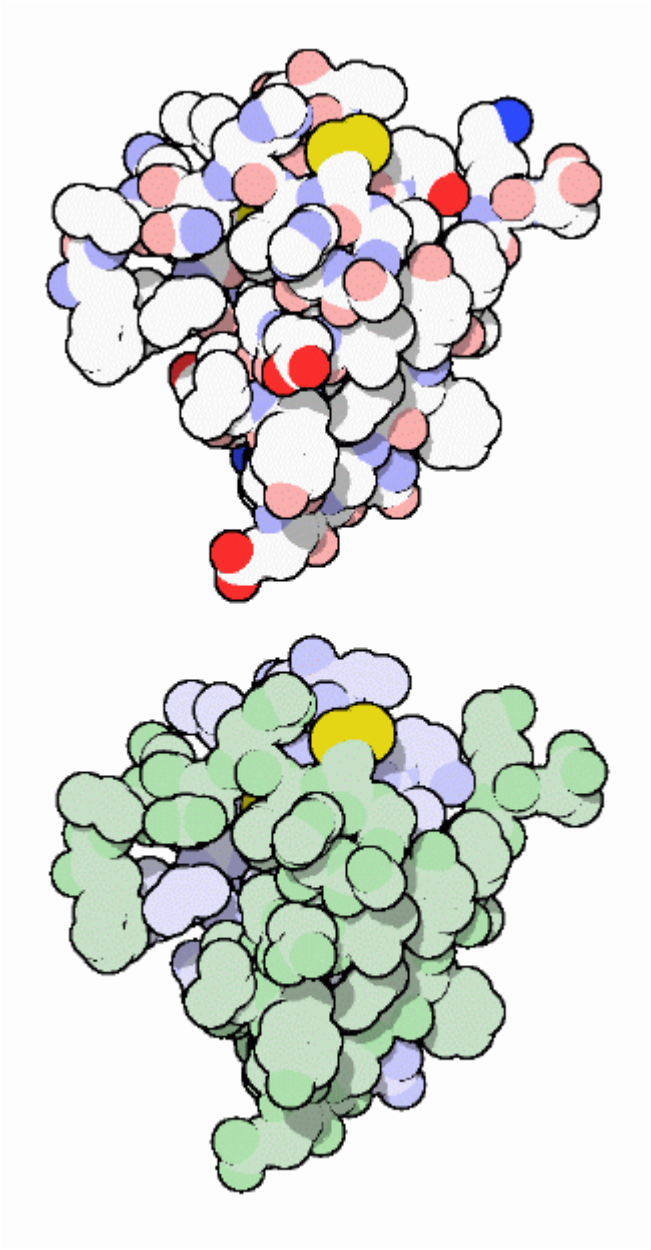
Insulin — A Molecular Messenger

Our cells communicate using a molecular postal system: the blood is the postal service and hormones are the letters. Insulin is one of the most important hormones, carrying messages that describe the amount of sugar that is available from moment to moment in the blood. Insulin is made in the pancreas and added to the blood after meals when sugar levels are high. This signal then spreads throughout the body, to the liver, muscles and fat cells. Insulin tells these organs to take glucose out of the blood and store it, in the form of glycogen or fat.

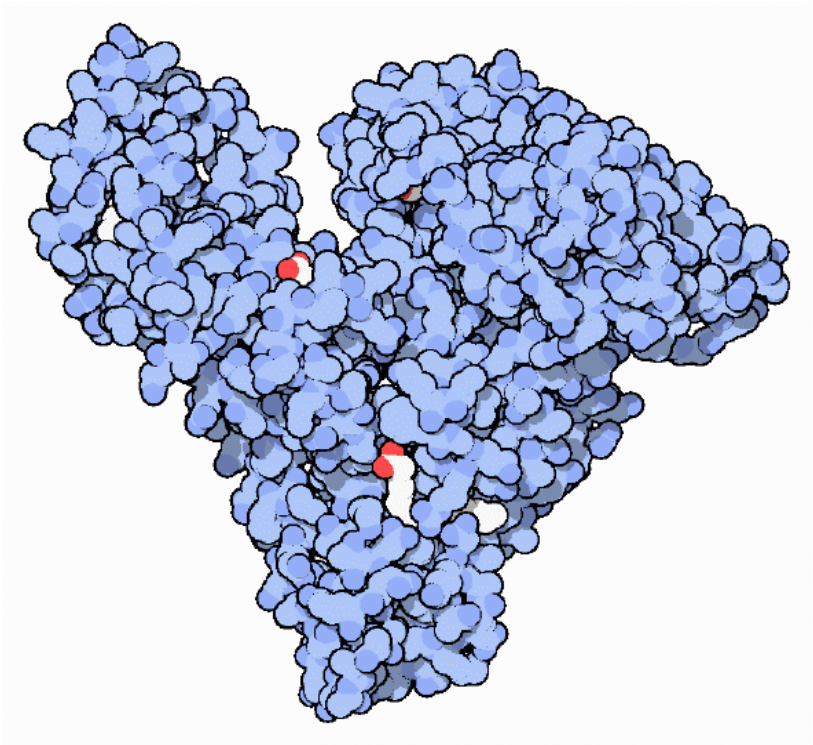


Folding Tiny Proteins

Insulin is a tiny protein. It moves quickly through the blood and is easily captured by receptors on cell surfaces, delivering its message. Small proteins pose a challenge to cells: it is difficult to make a small protein that will fold into a stable structure. Our cells solve this problem by synthesizing a longer protein chain, which folds into the proper structure. Then, the extra piece is clipped away, leaving two small chains in the mature form. These two chains are shown in the lower diagram in blue and green, for insulin from pigs. The structure is further stabilized by three disulfide bridges, one of which is seen in yellow in each illustration.

Diabetes Mellitus

When insulin function is impaired, either by damage to the pancreas or by the rigors of aging, glucose levels in the blood rise dangerously, leading to diabetes mellitus. For people totally deficient in insulin, such as children that develop diabetes early in life, this can be acutely dangerous. High glucose levels lead to dehydration, as the body attempts to flush out the excess sugar in urine, and life-threatening changes in blood pH, as the body turns to other acidic molecules for delivery of energy. Diabetes mellitus has severe long- term effects as well. It is one of the major chronic diseases in the industrialized world. Lowered levels of insulin that may occur as we age allow elevated levels of sugar in the blood over extended periods of time. Sugar molecules attach to proteins throughout the body, compromising their function, and sugars derived from glucose build up, distorting and clogging cells.



Serum-albumin

Think about how convenient it is to be able to eat. Each one of your ten trillion cells requires a constant supply of nourishment. But we don't have to worry about this--we merely eat our dinner and our body does the rest. The food is digested and the useful pieces are delivered to cells throughout the body, using the bloodstream as the delivery system. Delivery of water-soluble molecules, like sugar, is easy. They float in the watery bloodstream and are picked up by cells along the way. Other important nutrients, however, are not soluble in water, so special carriers must be made to "carry" them to hungry cells.

Serum albumin is the carrier of fatty acids in the blood. Fatty acids are essential for two major things in your body. They are the building blocks for lipids, which form all of the membranes around and inside cells. They are also rich sources of energy, and may be broken down inside cells to form ATP. Thus, your body maintains a storehouse of fatty acids, stored as fat. When your body needs energy or needs building materials, fat cells release fatty acids into the blood. There, they are picked up by serum albumin and delivered to distant parts of the body. Serum albumin is the most plentiful protein in blood plasma. Each protein molecule can carry seven fatty acid molecules.