#4: Protein Function

BIOCHEM2280

Protein-Ligand Binding

- Interaction between a **protein** (receptor) and a **ligand** (molecule that binds to the receptor).

- **Specificity:**
  - Protein-ligand binding is highly specific.
    - Based on complementary shapes and chemical properties

- **Affinity:**
  - Affinity refers to the strength of the interaction between a protein and a ligand
  - High affinity indicates a strong binding interaction

Binding occurs with either weak or strong forces!

Types of interactions:
- **London dispersion forces**
- **Hydrogen bonding**
- **Polar-covalent bonds**

- **Binding Site:**
  - Proteins have specific regions where ligands bind
    - These sites often involve amino acid residues that form non-covalent interactions with the ligand

Binding Dissociation Constant

- **Dissociation Constant (Kd):**
  - The Kd represents the *concentration of ligand at which half of the available binding sites on the protein are occupied*

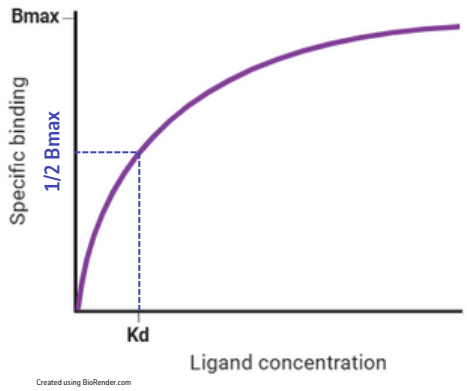
- *Lower Kd values indicate higher affinity = greater binding*

- **Equilibrium between free ligand and protein-ligand**

$$PL \rightleftharpoons P + L$$

- **Saturation and Binding Curves:**
  - **Saturation** occurs when nearly all binding sites on the protein are occupied by ligands.
  - **Binding curves** illustrate the relationship between ligand concentration and the fraction of binding sites occupied.

- **Cooperativity:**
  - Cooperative binding occurs when the binding of one ligand molecule affects the binding of other molecules, either positively or negatively.



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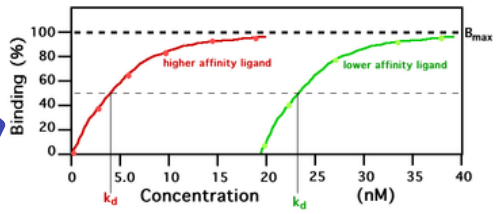


Sourced from: https://www.wikidoc.org/index.php/Filter_binding_assay

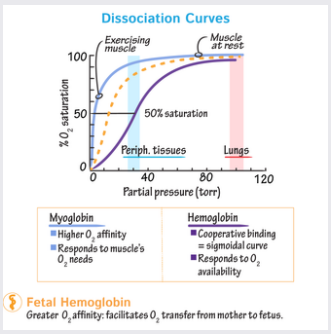
Myoglobin and Hemoglobin: Oxygen Binding Protein

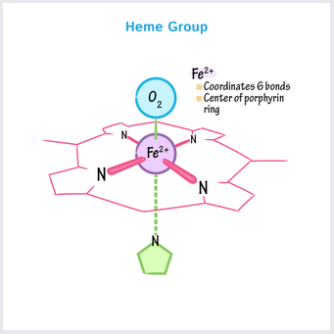
Myoglobin structure
- Contains a polypeptide chain and the iron-containing porphyrin derivative, **heme**
  - Heme contains a **central Fe(II) atom** which has *6 ligand binding sites* and can therefore have up to 6 ligands

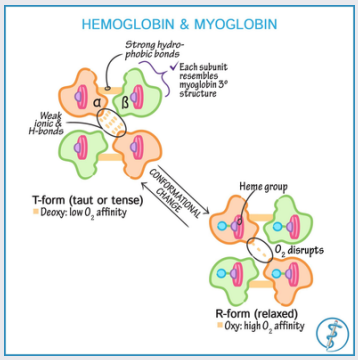
Ligands of heme
- *Ligand binding sites 1-4:* Fe(II) atom is liganded to **four porphyrin nitrogen atoms**
- *Ligand binding site 5:* Fe(II) is liganded to the nitrogen of **Histamine F8** below the porphyrin plane
- *Ligand binding site 6:* Oxygen (O_2) binds reversibly to the sixth coordination site above the porphyrin plane
  - The residue **Histamine E7** in the myoglobin forms a hydrogen bond to O_2 to *further stabilize oxygen binding to heme*

Heme oxidation properties
- Heme alone is *not an effective oxygen carrier*
  - The central Fe(II) atom can easily oxidize to Fe(III), which *cannot bind to O_2*

Therefore, the oxidation of Fe(II) to Fe(III) in heme prevents effective oxygen binding.







Sourced from: https://app-web.drawittoknowit.com/course/biochemistry/glossary/biochemical-pathway/hemoglobin-myoglobin-4-dissociation-curves?source=/course/physiology/respiratory/terms&source-glossary=physiology

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-The WebStraw team

♡ Note to Instructors: If this resource has been created for your course and you would like to collaborate with us, please email us at team@webstraw.org

Note: Marvin was used for drawing, displaying and characterizing chemical structures, substructures and reactions, Marvin 24.4.1, Chemaxon (https://www.chemaxon.com)

biochem 2280.

a handmade guide

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