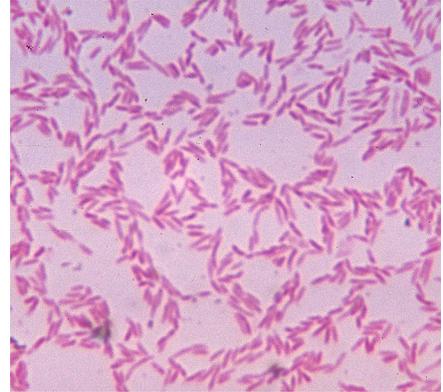


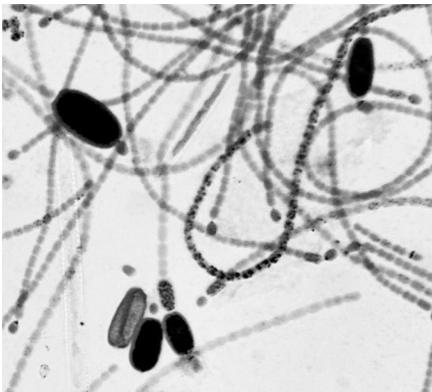
Public Domain, NOAA.

Bacillariophyceae spp.



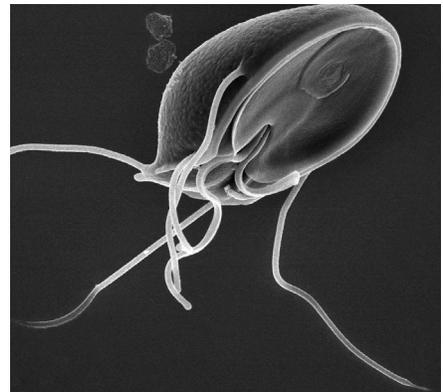
Public Domain, CDC.

Bacteroidetes spp.



(CC BY SA-3.0) Matthew J. Parker.

Cyanobacteria spp.



Public Domain, CDC.

Giardia intestinalis

Bacteroidetes spp.

Domain: Bacteria

Size: 1 μm

Shape: Rod

Lives: Anaerobic soil, seawater, gut, and skin environments

Inputs/Outputs: Input sugars, amino acids and lipids, and use them to build cells. Output alcohols, hydrogen (H_2), and carbon dioxide (CO_2) as a result of fermentation.

Fun Facts:

- Bacteroidetes make up the largest portion of the mammalian gastrointestinal microbiota. In the host intestine, they play a fundamental role by breaking down complex molecules to simpler ones.
- Bacteroidetes are some of the most well studied bacteria.

Bacillariophyceae spp.

Domain: Eukarya

Size: 5–30 μm

Shape: Variety

Lives: Anaerobic, aquatic and soil environments

Inputs/Outputs:

- Some are photosynthetic, use light and water for energy and use carbon dioxide (CO_2) to make sugars and build cells.
- Some breathe oxygen (O_2) and use sugars to build cells.

Fun Facts:

- Bacillariophyceae are also known as diatoms
- Fossils suggest that diatoms evolved during or before the early Jurassic period.
- Measuring diatom communities is a popular method for monitoring environmental conditions and is commonly used to study water quality.

Giardia intestinalis

Domain: Eukarya

Size: 15 μm

Shape: Flagellated protozoan (refer to image)

Lives: Anaerobic aquatic environments, guts

Inputs/Outputs: Uses sugars and produces ethanol and carbon dioxide (CO_2) through fermentation.

Fun Facts:

- If humans ingest or come into contact with contaminated food, water, or soil, these parasites cause the disease giardiasis. The disease is also called 'beaver fever' because it is most often transmitted through contaminated water from beavers to humans.
- *Giardia* is thought to be one of the earliest eukaryotes to evolve.

Cyanobacteria spp.

