

Cellular Assemblies

Lecture 5

Acknowledgements:

Alberts - Molecular Biology of the Cell

Scitable by Nature Education

Nature Resources

Internet resources

OBJECTIVE OF THE LECTURE

1. Understand the meaning of self-assembly
 - a) Some examples of artificially created self assembled structures
2. Self assembled structures in cells
3. PDB structure
4. Understand the principles Protein folding

Definitions of Self Assembly & Self Organization

- *Self organization is a process in which pattern at the global level of the system emerges solely from the numerous interactions among the lower-level components of the system. Moreover, the rules specifying interactions among the system's components are executed using only local information without reference to the global pattern ... Camazine et al, 2003*

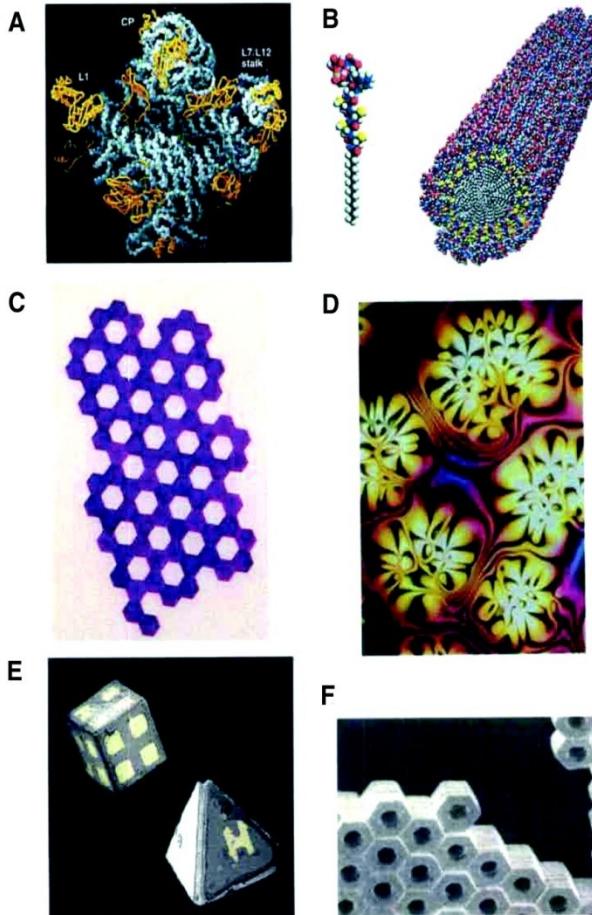
ON THE OTHER HAND

- Self-assembly is the fundamental principle which generates structural organization on all scales from molecules to galaxies. It is defined as reversible processes in which pre-existing parts or disordered components of a preexisting system, form structures or patterns



