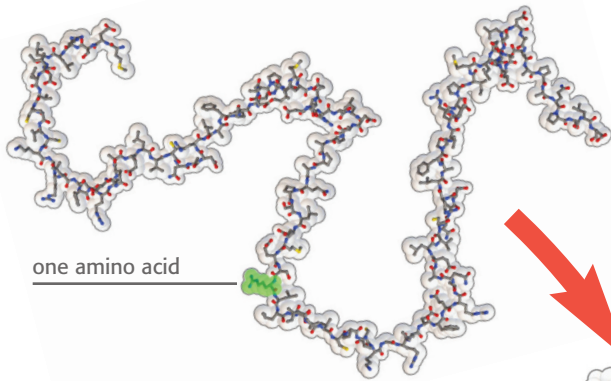


# What is a Protein?

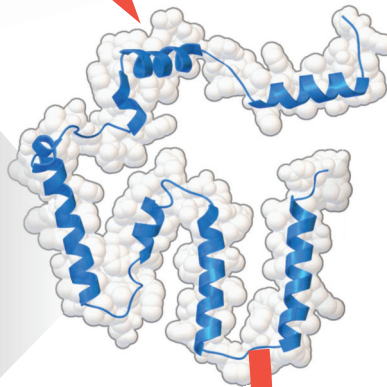
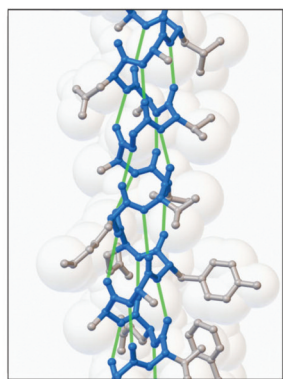
Proteins play countless roles throughout the biological world, from catalyzing chemical reactions to building the structures of all living things.

Despite this wide range of functions all proteins are made out of the same twenty amino acids, but combined in different ways. The way these twenty amino acids are arranged dictates the folding of the protein into its unique final shape. Since protein function is based on the ability to recognize and bind to specific molecules, having the correct shape is critical for proteins to do their jobs correctly.



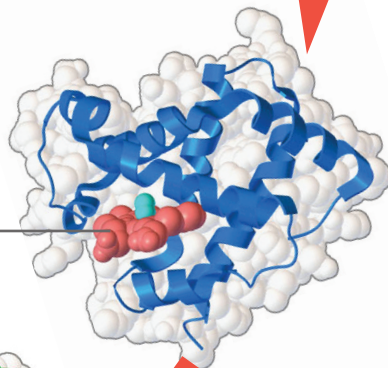
## Primary Structure

Primary structure is the linear sequence of amino acids as encoded by the DNA. This sequence defines how the protein will fold and therefore also defines how it will function. A single change in the amino acid sequence of hemoglobin can cause the proteins to clump together, resulting in the disease sickle cell anemia.



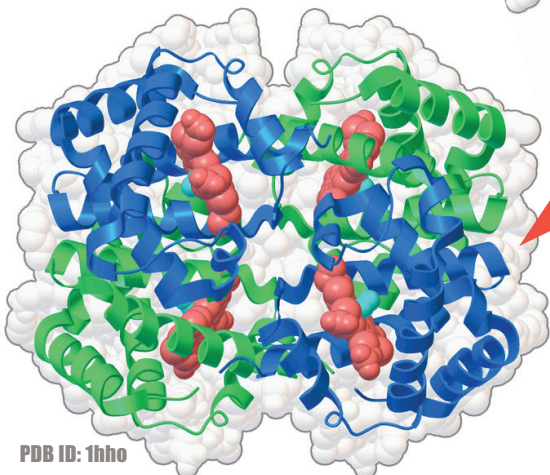
## Secondary Structure

Hydrogen bonds between amino acids form two particularly stable structural elements in proteins: alpha helices and beta sheets. Alpha helices (shown in blue) are the basic structural elements found in hemoglobin, but many other proteins also include beta sheets. The inset highlights the pattern of hydrogen bonds (shown in green) that stabilizes alpha helices.



## Tertiary Structure

Many functional proteins fold into a compact globular shape, with many carbon-rich amino acids sheltered inside away from the surrounding water. The folded structure of hemoglobin includes a pocket to hold heme, which is the molecule that carries oxygen as it is transported throughout the body.



## Quaternary Structure

Two or more polypeptide chains can come together to form one functional molecule with several subunits. The four subunits of hemoglobin cooperate so that the complex picks up and delivers more oxygen than is possible with single subunits.

