Respiratory Failure

- The main reason people need ventilatory support.
- pH < 7.25, PaCO2 > 50,
  - <u>and/or</u> PaO2 < 50 .
- ABG values on R.A. no ventilatory assistance.
- Can be an Oxygenation problem, a ventilatory problem or both.

Pulmonary Hypoxia vs Respiratory Acidosis

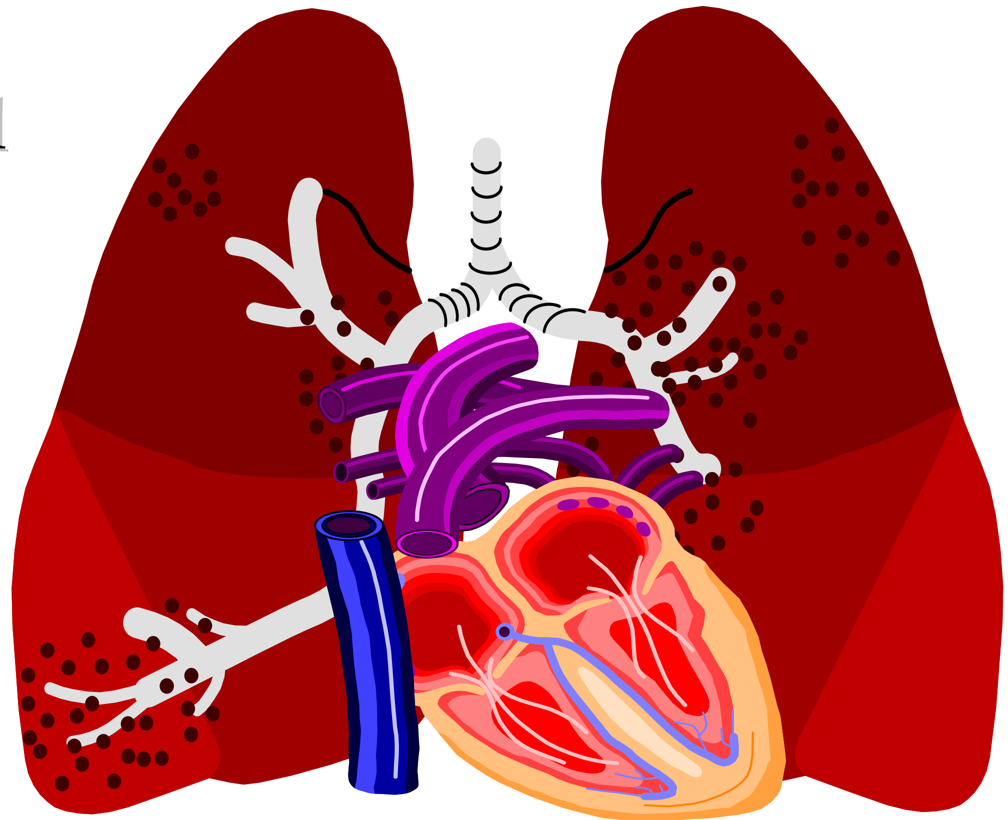
- Hypoxia:
  - PaO2 below 50 on RA
    - May not respond well to increased FIO2
    - Considered a life threatening drop in PaO2.
    - Lungs have failed
    - a/A ratio will be low

Pulmonary Hypoxia vs Respiratory Acidosis

- Acute Respiratory Acidosis:
  - pH < 7.26
  - PaCO2 > 50
  - HCO3 near normal
    - Cannot maintain near normal pH
    - Life threatening pH
    - Lungs have failed
    - a/A could be near normal

CardioPulmonary Indices:

- Respiratory Rate
- Blood Pressure and heart rate.
- Skin color and appearance.
- Use of accessory muscles.
- MIP, VC, a/A, pH



Respiratory Failure vs Respiratory Insufficiency

- Respiratory Failure:
  - Increased PaCO2
  - Decreased Ph
  - Life-threatening
  - Based in ABGs.
  - Most likely to require artificial ventilatory support.

Respiratory Failure vs Respiratory Insufficiency

- Respiratory Insufficiency:
  - breathing accompanied by abnormal signs or symptoms.
  - increased WOB
  - Normal ABGs.
  - Precedes Respiratory Failure.
  - Can prevent need for ventilator.

