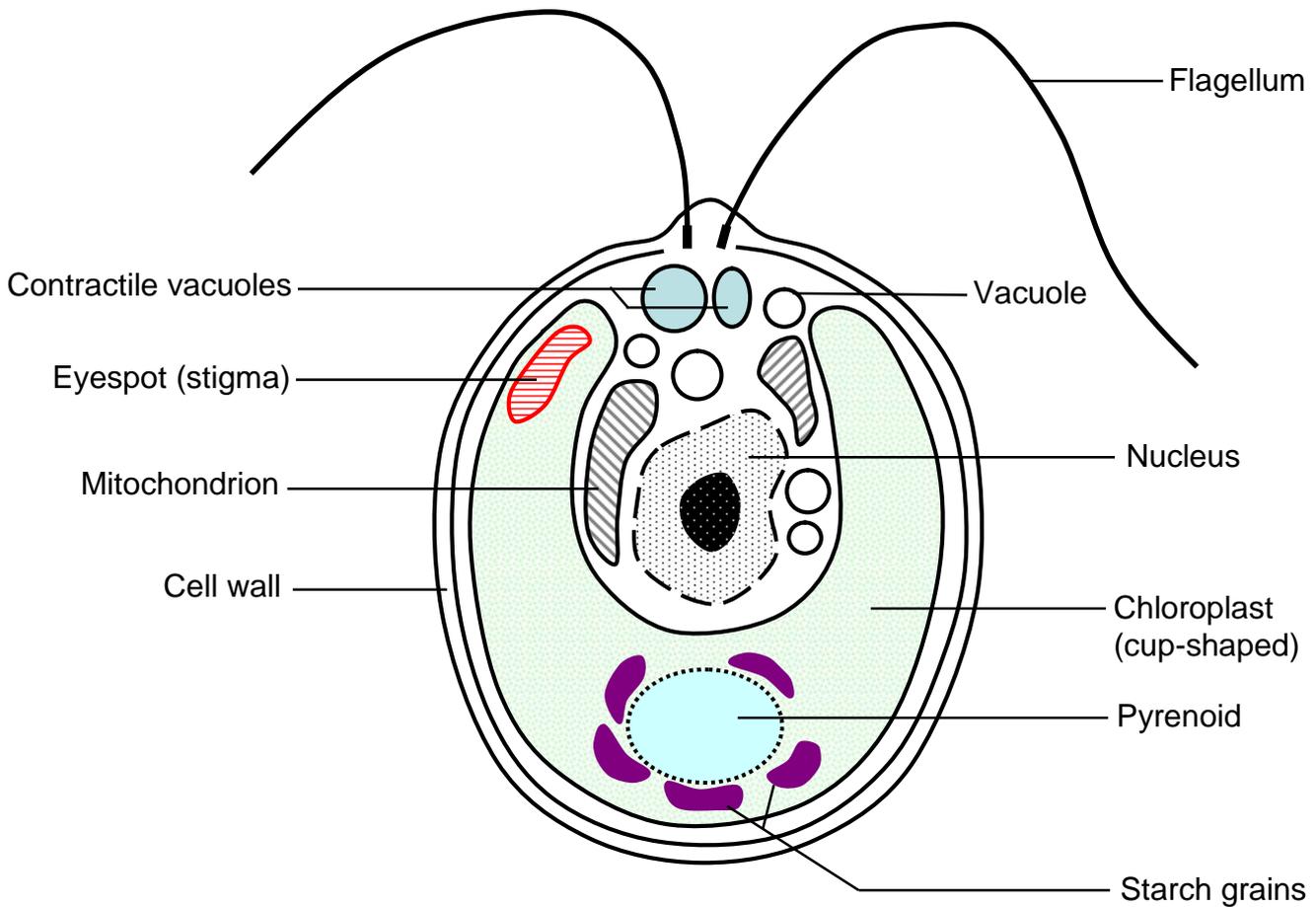


Chlamydomonas



Cell wall: a tough 'shell' enclosing the cell, made of proteins and carbohydrates.

Chloroplast: cup-shaped, contains the green pigment chlorophyll which traps energy from sunlight.

Contractile vacuoles: *Chlamydomonas* has one pair of contractile vacuoles, hollow balls that rhythmically fill with excess water and then contract as they pump the excess water from the cell.

Eyespot (stigma): part of the light-sensor ('eye') that allows the cell to detect where light is coming from so that it can stay in sunlight for photosynthesis to occur.

Flagellum (plural flagella): *Chlamydomonas* has one pair of flagella - whip-like appendages, the cell's engines, that wave about enabling the cell to swim by pulling it through the water.

