Gas Vacuoles and Gas Vesicles Encyclopedia Article

Gas Vacuoles and Gas Vesicles

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Gas Vacuoles and Gas Vesicles

Gas vacuoles are aggregates of hollow cylindrical structures called gas vesicles. They are located inside some **bacteria**. A membrane that is permeable to gas bound each gas vesicle. The inflation and deflation of the vesicles provides buoyancy, allowing the bacterium to float at a desired depth in the water.

Bacteria that are known as cyanobacteria contain gas vacuoles. Cyanobacteria, which used to be called **blue-green algae**, live in water and manufacture their own food from the photosynthetic energy of sunlight. Studies have demonstrated that the inflation and deflation of the gas vesicles is coordinated with the light. The buoyancy provided by the gas vacuoles enables the bacteria to float near the surface during the day to take advantage of the presence of sunlight for the manufacture of food, and to sink deeper at night to harvest nutrients that have sunk down into the water.

Gas vesicles are also found in some archae, bacteria that are thought to have branched off from a common ancestor of **eukaryotes** and prokaryotes at a very early stage in **evolution**. For example, the gas vesicles in the bacterium *Halobacterium NRC-1* allow the bacteria to float in their extremely salt water environments (the bacteria are described as halophilic, or "salt loving." The detailed genetic analysis that has been done with this bacterium indicates that at least 13 to 14 genes are involved in production of the two gas vesicle structural proteins and other, perhaps regulatory, proteins. For example, some proteins may sense the environment and act to trigger synthesis of the vesicles. Vesicle synthesis is known to be triggered by low oxygen concentrations.

The gas vesicles tend to be approximately 75 nanometers in diameter. Their length is variable, ranging from 200 to 1000 nanometers, depending on the species of bacteria. The vesicles are constructed of a single small protein. In at least some vesicles these proteins are linked together by another protein. The interior of the protein shell is very **hydrophobic** (water-hating), so that water is excluded from the inside of the vesicles. Yet it is still unclear how the regular arrangement of proteins produces a shell that is permeable to gas. Presumably there must be enough space in between the protein subunits to permit the passage of air.