Respiratory Failure vs Respiratory Insufficiency

- **Respiratory Insufficiency:**
  - **breathing accompanied by abnormal signs or symptoms.**
  - **increased WOB**
  - **Normal ABGs.**
  - **Precedes Respiratory Failure.**
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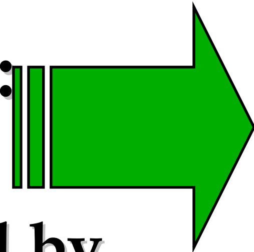
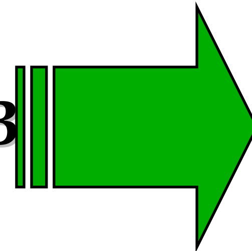




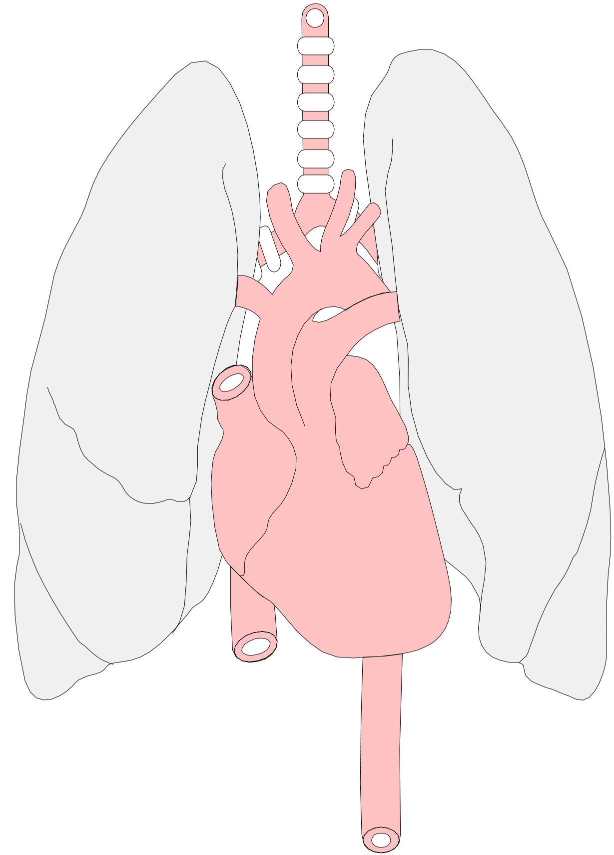
- Respiratory Failure:
  - Increased PaCO2
  - Decreased Ph
  - Life-threatening
  - Based in ABGs.
  - Most likely to require artificial ventilatory support.

Question 1

- Define Respiratory Failure without using blood gases as a part of your definition.
- Give a definition of both types of respiratory failure using ABGs to show the differences between the two types.
- What other factors may be assessed at the bedside to predict or confirm both types of respiratory failure, keep the factors separated by type of RF.

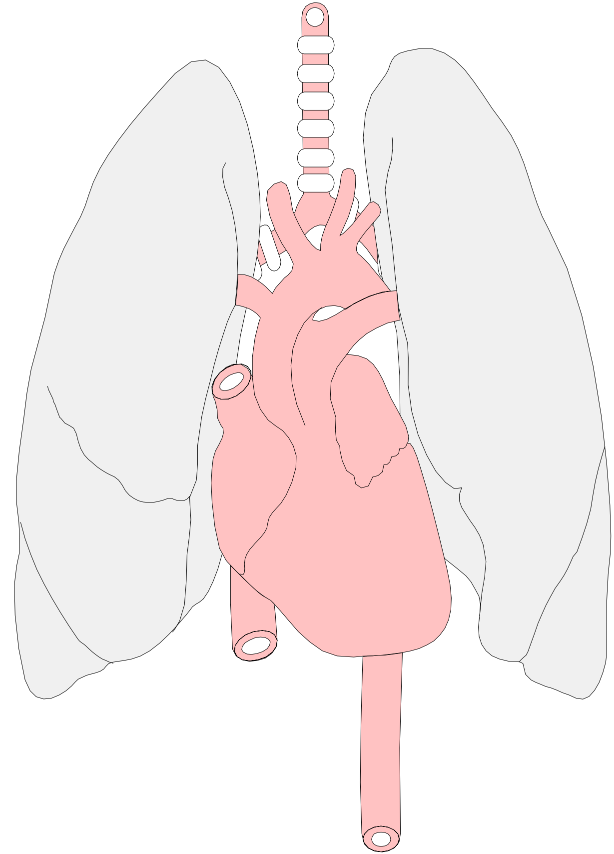
Respiratory Failure

- What are we going to do about it?-analysis
  - Treat what?-problem
    - head injury
    - crushed chest
    - COPD
    - near drowning
    - Pul.fibrosis
    - Pickwick.Syndrome
    - smoke inhalation
    - Asthma
  - How?-the plan
    - Ventilation
    - Oxygenation
    - Support