Mitochondrion (plural mitochondria): power house of the cell - uses oxygen to burn sugars as fuel.

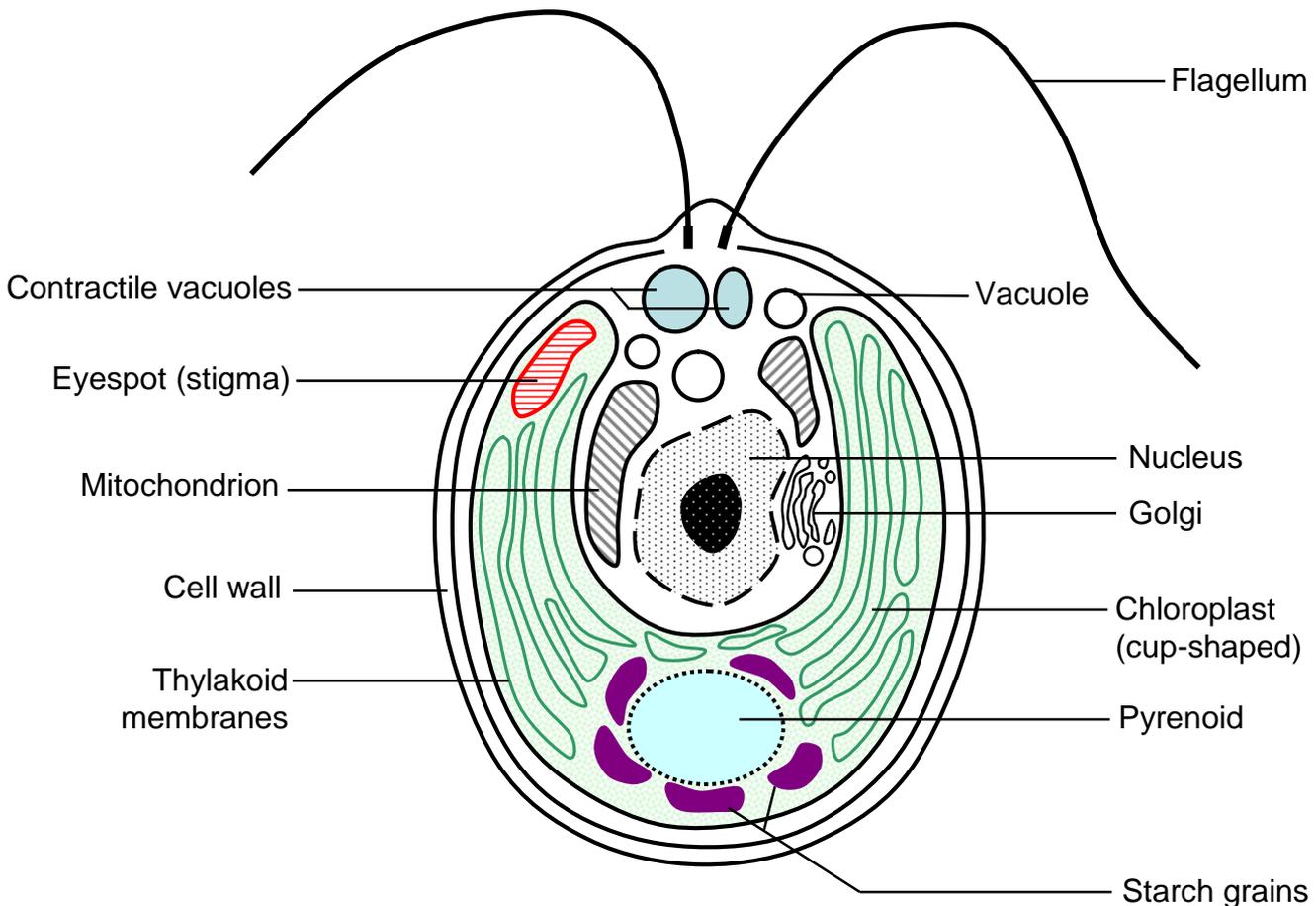
Nucleus: the command and control centre of the cell; stores information as DNA (deoxyribonucleic acid).

Pyrenoid: part of the chloroplast that uses energy trapped from sunlight by chlorophyll to synthesise starch from carbon dioxide.

Starch grains: a carbohydrate fuel reserve, some of the starch is broken down into glucose as burnt inside the mitochondrion to provide the cell with energy. Some is converted into other building materials, such as oils, other carbohydrates, proteins and DNA.

Vacuoles: fluid-filled balls that store materials.