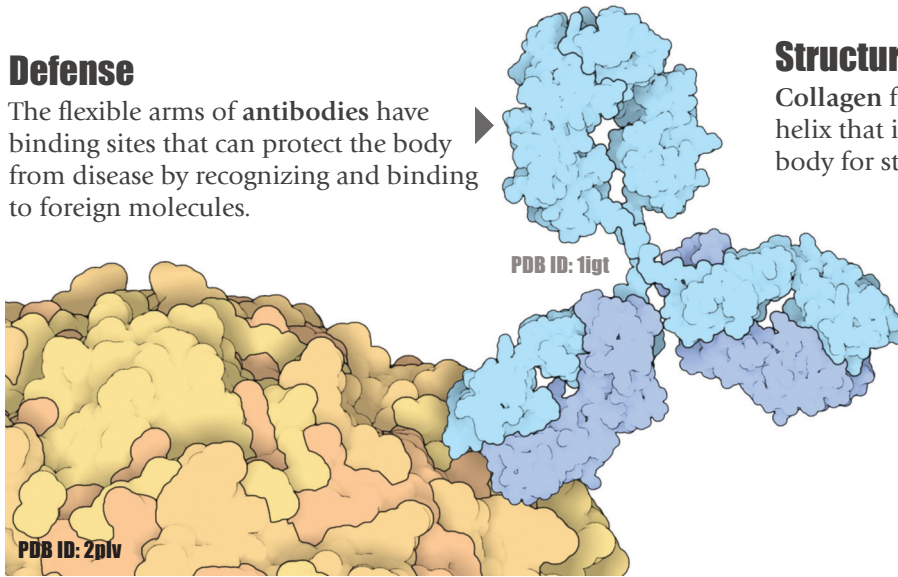
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# Protein Shape & Function

Specific amino acid sequences give proteins their distinct shapes and chemical characteristics. Protein shape is important because many proteins rely on the recognition of specific 3D molecular shapes to function correctly.

## Defense

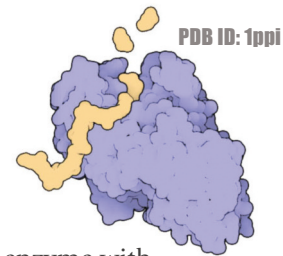
The flexible arms of **antibodies** have binding sites that can protect the body from disease by recognizing and binding to foreign molecules.



## Structure

**Collagen** forms a strong and flexible triple helix that is widely used throughout the body for structural support.

PDB ID: 1bkv



## Communication

**Insulin** is a small, stable protein that can easily maintain its shape while traveling through the blood to regulate blood sugar levels.

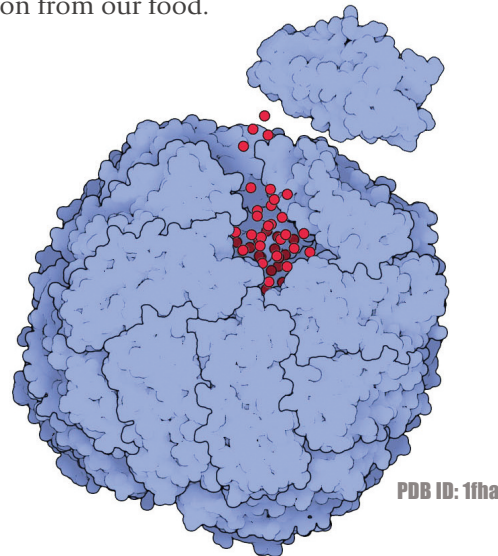
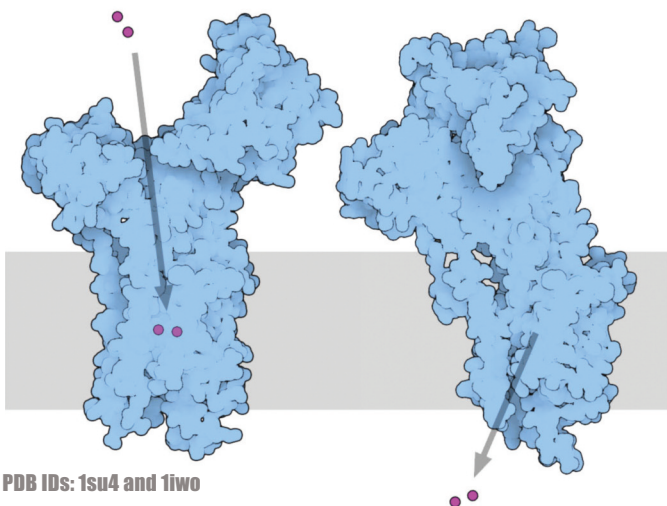


## Enzymes

**Alpha amylase** is an enzyme with a specific catalytic site that begins the breakdown of carbohydrates in our saliva.

## Storage

**Ferritin** forms a hollow shell that stores iron from our food.



To learn more about these and other proteins please visit PDB-101 at [www.rcsb.org/pdb-101](http://www.rcsb.org/pdb-101)

RCSB PDB-101