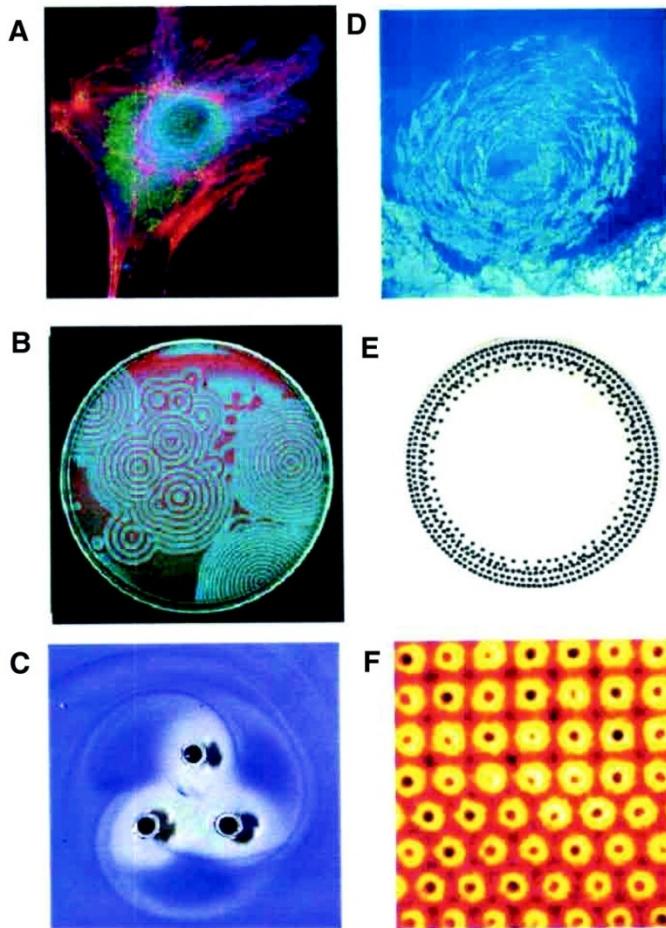
Flocks of Starlings

Examples of Self assembly



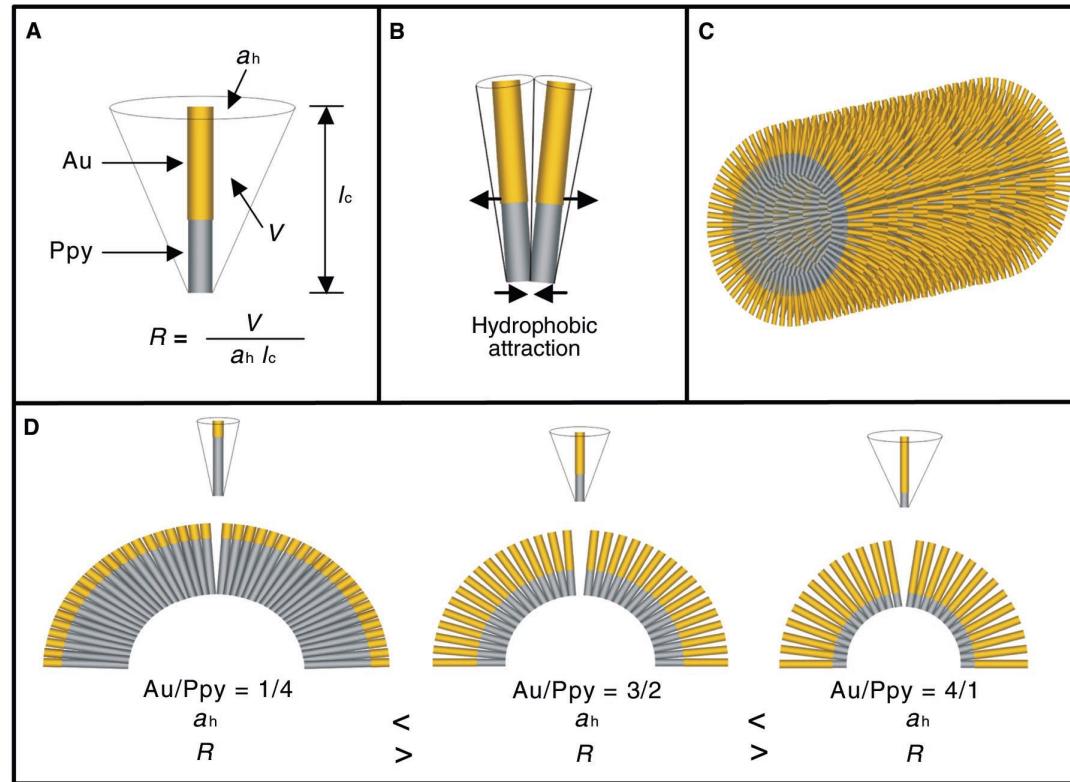
- A. Crystal structure of a ribosome.
- B. Self-assembled peptide-amphiphile nanofibers.
- C. An array of millimeter-sized polymeric plates assembled at a water/perfluorodecalin interface by capillary interactions.
- D. Thin film of a nematic liquid crystal on an isotropic substrate.
- E. Micrometer-sized metallic polyhedra folded from planar substrates.
- F. A three-dimensional aggregate of micrometer plates assembled by capillary forces.

Examples of Self Organization



- A. An optical micrograph of a cell with fluorescently labeled cytoskeleton and nucleus; microtubules (~24 nm in diameter) are colored red.
- B. Reaction-diffusion waves in a Belousov-Zabatinski reaction in a 3.5-inch Petri dish.
- C. A simple aggregate of three millimeter-sized, rotating, magnetized disks interacting with one another via vortex-vortex interactions.
- D. A school of fish.
- E. Concentric rings formed by charged metallic beads 1 mm in diameter rolling in circular paths on a dielectric support.
- F. Convection cells formed above a micropatterned metallic support. The distance between the centers of the cells is ~2 mm.

