Hemoglobin & O₂ Transport:

*Total Blood O₂=

- 0.3 mls:
- 19.7 mls:

*Indicates importance of:
- Majority of oxygen can NOT be carried:
- Oxygen must be transported on:

Hemoglobin Saturation:

* Dependent upon 2 factors:
  1. Hemoglobin:
  2. Partial Pressure of Oxygen

PARTIAL PRESSURE OF OXYGEN

- High PO₂ (concentration)
  - Favors:
  - Forms:
- % Hemoglobin Saturation: Related to:
  - Greater the PO₂ the higher the;

Oxyhemoglobin Dissociation Curve

* PO₂ = (Arterial Blood)
  % saturation =
  ⇒ Blood O₂:
  mls O₂/100 mls blood
* PO₂ = (Venous Blood)
  % saturation is =
  ⇒ Blood O₂:
  mls O₂/100 mls blood

⇒ O₂ Delivered:

✓ Significance: Even in low partial pressures, hemoglobin has HIGH:
  - Ensures a significant blood:

HEMOGLOBIN DUAL AFFINITY

1. High O₂ Affinity: Bind O₂ Tightly
  ⇒ LUNGS: Carry to:
Hemoglobin Loading

2. **Low O₂ Affinity**: Release O₂

   ⇨ TISSUES: Release O₂ to:

Hemoglobin Unloading

* **Hemoglobin Affinity Changes**: Caused by changes in:

Carbon Dioxide Transport:
Carried in blood in 3 forms:
1. Dissolved in plasma:
   ✔
2. Bound to hemoglobin:
   ✔ **Carbaminohemoglobin**
3. Bicarbonate:

**Bicarbonate Formation**:

• Primary form of:
  1. CO₂ combines with:
     ⇨ Facilitated by RBC enzyme:
  2. Forms:
     ⇨ CO₂ + H₂O → H₂CO₃
  3. Carbonic Acid dissociates into:
     ⇨ H₂CO₃ → H⁺ + HCO₃⁻ (Bicarbonate)

*Significance: H⁺: By-product =

Effects of ↑ H⁺:
1. H⁺: Binds:
   ⇨ RBCs: **Positively charged** due to:
2. Increased Hemoglobin Acidity
   ⇨ Low pH reduces:
   ⇨ FUNCTIONALLY:
   ⇨ Promotes:

* **BOHR Effect**: Acidity = O₂ Affinity

Physiological Correlation:
* Anaerobic Exercise:
   ⇨ Decreases:
**Increases Oxygen:**

**TISSUES:** Hemoglobin Affinity:

- CO₂ plasma concentrations:
  - H⁺ concentrations:
  - H⁺ binds:
  - Hemoglobin Affinity:

**LUNGS:** Hemoglobin Affinity:

- Low Alveolar PCO₂ drives:
  - Reaction occurs in reverse
    - Carbonic Acid converted into:
      - Facilitated by:
      - Hemoglobin’s affinity increases as:
        - H⁺ is combined with:

**Important Points:**

1. MOST Oxygen carried on Hemoglobin =
2. O₂ delivered to tissues =
3. Venous blood maintains a **HIGH** O₂ concentration
   - Hemoglobin saturation = ~75%

**Venous Blood:**

4. Hemoglobin affinity directly affect by:
5. Primary stimuli for controlling breathing are

**Study Questions:**

1. What 2 factors determine hemoglobin saturation?
2. When the blood is 100 % saturated, what is the approximate quantity of Oxygen (mls O₂/100mlblood)?
3. What is the approximate hemoglobin saturation with oxygen in the veins? What is the approximate quantity of oxygen?
4. How much oxygen is therefore delivered to the tissues: % O₂ and mls / 100 mls blood? What is the Oxygen Reserve?
5. What causes hemoglobin to alter its affinity to oxygen? Remember it is the same protein molecule.
6. How is carbon dioxide carried in the blood? How do red blood cells (NOT hemoglobin) help in carrying carbon dioxide in the blood?
7. What is the relationship between plasma CO₂ and plasma pH? What affect does increased hydrogen ions have on the hemoglobin’s affinity for oxygen?
8. What is the Bohr effect? How does the Bohr effect help explain the increase in unloading which occurs during intense exercise?
9. What directly affects Hemoglobin’s affinity? What is the primary stimulus regulating ventilation? Why is it appropriate that the body senses carbon dioxide and NOT oxygen in order to regulate breathing?
10. If someone is anxious and hyperventilating (breathing too quickly) what effect will this have on the overall oxygen and carbon dioxide concentration? Why does breathing into a paper bag alleviate the affects resulting for the hyperventilation?
11. In exercise, the local acidity can increase significantly from 7.3 to 6.0. Explain how this decrease in pH might affect the unloading reaction.

12. A diabetic experiencing increase in ketones enough to produce ketoacidosis will often time have increased ventilation (rapid breathing). With what you now know about how acidity affects ventilation, explain this characteristic sign of acidosis.

13. What is the approximate O2 saturation of arterial blood; venous blood? What is meant by the term oxygen reserve?