Domain: Bacteria

Size: 10 μm

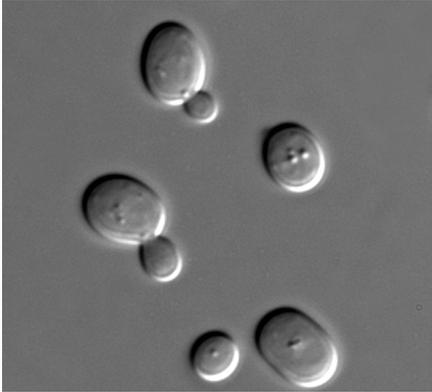
Shape: Spherical (can form filaments and colonies)

Lives: Aerobic aquatic environments

Inputs/Outputs: Uses light and water for energy, produces oxygen (O_2), and makes carbon dioxide (CO_2) into glucose to build cells.

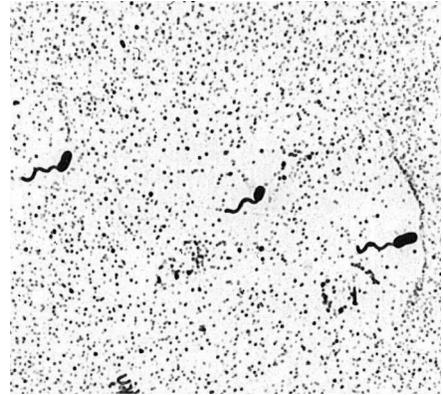
Fun Facts:

- It is thought that early cyanobacteria were responsible for producing the large amounts of oxygen (O_2) that appeared in the early Earth's atmosphere.



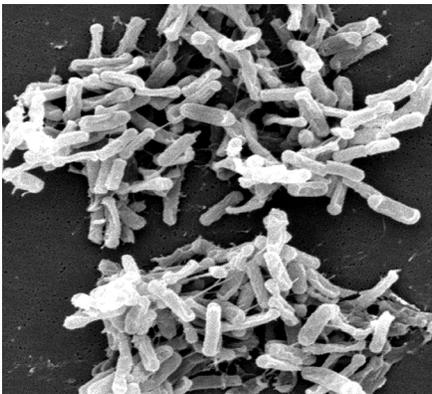
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Saccharomyces cerevisiae



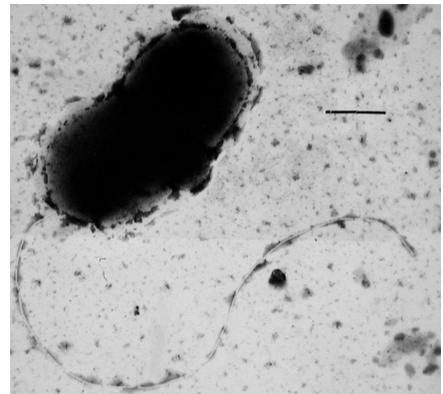
Public Domain, CDC.

Vibrio spp.



Public Domain.

Clostridium spp.



Public Domain.

Desulfovibrio desulfuricans

Vibrio spp.

Domain: Bacteria

Size: 10 μm

Shape: Rod or comma-shaped

Lives: surface of plants, gastrointestinal tracts of insects and mammals, soil, fresh water

Inputs/Outputs: Eats sugars, breathes oxygen (O_2) and outputs carbon dioxide (CO_2) and water. Builds cells out of input sugars.

Fun Facts:

- Some strains of *Vibrio cholera*, one species of *Vibrio*, can cause the deadly disease cholera when they are infected by a particular virus. John Snow is considered the father of epidemiology (the study of the spread of disease) for his work on the cholera outbreaks from contaminated water in England in the 1850s.
- Another species, *Vibrio fischeri*, is a bioluminescent bacterium that forms symbiotic relationships with marine animals, most notably the bobtail squid.

Saccharomyces cerevisiae

Domain: Eukarya

Size: 10 μm

Shape: Spherical

Lives: Aerobic and anaerobic environments such as surface of plants, gastrointestinal tracts of insects and mammals, soil, fresh water, bread and beer.

Inputs/Outputs: Uses sugars to build cells. Produces alcohol and carbon dioxide (CO_2) through fermentation converts sugar into alcohol.

Fun Facts:

- This yeast is often used in winemaking, brewing, and baking.
- It is also commonly used as a model organism by scientists and has been used to study aging, the cell cycle, and gene function and interactions.

Desulfovibrio desulfuricans

Domain: Bacteria

Size: 1 μm

Shape: Rod

Lives: Anaerobic environments of soil, sediment and sand.

