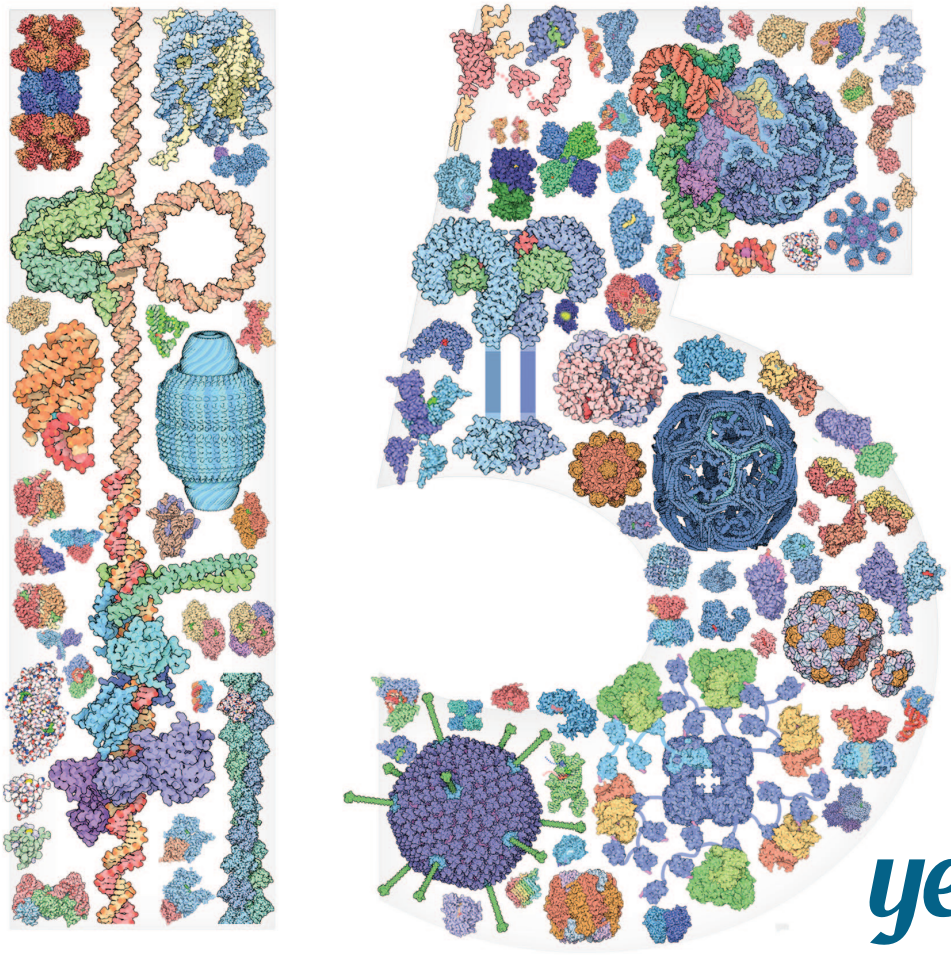
2015 CALENDAR



15 years

of Molecule of the Month

RCSB PDB
PROTEIN DATA BANK

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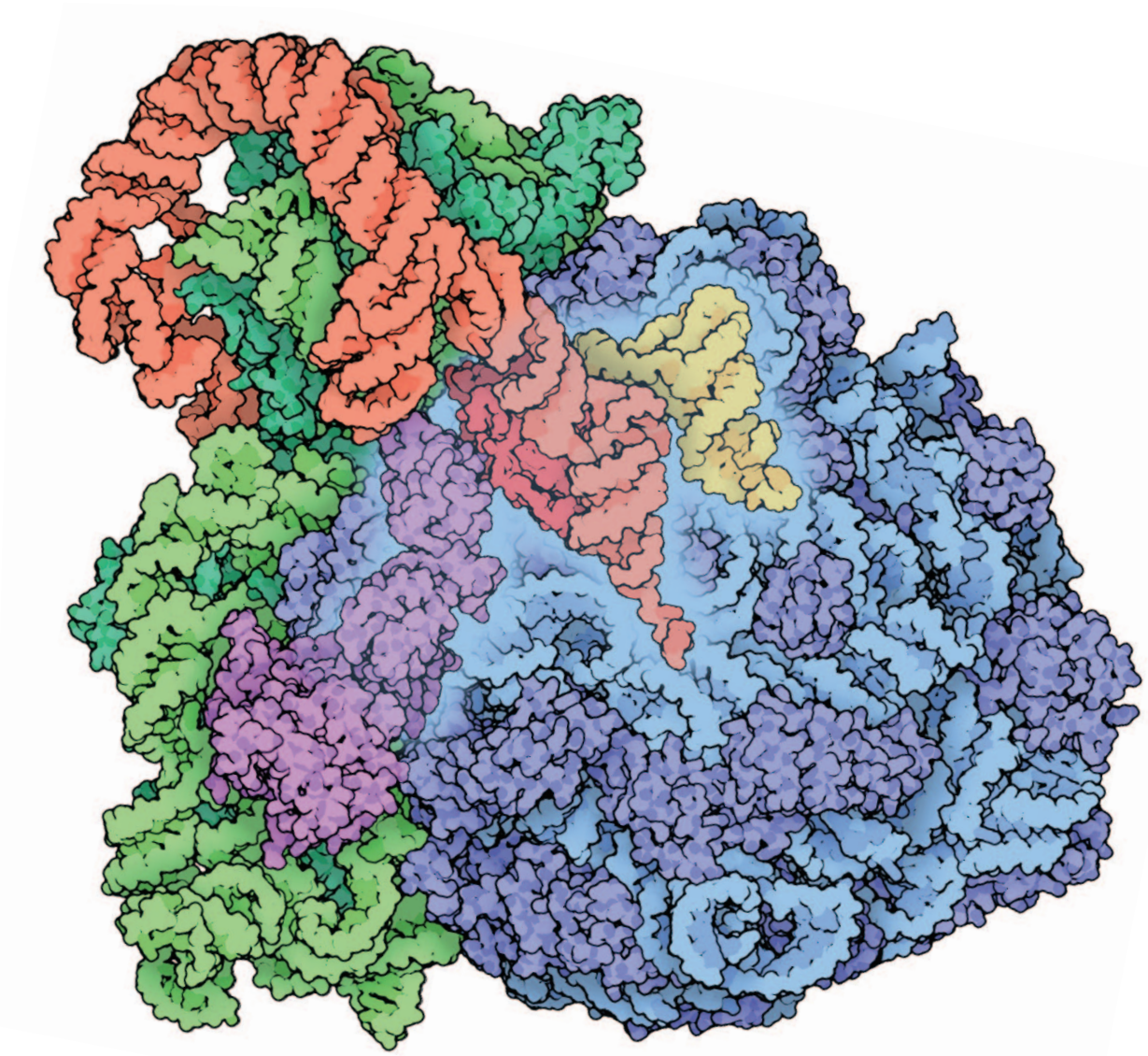
rcsb.org/pdb-101

Transfer-Messenger RNA

Transfer-messenger RNA rescues ribosomes that are stalled on truncated mRNA. This structure was solved by cryoelectron microscopy, and includes a ribosome with tmRNA, tRNA and elongation factor G.



