Course content

Topics (lectures)**:**
1. **Introduction** (1)
2. **Structure** (2-5)
3. **Single molecule mechanics** (6-9)
4. **Collective/emergent properties** (9-11)
5. **Student presentations** (11-13)

Course structure:
1. **Introduction to topic**
2. **Awardees (1-2 per week)**
   - **History, first-person, second-person accounts (C)**
   - **Article, analysis of scientific work (E)**
3. **Discussion of topic, outlook**

Lecture 3: Photosynthetic reaction centers

Clayton & Feher

• Roderick Clayton: Purification of photosynthetic reaction center (1968)
• George Feher: Reaction center structure (1974)

"*For his many contributions to the understanding of the physics of photosynthesis; specifically, for his role in the pioneering of the concept of reaction enters in photosynthetic bacteria, their isolation, their spectroscopy and their structural characterization.*" (1982 Delbruck Prize)

The most important reaction on earth

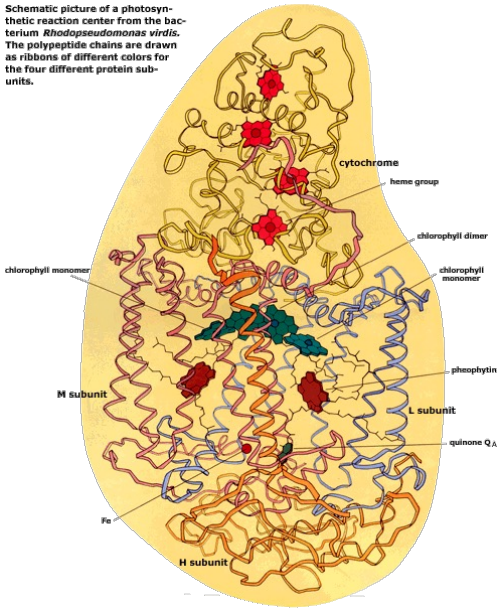
Where do plants get their mass?

Aristotle for example was clueless about the subject. He applied an animal model of feeding on plants. Like Africans envisioned Baobabs as upside down trees he thought all plants were upside down, mouths buried in soil and bottoms exposed to the sky. He envisioned plants fed through their roots and excreted fruits. The true nature of photosynthesis began to be understood only after 1771.

"It might be thought," Aristotle says, "that [plants] are fed by one substance only, viz. by Water," but in fact they "are fed by more than one, for Earth has been mixed with the water".

The most important reaction on earth

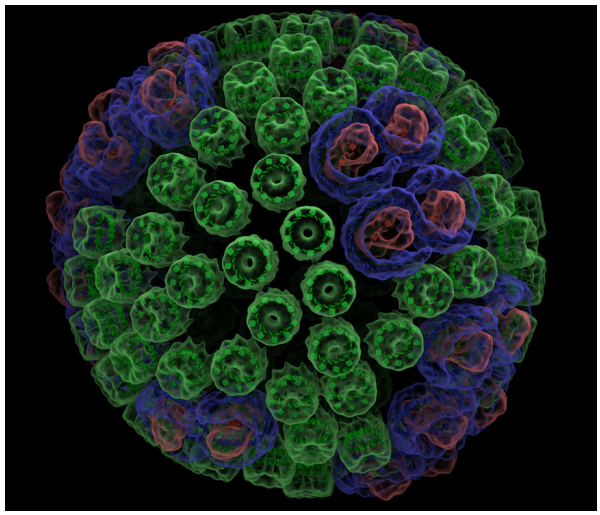
- Photosynthesis is a process by which organisms use sunlight to synthesize nutrients from carbon dioxide and water.
- A photosynthetic reaction center is a protein where light reacts with pigments to perform photosynthesis.
- Bacterial photosynthesis evolved before algae and plant photosynthesis.
- 1988 Nobel Prize for 3D structure of photosynthetic reaction center. "First high-resolution structure of a membrane protein, and most complex molecular structure."



https://naturedocumentaries.org/10031/purple-bacteria-photosynthesis-chromatophore-molecular-structure/

The most important reaction on earth

- Light-harvesting reactions in photosynthesis, require the cooperation of hundreds of proteins. In purple bacteria light-harvesting takes place in structures called chromatophores.
- Chromatophores are tiny spherical membranes of 50 nm diameter. They are made up of over a hundred proteins and ~3000 bacteriochlorophylls absorbing photons.
- Initially, two types of light-harvesting proteins absorb a photon to excite an electron. This electronic excitation travels through the light-harvesting network to the reaction center. Here, electrical energy is converted into an initial form of chemical energy.
- Molecules called quinols carry this chemical energy across the organelle to the fourth type of protein—the bc1 complex—where a charge separation process strips the quinol of electrons. This process triggers a current of protons in the fifth type of protein, known as ATP synthase, driving the molecule's paddle wheel-like c-ring to produce ATP.



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