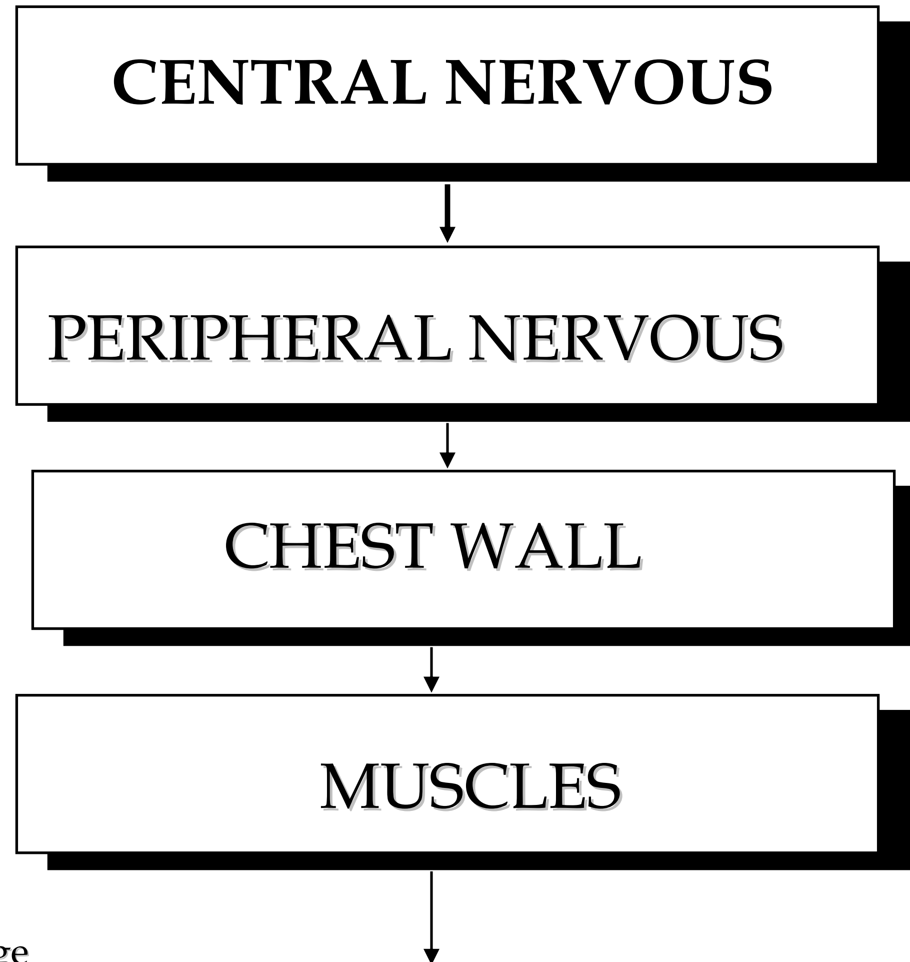


Respiratory Failure

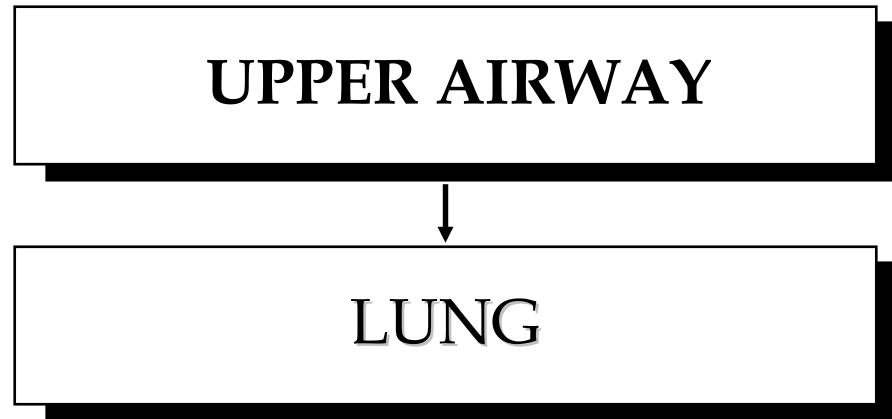
- What are we going to do about it?-analysis
  - Treat what?-problem
    - Decreased ventilation
    - Decreased oxygenation
    - Increased WOB
  - How?-the plan
    - Assist-control
    - PEEP
    - Pressure-support