Inputs/Outputs: Eats hydrogen (H_2), alcohols and sugars, breathes sulfur or sulfate, produces sulfuric acid. Builds cells by making carbon dioxide (CO_2) into sugars.

Fun Facts:

- *Desulfovibrio* causes health and safety concerns because of its metal corroding ability.
- *Desulfovibrio* also shows potential for bioremediation, because it may neutralize pollutants in the soil.

Clostridium spp.

Domain: Bacteria

Size: 2 μm

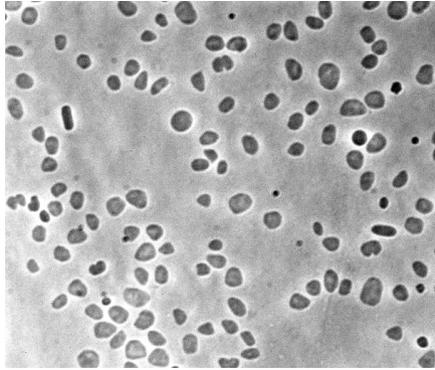
Shape: Rod

Lives: Anaerobic environments like guts and soil

Inputs/Outputs: Eats sugars, produces alcohol, carbon dioxide (CO_2) and hydrogen (H_2) through fermentation. Some strains also produce acetone and butanol. Builds cells out of input sugars.

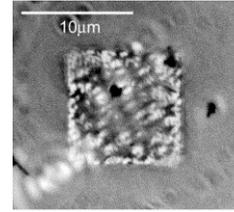
Fun Facts:

- *Clostridium* is a natural part of the human microbiota, but can cause life threatening diarrhea if it grows beyond its usually relatively low numbers.
- Another species *Clostridium botulinum* produces a neurotoxin used in Botox.
- *Clostridium* species are being used to make biofuels called biodiesel.



(CC BY-SA 3.0) Yefineun.

Haloferax volcanii



Walsby, A. (2006). Trends Micro
13, 5: 193-195.

Haloquadratum walsbyi



Public Domain.

Borrelia spp.



(CC BY-SA 3.0) Barfooz.

Paramecium aurelia

Haloquadratum walsbyi

Domain: Archaea

Size: 5-10 μm

Shape: Flat square boxes

Lives: Aerobic salt water

Inputs/Outputs: Eats sugar and oxygen (O_2), produces carbon dioxide (CO_2). Eats sugars to build cells.

Fun Facts:

- This microbe was discovered in 1980 by A.E. Walsby in a very salty brine pool in Egypt.
- They are known for their unique square shaped cells.

Haloferax volcanii

Domain: Archaea

Size: 2 μm

Shape: Curved discs

Lives: Aerobic salt water

Inputs/Outputs: Eats sugar, breathes oxygen (O_2), produces carbon dioxide (CO_2). Eats sugars to build cells.

Fun Facts:

- *Haloferax volcanii* can tolerate extremely salty environments such as the Great Salt Lake and the Dead Sea.

Paramecium spp.

Domain: Eukarya

Size: 150 μm

Shape: Oblong oval

Lives: Aerobic, warm stagnant water

Inputs/Outputs: They mostly prey on bacteria, but also eat yeasts, algae, and other small protozoa for sugars. Breathes oxygen (O_2). Eats sugars to build cells.

Fun Facts:

- Some species of Paramecium like *P. caudatum* form relationships with bacteria; they host bacteria *Holospora obtusa* in the macronucleus.
- Paramecium contain 800 copies of each gene in their genomes.

Borrelia spp.

Domain: Bacteria

Size: 0.2–0.3 μm wide and 15 μm long

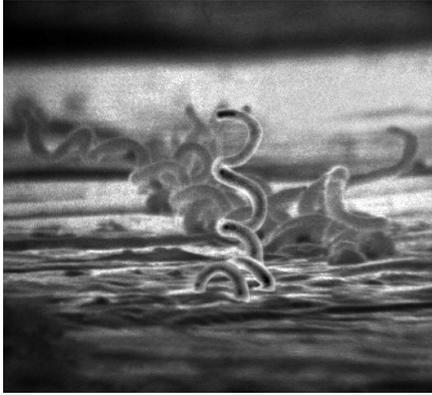
Shape: Spiral-shaped

Lives: Anaerobic environments including human and insect guts

Inputs/Outputs: Eats sugars to build cells. Produces carbon dioxide (CO_2) and alcohol by fermentation.