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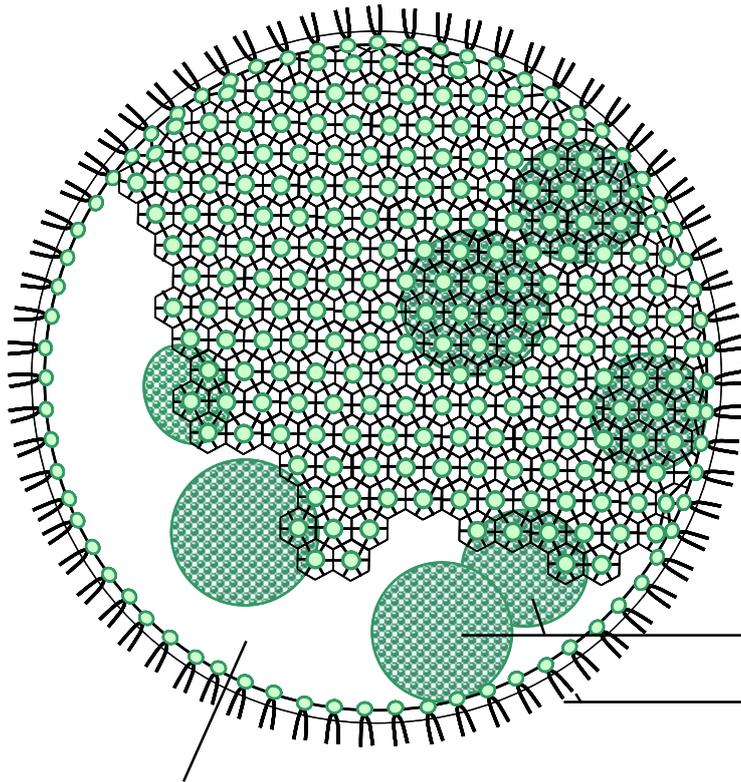
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Volvox

Volvox is a hollow ball of 500 - 50 000 cells, called a colony or coenobium, each with a pair of hair-like appendages called flagella. The flagella beat in synchrony, allowing the colony of cells to swim. One pole is the anterior (head) end as this always leads. Each cell possesses a green chloroplast containing the green pigment chlorophyll. Chlorophyll captures energy from sunlight which *Volvox* uses to make the food it needs by photosynthesis.

Daughter colonies

Flagella (one pair per cell)

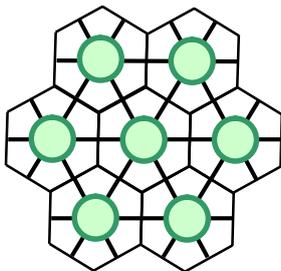
Cells removed to show fluid-filled interior



