

Phylum Proteobacteria

3-Class Gammaproteobacteria

2- Order Vibrionales

Contains one family, *Vibrionaceae*; and eight genera . Most are aquatic, most free-living.straight or curved rods, oxidase positive, flagellated ,some important pathogens ,some symbiotic in luminous organs of fish

Closely related to two other orders : *Enterobacteriales* and *Pasteurellales*

Vibrio cholerae

Pathogen that causes cholera. Genome has been sequenced has two circular chromosomes,copies of some genes present on both chromosomes, cholera toxin gene is integrated phage on chromosome.

Scientific classification

Domain	Bacteria
Phylum	Proteobacteria
Class	Gammaproteobacteria
Order	Vibrionales
Family	Vibrionaceae
Genus	Vibrio
Species	<i>V. cholerae</i>

3-Order Enterobacteriales

One family, *Enterobacteriaceae* includes **44** genera ,called enteric bacteria or enterobacteria. Facultative anaerobes .Chemoorganotrophs degrade sugars by glycolytic pathway , cleave pyruvate to yield formic acid.

Family Enterobacteriaceae

Divided into **two** groups based on fermentation product, majority are mixed acid fermenters ,produce lactate, acetate, succinate, formate, and ethanol,others are butanediol fermenters,Produce **butanediol**, **ethanol** and **carbon dioxide**

Biochemical tests used to distinguish genera in addition to morphology, motility, growth responses. Very common, widespread, and important.

Escherichia coli

Probably best studied bacterium .Inhabitant of intestinal tracts of many animals .Used as indicator organisms for testing water for fecal contamination .Some strains are pathogenic causing gastroenteritis and urinary tract infections.

Scientific classification

Domain	Bacteria
Phylum	Proteobacteria
Class	Gammaproteobacteria
Order	Enterobacteriales
Family	Enterobacteriaceae
Genus	Escherichia
Species	<i>E. coli</i>

Important Pathogenic Enteric Bacteria

Salmonella is the causative agent of **typhoid fever** and **gastroenteritis**.

Shigella is the causative agent of **bacillary dysentery**

Klebsiella is the causative agent of **pneumonia**

Yersinia is the causative agent of **plague**

4-Class *Deltaproteobacteria*

Contains eight orders and **20** families,divided into **two** general groups:

Aerobic, chemoorganotrophic predators.

Anaerobic, chemoorganotrophic sulfur- and sulfate-reducers.

5-Class *Epsilonproteobacteria*

The smallest of proteobacterial classes includes **two** orders, *Campylobacteriales* and *Nautiliales* distributed into **three** families.

1-Genus *Campylobacter*

Campylobacter fetus Slender Gram-negative rods, causes reproductive disease and abortions in cattle and sheep , septicemia and enteritis in humans , septicemia by pathogens or their toxins in blood , enteritis – inflammation of intestinal tract.

Campylobacter jejuni is the causative agent of abortions in sheep and enteritis diarrhea in humans.

2-Genus *Helicobacter*

At least **23** species isolated from stomachs and upper intestines of mammals. *Helicobacter pylori* causes gastritis and peptic ulcer disease.

Motility important for colonization , does not grow below **pH 4.5** , urease converts urea to ammonia and **CO₂** and urea hydrolysis appears to be associated with virulence.

Scientific classification

Domain Bacteria
Phylum Proteobacteria
Class Epsilonproteobacteria
Order Campylobacteriales
Family Helicobacteriaceae
Genus Helicobacter
Species *H. pylori*

Phylum Firmicutes

The low **G + C** Gram-positive bacteria are placed in the phylum Firmicutes (Fig.1)

