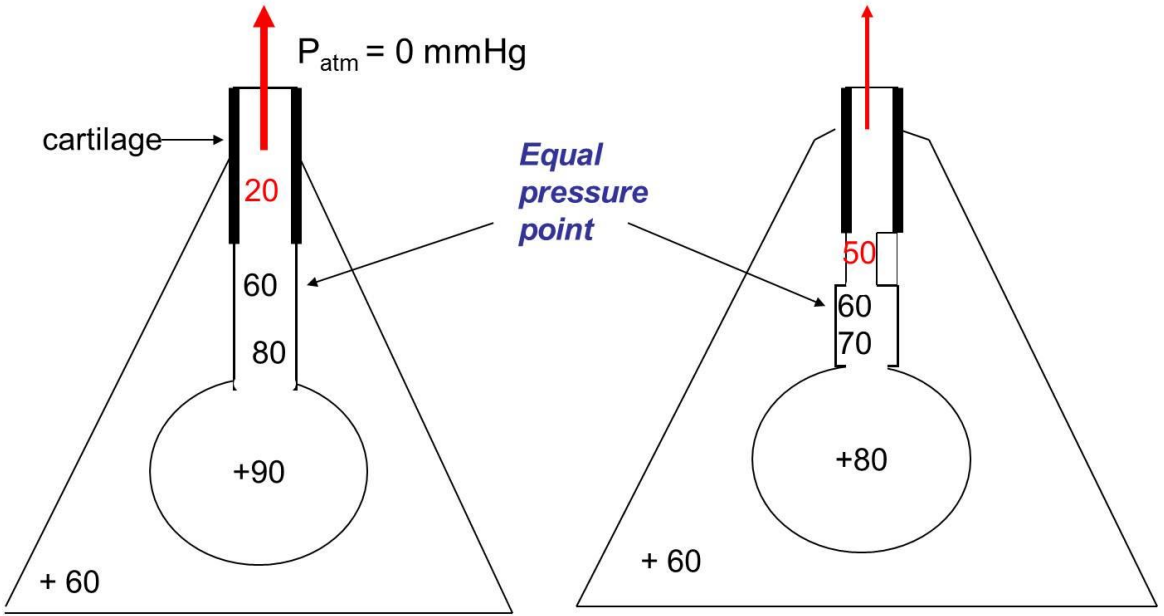
1. Airway diameter – the smaller the diameter the more resistance in that tube
   in lung, more tubes as you go further into lung - so combined resistance gets lower as enter lung

2. Lung volume – if have a greater lung volume then airways are not as compressed – can be a compensation to lung disease with increased resistance

3. Muscle tone – parasympathetic stimulation causes bronchiolar smooth muscle to contract; sympathetic stimulation causes relaxation

4. Elastic recoil of airways – in some diseases such as emphysema, have decreased elastic recoil which leads to less negative P_{ip} so airway diameter will be smaller and resistance higher

Resistance & Air Flow



Forced Exhalation (FE) in normal lung: $P_{ip} > P_{airway}$ airway has cartilage no compression of airway

FE in obstructive lung disease: $P_{ip} > P_{airway}$ airway has no cartilage dynamic compression

$$F = (P_A - P_{atm}) / R$$

Key Concepts

- $P_A - P_{ip}$ determines lung size and $P_A - P_{atm}$ determines air flow

- Airway resistance increases during expiration. During forced expiration, when intrapleural pressures become positive, small airways are compressed (dynamic compression) and may even collapse.