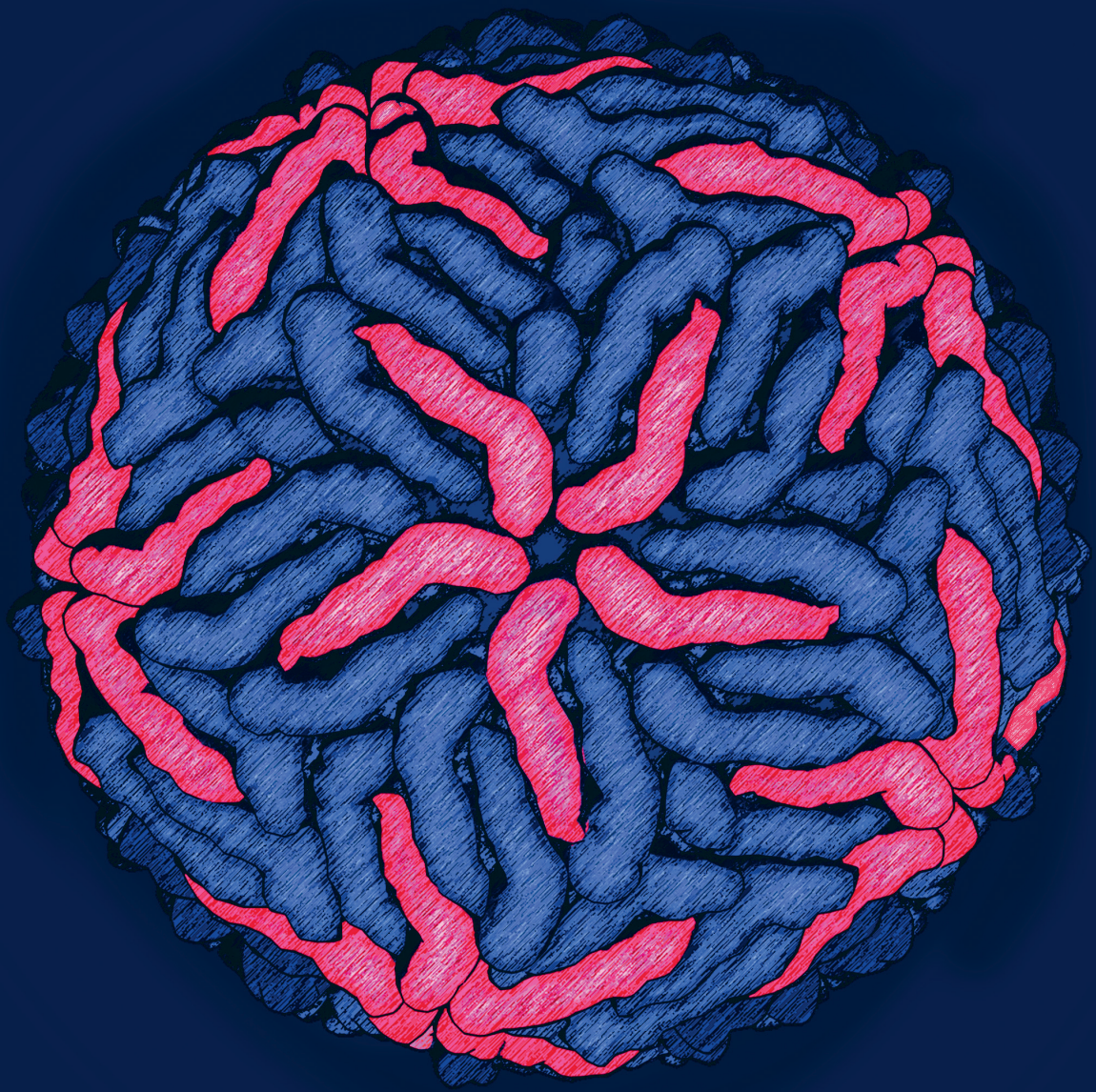
Coloring Molecular Machinery:
A Tour of the Protein Data Bank



200th Molecule of the Month

RCSB PDB-101

pdb101.rcsb.org

This is a molecular coloring book for all artists. Featured are selected highlights from the RCSB PDB's *Molecule of the Month* series, which is celebrating the release of its 200th article in August 2016.

Cells build many complex molecular machines that perform the biological jobs needed for life. Some of these machines are molecular scissors that cut food into digestible pieces. Others then use these pieces to build new molecules when cells grow or tissues need to be repaired. Some molecular machines form sturdy beams that support cells, and others are motors that use energy to crawl along these beams. Some recognize attackers and mobilize defenses against infection.

Researchers around the world are studying these molecules at the atomic level. These 3D structures are freely available at the Protein Data Bank (PDB), the central storehouse of biomolecular structures. Since 2000, the *Molecule of the Month* features have highlighted the structure and function of these important molecules and their relevance to human health and welfare.

Visit **pdb101.rcsb.org** to learn more about the PDB and the *Molecule of the Month*.

pdb101.rcsb.org

PDB-101 helps teachers, students, and the general public explore the 3D world of proteins and nucleic acids.

Learning about their diverse shapes and functions helps to understand all aspects of biomedicine and agriculture, from protein synthesis to health and disease to biological energy.

All resources are freely available, including curricular materials, paper molecular models, posters, animations, and more. Resources are searchable as well as organized by topics such as Health and Disease, Molecules of Life, Biotech and Nanotech, and Structures and Structure Determination.

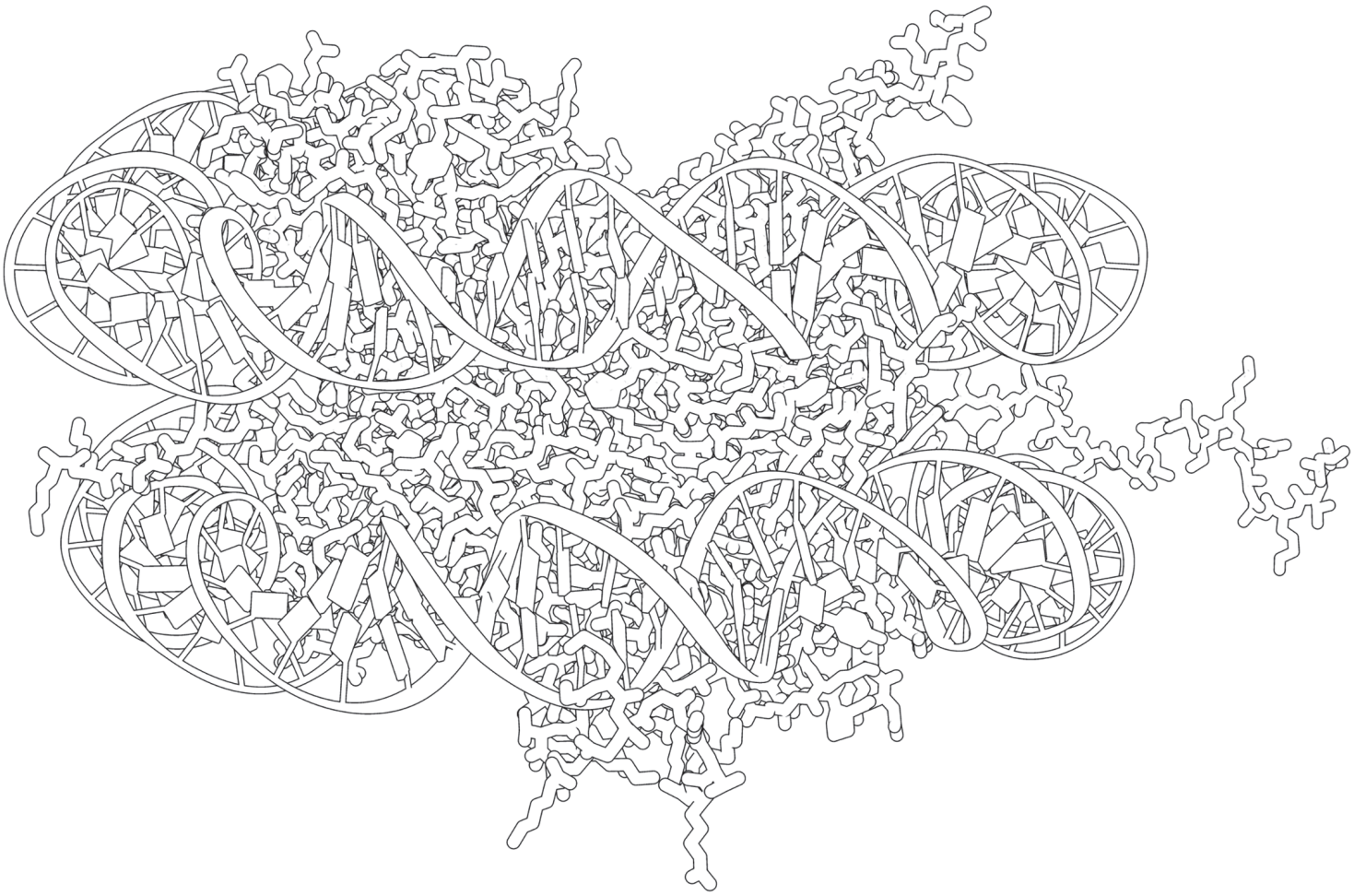
DNA

Atomic structures reveal how the iconic double helix encodes genomic information.

Nucleosome

(View 1)

The cell's genome is stored and protected by nucleosomes.



