

MY FAVORITE PROTEIN

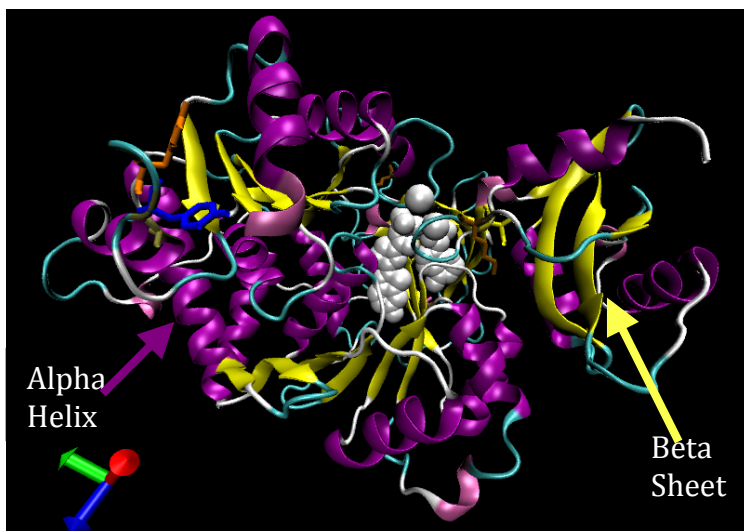
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INTRODUCTION:

Proteins are a diverse class of biological molecules, which play a crucial role in almost every biological process. Proteins, known as enzymes, are responsible for the catalysis of nearly every reaction in the cell. You may remember studying the enzymes DNA polymerase, ATP synthase and ribosomes already in this class. Proteins perform widely different tasks in our cells, but they are all made of the same 20 amino acids listed in your textbook. How is this possible? Because a protein's structure - its 3-dimensional form - and its function - how it performs its specific job - are very sensitive to the order of these amino acids in the protein chain. They are so sensitive, that a change (mutation) in the sequence of even one amino acid can lead to a loss of function if that amino acid was important for the protein to fold up into its proper structure or if it was important for reacting with other molecules in the protein's active site.

WHAT WILL YOU BE DOING:



VMD image of the protein Luciferase

For this assignment, you will choose a protein and study its 3-dimensional structure using the program, Visual Molecular Dynamics (VMD). You will identify the active site or binding site(s) in your chosen protein and the structural features (e.g. alpha helices, beta sheets, disulfide bridges, & hydrophobic center) which contribute to its stability.

You will then highlight these features using the drawing and coloring methods available in VMD, doing your best to simplify the rest of the protein so that the important parts can be most easily appreciated.

CHOOSE A PROTEIN!!!

Before we can do anything with VMD, you must select a protein to work with. You may choose any ENZYME (see familiar enzymes from class in the box below). To select your protein, go to **WWW.RCSB.ORG**. This link will take you to the protein data bank website. Scroll down to the bottom of the page to find a special section called "Molecule Of The Month". Click on the "Previous Features" link. This is the list you will select your protein from!

HOW DO I KNOW WHICH PROTEINS ARE ENZYMES???????????
MOST OF THEM ARE. LOOK FOR MOLECULES WHICH END IN ASE,
IN, OR ZYME. REMEMBER, ENZYMES SPEED UP CHEMICAL
REACTIONS

RESEARCH OF PROTEIN FUNCTION:

- Click on your selected protein. This will take you to some interesting pages regarding the function of your protein. You will need to report on the following regarding your protein's function:
 - Specifically, what does it do in the cell (or outside the cell)?
 - Why is this protein necessary for survival of a cell and/or a whole organism?
 - ALL of these proteins have something unique and interesting regarding their function, you **MUST** report on the special aspects of this protein's function!

