Respiratory System

- Transport
  - Pump
- Distribution
  - Network
- Exchange
  - Surface area

Chest wall:
- Stiffens during quiet breathing
- Assists (expands) during heavy breathing

SRC: PNP, p.555
Elec 371 - Respiratory System

Transport

- Visceral Pleura
  (attached to lung)
- Parietal Pleura
  (attached to thoracic cage - ribs)
- Pleural Fluid

Inspiration

Expiration

Distribution

Upper Respiratory Tract
- Nose & Mouth
- Pharynx
  (throat)
- Larynx
  (voice box / Adam's Apple)
- Trachea

Lower Respiratory Tract
- Bronchi
- Bronchioles
- Alveoli

Lung: Distribution Exchange

SRC: PNP
Exchange

Measurements

- Composition
  - End-tidal $CO_2$

- Volume / Capacity (CC)
  - Spirometry
  - Nitrogen washout
  - Plethysmography

- Flow (l/min)
  - Tidal flow
  - Peak expiry

- Airway Resistance
  - Flow: easy
  - Pressure at AWO: easy
  - Pressure at pleura: difficult

$$R = \frac{P_{\text{pleura}} - P_{\text{AWO}}}{\text{flow}}$$
Definitions

• Absolute
  – TLC = total lung capacity
  – FRC = functional reserve capacity
  – RV = reserve volume

• Relative
  – IC = inspiratory capacity
  – ERV = expiratory reserve volume
  – VC = vital capacity
  – V_t = tidal volume
Spirometer

Mechanical integrator

Air

Water

Tidal Flow

Pneumotachograph

Small bore tubes

Differential pressure transducer

Processor

flow = \frac{\Delta P}{R}

SRC: www.anaesthesiak.com

Rotameters

Constant taper

Variable taper

Constant P (supports indicator)

Variable R (decreases w height)

SRC: www.anaesthesiak.com
Nitrogen Washout (Volume)

Air $\approx 78\%$ $N_2$, $22\%$ $O_2$

Nitrogen Washout Test

$V_L = \text{lung volume}$

$M_L = 78\%$

$T_L = \text{lung temperature}$

$V_S = \text{spirometer reading}$

$M_S = \text{molar fraction of } N_2 \text{ in spirometer}$

$T_S = \text{spirometer temperature}$

$$\frac{V_L M_L}{T_L} = \frac{V_S M_S}{T_S} \quad V_L = \frac{T_L M_L V_S}{T_S M_L}$$

At start of test  At end of test