Nucleosome

(View 2)

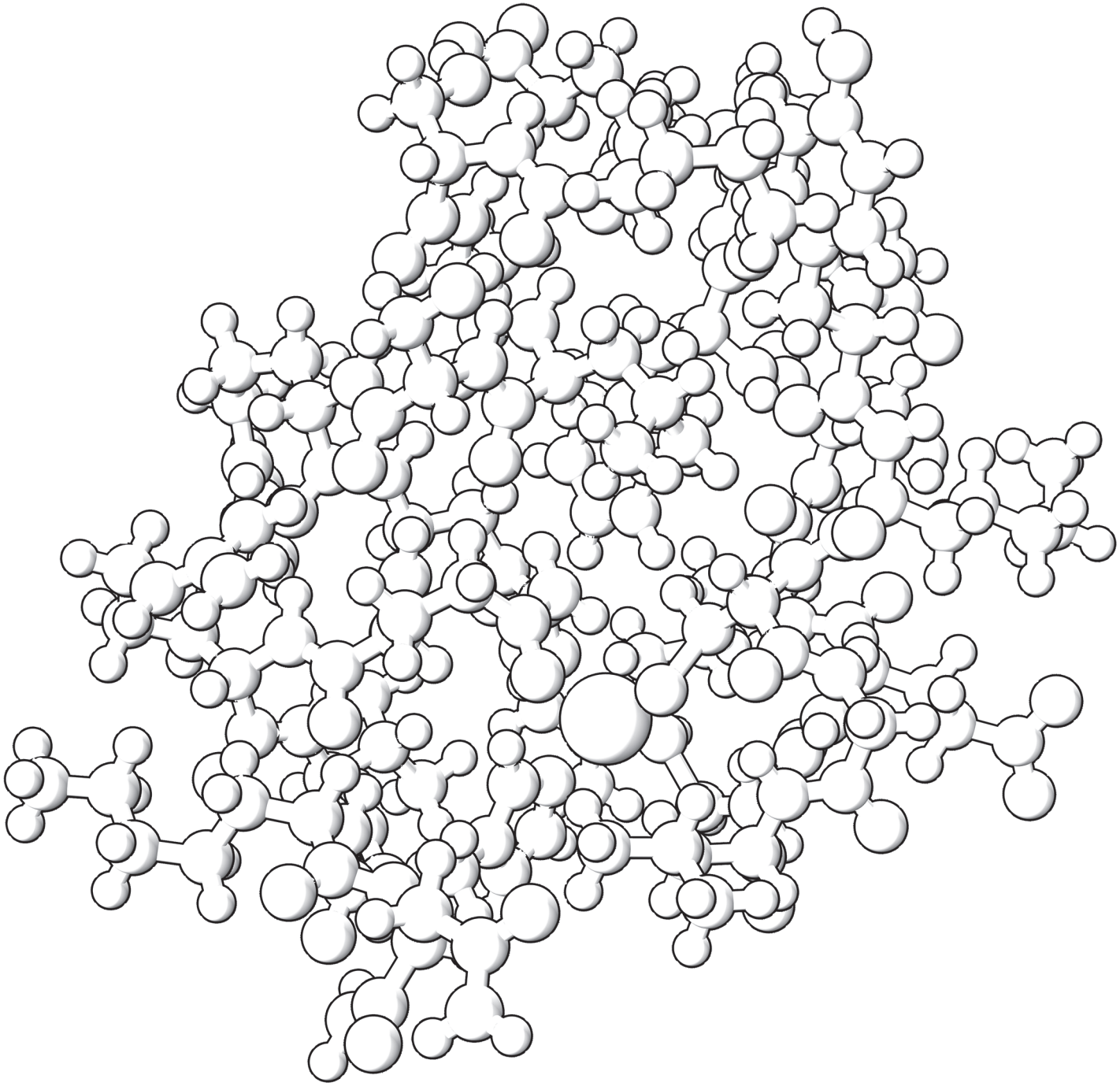
The long "tails" of nucleosomes interact with each other to control the accessibility of the genes to polymerases, thus regulating the gene transcription activity.

TATA-Binding Protein

TATA protein tells RNA polymerase where to get started on a gene.

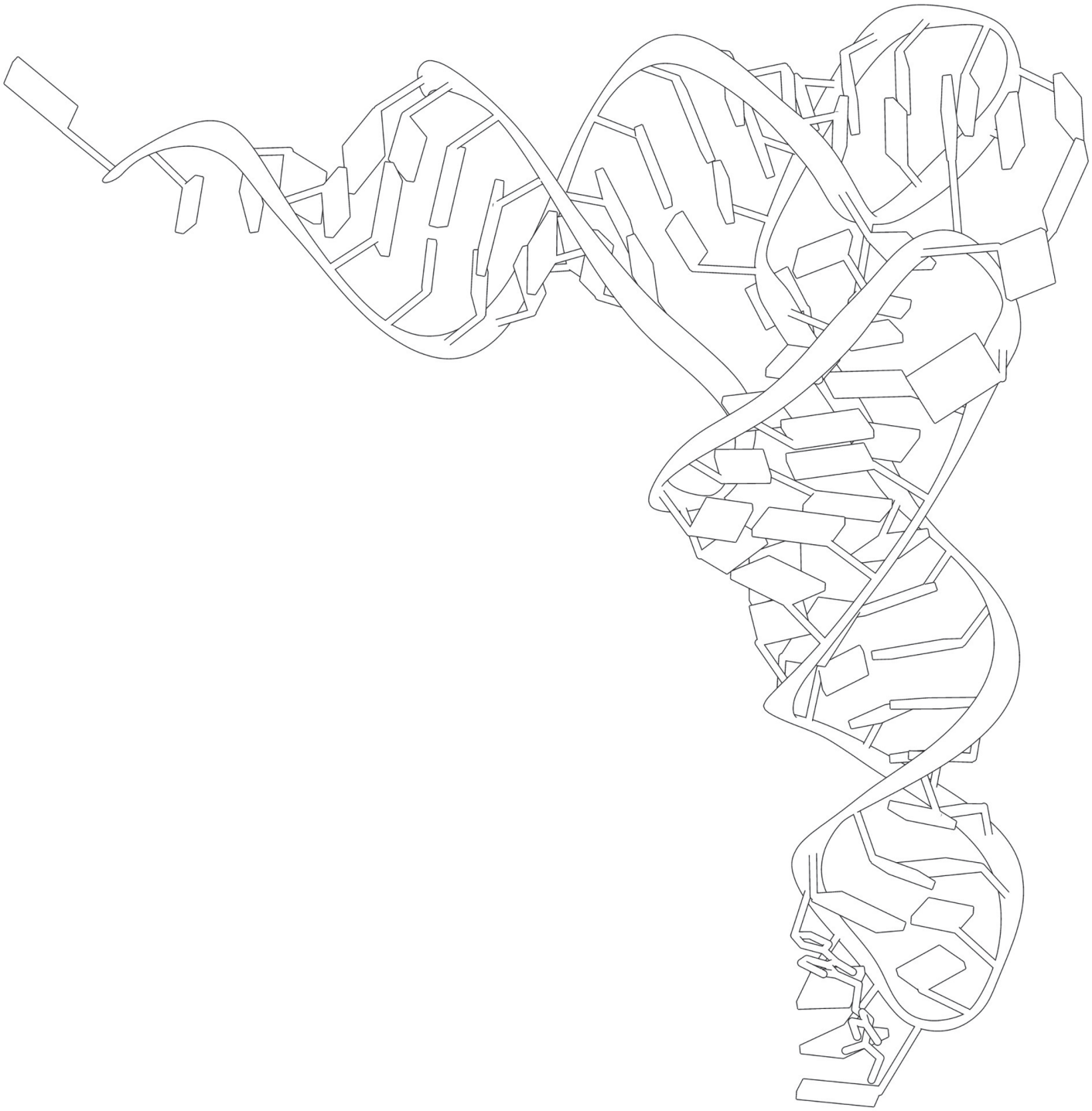
Zinc Fingers

Zinc ions are used to strengthen small protein modules that recognize DNA.



