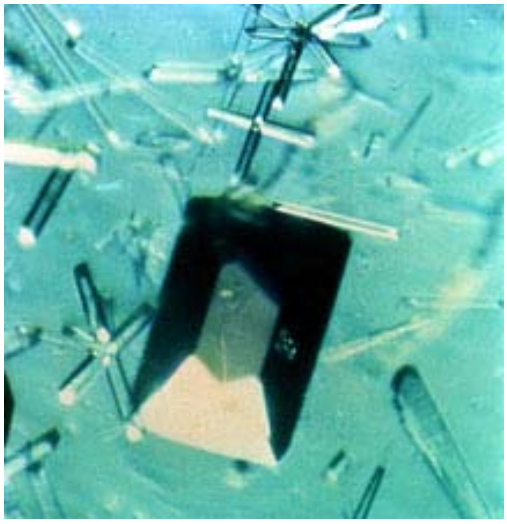
Building Blocks Of Life

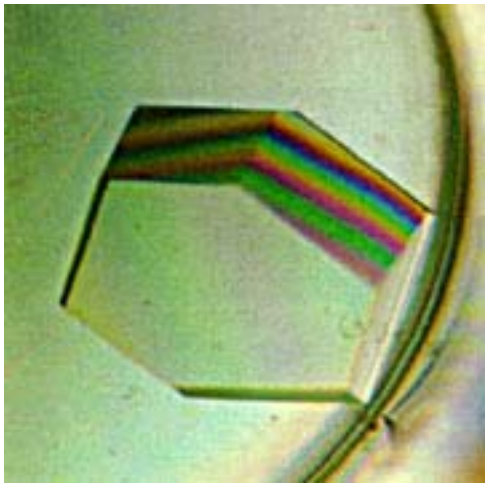


They're the basic building blocks of life down here, on Earth. But, the best way to understand them may be up there, in space.

One of the biggest areas in which doctors and scientists believe there is still a great deal to learn about the way living organisms function is proteins. Proteins, which were first discovered in 1838, are considered to be the main ingredients of living cells, and their interactions have huge impacts on organisms in a number of areas, including such things as whether a living thing will be healthy or sick.

Proteins are complex compounds made up of amino acids, which are simpler compounds containing carbon, oxygen, nitrogen, and hydrogen atoms. Within the human body, there are thousands of different proteins. Proteins help humans in numerous ways, such as making it possible for blood to carry oxygen throughout the body, and helping to transmit nerve impulses that let us hear, smell, taste, and feel. However, proteins are also involved in things that can negatively affect a living being, causing regular body functions to be thrown off, or making it possible for an invading microbe or parasite to harm an organism.

Unique chemical structures determine the function of proteins, and give each type of protein a unique "shape." Chemical structures sticking out of proteins allow them to interact with other proteins or with chemicals in an organism. By learning more about these shapes and structures, researchers can better understand the way proteins work. This knowledge could help scientists develop ways to help or hinder a particular protein.



One of the most common ways scientists try to learn about the structure of proteins is by studying protein crystals. By using a process called vapor diffusion, scientists can cause protein samples to concentrate into a crystal form. X rays are used to study the crystals, allowing researchers to map the atomic structure of the crystal and to create a diagram of the shape of the component proteins.

With this knowledge, pharmaceutical companies can design compounds that match the unique shape of a particular protein, creating more effective medications, which would also have fewer side effects since they would not react with compounds in the body

besides the targeted protein. However, the structure of many proteins still remains a mystery because researchers have been unable to create crystals of those proteins of the necessary quality or size for the X-ray mapping.

That's where space becomes involved. Through experiments conducted in orbit, NASA has learned that larger, higher-quality protein crystals can be created in microgravity. The agency has established a Protein Crystal Growth Program to learn more about how protein crystals form in space and how the growth process there can be improved. Such crystals, grown to a larger size and with a more perfect form, would be easier for researchers to study.

NASA first began performing protein-growth experiments on the Space Shuttle in 1985, and more than 40 protein-growth payloads have been flown on the Shuttle since then. In addition, protein-growth research has been performed onboard the International Space Station. One such project performed on the Space Station consisted of 1,008 individual experiments in which protein crystals were grown over the course of several months, becoming gradually larger over time. Astronauts living on the Station monitored the experiments on a daily basis. Once that phase of the project was complete, the experiment module was returned to Earth, where scientists used the X-ray mapping process to create three-dimensional models of the crystals grown in orbit.

Benefits from protein-growth experiments conducted in space have already been seen. Crystallization experiments involving human insulin have given researchers a better understanding of this compound, which they believe will help lead toward a more effective treatment for diabetes. Studies of proteins involved in the human immune system may lead to safer surgeries through such things as decreasing inflammation problems associated with open-heart surgery.

Who would have thought that answers to mysteries inside the human body would be found outside the Earth's gravity?

Courtesy of NASA's
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