Self-Assembly of Mesoscopic Metal-Polymer Amphiphiles



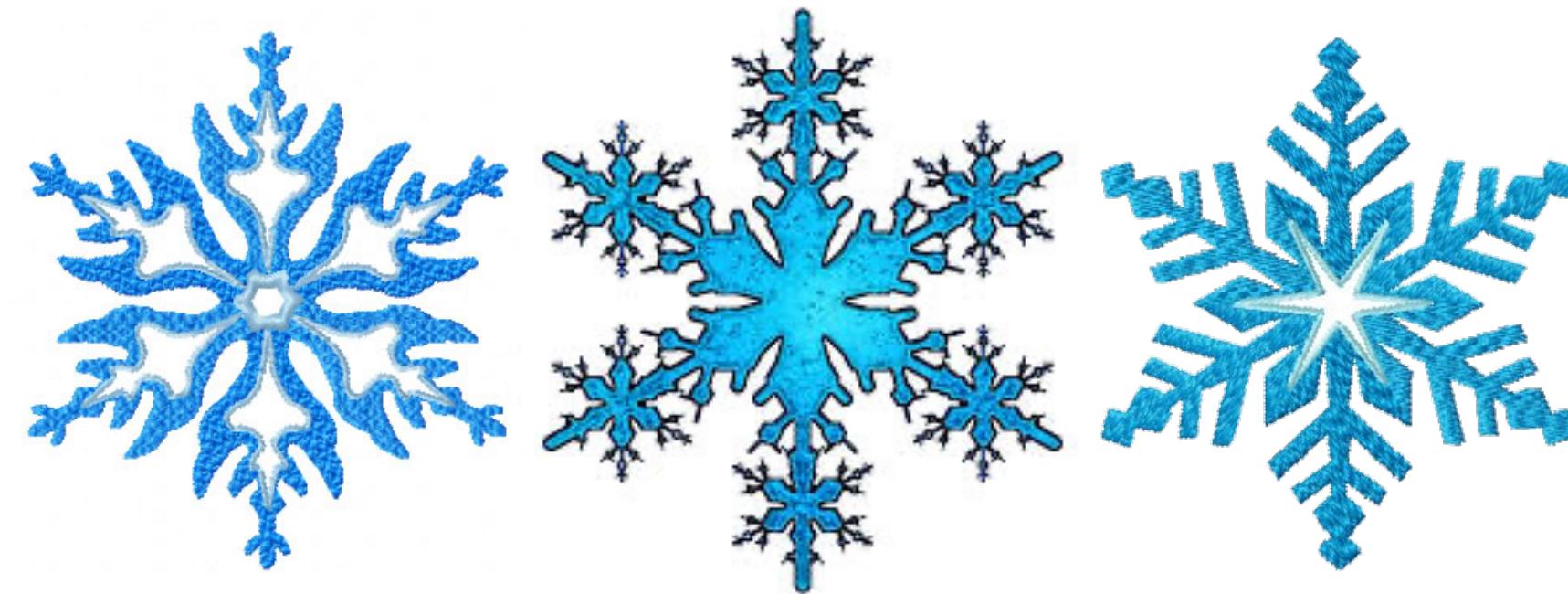
Hard hydrophilic domain is an inorganic material such as gold, and the soft domain is a hydrophobic conducting polymer such as oxidized polypyrrole, which can be electrochemically polymerized within the confines of an alumina template

Self assembly of gold-polypyrrole rods

❖ Au block diameter was 400 (30) nm and the polypyrrole block diameter was 360 (25) nm. These structures self-organize into mesoscopic architectures with unusual structures, including bundles, tubes of varying diameters, and sheets