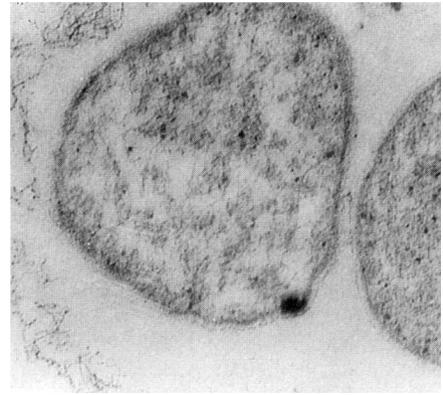
Fun Facts:

- This microbe causes Lyme disease when transmitted to humans through the bite of an infected tick.



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Treponema pallidum



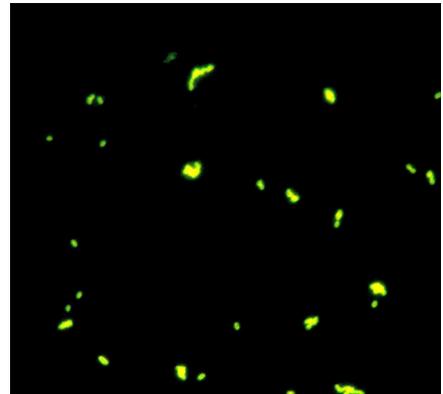
Beeder et al. Appl Environ Microbiol. 1994; April; 60(4):1227-1231.

Archaeoglobus fulgidus



(CC BY 2.0) Ishii et al. BMC Microbiology 2008 8:6.

Geobacter metallireducens



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Methanobrevibacter smithii

Archaeoglobus fulgidus

Domain: Archaea

Size: 1 μm

Shape: Spherical

Lives: Anaerobic hot springs, oil wells, and hydrothermal vents in the ocean.

Inputs/Outputs: Eats hydrogen (H_2), breathes sulfate (SO_4), produces sulfuric acids. Turns carbon dioxide (CO_2) to sugars to build cells.

Fun Facts:

- These microbes live in very hot temperatures and grow optimally at 83 °C (181 °F)!

Treponema pallidum

Domain: Bacteria

Size: 15 μm long

Shape: Spiral-shaped

Lives: Anaerobic environments inside of mammals (i.e. mucus membranes)

Inputs/Outputs: Eats sugars and amino acids, produces alcohols and carbon dioxide (CO_2). Eats sugars to build cells.

Fun Facts:

- This bacterium cannot be cultured and investigated using common lab techniques. Genome sequencing is, therefore, extra important in allowing scientists to better understand how this microbe causes the disease syphilis.

Methanobrevibacter smithii

Domain: Archaea

Size: 1 μm

Shape: Shape between a sphere and a rod

Lives: Anaerobic environments including the human gut

Inputs/Outputs: Eats hydrogen (H_2), alcohol, and carbon dioxide (CO_2); produces methane (CH_4). Turns carbon dioxide (CO_2) to sugars to build cells.

Fun Facts:

- Plays an important role in the digestion of complex sugars where it may contribute to obesity in humans.

Geobacter metallireducens

Domain: Bacteria

Size: 1 μm

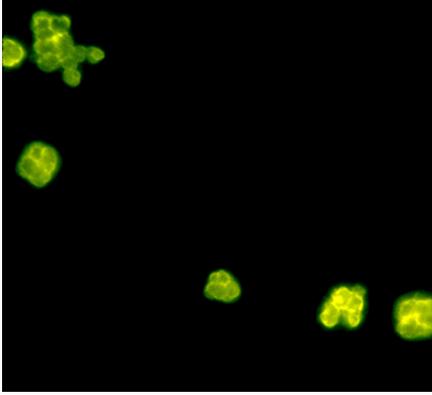
Shape: Rod-shaped

Lives: Anaerobic soil

Inputs/Outputs: Eats sugars, breathes iron, produces rust. Turns carbon dioxide (CO_2) to sugars to build cells.