doi: 10.2210/rcsb_pdb/mom_2013_1

PDB ID
4v6t

January 2015

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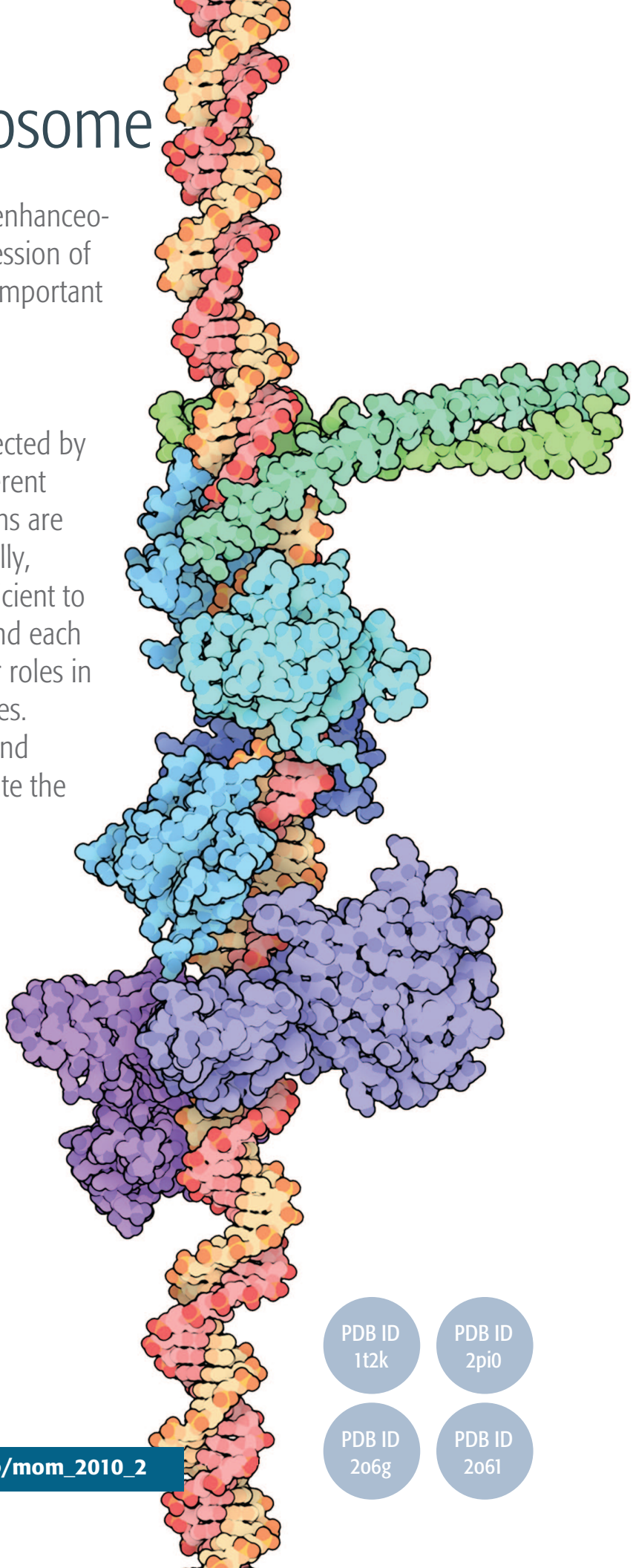
Enhanceosome

The transcriptional enhanceosome controls expression of interferon-beta, an important protein for fighting viral infection.

When the cell is infected by viruses, several different DNA-binding proteins are produced. Individually, each one is not sufficient to activate the gene, and each one also plays other roles in activating other genes. But when they all bind together, they activate the gene and interferon is made.



PDB ID 1t2k

PDB ID 2pi0

PDB ID 2o6g

PDB ID 2o61

doi: 10.2210/rcsb_pdb/mom_2010_2

February 2015

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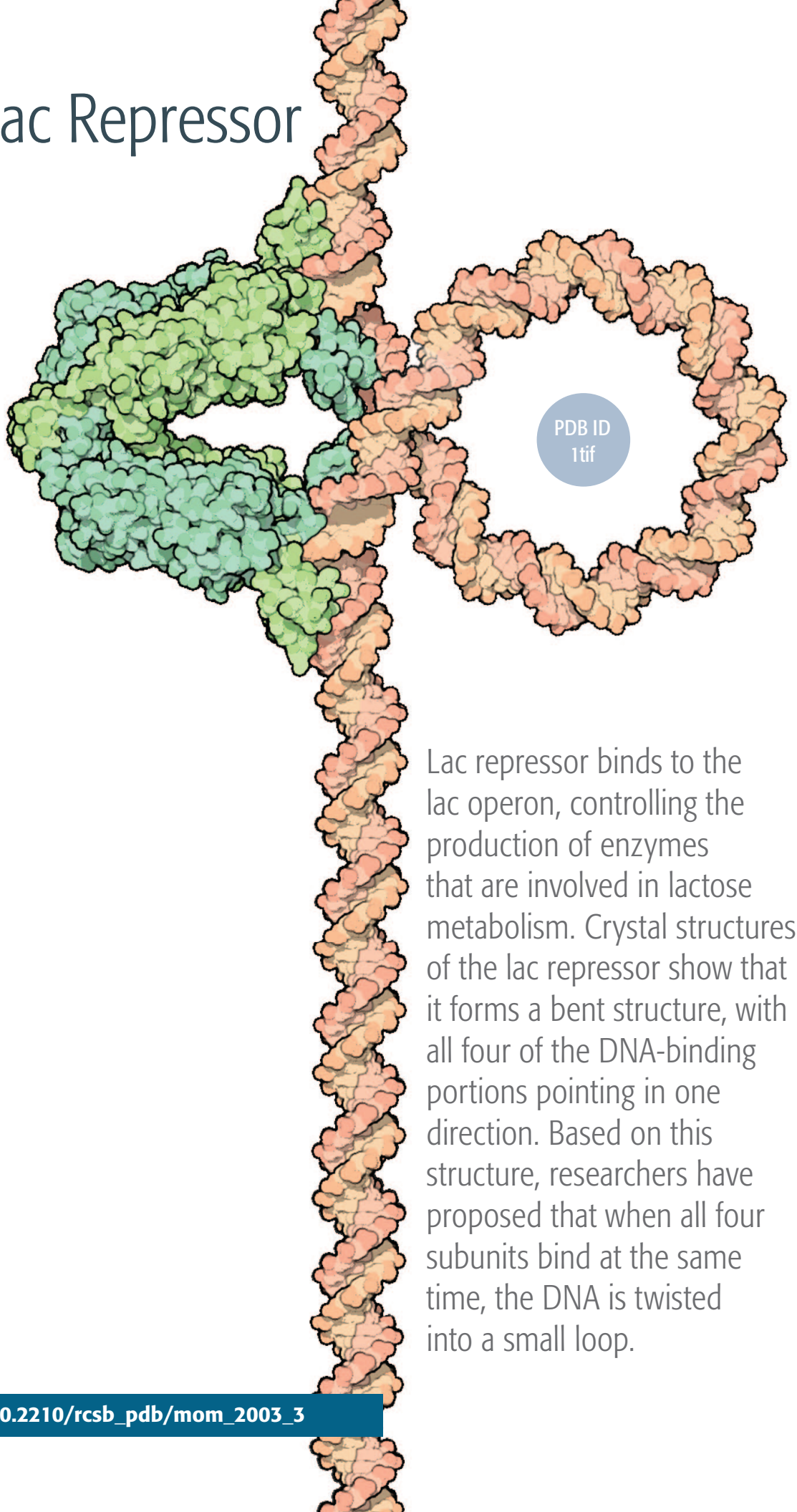
lac Repressor



Lac repressor binds to the lac operon, controlling the production of enzymes that are involved in lactose metabolism. Crystal structures of the lac repressor show that it forms a bent structure, with all four of the DNA-binding portions pointing in one direction. Based on this structure, researchers have proposed that when all four subunits bind at the same time, the DNA is twisted into a small loop.