Science 303, 348 (2004);
Sungho Park et al.⁶

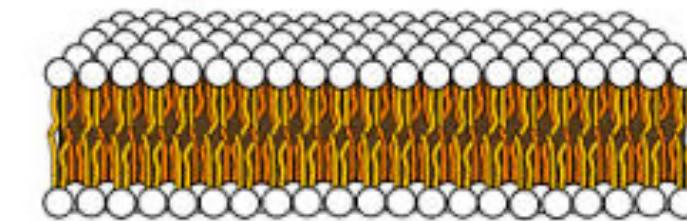
Self assembly of snowflakes



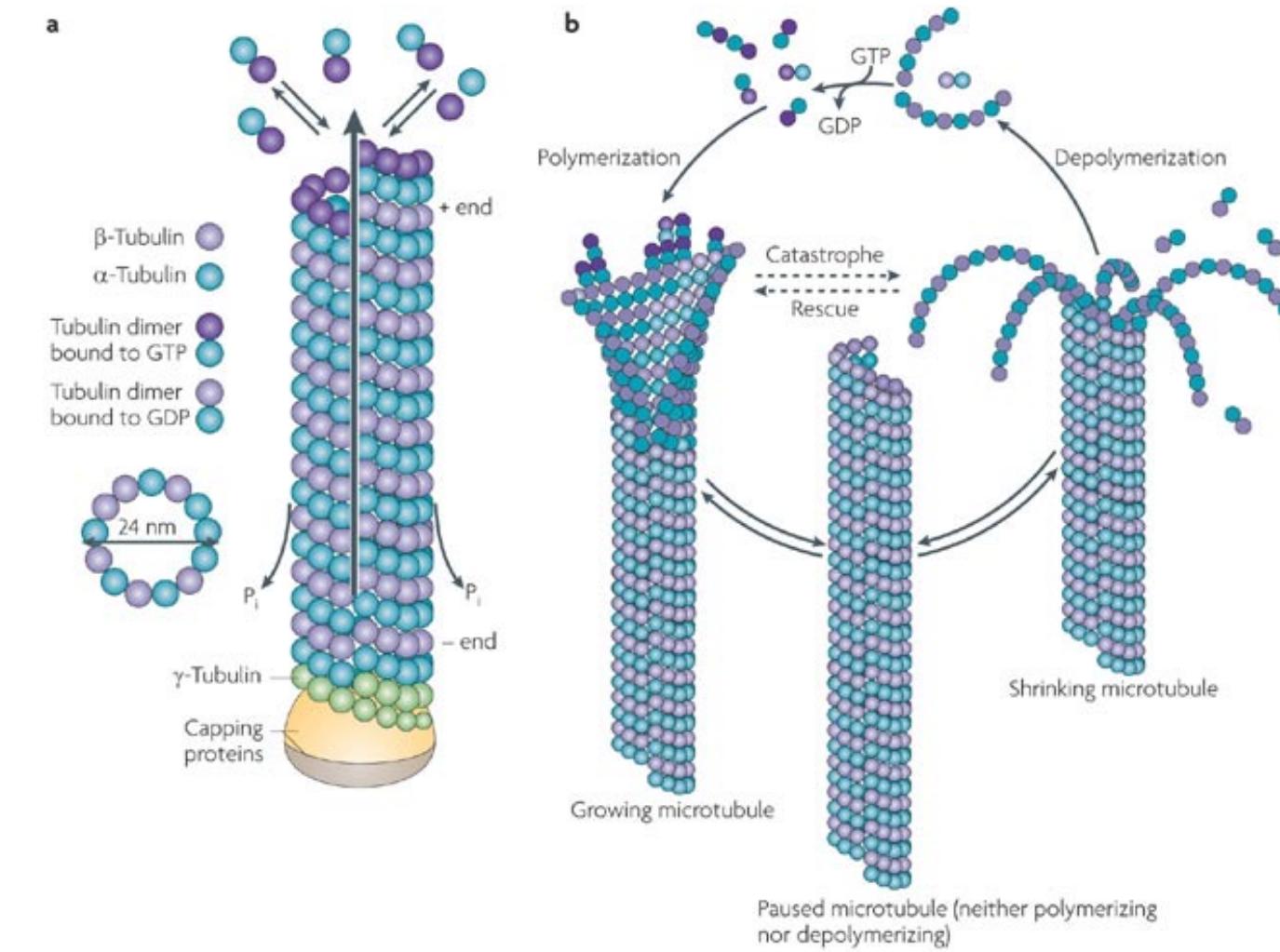
[Snowflakes BBC](#)

Bilayer Self Assembly

[Bilayer sheet self assembly video](#)

