

Glossary of the Gut Microbiome
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Microbiota (or microbiome) is the community of microorganisms that typically inhabits a bodily organ or part. The human body contains more than 10 times as many microbial cells as human cells. These microorganisms may be *commensal* (living in close association that allows one species to benefit without harming the other), *symbiotic* (having an interdependent relationship), and *pathogenic* (disease-producing). Human beings have clusters of bacteria in different parts of the body, such as the skin, the mouth, the vagina, and the intestine.

Organisms typically found in the human microbiome may generally be categorized as bacteria (the majority), members of domain Archaea, yeasts, single-celled eukaryotes, and various helminth parasites and viruses, the latter including viruses that infect the cellular microbiome organisms, e.g., bacteriophages, the viruses of bacteria.

Gut microbiota refers to the community of microorganisms that live in the gastrointestinal tract. Gut refers to the intestine. Gut microbiota consists of tens of trillions of microorganisms, including at least 1,000 different species of known bacteria with millions of genes. Microbiota can, in total, weigh up to 4.5 pounds. Research suggests that the relationship between gut microbiota and humans is not merely commensal, but rather a mutualistic relationship. The metabolic activities performed by these bacteria resemble those of an organ.

Gut microbiota perform a host of useful functions, such as fermenting unused energy substrates, training the immune system, preventing growth of harmful, pathogenic bacteria, regulating the development of the gut, producing vitamins for the host, such as biotin and vitamin K, and producing hormones to direct the host to store fats. However, in certain conditions, some species are thought to be capable of causing disease by producing infection or increasing cancer risk for the host.

Gut flora is an older term that refers to plants or plant-like organisms, though it is now known that many of the micro-organisms that inhabit our bodies are not related to plants. The term microbiota is now preferred and should be used instead of flora or microflora. Many, however, continue to use these terms interchangeably.

Bacteria constitute a large domain of prokaryotic microorganisms. They were among the first life forms to appear on Earth, and are present in most of its habitats. Bacteria also live in symbiotic and parasitic relationships with plants and animals. The majority of bacteria in the human body are harmless or beneficial, the largest number being in the gut flora. However, some species of bacteria are pathogenic and cause infectious diseases.

Archaea are a kingdom of single-celled prokaryotic microorganisms that are often mutualists (two different species that exist in a mutually beneficial relationship) or commensals (a species that benefits from other organisms without effecting them). Archaea can be found in extreme habitats, as they can withstand extreme temperature and highly acidic conditions. One example is the

methanogens that inhabit the human gut and the ruminant gut, where their vast numbers aid digestion.

Bacterial classification. All organisms are classified in a hierarchical manner. For bacteria, we begin with the broadest division, the phylum, and work all the way down through sub-phylum, class, order, family, genus, and species, to strain. Most bacterial names that we encounter are described in terms of their genus, species and strain, which provides a very precise description of an individual organism. For example, the bacteria included in the **phylum Firmicutes** make up the largest portion of the gut microbiome, and are involved in energy resorption and obesity.

Bacteroides are a phylum of bacteria commonly found in the human intestine, where they have a symbiotic host-bacterial relationship with humans. They assist in breaking down food and producing valuable nutrients and energy that the body needs. However, *Bacteroides* can be pathogenic when introduced to parts of the body other than the gastrointestinal area. They can cause or exacerbate abscesses and other infections. *Bacteroides* are increasingly regarded as specialists for the degradation of proteins and carbohydrates.

Bifidobacterium is a genus of Gram-positive, non-motile, often branched anaerobic bacteria that are a type of lactic acid bacteria. They are widespread inhabitants of the gastrointestinal tract, vagina, and mouth of mammals, including humans. *Bifidobacteria* are one of the major genera of bacteria that make up the colon flora in mammals. *Bifidobacteria* are used as probiotics.

Dysbiosis (also called dysbacteriosis) refers to microbial imbalance resulting from a change in the number or types of bacteria on or inside the body. Dysbiosis is most prominent in the digestive tract or on the skin, but can also occur on any exposed surface or mucous membrane. Researchers speculate that it may have a role in illnesses such as inflammatory bowel disease, chronic fatigue syndrome, obesity, or certain cancers. One cause of dysbiosis is antibiotic exposure.

Fungus refers to any member of a large group of eukaryotic organisms that includes microorganisms such as yeasts and molds, as well as mushrooms. These organisms are classified as a kingdom, Fungi, which are separate from plants, animals, protists and bacteria.