10.2210/rcsb_pdb/mom_2003_3

March 2015

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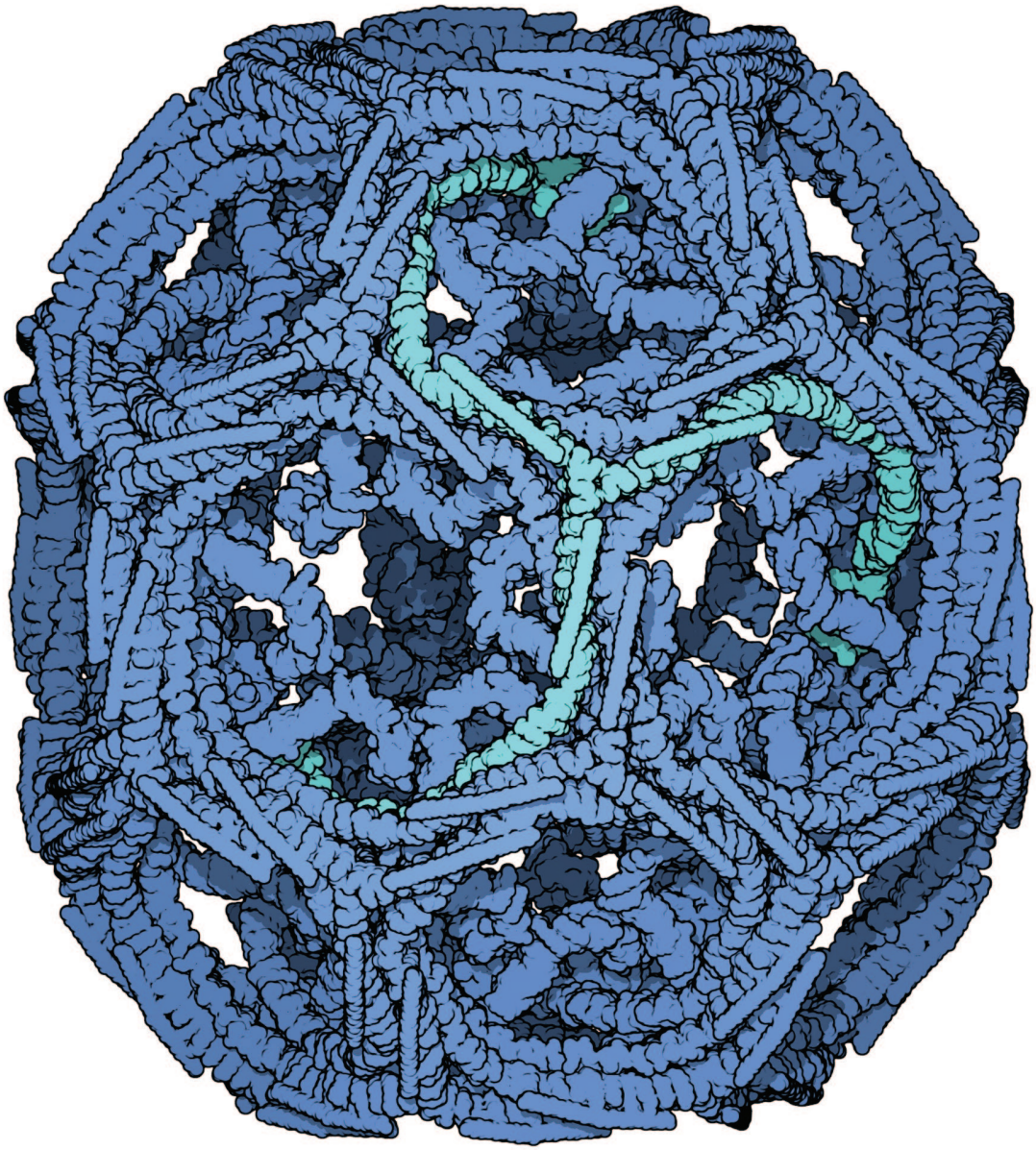
Clathrin

Clathrin was named in the 1960s for its clathrate (lattice of bars) appearance in electron micrographs. Like many proteins, clathrin represents a perfect case of form following function: it performs critical roles in shaping rounded vesicles for intracellular trafficking.



PDB ID
1xi4

doi: 10.2210/rcsb_pdb/mom_2007_4

April 2015

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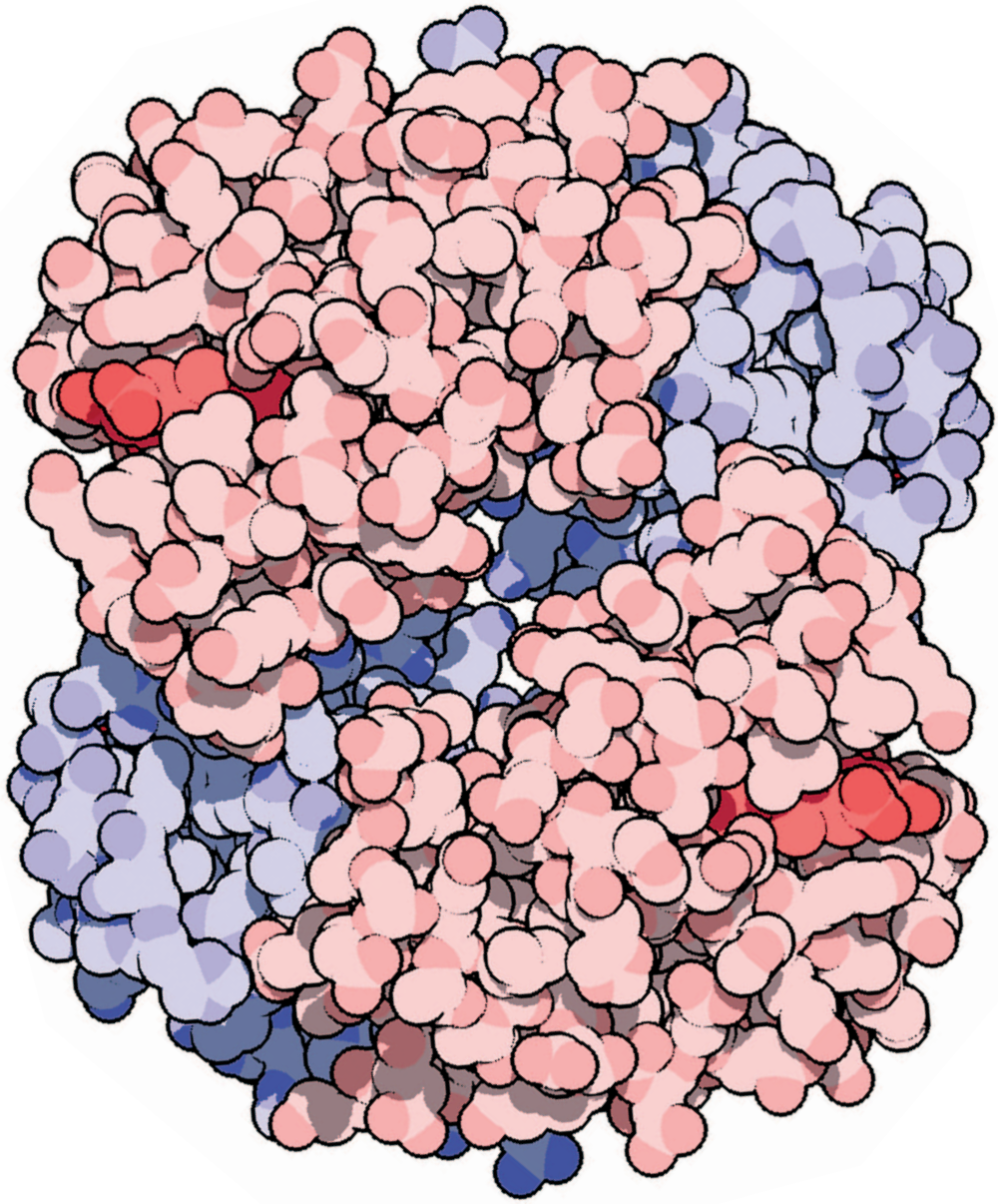
Hemoglobin