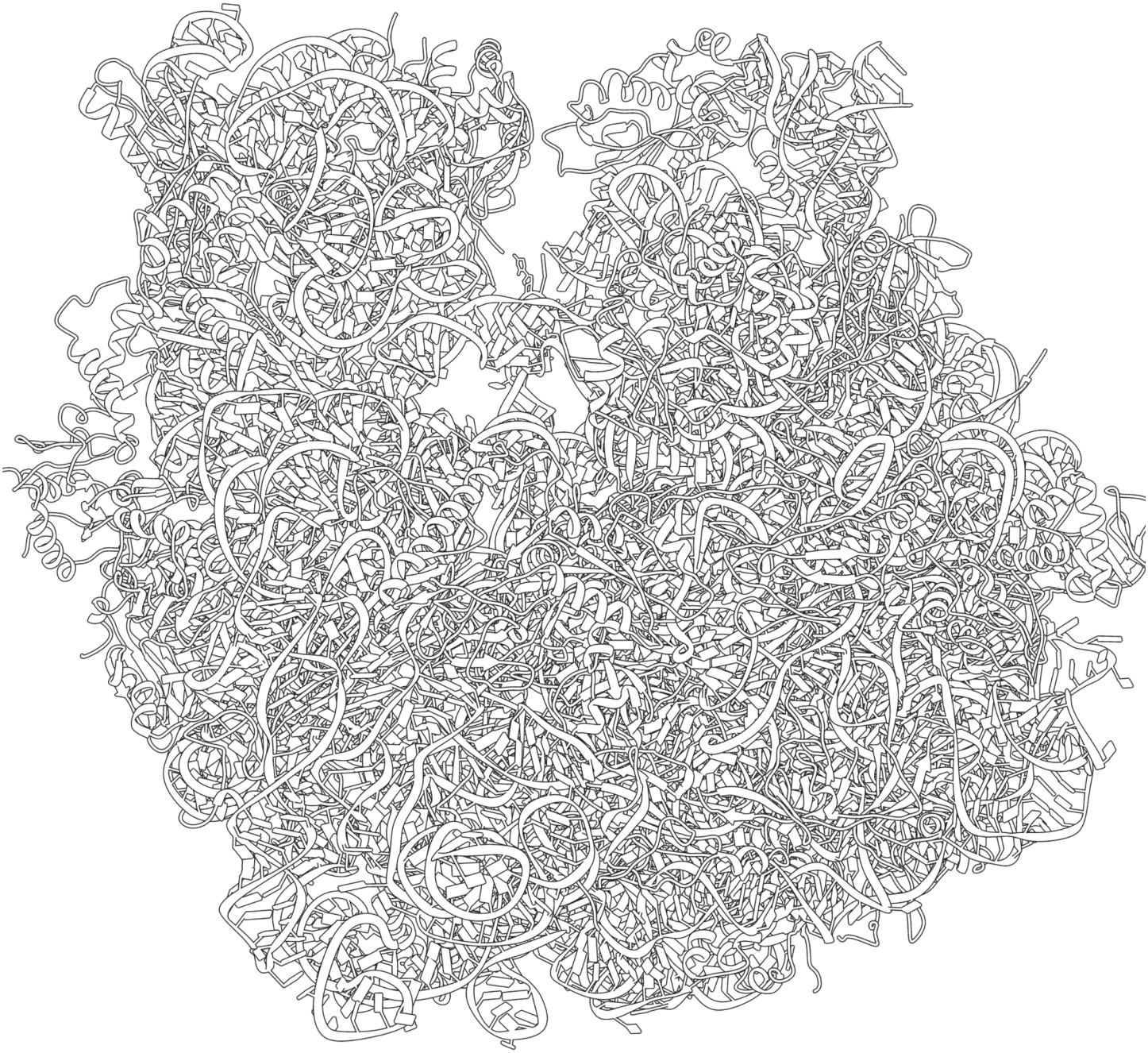
Transfer RNA

Transfer RNA translates the language of the genome into the language of proteins



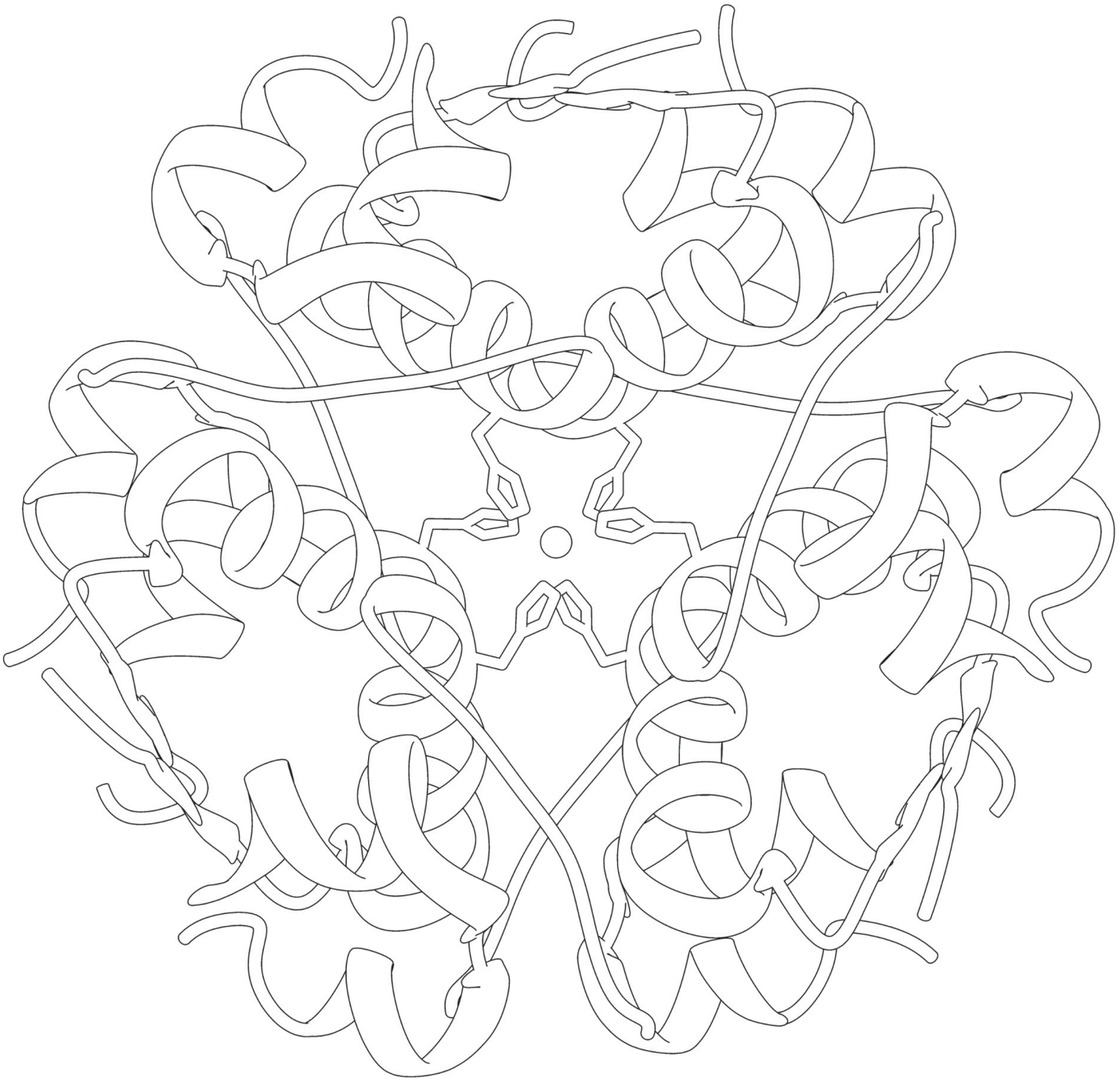
Ribosome

Ribosomes are complex molecular machines that build proteins.



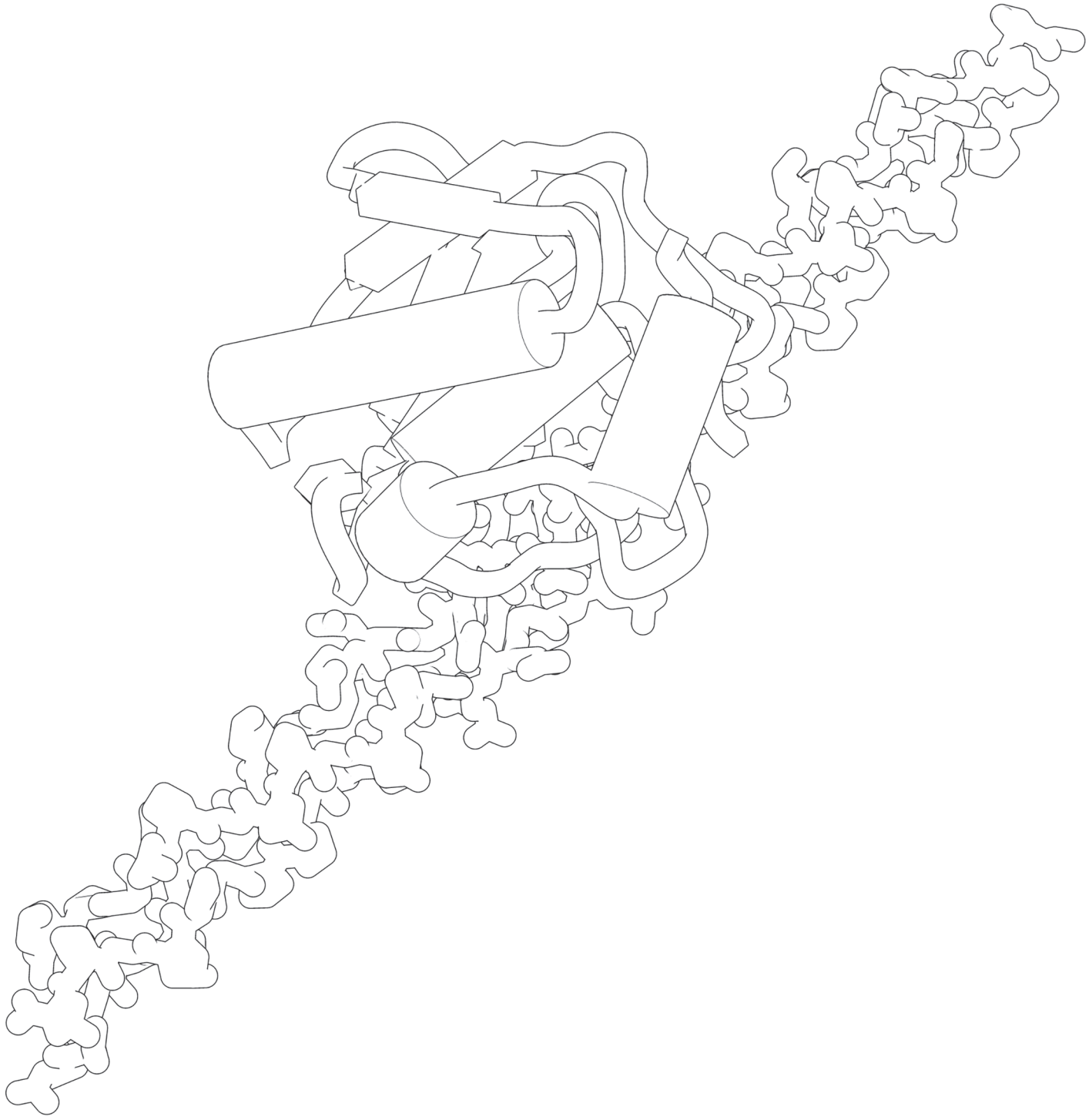
Insulin

The hormone insulin helps control the level of glucose in the blood.