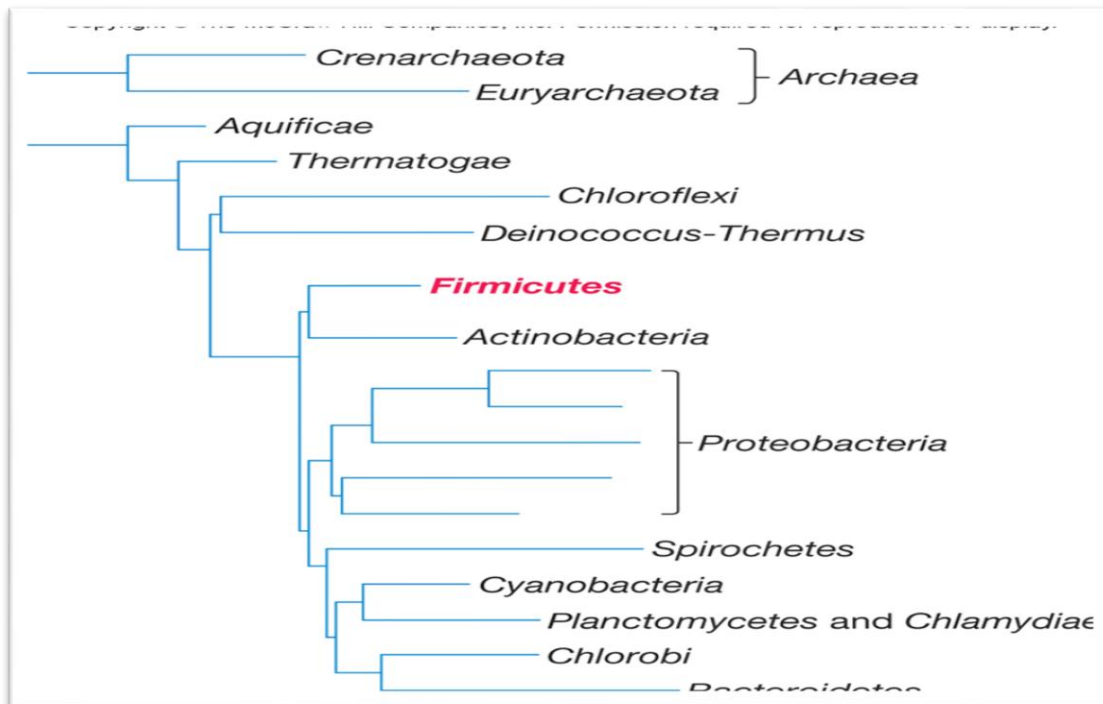


Fig.1: Phylogenetic relationships among Bacteria and Archaea ;the Phylum Firmicutes is highlighted

Firmicutes is divided into **two** classes: **Clostridia** and **Bacilli**, low **G + C** endospore-forming bacteria with over **100** species, Clostridium is the largest genus in the class. It includes obligately anaerobic, fermentative, Gram-positive bacteria that form endospores (Figure.2).

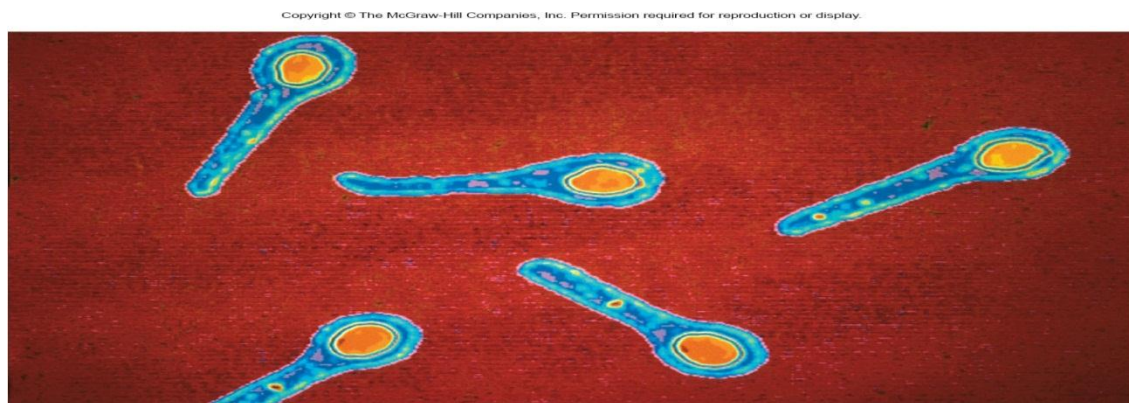


Fig.2: Clostridium endospores

1-Class Clostridia :

Genus Clostridium: Members of this genus have great practical impact. Because they are anaerobic and form heat-resistant endospores, they are responsible for many cases of food spoilage, even in canned foods.

Clostridia often can ferment amino acids to produce ATP by oxidizing one amino acid while using another as an electron acceptor in a process called the **Stickland reaction**. This reaction generates ammonia, hydrogen sulfide, and fatty acids during the anaerobic decomposition of proteins. Although some clostridia are industrially valuable (*C. acetobutylicum*) is used to manufacture butanol), the pathogenic species that produce toxins are most well-known. For instance, *C. perfringens* causes gas gangrene and food poisoning. *C. botulinum* is the causative agent of botulism, and *C. tetani* causes tetanus

Scientific classification

Domain Bacteria
Phylum Firmicutes
Class Clostridia
Order Clostridiales
Family Clostridiaceae
Genus Clostridium
Species *C. botulinum* & *C. tetani*

Heliobacteria further illustrate the diversity of this class. The genera **Heliobacterium** and **Heliophilum** contain unusual anaerobic, phototrophic species characterized by the presence of bacteriochlorophyll g.

Like the clostridia, Heliobacteria are capable of **nitrogen fixation**. Although they have a Gram-positive cell wall, they have a low peptidoglycan content, and they stain Gram negative. Some Heliobacteria form endospores .

Veillonella spp. are plentiful on the tongue and dental **plaque** of humans. They are well adapted to the oral environment because they use lactic acid produced by streptococci and other oral bacteria. Like many groups of anaerobic bacteria, members of the genus Veillonella have not been thoroughly studied. Some species are part of the normal biota of the mouth, the gastrointestinal tract, and the urogenital tract of humans and other animals.