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Phylum: Aquificae

Aquificae

 Bacteria are some of the oldest living species to exist on Earth. Bacteria can have positive effects on human’s lives such by fermenting food such as cheese and bread or negative effects on human’s humanity through bacteria bioterrorism. Whether it is the bacteria in our soil, our water, our food, or even our own bodies, it is an important to understand all aspects of every bacterium that exist on Earth. Aquificae, a phylum of bacteria that may be the oldest bacteria found by researchers, is extremely important to humans because of its age and clues it may give researchers to find out what life was like on Earth millions of years ago.

Aquificae is phylum of bacteria that is extremely unique. Aquificae bacteria are considered to be extremophiles, specifically thermophiles. Extremophiles are microorganisms that are able to survive in extreme conditions such as hydrothermal vents, sulfur pools, and hot springs. These extreme environments persist at very high or very low temperatures and/or very high or very low pressure. Aquificae are considered to be thermophiles, surviving at temperatures above 90 degrees Celsius. Humans consider these conditions to be extreme because of the lack of oxygen and high temperatures, however, bacteria such as those a part of Aquificae, give researchers clues to what life was on Earth billions of years ago. (An extremophile is an organism that thrives in extreme environments.)

The Aquificae phylum falls under the domain of Bacteria, even though they may be confused for organisms in the domain Archaea. Aquificae bacteria have been sequenced such as Aquifex aeolicus and have shown a significant amount of close relation to Archaea being the some of the earliest members of the Bacteria domain. The Aquificae phylum contains one class, one order, and five genera, including Aquifex, Hydrogenivirga, Hydrogenobacter, Hydrogenobaculum, and Thermocrinis. (Bacteria I)

Geothermal habitats, which are places where heat from the Earth’s interior creates a constant supply of hot water, are a prime location for Aquificae bacteria to thrive. Places such as volcanoes, hot springs, and hydrothermal vents are where most Aquificae bacteria are found. Due to these extreme environments, Aquificae survive as chemolithoautotrophs by splitting hydrogen gas of hydrogen sulfide and fixing carbon dioxide for carbon. Electron donors include hydrogen, sulfur, and thiosulfate. Electron acceptors include oxygen and nitrogen. (Griffiths 99) Aquificae bacteria contribute to nutrient recycling, even though they are not they fully understood how. Thermophilic bacteria do mineralize organic sulfur and nitrogen as a result of their microbial metabolism. (Santana)

One of the most studied genera of the Aquificae phylum is Aquifex. Two species that have been researched are Aquifex pyrophilus and Aquifex aeolicus. A. pyrophilus is a rod-shaped bacteria being only a few micrometers. This bacterium grows best in temperatures ranging from 85 to 95 degrees Celsius and is found in underwater volcanoes and hot springs. This bacteria interestingly produces water as a byproduct of oxygen respiration, however, it can grow anaerobically as well. A.pyrophilus usually does not live alone; large conjugations of about 100 of these bacteria live together to survive. Aquifex aeolicus also is rod-shaped and only a few micrometers. It usually survives in hydrothermal vents, volcanoes, and hot springs between 85-95 degrees Celsius. It uses oxygen respiration to survive, even though it can exist where oxygen is as low as 7.5 ppm. It also creates water as a byproduct. A.aeolicus’s genome has been sequenced and it was found that it is one third the length of a genome of E.coli. It has been found that 16% of A.aeolicus’s genes relate to genes from the Archaea domain. This genome is extremely small, one of the smallest genomes known, with only 1512 genes. (Deckert)

Some may question the human relevance bacteria from the Aquificae genera may have being that they live in such an extreme environment, however, many studies have shown that Aquificae bacteria and thermophilic bacteria in general, offer humans more clues about life than we think. Aquificae bacteria should be of great interest because of their extreme susceptibility to high temperatures and their makeup that allows them to do so. Researchers have said that their “heat resistant” enzymes are a key factor to their ability to survive. Because Aquificae bacteria were the first diverging group of bacteria found, it confirms information of the environment and life on Earth billions of years ago. If these bacteria have been able to survive throughout Earths history, the environment must have been extremely different than what it is today.

Although the bacteria contained in the Aquificae phylum are not readily studied or considered by researchers, they are extremely important to the study of microbiology and life. This thermophillic, chemolithoautotrophic bacteria may be in the far depths of our oceans and in the scorching heat of hydrothermal vents, but it is still relevant to human life on Earth.

Works Cited

1) "An extremophile is an organism that thrives in extreme environments." *National Oceanic and Atmospheric Administration*. United States Department of Commerce, 11 Jan 2013. Web. 5 Apr 2013. <http://oceanservice.noaa.gov/facts/extremophile.html>.

2) "Bacteria I." *Inside Bard*. Bard College, 30 Sept. 2008. Web. 05 Apr. 2013.

 <http://biology.bard.edu/ferguson/course/bio303/Lectures\_>.

3) Griffiths, Emma. "Molecular signatures in protein sequences that are characteristics of the phylum Aquificae." *International Journal of Systematic and Evolutionary Microbiology*. (2006): 99. Print. <http://www.bacterialphylogeny.com/reprints/IJSEM Aquificae-2006.pdf>.

4) Santana, M. "Presence and potential role of thermophilic bacteria in temperate terrestrial environments." n. page. Web. 5 Apr. 2013. <http://digital.csic.es/bitstream/10261/42981/1/Presence and potential role of thermophilic bacteria.pdf>.

5) Deckert, Gerard. "The complete genome of the hyperthermophilic bacterium Aquifex aeolicus." *NATURE*. 392. (1998): n. page. Web. 5 Apr. 2013. <http://www.nature.com/nature/journal/v392/n6674/pdf/392353a0.pdf>.