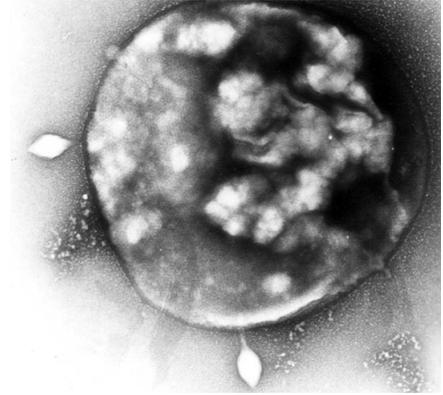
Fun Facts:

- Geobacter plays a role in bioremediation, helping turn contaminants into less harmful forms.
- Geobacter can produce electricity and has been used to power microbial fuel cells. This microbe produces tiny conductive nanowires to connect to iron and other metals.
- Geobacter can survive for two hours at 130 °C (266 °F).



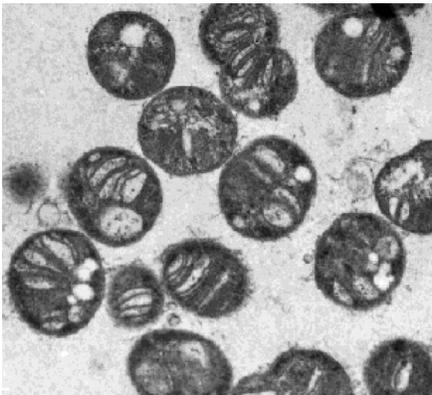
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Methanosarcinae spp.



Public Domain.

Sulfolobus islandicus



(CC BY 2.5) Anne Fjellbirkeland.

Methylococcus spp.



Public Domain.

Rhodospseudomonas spp.

Sulfolobus islandicus

Domain: Archaea

Size: 1 μm

Shape: Irregular

Lives: Aerobic, acidic hot springs (like those found in Yellowstone National Park)

Inputs/Outputs: Eats hydrogen sulfide (H_2S) or sugars, breathes oxygen (O_2), produces carbon dioxide (CO_2) and sulfuric acid.

Fun Facts:

- Their ideal environment is very acidic (pH 2–3) and high temperatures of 75–80 °C (167–176 °F).
- Sulfolobus cells can be infected by many different viruses. They combat infection using a microbial form of adaptive immunity.

Methanosarcinae spp.

Domain: Archaea

Size: 1 μm

Shape: Irregular spheres

Lives: Anaerobic environments including oil wells, sediment, soil, wastewater treatment plants, and cow rumen.

Inputs/Outputs: Eats hydrogen (H_2) and alcohols, breathes carbon dioxide (CO_2) produces methane (CH_4). Turns carbon dioxide (CO_2) to sugars to build cells.

Fun Facts:

- Based on what is available in their environment, they can alternate between three different metabolic pathways to produce methane.
- Methanosarcinae produce methane or natural gas which can be used as a biofuel.
- Methanosarcinae and other methanogens were the organisms Carl Woese first used to identify the Archaea.

Rhodopseudomonas spp.

Domain: Bacteria

Size: 1 μm

Shape: Rod-shaped

Lives: Anaerobic or aerobic marine environments.

Inputs/Outputs: Uses light and hydrogen sulfide (H_2S) for energy. Produces sulfate. Turns carbon dioxide (CO_2) to sugars to build cells. Can also eat sugars and breathe oxygen (O_2) to produce (CO_2).

Fun Facts:

- Rhodopseudomonas can be identified by its purple color and is known for its ability to switch between four different metabolic processes based on what is available in its environment.

Methylococcus spp.

Domain: Bacteria

Size: 1 μm

Shape: Spherical

Lives: Aerobic soil environments

Inputs/Outputs: Eats methane (CH_4) and breathes oxygen (O_2). Produces carbon dioxide (CO_2) and uses it to make sugars and build cells.

Fun Facts:

- By consuming methane, a potent greenhouse gas, Methylococcus in the soil can mediate climate change. As tundra warms and methane emissions increase, organisms like this microbe are a focus of climate science.