Lactobacillus is a genus of Gram-positive facultative anaerobic or microaerophilic (which requires low levels of oxygen to grow and metabolize energy, but are poisoned by high levels of oxygen) rod-shaped bacteria. They are a major part of the lactic acid bacteria group, so named because most of its members convert lactose and other sugars to lactic acid. In humans, they are present in the vagina and the gastrointestinal tract, where they make up a small portion of the gut flora. *Lactobacilli* are also in some fermented foods like yogurt and in dietary supplements. *Lactobacilli* are used for treating and preventing diarrhea, including infectious types such as rotaviral diarrhea in children and traveler's diarrhea. They are also used to prevent and treat diarrhea associated with using antibiotics.

Probiotics are live micro-organisms that are similar to those found naturally in the human body, and may be beneficial to health when administered in sufficient quantities. Probiotics help maintain the balance of microbiota in the intestines. They are commonly consumed as part of

fermented food (e.g. yogurt, dietary supplements). The largest group of probiotic bacteria in the intestine is made up of lactic acid bacteria, of which *Lactobacillus acidophilus*, found in yogurt with live cultures, is the best known. Some yeasts may also act as probiotics.

Prebiotics are non-digestible food components that pass undigested through the upper part of the gastrointestinal tract and stimulate the growth and/or activity of advantageous bacteria (e.g., *Bifidobacteria* and *Lactobacilli*) that colonize the large intestine. As a functional food component, prebiotics, like probiotics, are conceptually intermediate between foods and drugs.

***Clostridium difficile* (or *C. difficile*)** is a bacterium that can cause symptoms ranging from diarrhea to life-threatening inflammation of the colon. *Clostridium difficile* most commonly affects older adults in hospitals or in long-term care facilities and typically occurs after use of antibiotic medications. When the normal gut microbiota has been suppressed or destroyed (usually after a broad-spectrum antibiotic has been used), the gut becomes overrun with *C. difficile*. The bacteria release toxins that can cause bloating and diarrhea with abdominal pain, which may become severe. However, in recent years, *C. difficile* infections have become more frequent, severe and difficult to treat.

Fecal transplant, also known as “fecal microbiota transplant” or “stool transplant,” is the process of transplantation of fecal bacteria from a healthy individual into a recipient. The aim is to re-establish healthy microbiota in the gut of the recipient. It has been proven to be a highly effective treatment for patients suffering from *C. difficile*. It involves restoration of the intestinal microbiome by introducing healthy bacterial flora through infusion of stool obtained from a healthy human donor.

Human Microbiome Project (HMP) (<https://commonfund.nih.gov/hmp/index>) aims to develop tools and datasets for the research community studying the role of these microbes in human health and disease. The first phase of HMP characterized the composition and diversity of microbial communities, which inhabit major mucosal surfaces of the human body, including nasal passages, oral cavities, skin, gastrointestinal tract, and urogenital tract, and evaluated the genetic metabolic potential of these communities. The current phase of HMP is focused on the creation of the first integrated dataset of biological properties from both the microbiome and host from cohort studies of microbiome-associated diseases. This project utilizes a new field of research, metagenomics, which allows the comprehensive examination of microbial communities without the need for cultivation.

Sources:

World Gastroenterology Organisation <http://www.wgofoundation.org/wdhd-2014.html>

WikiPedia Gut Flora http://en.wikipedia.org/wiki/Gut_flora

University of Bologna, Introduction to Intestinal Microbiota <http://www.mf.uni-mb.si/mf/instituti/IPweb/html/DiGioiaD%20Introduction%20to%20intestinal%20microbiota.pdf>

Human Microbiome Project <http://www.mf.uni-mb.si/mf/instituti/IPweb/html/DiGioiaD%20Introduction%20to%20intestinal%20microbiota.pdf>

NIH “Your Microbes and You: *The Good, Bad and Ugly*”
<http://newsinhealth.nih.gov/issue/nov2012/feature1>

NIH National Center for Complementary and Alternative Medicine, “Get the Facts: Oral Probiotics: An Introduction”
http://nccam.nih.gov/sites/nccam.nih.gov/files/Get_The_Facts_Probiotics_01-08-2013.pdf

Guinane, CM, Cotter PD, Role of the gut microbiota in health and chronic gastrointestinal disease: understanding a hidden metabolic organ, *Therap Adv Gastroenterol*. Jul 2013; 6(4): 295–308.
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3667473/>

MicrobWiki <https://microbewiki.kenyon.edu/index.php/MicrobeWiki>

MicrobeWorld <http://www.microbeworld.org/types-of-microbes/bacteria>