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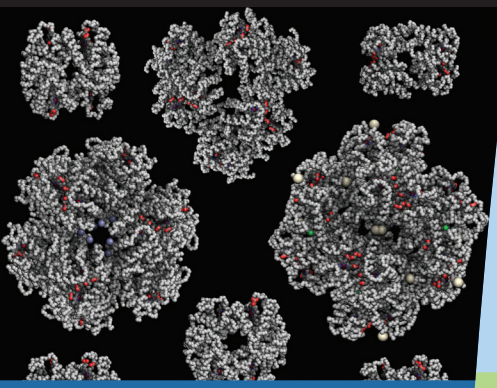

About Our Cover

This image shows hemoglobin proteins from diverse members of the animal kingdom. Starting in the top right corner and moving clockwise are hemoglobin proteins from clam (4HRR), tubeworm (2ZS0), buffalo (3CY5), human hemoglobin S (2HbS) and above it, normal human hemoglobin (2HHb), turtle (3AT5), a tubeworm species from a hydrothermal vent (1YHU), an emerald rock cod (3GKV), and the common earthworm (1X9F).

In each case, the amino acid backbone is colored light grey, and the amino acid sidechains are hidden. Heme groups can be identified by their oxygen atoms, which are colored in red.

Hemoglobin proteins perform an essential function by ferrying oxygen from the lungs to the deepest recesses of our tissues. When oxygen is plentiful, it binds to the iron component of heme, a chemical group held in place by two or more kinds of hemoglobin proteins. When the oxygen concentration drops, these proteins change shape, releasing oxygen from the red blood cells to surrounding cells and tissues.

The combined requirements of binding and releasing oxygen in a controlled manner limit the kinds of structural change that can be tolerated by the heme group during evolution. One consequence is that hemoglobin proteins from different organisms appear similar in structure.

Another consequence is that DNA mutations that alter the hemoglobin structure often result in disease. In humans, sickle cell anemia is an inherited autosomal recessive disorder following the Mendelian pattern of incomplete dominance. A single nucleotide mutation of the β-globin gene, found on the short arm of chromosome 11, changes an adenine base to a thymine base. This results in a valine substitution for glutamic acid at position 6 of the β-globin protein chain. This change in one amino acid causes hemoglobin to polymerize into longer chains (HbS; bottom, center) in conditions of low oxygen concentration. These hemoglobin polymers change the shape of the red blood cells, making it difficult for the erythrocytes to flow through capillaries and deliver oxygen, leading to serious complications.

The cover image was created by Sandra Porter, PhD (sandra@digitalworldbiology.com), Digital World Biology LLC, with the Molecule World™ iPad app, DigitalWorldBiology.com. All structures were obtained from the NCBI, ncbi.nlm.nih.gov.

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