Hemoglobin is the protein that transports oxygen in the blood. This historic structure was the first structure of a multisubunit protein, solved in the laboratory of Max Perutz.



PDB ID
2dhb

doi: 10.2210/rcsb_pdb/mom_2003_5

May 2015

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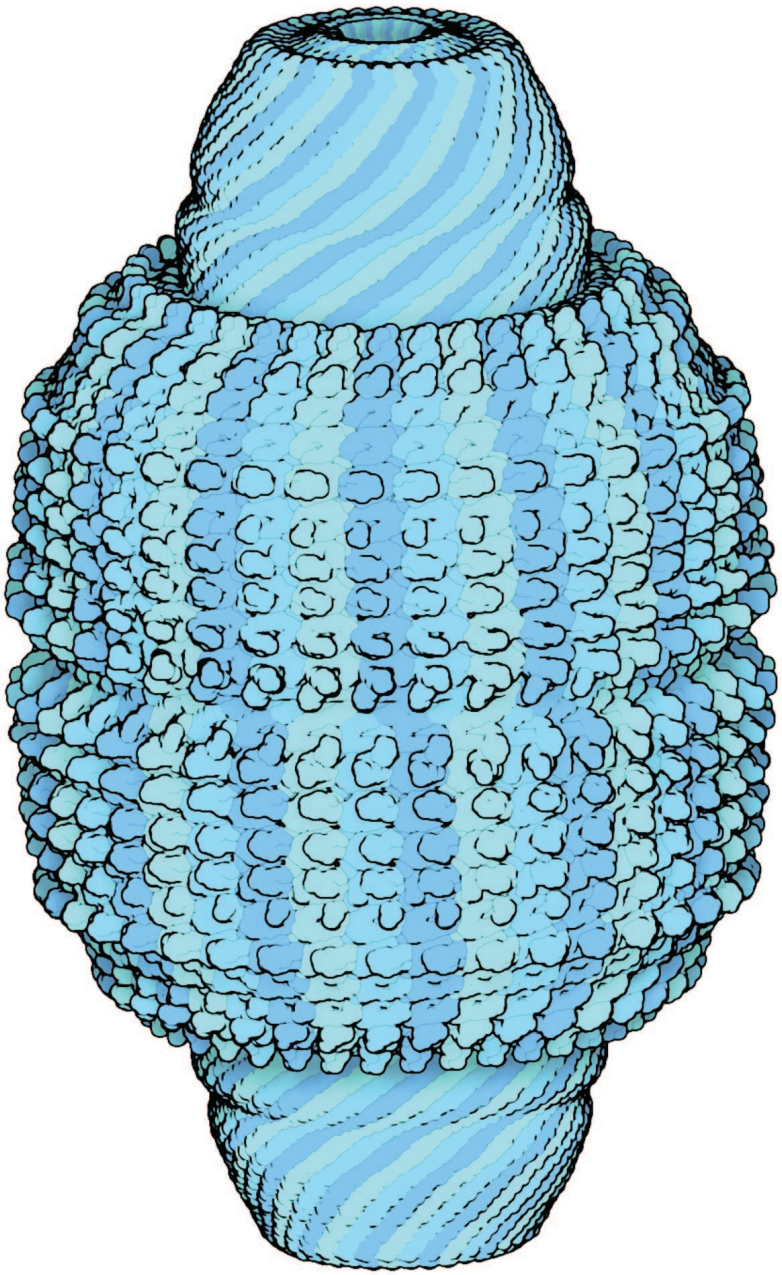
Su 31

Vaults

Vaults are large protein-enclosed compartments found in many types of cells. For instance, our own cells contain about 100,000. They have been found in the cytoplasm, nucleus, and even in nuclear pores, suggesting that they may be important for transport within the cell.



PDB ID
4v60

doi: 10.2210/rcsb_pdb/mom_2009_6

June 2015

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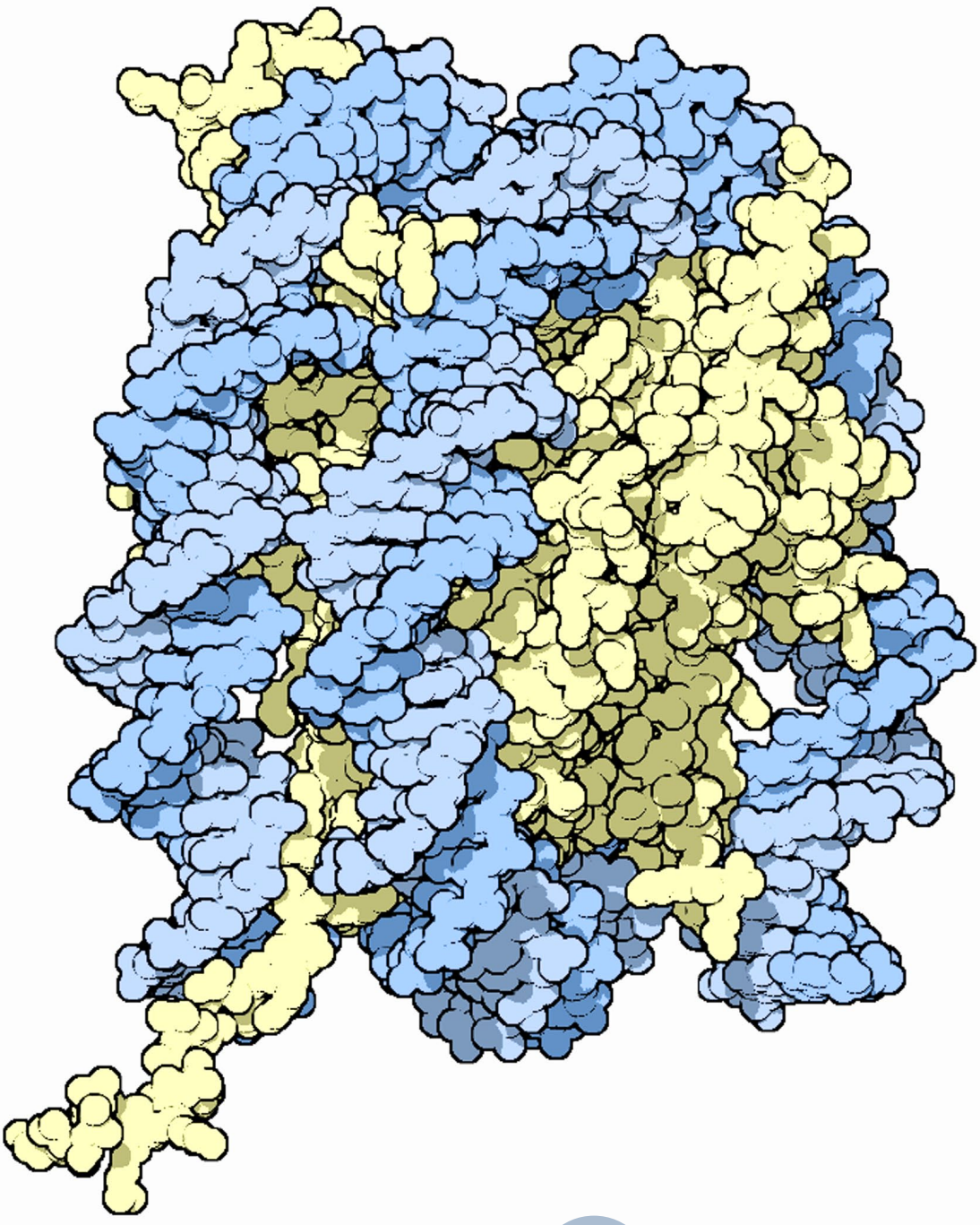
Nucleosome