Key Functional Divisions of Respiratory System:



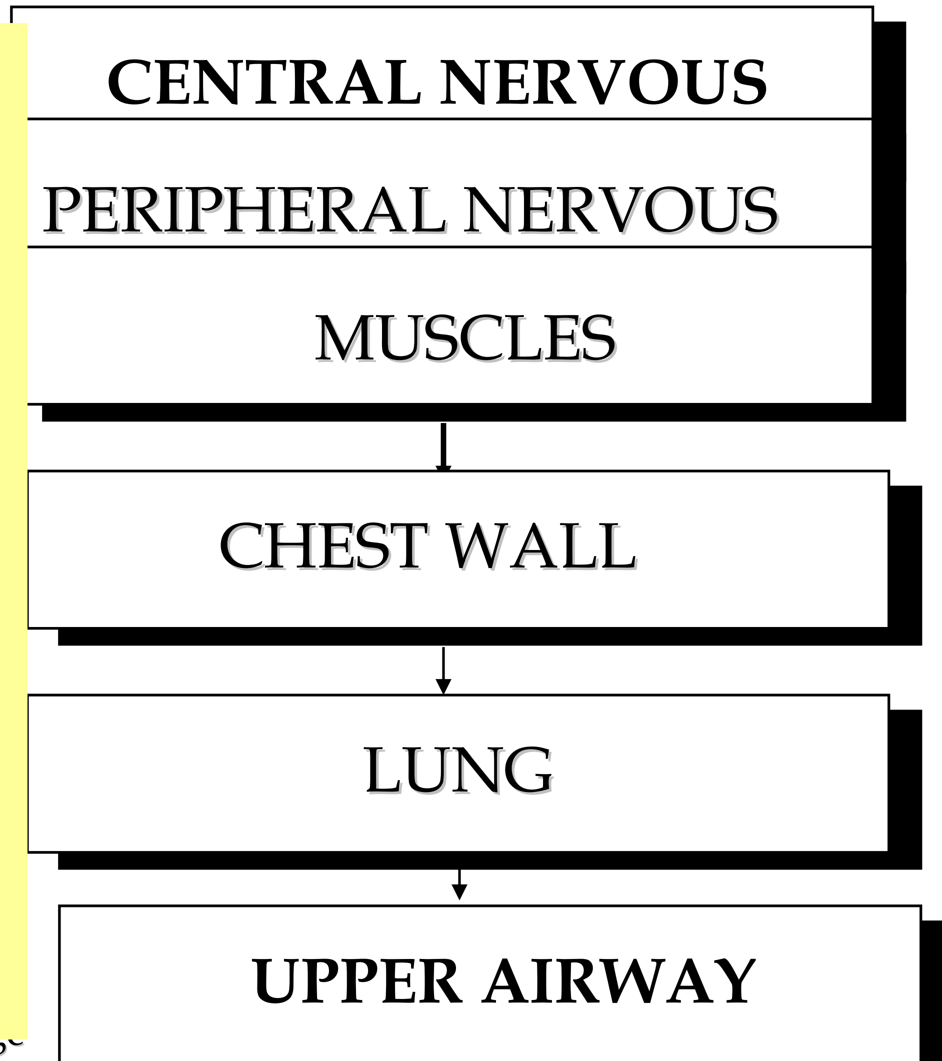
Key Functional Divisions of Respiratory System:



SEE TABLE IN EGAN FOR CAUSES OF RESPIRATORY FAILURE IN EACH OF THE FUNCTIONAL DIVISIONS.

Reorganization of Functional Divisions of Respiratory System:

See New Text book and find two or more conditions in each category and take one and describe physiology, clinical manifestations and possible RC goals and plan of care.



BREAK TIME !!