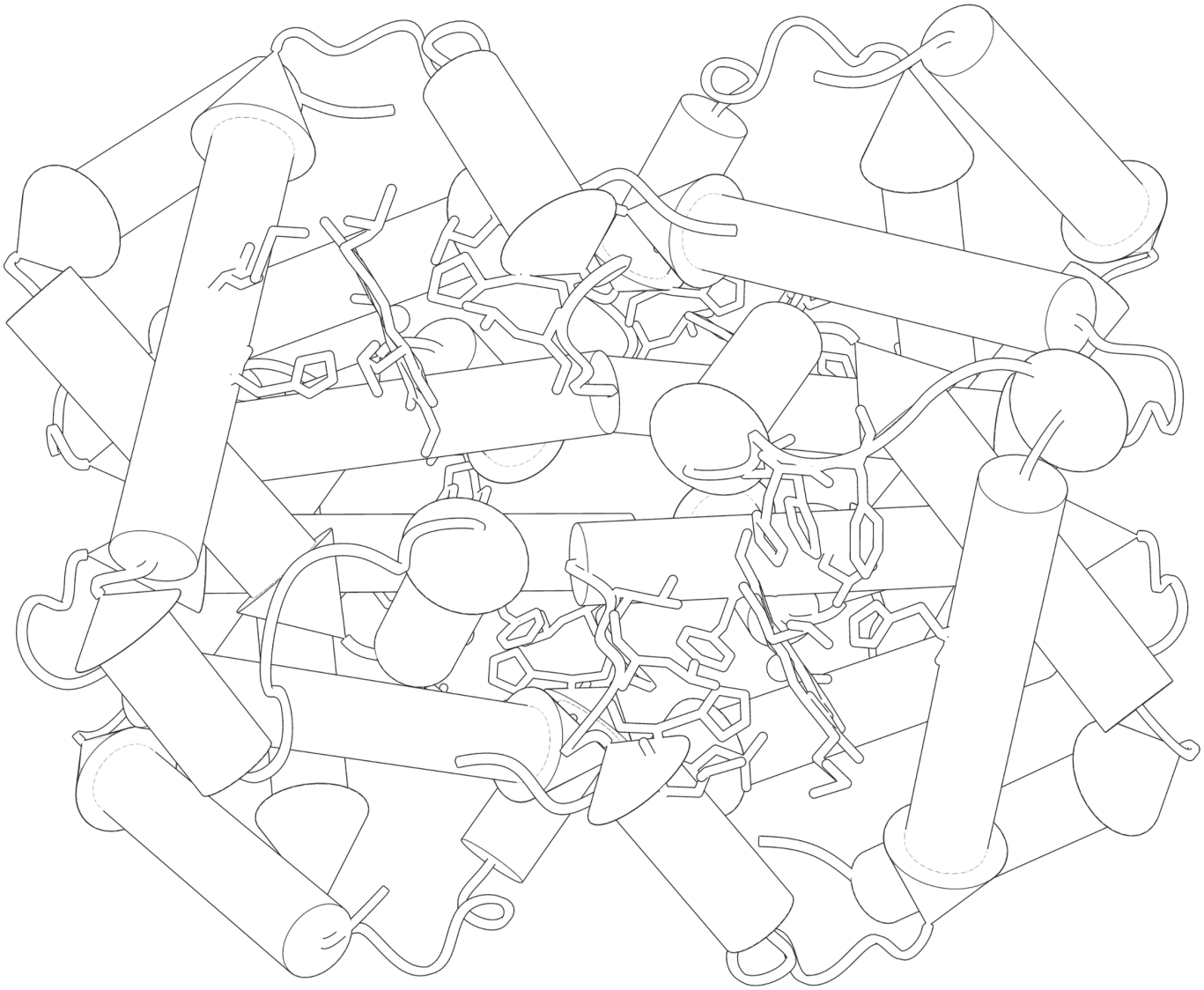
Collagen with Bound Metalloproteinase

Long, sturdy fibers of collagen give structure to our bodies. Metalloproteinase is a small enzyme (shown center) that creates lesions in the fibrils that are necessary for tissue remodeling.



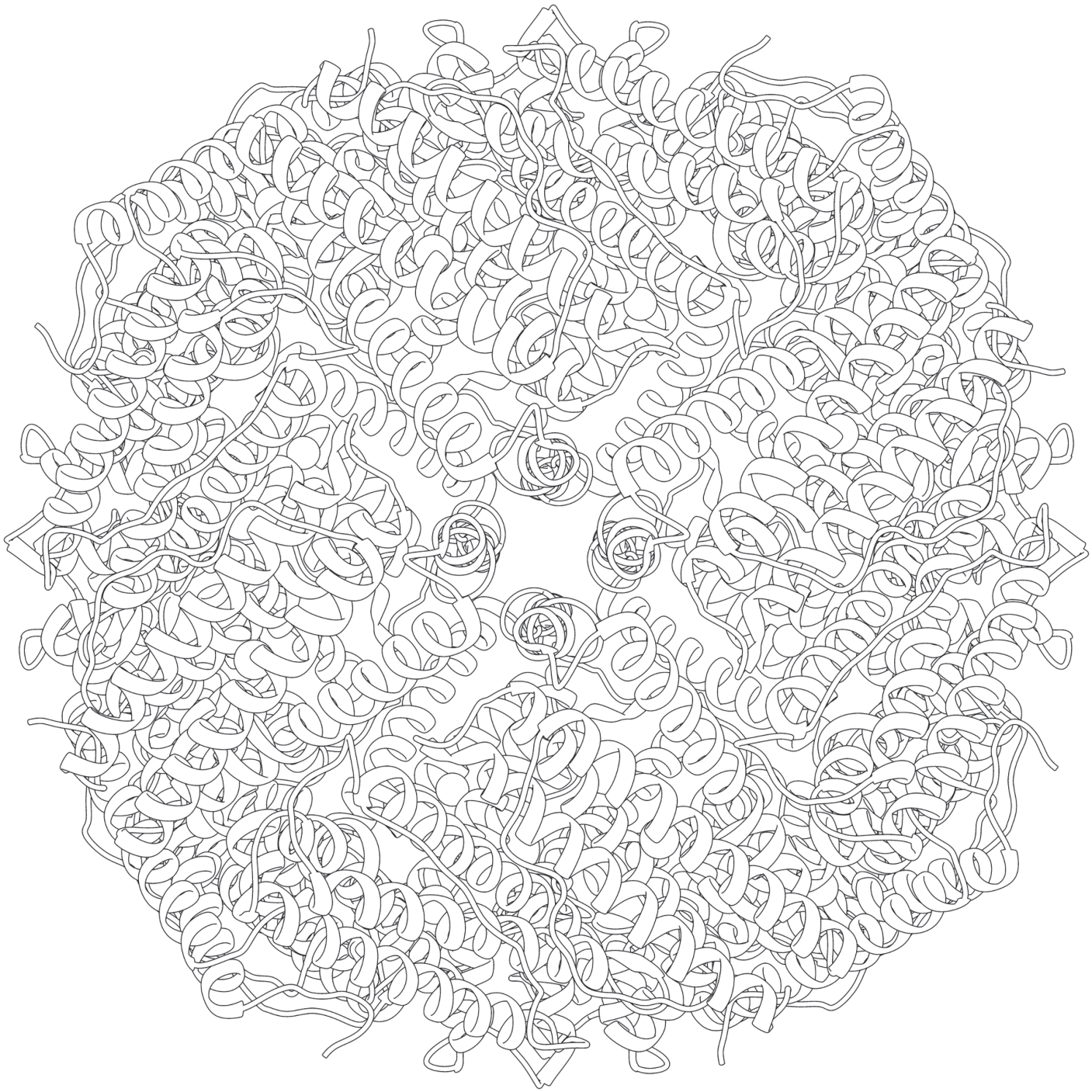
Hemoglobin

Hemoglobin carries oxygen from the lungs to the body's tissues.