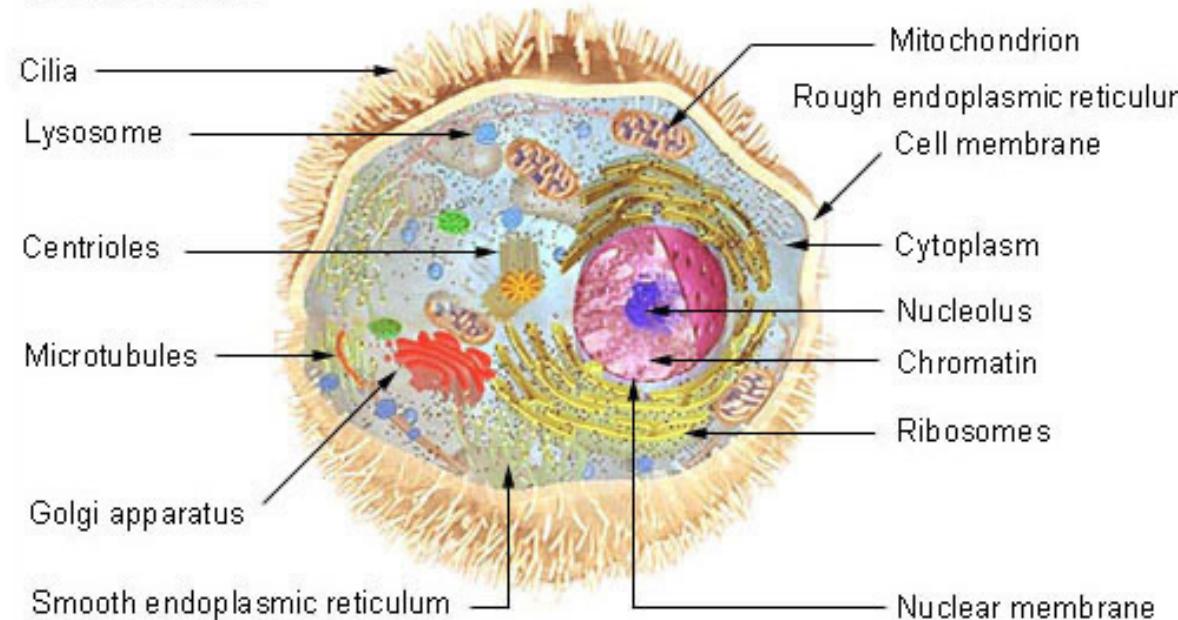


Tubulin and Microtubules



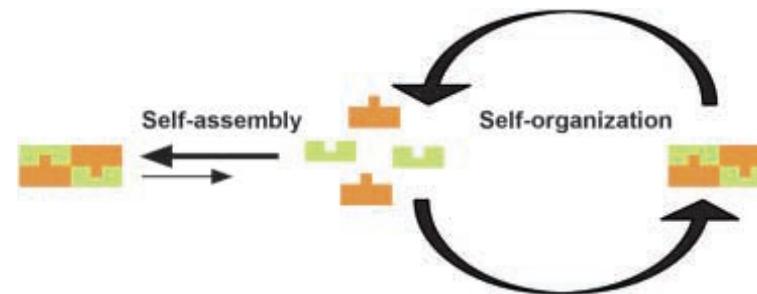
Self Assembly and self organization of internal cellular structures

Cell Structure



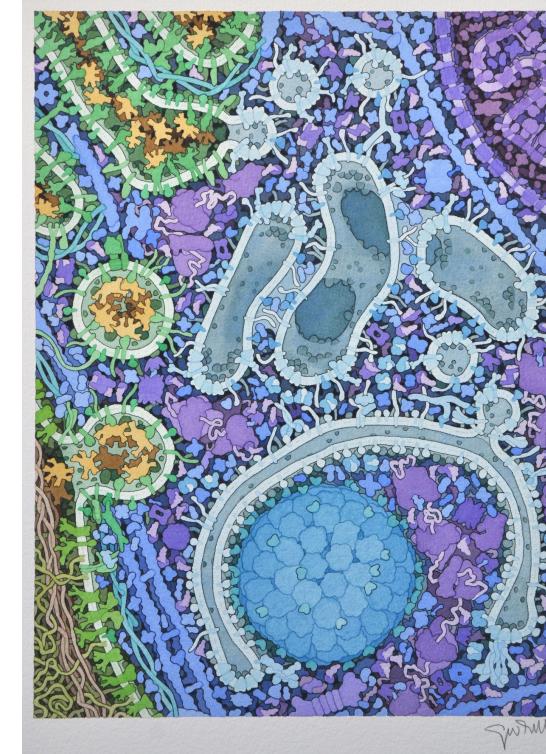
Cellular Components

- i. Nucleus
- ii. Golgi complex
- iii. Actin filaments for cellular structure
- iv. Autophagosomes
- v. Vesicles