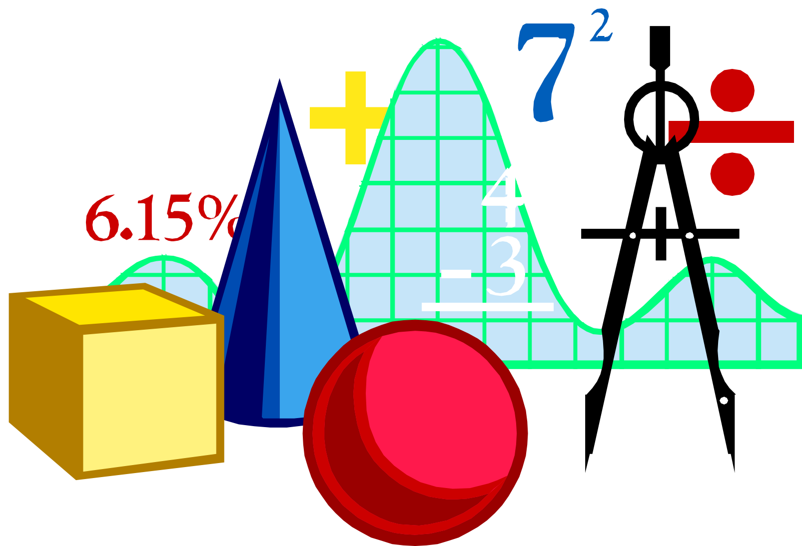
Question 2

- State the goal of artificial ventilation and how the management of a patient might be different for problems affecting each of the key functional divisions of the respiratory system.
- Give one disease/trauma example of each of the above.

DEADSPACE VENTILATION

- Changing PaCO2 via Ve
- TYPES OF DEADSPACE
- V_D/V_T RATIO
- MONITORING
- IMPLICATIONS FOR ARTIFICIAL VENTILATION

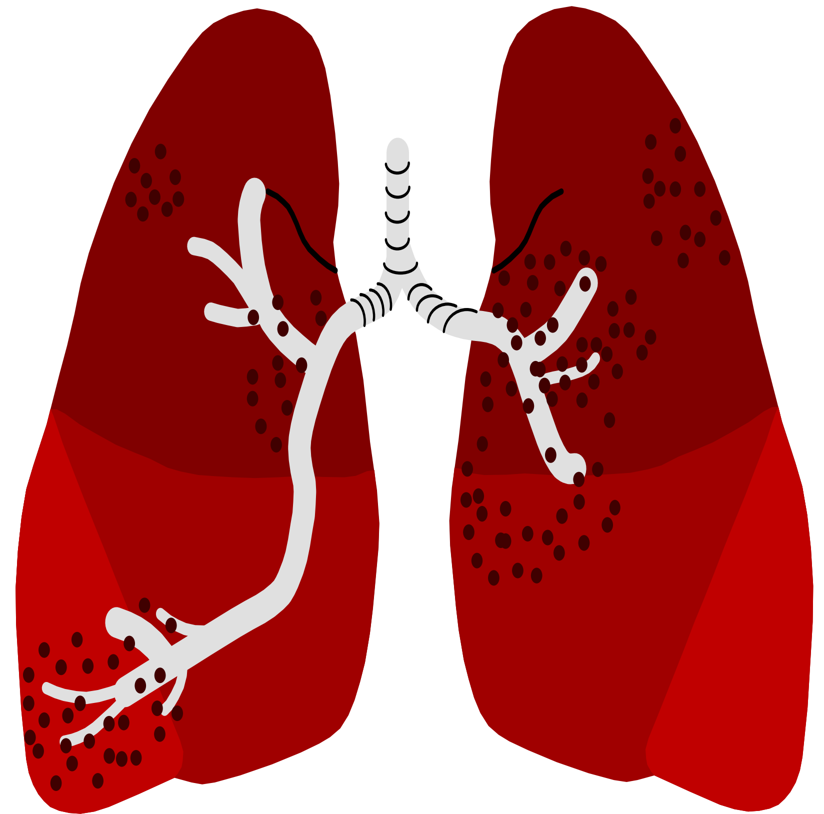
Changing PaCO2 via Ve/min



- Current:
  - **PaCO2 x Vt x RR**
    - **Equals**
- New:
  - **PaCO2 x Vt x RR**
- Decide to how much to change PaCO2.
- Decide to change Vt or RR.

TYPES OF DEADSPACE:

- MECHANICAL
  - AMOUNT OF REBREATHED V_T
- ANATOMICAL
  - 1CC/LB IBW
- ALVEOLAR
  - SHOULD BE ZERO
- PHYSIOLOGICAL
  - VENTILATION WITHOUT PERFUSION.



Deadspace and Alveolar Ventilation

- Deadspace ventilation does not participate in alveolar respiration`.
- As rate increases so does the minute deadspace ventilation, thus reducing VA.
- The higher the rate the greater the inefficiency of ventilation.

$$V_A = V_T - V_D$$

$$\dot{V}_A = V_T - V_D \times RR$$

V_D / V_T RATIO:

- RATIO OF DEADSPACE TO TIDAL VOLUME.
- REPRESENTS THE PROPORTION OF VENTILATION THAT IS WASTED, NOT PARTICPATING IN ALVEOLAR VENTILATION.