DNA is safely packaged inside the nucleus in nucleosomes. This structure shows a long piece of DNA wrapped around histone proteins.



PDB ID
1aoi

doi: 10.2210/rcsb_pdb/mom_2000_7

July 2015

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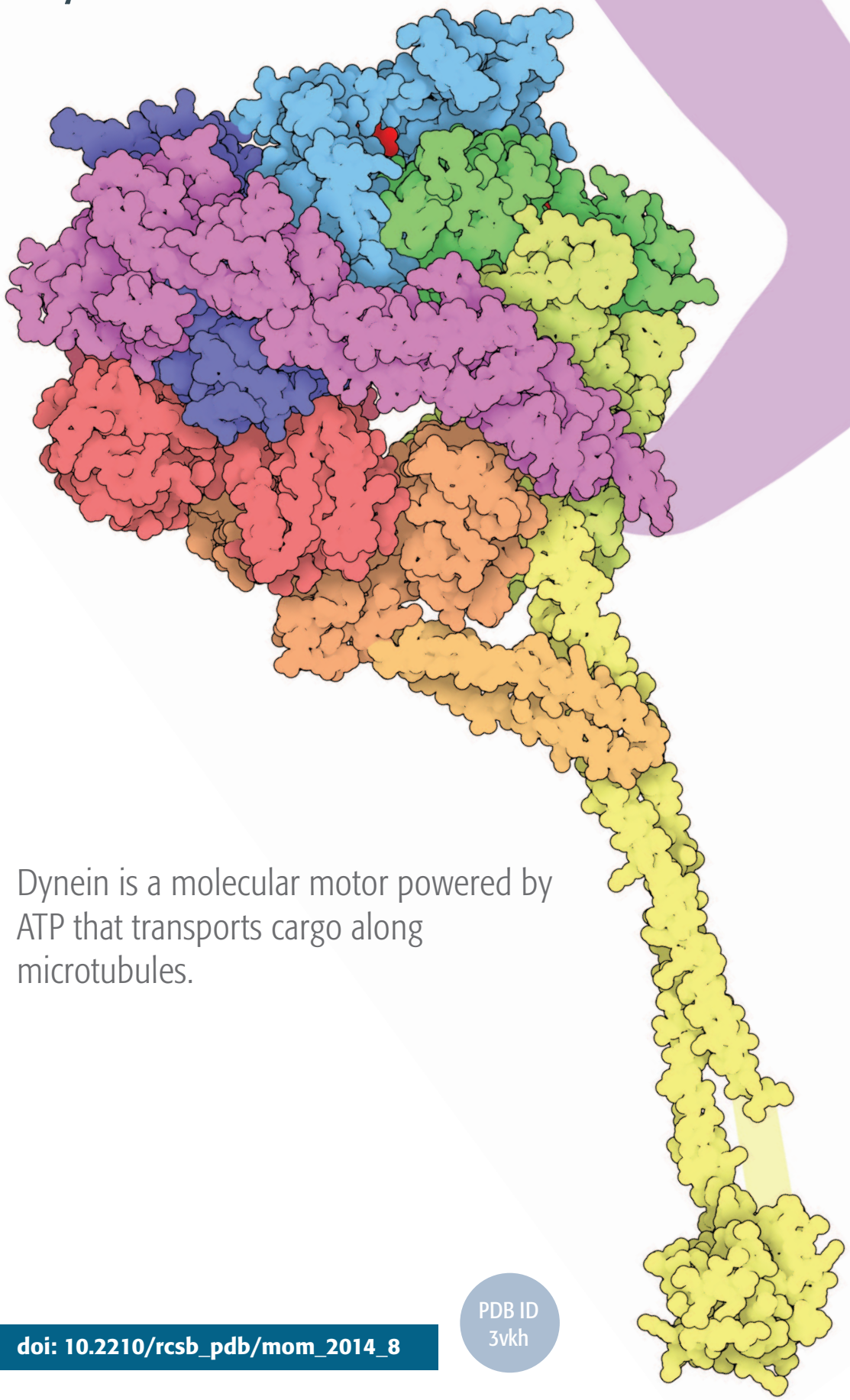
Dynein



Dynein is a molecular motor powered by ATP that transports cargo along microtubules.

PDB ID 3vkh

doi: 10.2210/rcsb_pdb/mom_2014_8

August 2015

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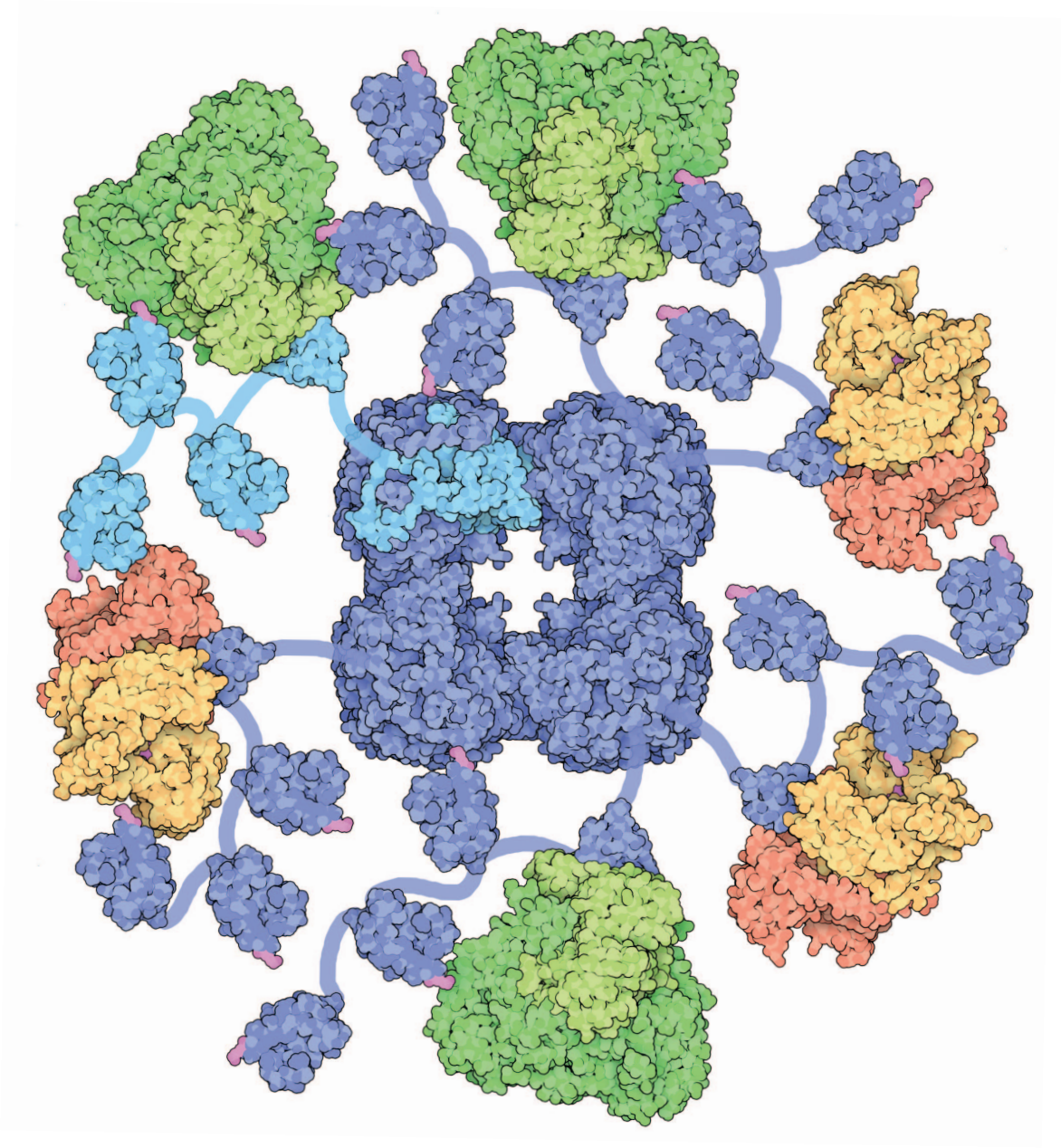
Pyruvate Dehydrogenase Complex