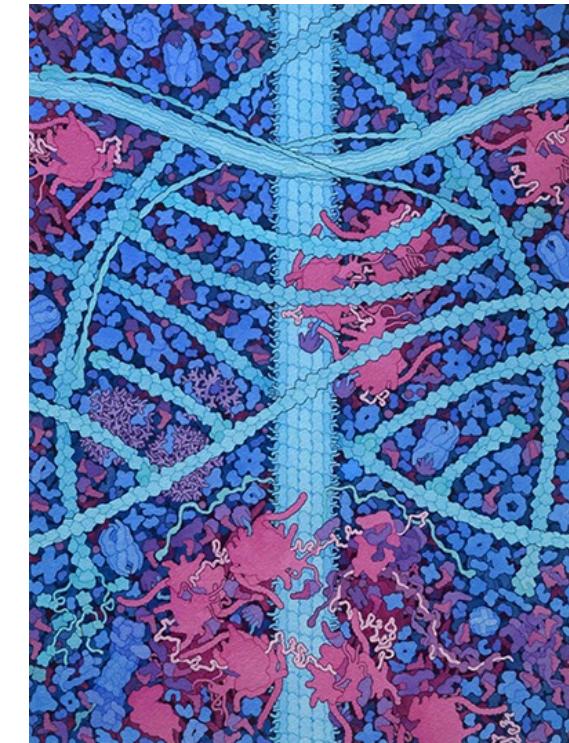


Images from the RCSB site

Autophagy



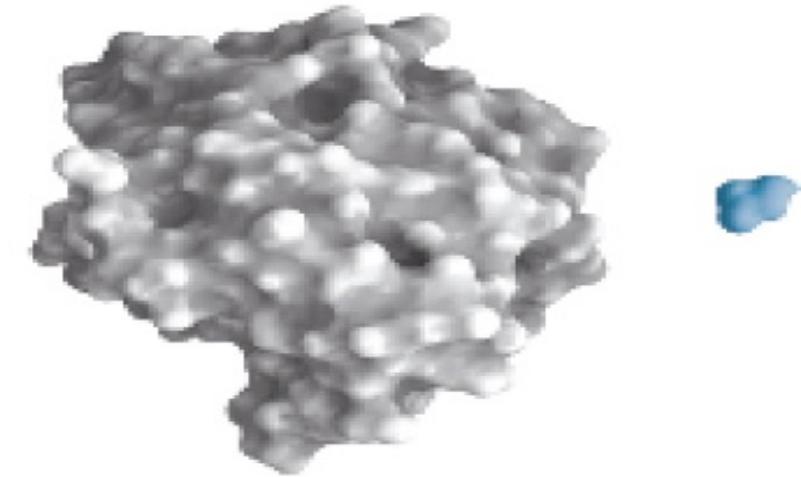
Cytoskeleton



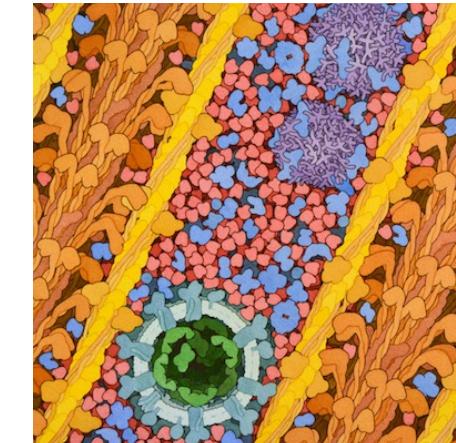
<https://ccsb.scripps.edu/goodsell/>

Protein structure and function

- ❖ Proteins can assume an unlimited number of configurations and yet possess a specific chemical and structural function
- ❖ The known three-dimensional structures of proteins are archived in the Protein Data Bank, or PDB (www.rcsb.org/pdb)
- ❖ The data from the PDB files provide only a series of coordinates detailing the location of atoms and their connectivity



Structure of the enzyme chymotrypsin



Myoglobin in a Whale Muscle Cell