- BORH EQUATION:
  - MATHAMATICAL FORMULA FOR CALCULATING:

$$V_D / V_T = \frac{P_aCO_2 - P_ECO_2}{P_aCO_2}$$

"Must have expired CO_2 for this formula."

Taylor's Estimate:

- Based on the basic physiology that minute ventilation and P_aCO_2 are related to the amount of Alveolar ventilation present with a constant $V_{D(anat.)}$

$$\dot{V}_D/\dot{V}_T = \frac{\text{Act. } \dot{V}_E}{\text{Pred. } \dot{V}_E} \times \frac{P_aCO_2}{40} \times 0.33$$

"Requires a Radford Nomogram but not an Expired CO_2"

Practice

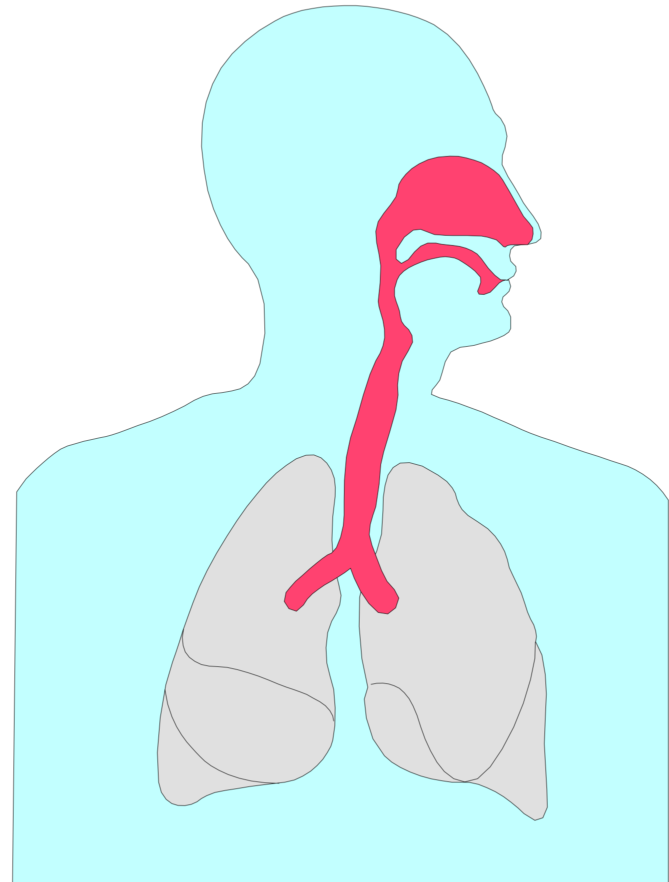
- Patient is 50 years old male
- IBW is 150 lbs.
- Tidal volume is 450
- Rate is 20
- $PaCO_2$ is 40
- Use Radford and Taylor formula to calculate Vd/Vt ratio

Practice

- Patient is 10 years old male
- IBW is 100 lbs.
- Tidal volume is 250
- Rate is 40
- PaCO2 is 40
- Use Radford and Taylor formula to calculate Vd/Vt ratio

CO_2 Monitoring Techniques

- CO_2 detectors.
  - Used for quick assessment of the presence of **CO_2**.
  - Change in color indicates the presence of **CO_2**.



Problem 1

- Monitoring exhaled gas during CPR using a CO2 detector . Ventilation and good breath sounds with AMBU. If no CO2 is detected, which of the following could explain this?(More than one possible)
  - a> CPR is working.
  - b> You are overventilating patient.
  - c> Reduce your respiratory rate.
  - d> Cardiac compression is not effective.
  - e> The tissues are not metabolizing.

Problem 1, hints:

- What is CO_2 is room air?
- What is CO_2 in exhaled air in the normal person?
- What if you stop circulating blood, what will be the CO_2 content of exhaled air?
- How would the above affect the reading of the CO_2 detector?…

The patient may have expired!

Problem 2:

- If your patient had a $P_E CO_2$ OF **32** and then experienced a significant pulmonary embolism, what will likely happen to the exhaled $P_E CO_2$,
  - **Go up or Go down, why?**
- What would be the normal respiratory response to this,
  - **How would the patient be breathing, why?**
    - **Respiratory rate go up or down?**
    - **Other concerns about breathing, PaO2, WOB?**

TAKE A BREAK!