Single cell



Two neighbouring cells connected by a protoplasmic bridge



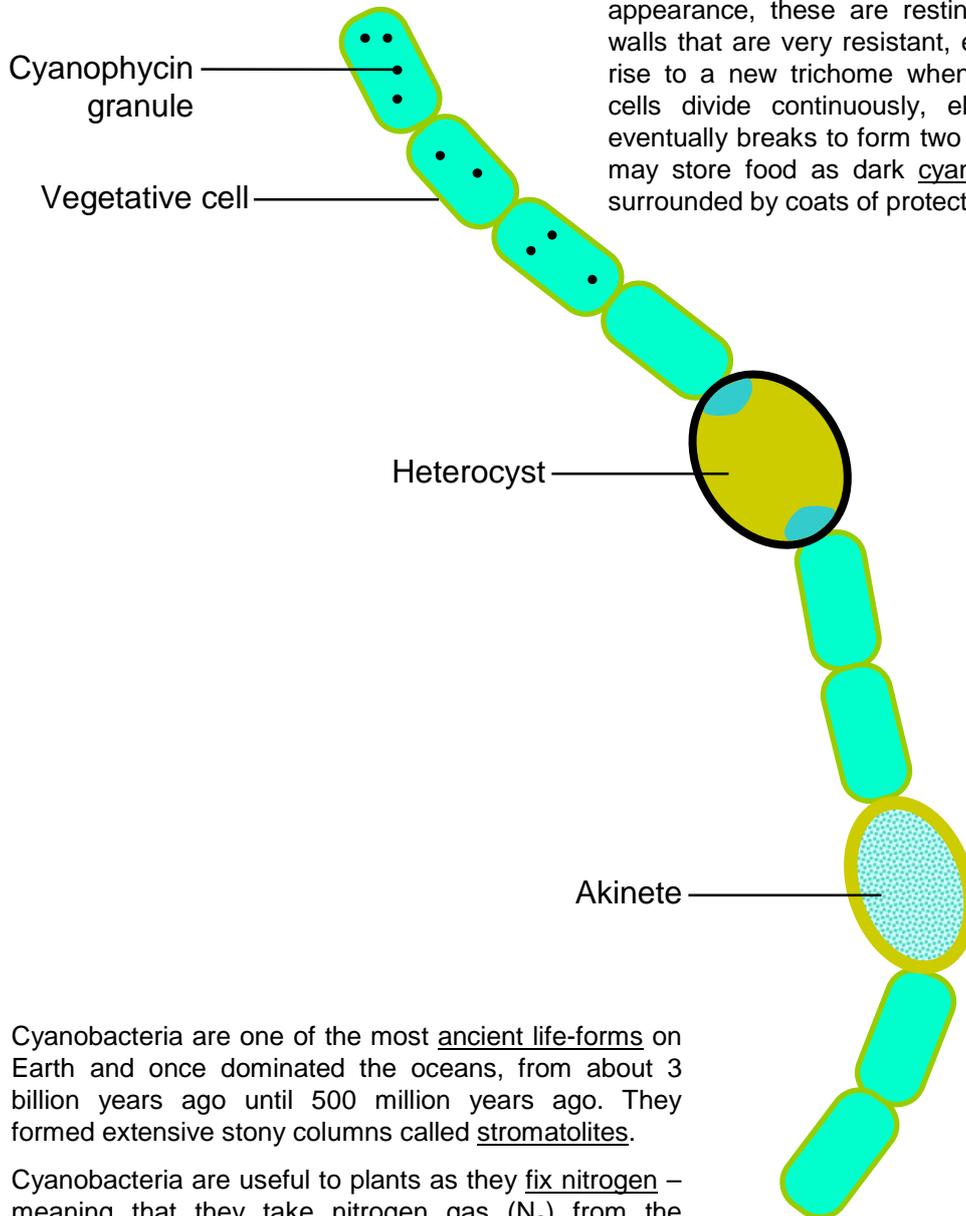
Each cell secretes a hexagonal enclosure of mucilage (jelly) around itself and is connected to its neighbours by a strand of protoplasm. This allows them to communicate with one-another.

Asexual reproduction: certain of the cells (at the posterior end of the *Volvox*) sink beneath the surface and divide to produce a curved plate of cells which curves around until it becomes a hollow ball of cells, or daughter colony, until it reaches the full number of cells (which is fixed according to species). Initially the ball of cells is inside-out and it must invert itself to turn itself the right-side out! Eventually the parent colony dies and breaks open and the daughter colonies escape.

Sexual reproduction: female *Volvox* produce a number of enlarged cells at their posterior end. These cells lose their flagella and become egg cells. In male *Volvox*, some of the cells at the posterior end divide to produce balls of sperm cells. These sperm are released into the water and fertilise the egg cells which remain in the female. After fertilisation the sperm and egg become a zygote, which becomes enclosed in a thick spiny wall which protects it as it becomes dormant. Eventually the zygote escapes when the parent dies and grows into a new *Volvox*. When they are ready to reproduce sexually *Volvox* release sex pheromones that stimulate other *Volvox* to ripen.

Anabaena

A cyanobacterium (blue-green bacterium) is a type of bacteria. *Anabaena* consists of a chain or filament of cells (a trichome) which photosynthesise. About every tenth cell is enlarged and specialised for nitrogen fixation and is called a heterocyst. Spores or akinetes are enlarged cells with a granular appearance, these are resting cells with especially thick cell walls that are very resistant, e.g. to drying, and these will give rise to a new trichome when conditions are right. Vegetative cells divide continuously, elongating the chain. The chain eventually breaks to form two daughter chains. Vegetative cells may store food as dark cyanophycin granules. The cells are surrounded by coats of protective slime.



Cyanobacteria are one of the most ancient life-forms on Earth and once dominated the oceans, from about 3 billion years ago until 500 million years ago. They formed extensive stony columns called stromatolites.

Cyanobacteria are useful to plants as they fix nitrogen – meaning that they take nitrogen gas (N_2) from the atmosphere and convert it into water-soluble forms that plants can absorb through their roots. Plants need nitrogen to build proteins and DNA. This is one reason why flood plains are so fertile – the river waters deposit cyanobacteria into the soil where they enrich the nitrogen content.

In some cyanobacteria, the trichomes can move by gliding over solid surfaces, powered by jets of slime. The cells can communicate with one another via electrical signals.

Cyanobacteria thrive in waters polluted by fertiliser, such as lakes or seas into which water runs-off from agricultural land. This causes algal blooms, which are often actually cyanobacteria, a process called eutrophication.

The cyanobacteria use up all the oxygen in the water and release toxins, killing animals that live in the water.