This complex performs a central step in energy production, catalyzing the reaction that links glycolysis with the tricarboxylic acid cycle. The reaction is performed in three separate steps by three separate enzymes, but all three enzymes are linked efficiently together into one large multienzyme complex.



doi: 10.2210/rcsb_pdb/mom_2012_9

PDB ID 1eaa

PDB ID 1lac

PDB ID 1w85

PDB ID 1ebd

September 2015

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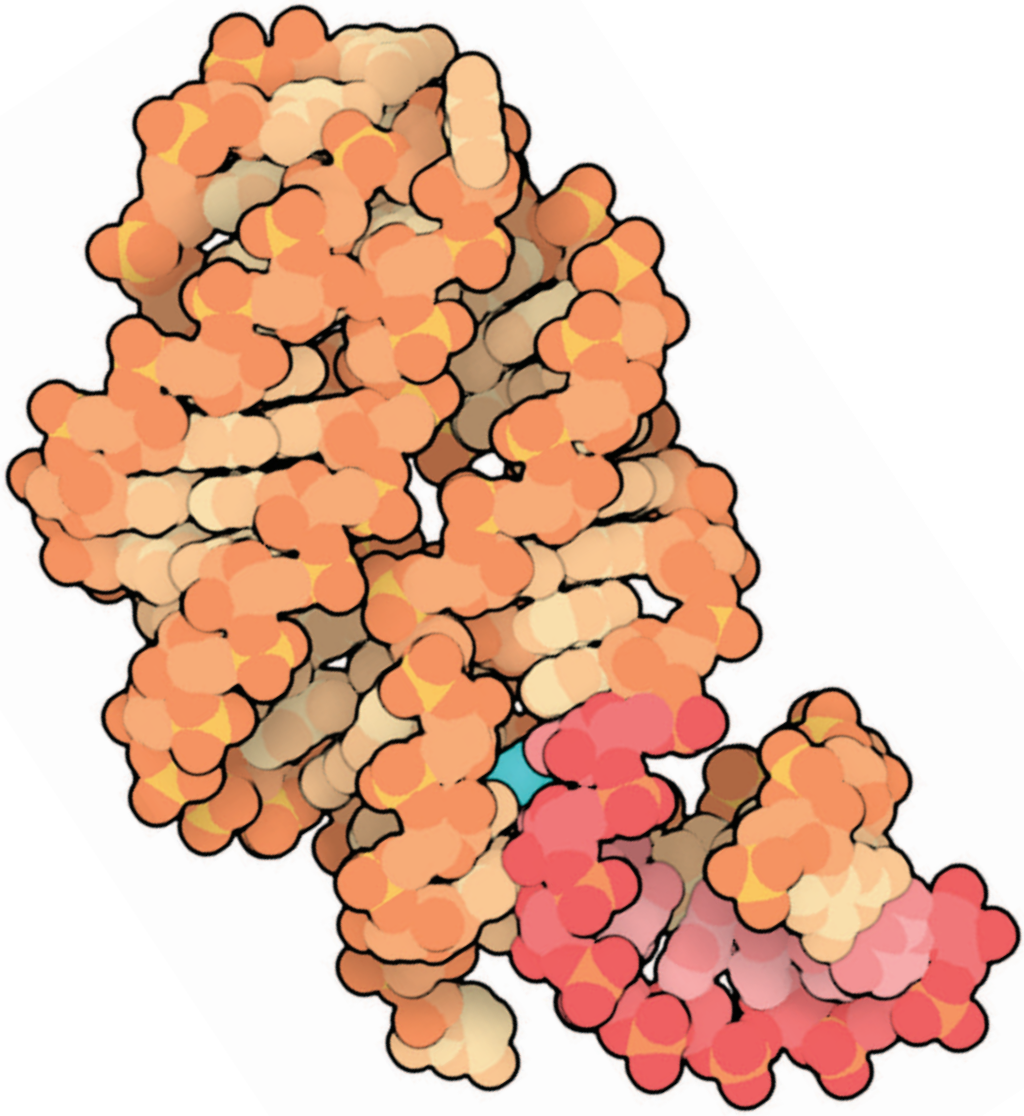
Riboswitch

Riboswitches are regulatory elements built directly into a messenger RNA. The riboswitch shown here senses the level of purine bases, binding tightly to guanine, hypoxanthine and xanthine. This riboswitch is part of the messenger RNA that encodes enzymes that transport and metabolize purines. So, when purine bases are prevalent, they bind to the riboswitch and slow down the production of the proteins when they're not needed.



