8.15C: Methane-Producing Archaea - Methanogens

Methanogens are an important group of microorganisms that produce methane as a metabolic byproduct under anaerobic conditions.

Learning Objectives

• Discuss the characteristics associated with methane-producing archaea

Key Points

• Methanogens are responsible for the methane in the belches of ruminants and in the flatulence in humans.
• Methanogens play a vital ecological role in anaerobic environments by removing excess hydrogen and fermentation products produced by other forms of anaerobic respiration.
• Methanogens play a key role in the remineralization of organic carbon and under the right conditions can form reservoirs of methanogen, a potent greenhouse gas.

Key Terms

• extremophiles: An extremophile (from Latin extremus, meaning “extreme,” and Greek philia (φ), meaning “love”) is an organism that thrives in physically or geochemically extreme conditions that are detrimental to most life on earth.

Methanogenic archaea, or methanogens, are an important group of microorganisms that produce methane as a metabolic byproduct under anaerobic conditions. Methanogens belong to the domain archaea, which is distinct from bacteria. Methanogens are commonly found in the guts of animals, deep layers of marine sediment, hydrothermal vents,
and wetlands. They are responsible for the methane in the belches of ruminants, as in, the flatulence in humans, and the marsh gas of wetlands. Methanogens should not be confused with methanotrophs, which consume methane rather than produce it.

![Image of a cow](https://bio.libretexts.org/Bookshelves/Microbiology/Book%3A_Microbiology_(Boundless)/8%3A_Microbial_Evolution_Phyloge...)

**Figure: Methane** The flatulence of cows is only a small portion of cows’ methane release. Cows also burp methane due to methanogens in their digestive systems.

Methanogens play a vital ecological role in anaerobic environments by removing excess hydrogen and fermentation products produced by other forms of anaerobic respiration. Because of this, methanogens thrive in environments in which all electron acceptors other than CO2 (such as oxygen, nitrate, trivalent iron, and sulfate) have been depleted.

In the human gut, accumulation of hydrogen reduces the efficiency of microbial processes, reducing energy yield. Methanogens such as *M. smithii* are pivotal in the removal of this excess hydrogen from the gut and may be useful therapeutic targets for reducing energy harvest in obese humans.

In marine sediments, biomethanation is generally confined to where sulfates are depleted, below the top layers. Methanogens play a key role in the remineralization of organic carbon in continental margin sediments and other aquatic sediments with high rates of sedimentation and organic matter. Under the correct temperatures and pressure, biogenic methane can accumulate in massive deposits, which account for significant fractions of organic carbon and key reservoirs of a potent greenhouse gas.

Some methanogens, called extremophiles, can thrive in extreme environments such as hot springs, submarine hydrothermal vents, and hot, dry deserts. Methanogens have been found buried under kilometers of ice in Greenland, as well as in the “solid” rock of the Earth's crust, kilometers below the surface.