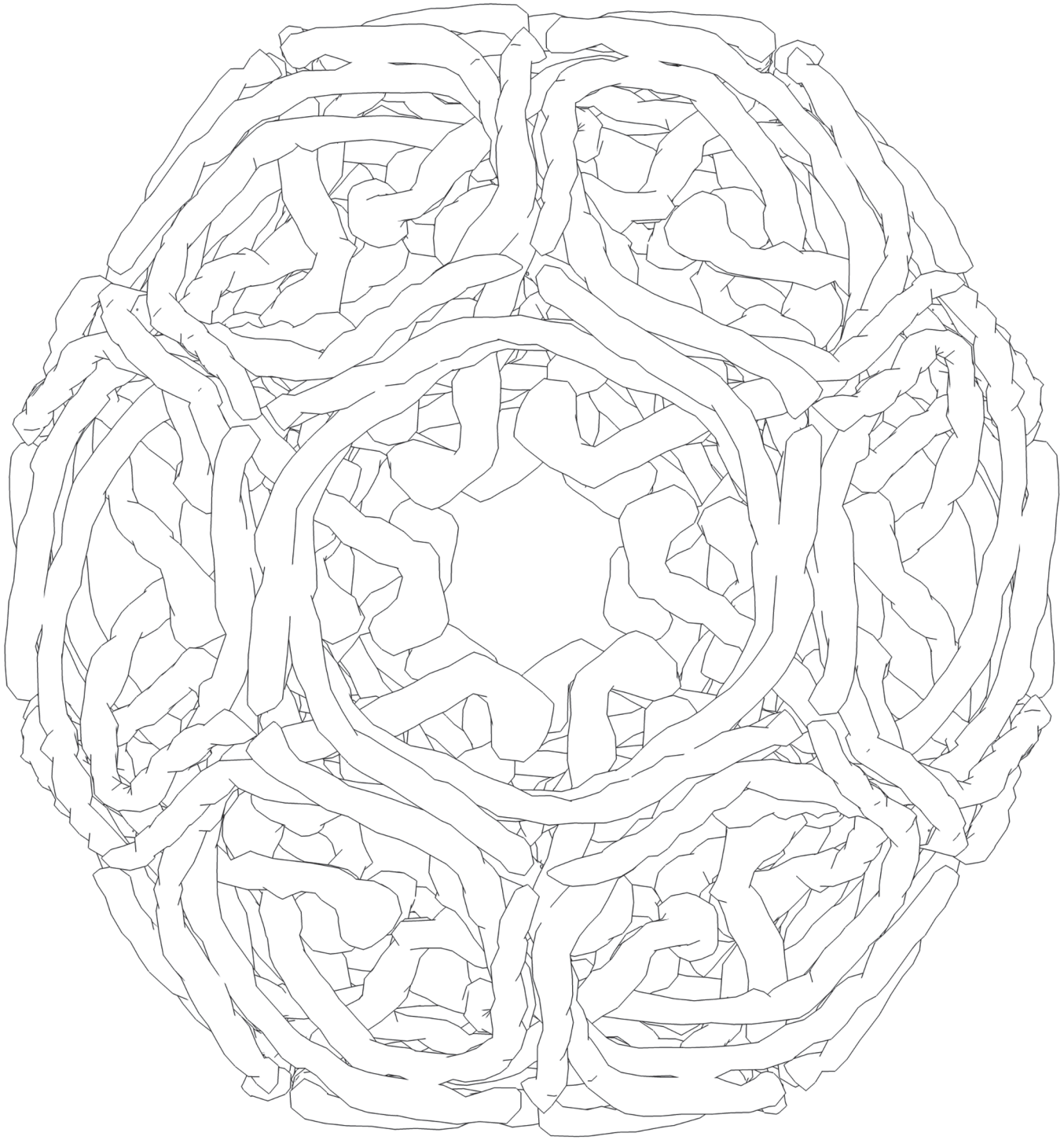
Ferritin

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



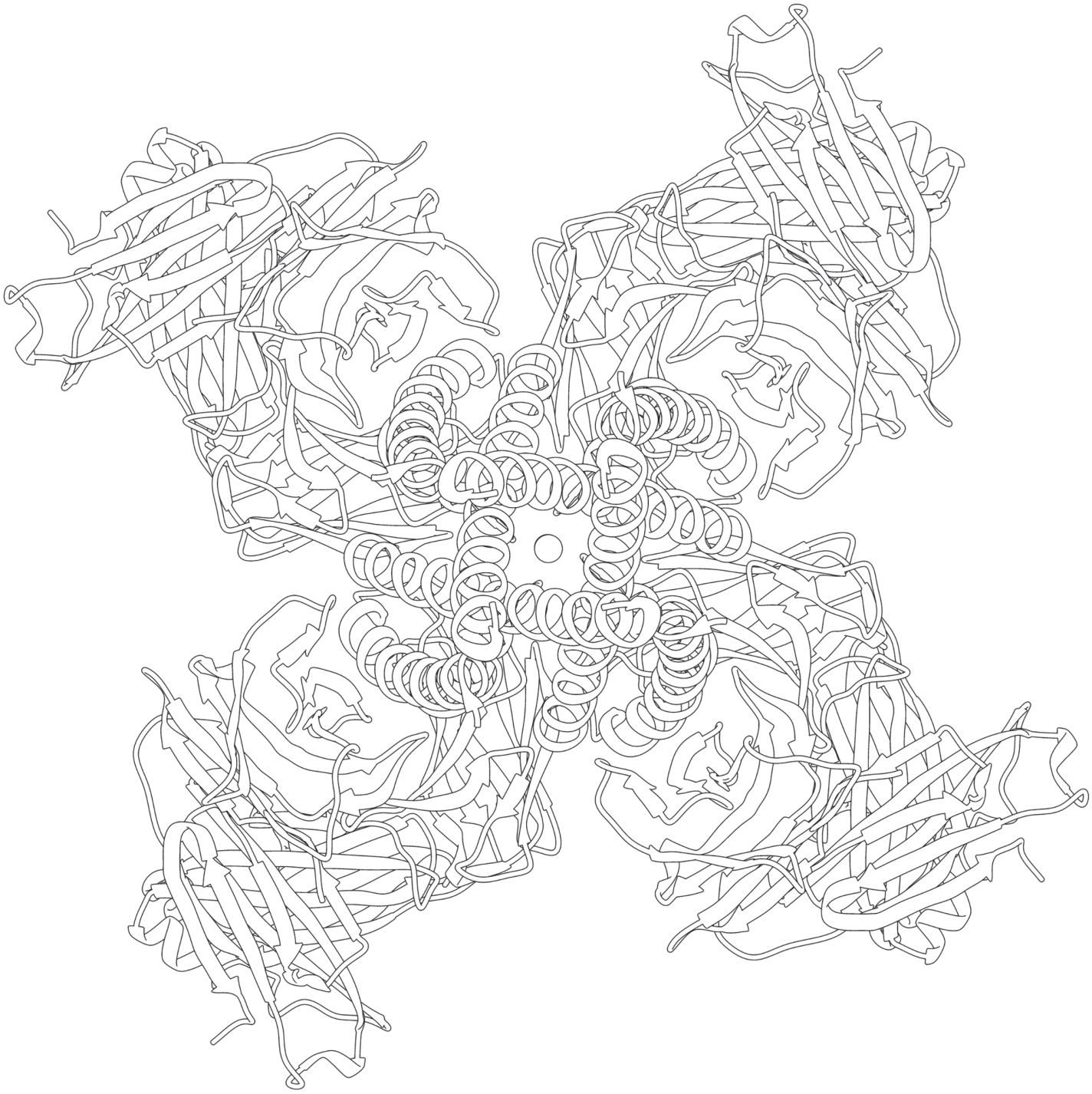
Clathrin

Three-armed clathrin triskelions are used to build molecular cages involved in transport.



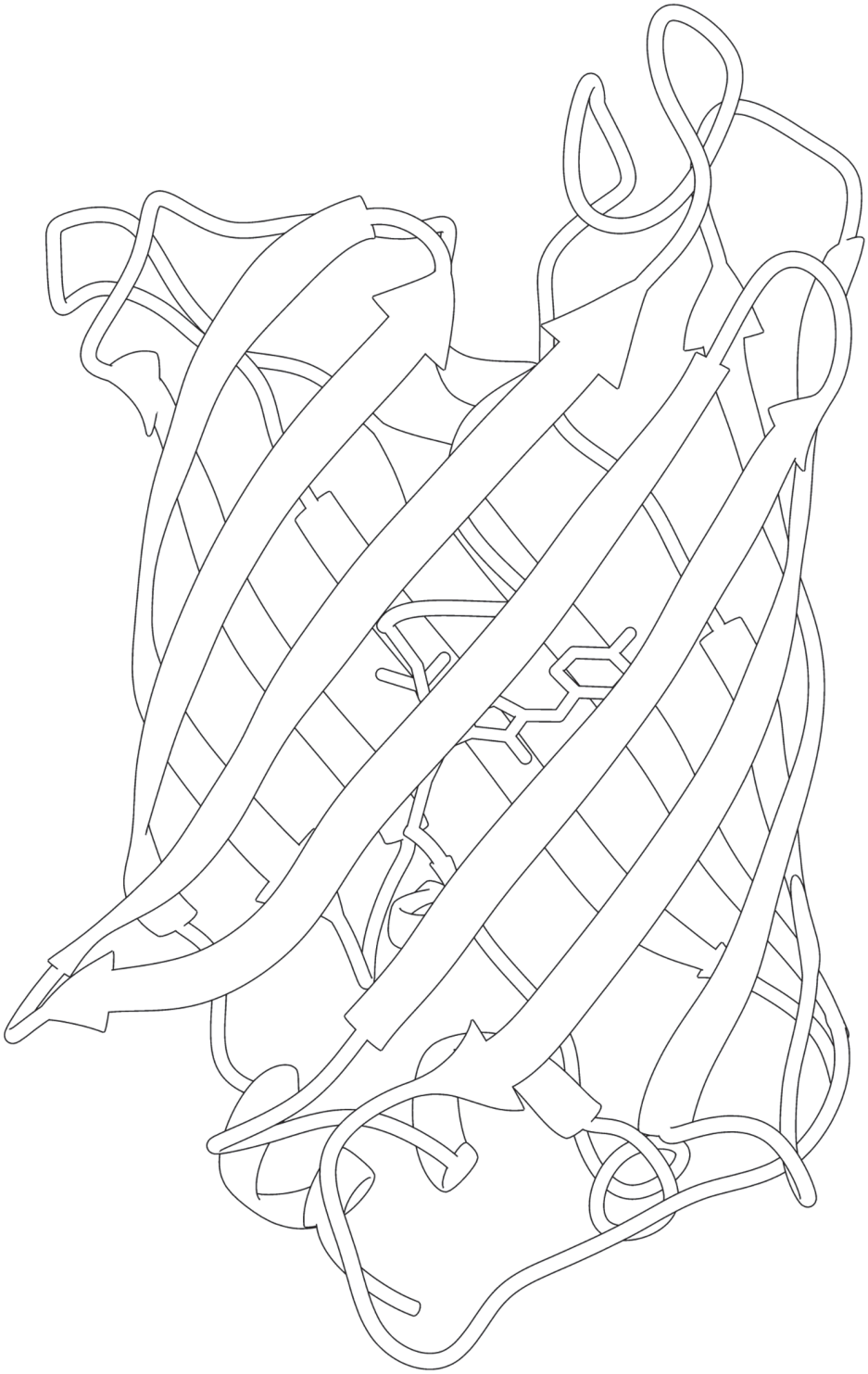
Potassium Channels

Potassium channels allow potassium ions to pass, but block the smaller sodium ions.



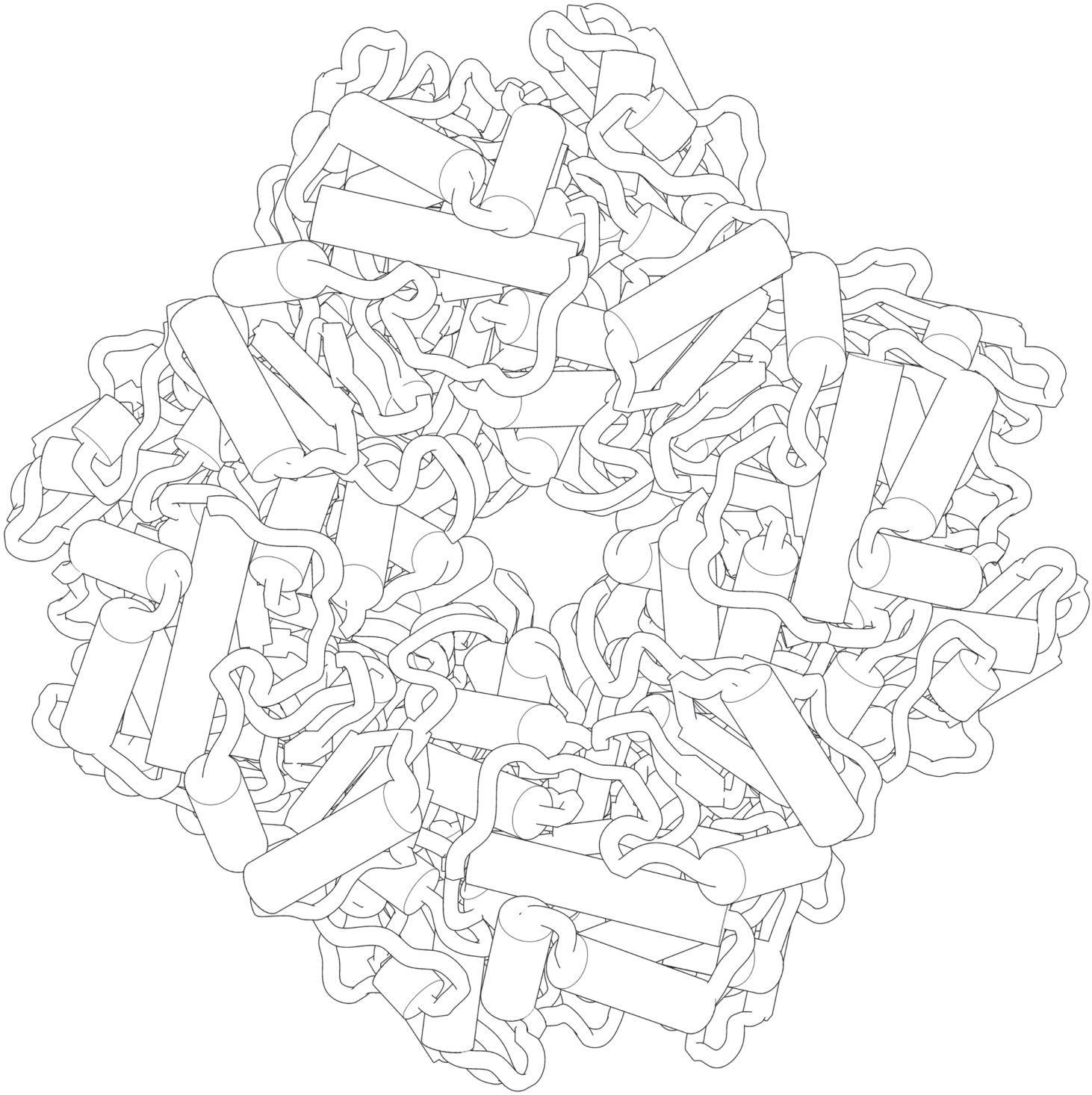
Green Fluorescent Protein (GFP)