PDB ID
4fe5

doi: 10.2210/rcsb_pdb/mom_2010_10

October 2015

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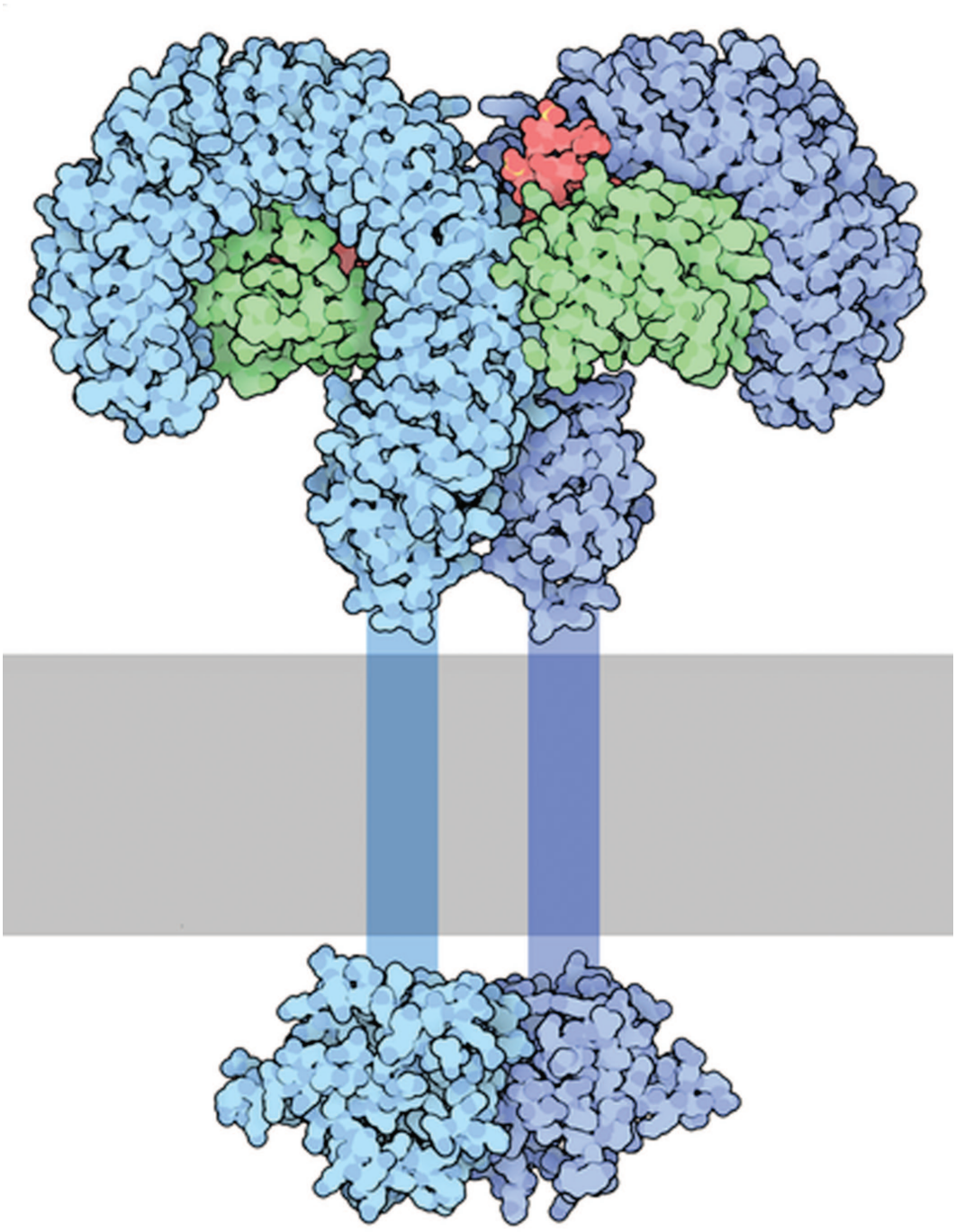
Toll-like Receptor

Toll-like receptors recognize foreign molecules as part of the innate immune system.



PDB ID 3fxi

PDB ID 2j67

doi: 10.2210/rcsb_pdb/mom_2011_11

November 2015

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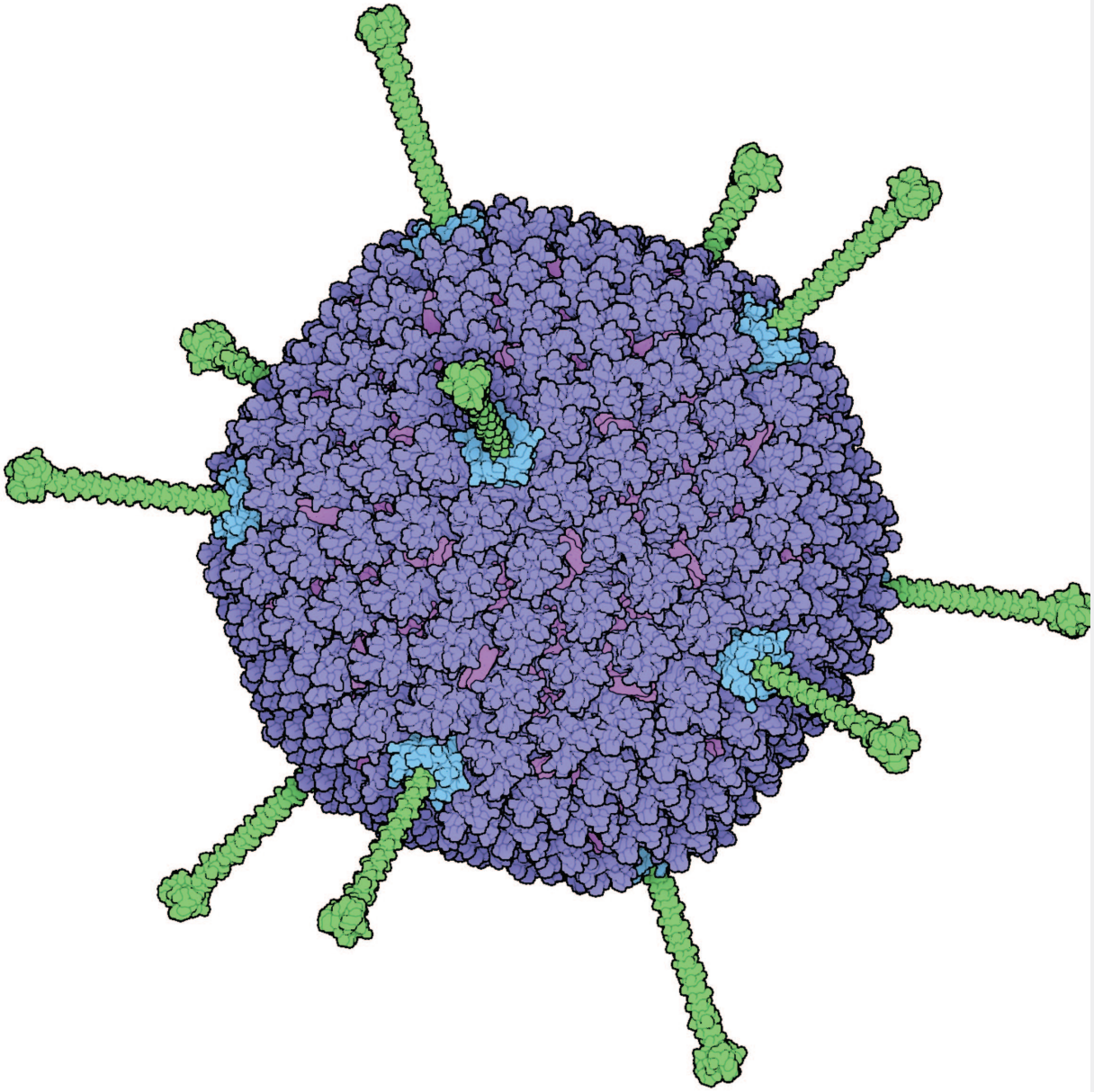
Adenovirus

Scientists are discovering ways to trick viruses, including the adenovirus, into improving our health. Found around the world, adenovirus usually causes only mild disease when it infects cells. It can be life-threatening, however, in infants or people with weakened immune systems. Modified forms of the virus are being developed to cure genetic diseases, fight cancer, and deliver vaccines.