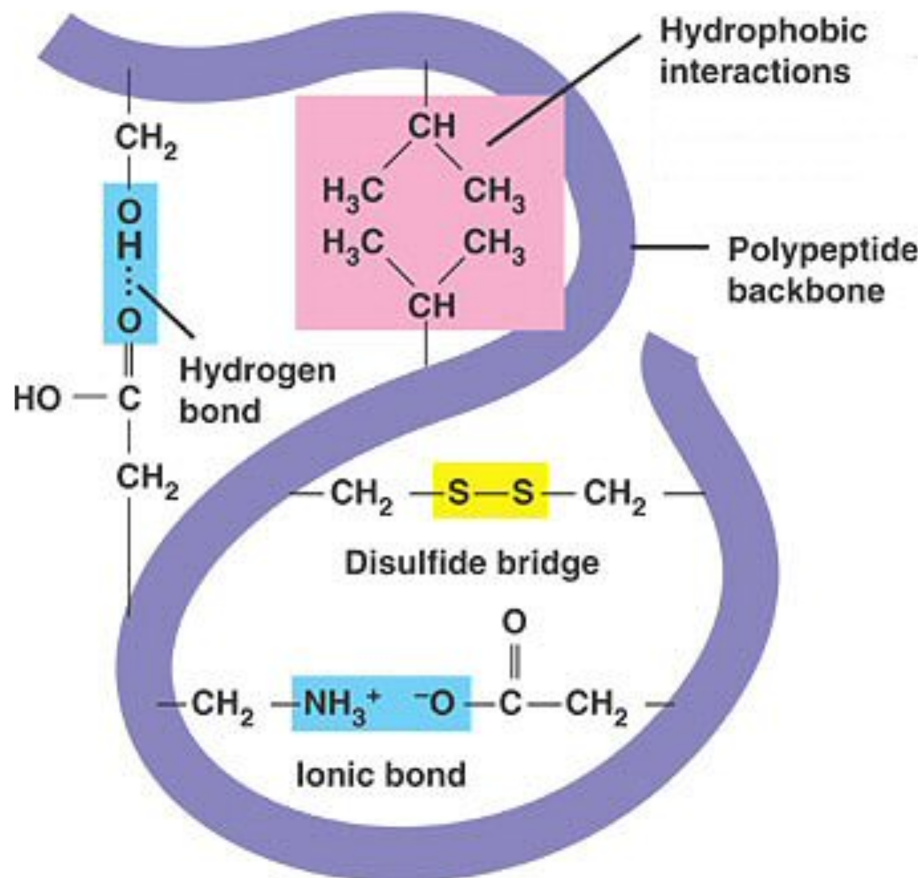
FAMILIAR PROTEINS FROM YOUR BIOLOGY CLASS:

1. **DNA replication** – DNA polymerase, DNA ligase, & nucleosomes
2. **Protein Synthesis** – RNA Polymerase, Transfer RNA, Ribosomal Proteins, & Chaperones of protein folding
3. **Respiration** - Cytochrome C, ATP Synthase, & Cytochrome C Oxidase
4. **Photosynthesis** - Photosystem I & Photosystem II
5. **Cytoskeleton & motor proteins** - Actin, myosin, & kinesin

RESEARCH OF PROTEIN STRUCTURE:

Your instructor will be leading you through a tutorial which will help you identify important aspects of your protein's structure. You will learn how to use the VMD program in order to highlight the following in your protein:

1. The binding or active site which gives your protein its specific function.
2. Which amino acids are located in your protein's active site.
3. Whether the amino acids in the protein's active site are polar, charged, or hydrophobic.
4. What type of outside molecule binds to your protein's binding/active site.
5. The location of hydrogen bonds, alpha helices, beta sheets, disulfide bridges, salt bridges, or hydrophobic interactions which stabilize your protein's structure (see picture below).



WHAT YOU WILL TURN IN:

A PHYSICAL 3-DIMENSIONAL MODEL OF YOUR PROTEIN'S STRUCTURE:

- You will be required to create a 3-dimensional model of your protein using any materials you want from home. Creativity in terms of what materials you use to build your model is encouraged!!
- You may approximate the overall shape of your protein. Do not waste time trying to model every last detail, however, **YOU MUST BE ACCURATE, IN MODELLING THE ACTIVE SITE (WHICH AMINO ACIDS ARE INVOLVED IN THE ACTIVE SITE CHEMISTRY?) AND STRUCTURES WHICH STABILIZE YOUR PROTEIN'S STRUCTURE (HYDROGEN BONDS, IONIC BONDS, DISULFIDE BONDS, HYDROPHOBIC INTERACTIONS).**

A WRITTEN REPORT:

- Each of you (not each group) will prepare a written report on your protein. It will be at least 3-pages long, double-spaced. **DO NOT COPY FROM ANY WEBSITE OR TEXTBOOK. YOUR REPORT MUST BE ORIGINAL AND MUST CONTAIN ALL OF THE FOLLOWING IN ORDER TO RECEIVE 100%:**
 - A concise discussion concerning the function and real-world significance of your protein.
 - At least 1 VMD representation of your protein which highlights interesting features of your protein's structure, such as its binding/active site and features contributing to its stability, like hydrogen bonds (for example in alpha helices & beta sheets), disulfide bridges, salt bridges, or hydrophobic centers. These features must be labeled and discussed in your report!
 - A concise discussion of your 3-dimensional physical model of your protein. You must discuss all of the interesting features you have attempted to model in your creation!
 - Explain at least one feature important for your protein's stability. Exactly how does this make the protein more stable?
 - Explain at least one feature important for your protein's function? Exactly how does this allow your protein to do its job?