GFP is a tiny protein from jellyfish that glows when exposed to ultraviolet light.



Rubisco

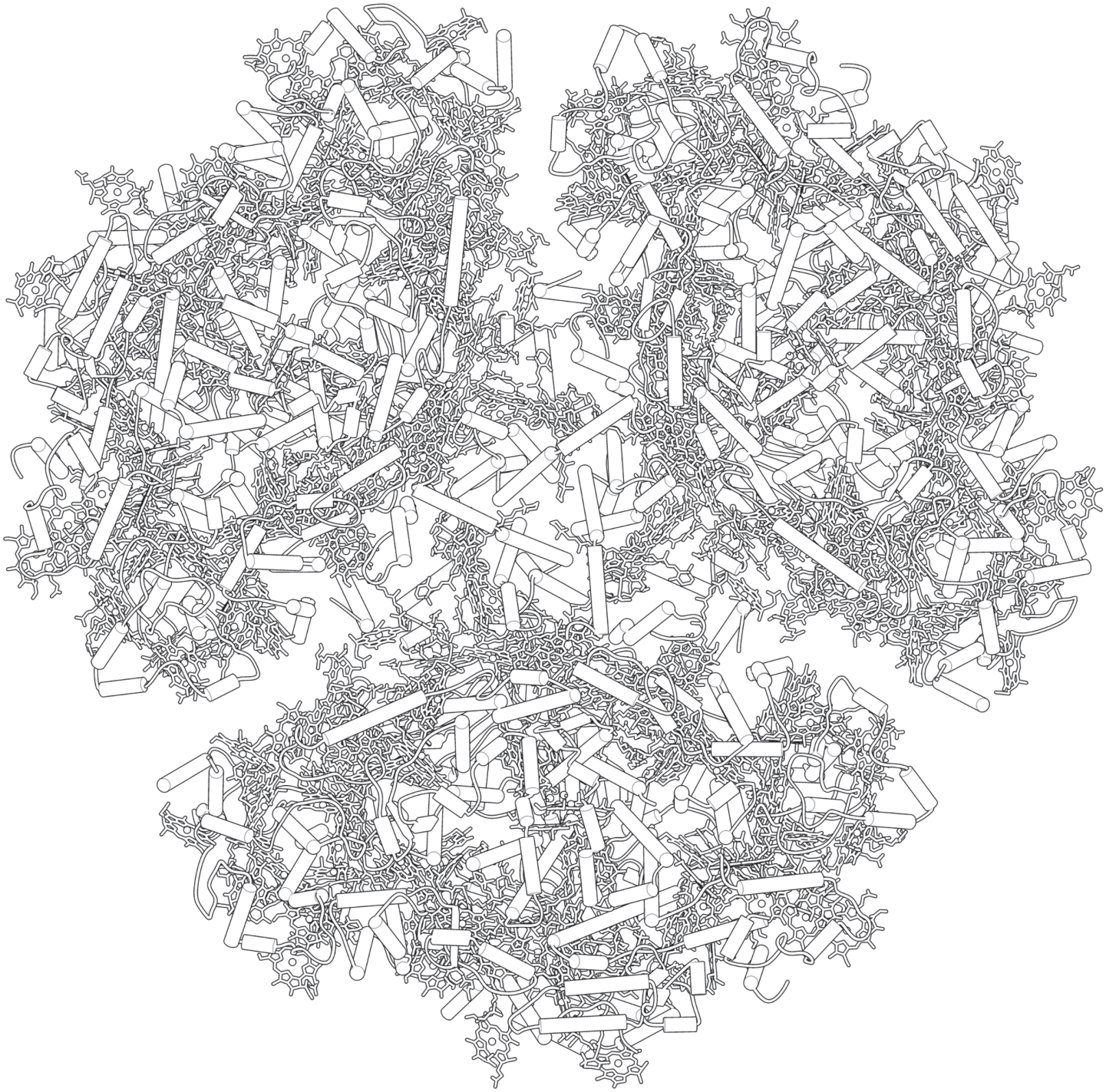
Rubisco fixes atmospheric carbon dioxide into bioavailable sugar molecules.



Photosystem I

(View 1)

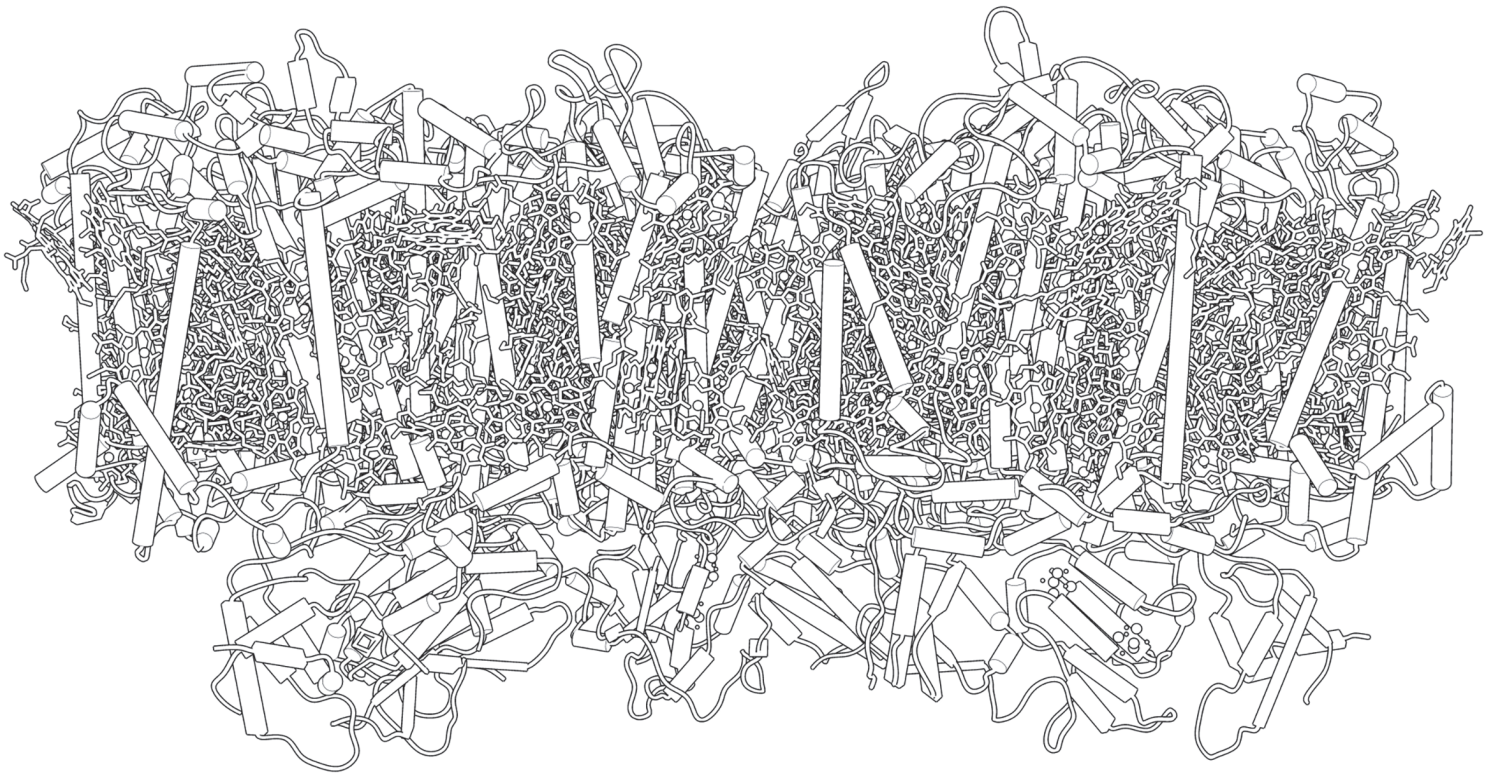
Photosystem I captures the energy in sunlight.