PDB ID 1vsz

PDB ID 1qiu

doi: 10.2210/rcsb_pdb/mom_2010_12

December 2015

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About

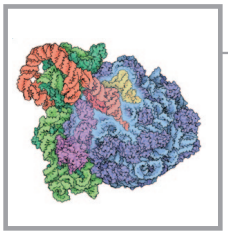
In January 2000, the *Molecule of the Month* was launched with a feature on myoglobin, the first structure determined using X-ray crystallography. Since then, 180 Molecule of the Month articles have explored the structure and function of PDB macromolecules from AAA+ proteases to Zinc fingers. These articles are one of the most popular features of the RCSB PDB website and are utilized by classrooms around the world.

Authored and illustrated by David S. Goodsell, *Molecule of the Month* features have grown over the years to include curated, interactive views, discussion topics, and links to specific examples. The carefully composed illustrations, available free for use as high resolution images, have been reproduced and used in countless educational resources. These unique pictures of molecular machines provided both inspiration and content for the Art of Science traveling exhibit.

Through the years, *Molecule of the Month* features have become tightly integrated with other RCSB PDB initiatives. Many posters, paper models, and animations have been built using these features. The articles have also led to the creation of the *Structural View of Biology* browser, which offers top-down contextual exploration of the PDB. January's focus on Cascade and CRISPR will be used in this year's protein modeling event in the Science Olympiad.

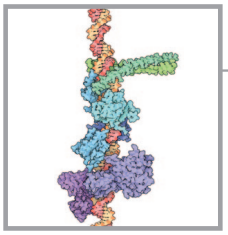
A small selection of the many molecular highlights of the past 15 years are featured here in celebration of this special anniversary.

References



Transfer-Messenger RNA from January 2013

4v6t D. J. Ramrath, H. Yamamoto, K. Rother, D. Wittek, M. Pech, T. Mielke, J. Loerke, P. Scheerer, P. Ivanov, Y. Teraoka, O. Shpanchenko, K. H. Nierhaus, C. M. Spahn. (2012) The complex of tmRNA-SmpB and EF-G on translocating ribosomes. *Nature* **485**: 526-529.

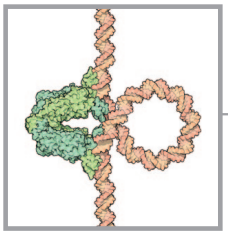


Enhanceosome from February 2010

1t2k D. Panne, T. Maniatis, S. C. Harrison. (2004) Crystal structure of ATF-2/c-Jun and IRF-3 bound to the interferon-beta enhancer. *EMBO J* **23**: 4384-4393.

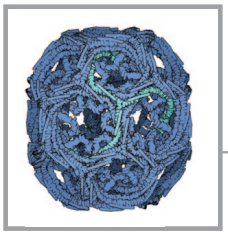
2pi0 C. R. Escalante, E. Nistal-Villan, L. Shen, A. Garcia-Sastre, A. K. Aggarwal. (2007) Structure of IRF-3 bound to the PRDIII-I regulatory element of the human interferon-beta enhancer. *Mol Cell* **26**: 703-716.

2o6g, 2o61 D. Panne, T. Maniatis, S. C. Harrison. (2007) An atomic model of the interferon-beta enhanceosome. *Cell* **129**: 1111-1123.



lac Repressor from March 2003

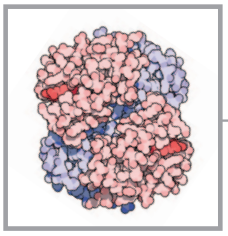
1tif V. Biou, F. Shu, V. Ramakrishnan. (1995) X-ray crystallography shows that translational initiation factor IF3 consists of two compact alpha/beta domains linked by an alpha-helix. *EMBO J* **14**: 4056-4064.



Clathrin from April 2007

1xi4 A. Fotin, Y. Cheng, P. Sliz, N. Grigorieff, S. C. Harrison, T. Kirchhausen, T. Walz. (2004) Molecular model for a complete clathrin lattice from electron cryomicroscopy. *Nature* **432**: 573-579.

The Clathrin feature was coauthored by David S. Goodsell and Graham Johnson



Hemoglobin from May 2003

2dhb M. F. Perutz, M. G. Rossmann, A. F. Cullis, H. Muirhead, G. Will, A. C. T. North. (1960) Structure of haemoglobin: a three-dimensional Fourier synthesis at 5.5 Å resolution, obtained by X-ray analysis. *Nature* **185**: 416-422.

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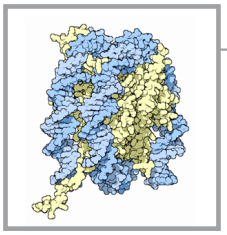
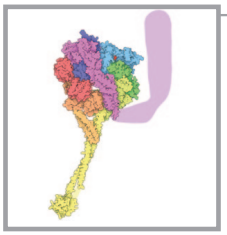
4v60 H. Tanaka, K. Kato, E. Yamashita, T. Sumizawa, Y. Zhou, M. Yao, K. Iwasaki, M. Yoshimura, T. Tsukihara. (2009) The structure of rat liver vault at 3.5 angstrom resolution. *Science* **323**: 384-388.



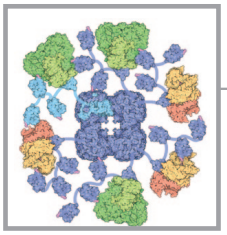
Nucleosome from July 2000

1aoi K. Luger, A. W. Mader, R. K. Richmond, D. F. Sargent, T. J. Richmond. (1997) Crystal structure of the nucleosome core particle at 2.8 Å resolution. *Nature* **389**: 251-260.



Dynein from August 2014

3vkh T. Kon, T. Oyama, R. Shimo-Kon, K. Imamula, T. Shima, K. Sutoh, G. Kurisu. (2012) The 2.8 Å crystal structure of the dynein motor domain. *Nature* **484**: 345-350.



Pyruvate Dehydrogenase Complex from September 2009

1eaa A. Mattevi, G. Obmolova, K. H. Kalk, A. Teplyakov, W. G. Hol. (1993) Crystallographic analysis of substrate binding and catalysis in dihydrolipoyl transacetylase (E2p). *Biochemistry* **32**: 3887-3901.

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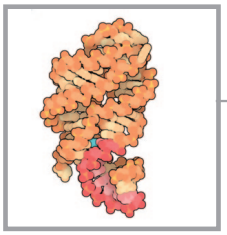

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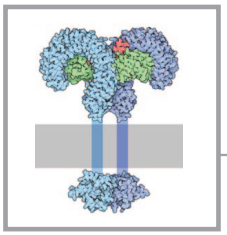
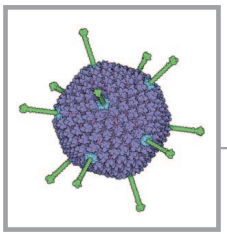
4fe5 R. T. Batey, S. D. Gilbert, R. K. Montange. (2004) Structure of a natural guanine-responsive riboswitch complexed with the metabolite hypoxanthine. *Nature* **432**: 411-415.



Toll-like Receptor from November 2011

3fxi B. S. Park, D. H. Song, H. M. Kim, B. S. Choi, H. Lee, J. O. Lee. (2009) The structural basis of lipopolysaccharide recognition by the TLR4-MD-2 complex. *Nature* **458**: 1191-1195.

2j67 T. Nyman, P. Stenmark, S. Flodin, I. Johansson, M. Hammarstrom, P. Nordlund. (2008) The crystal structure of the human toll-like receptor 10 cytoplasmic domain reveals a putative signaling dimer. *J Biol Chem* **283**: 11861-11865.



Adenovirus from December 2010

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