Photosystem I

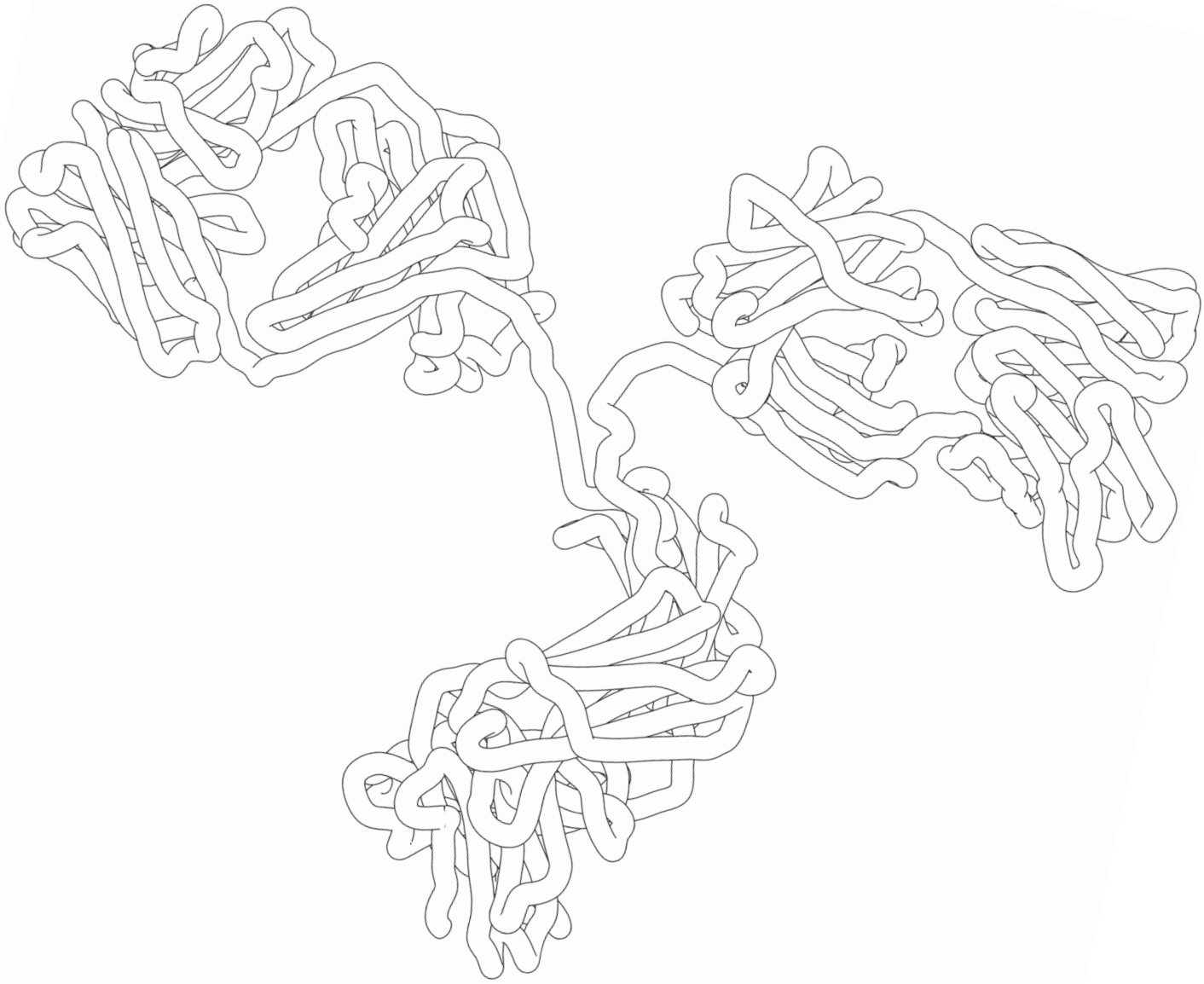
(View 2)

Photosystem I is a trimeric complex that forms a large disk. In cells, the complex floats in a membrane with the large flat faces exposed above and below the membrane.



Antibodies

Antibodies search for foreign molecules in the blood.

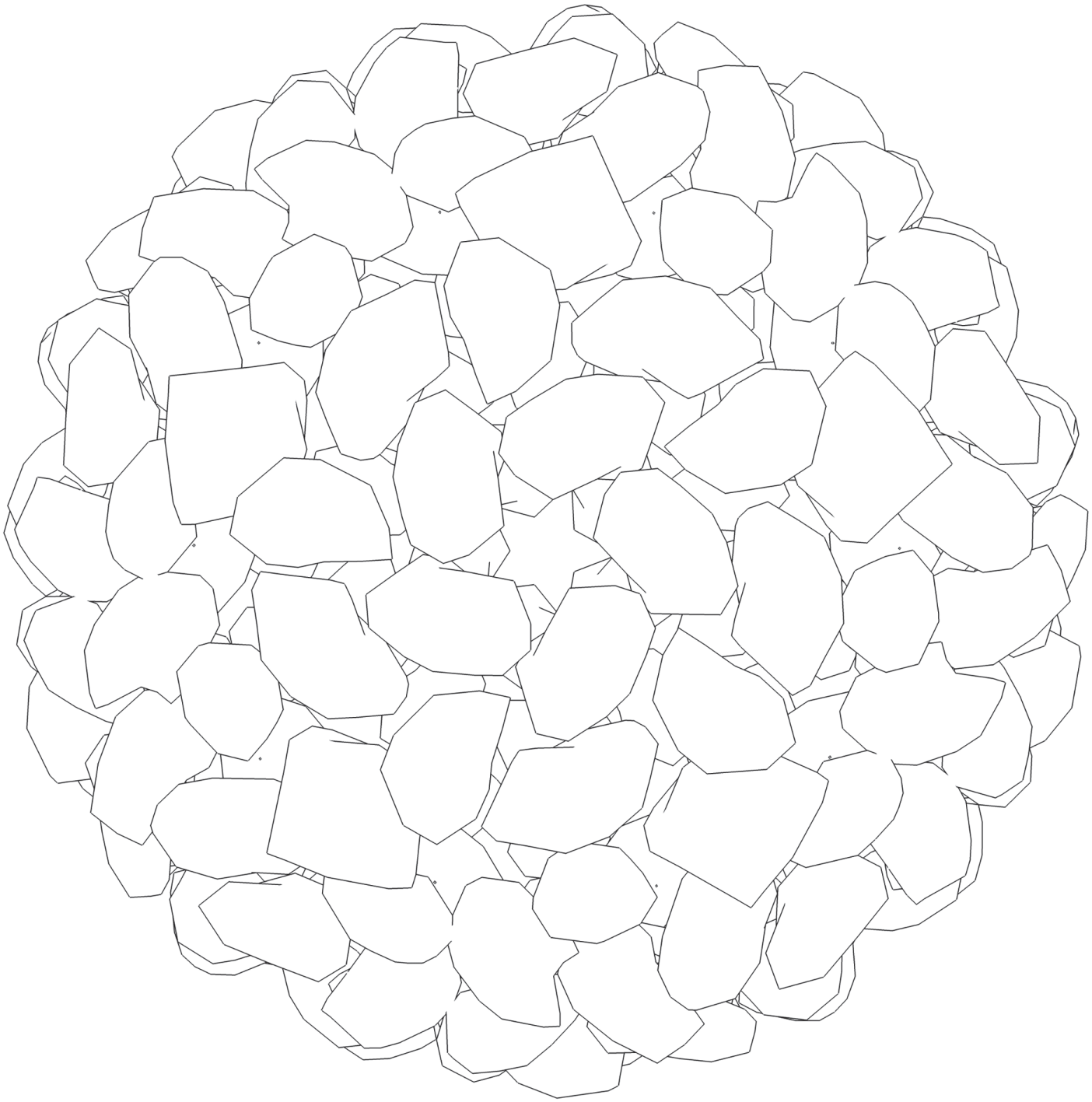


New Delhi Metallo-Beta-Lactamase

The New Delhi Metallo-Beta-Lactamase, shown as a stereoscopic image, is an enzyme found in some bacteria that inactivates a wide range of penicillin-like antibiotics.

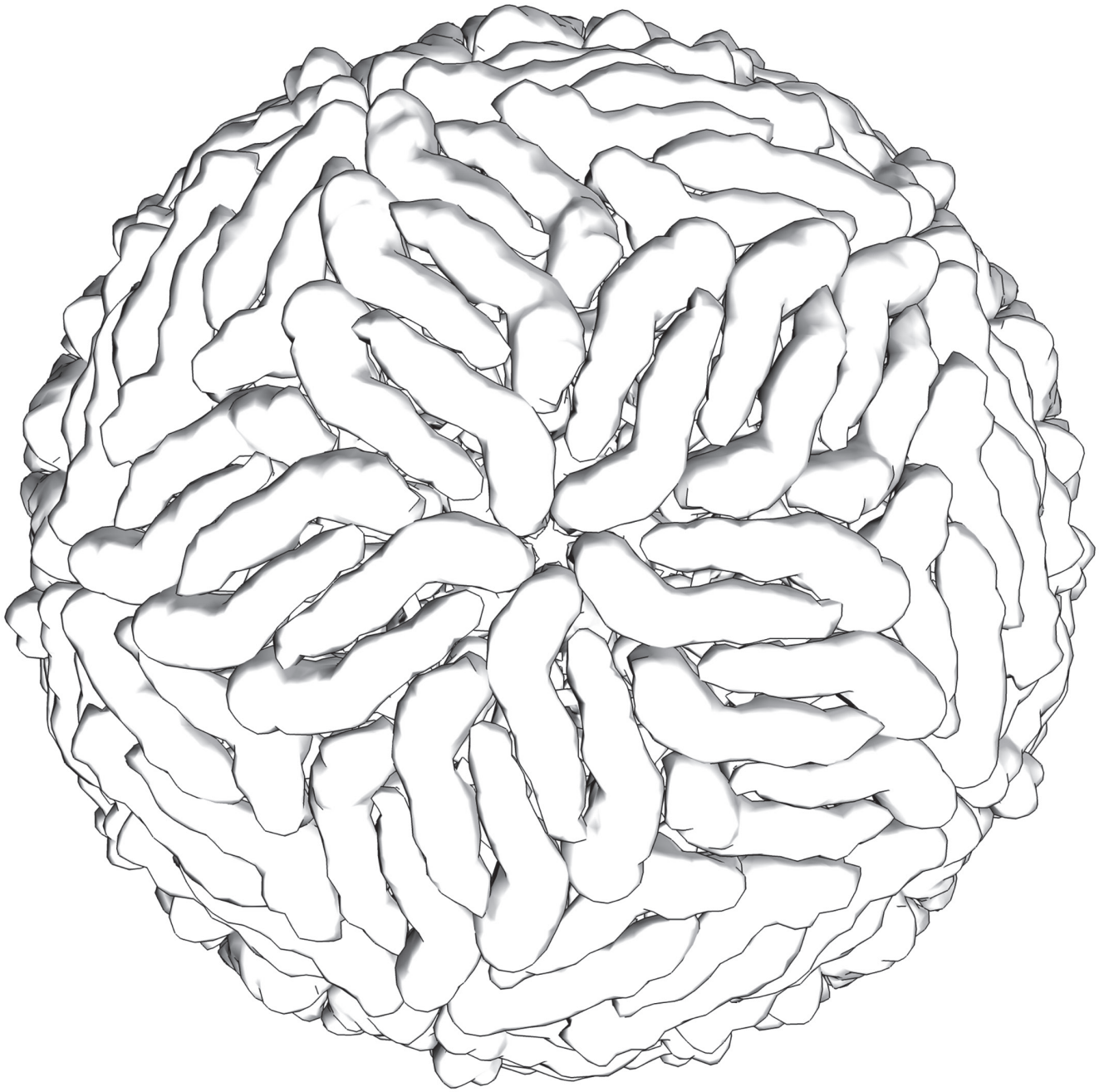
Rhinovirus

Rhinovirus is a picornavirus, or "little RNA virus". These viruses are composed of a protein shell surrounding a short piece of RNA.



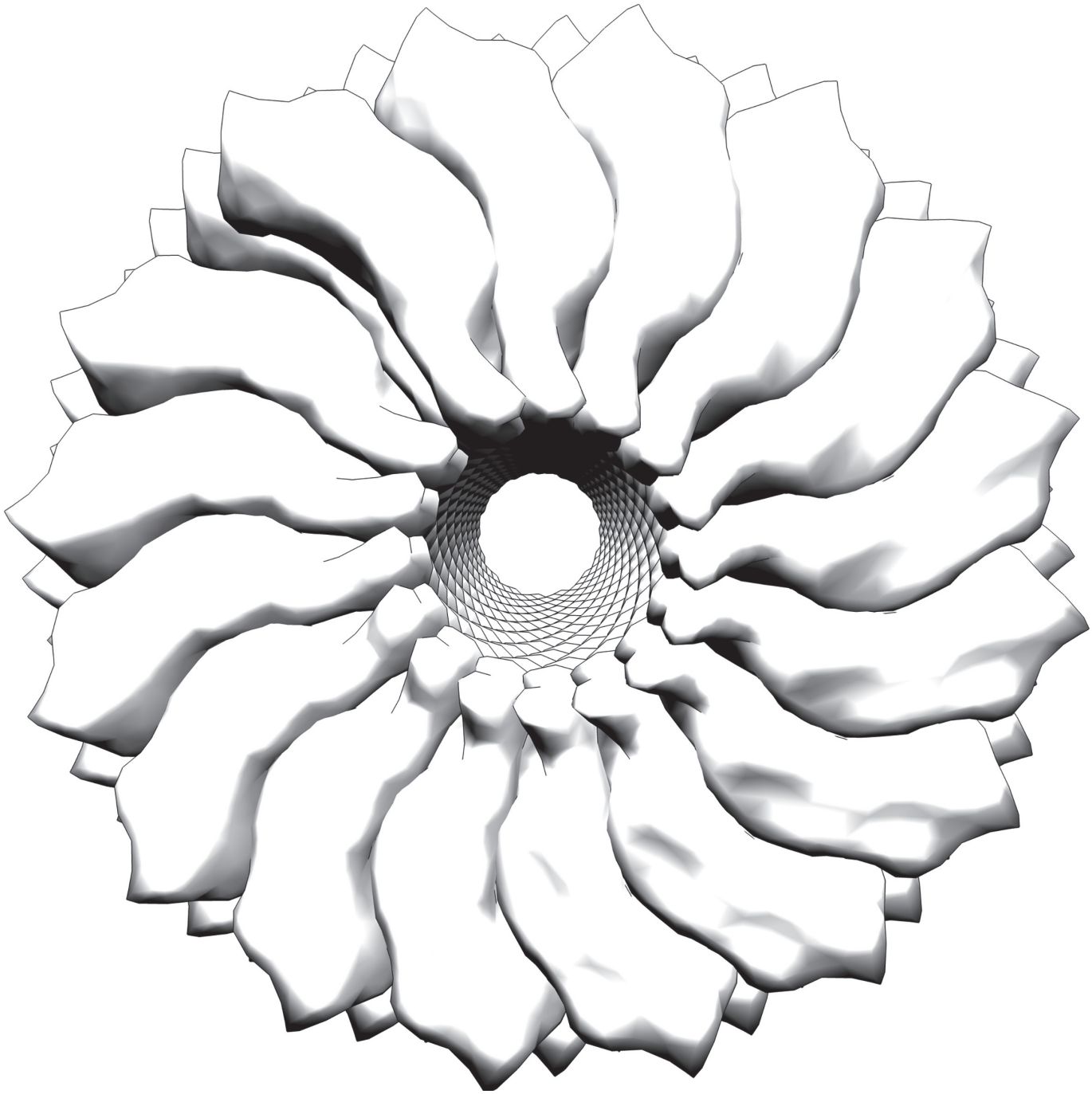
Zika Virus

Cryo-electron microscopy reveals the structure of Zika virus.



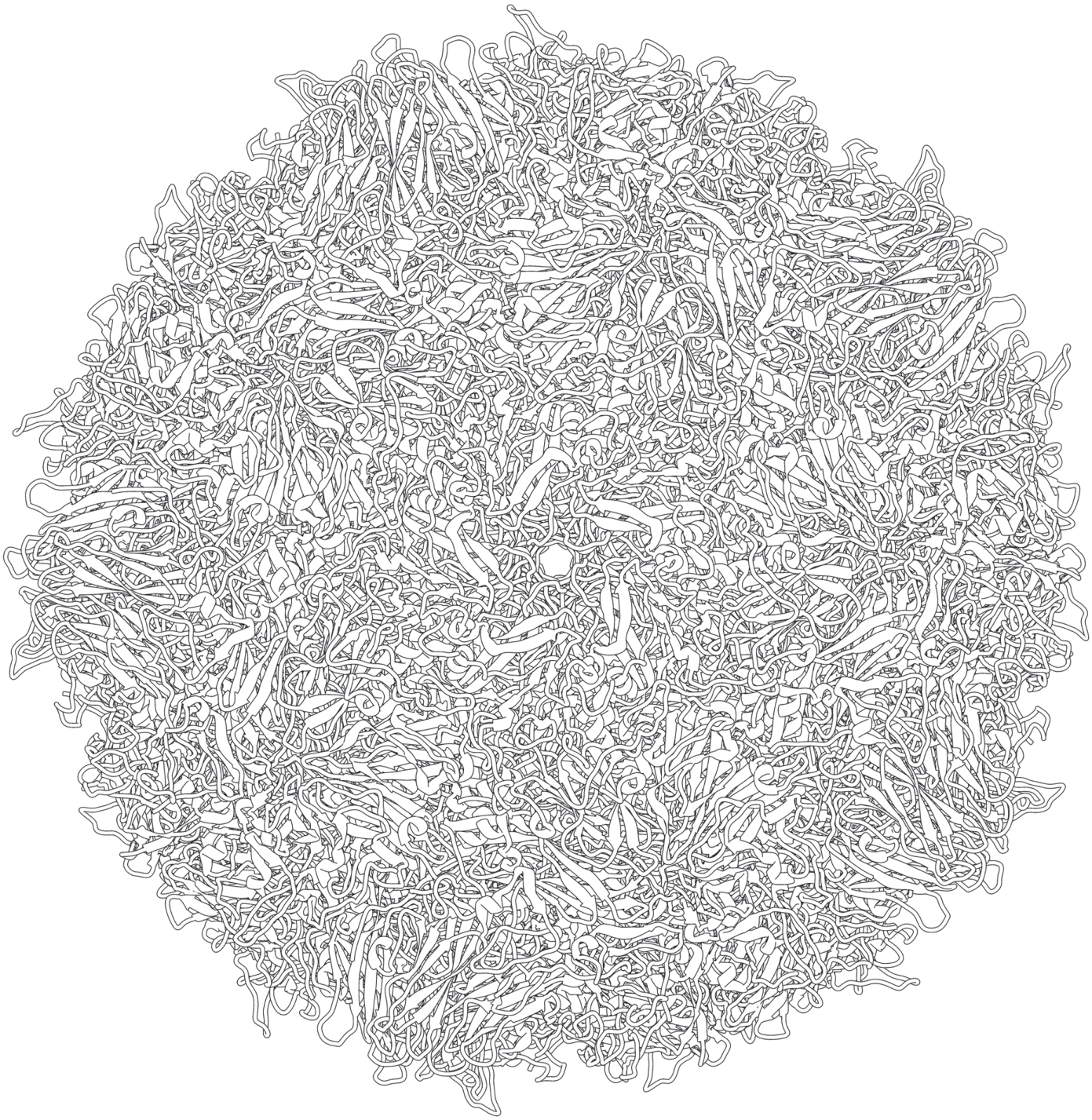
Tobacco Mosaic Virus

A cylindrical arrangement of proteins protects a long strand of RNA in TMV.



Poliovirus

Crystallographic structures reveal the atomic details of viruses and how to fight them.



Acknowledgments

The RCSB PDB *Molecule of the Month*[1] series by David S. Goodsell (RCSB PDB-Rutgers and The Scripps Research Institute) presents short accounts on molecules from the Protein Data Bank.

The molecular images in this booklet were created by Brian Hudson using UCSF Chimera[2].

1. David S. Goodsell, Shuchismita Dutta, Christine Zardecki, Maria Voigt, Helen M. Berman, Stephen K. Burley. (2015) The RCSB PDB "Molecule of the Month": Inspiring a Molecular View of Biology. *PLoS Biol* **13**: e1002140.

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Clathrin *(page 14)*
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Potassium Channels *(page 15)*
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TATA-Binding Protein *(page 6)*
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Zinc Fingers *(page 7)*
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