Principals of microbiology

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What is microbiology?

- Microbiology is the study of microbes. Microbes, which are also called micro-organisms, are a group of organisms that are too small to be seen with the naked eye. Despite being even smaller than the human cell, microbes still vary dramatically in size, with most viruses being up to 100 times smaller than the average bacterium. Microbes are the oldest life form on this planet and there is even fossil evidence in Australian rocks of microbial communities living 3.48 billion years ago.
- Microbes that cause disease are called pathogens. While it might seem that they make up a large proportion of the microbes on our planet, human pathogens account for less than 1% of microbial species.

Why does microbiology matter?

- Some of the most important discoveries that have underpinned modern society have resulted from the research of famous microbiologists, such as Edward Jenner and his vaccine against smallpox; Alexander Fleming and the discovery of penicillin and Harald zur Hausen, who identified the link between papilloma virus and cervical cancer. In recent years, microbiologists were integral in the response to the emergence of SARS-CoV-2, they mapped its genome, monitored it’s spread and created vaccines to protect us.

Why does microbiology matter?

- By studying small things, microbiologists can answer some big questions which affect many aspects of our lives, from degrading food waste to causing and curing disease. The study of microbes helps us to understand our world and our place within it.

Microbiology Branches

Basic Microbiology:

1. Deal with all microorganisms.
2. Classification of microorganisms.
3. Visualization of microorganisms (microscopes & staining).
4. Metabolism and metabolic pathways.
5. Nutrition, growth and its requirements.
6. Techniques of sterilization & the disinfection.

Medical Microbiology

1. Is the study of organisms that cause diseases to humans (pathogenic organisms).

2. The relationship between microorganism and the disease, e.g. S. typhi cause typhoid fever.

3. Characteristics of microorganism causing disease, and how microorganism cause disease as invasion of tissue or by producing toxic products.

4. Mechanism of disease establishment called Pathogenesis.

5. Virulence factor of the microorganism called Pathogenicity, e.g. ability to invade host tissue, production of toxins as by-products.

6. Epidemiology of the disease, deal with source of the disease and method of spread.

7. Diagnosis of disease, based on:

8. Proper sampling.

9. Stain and culturing.

10. Recovery of pathogenic organism.

11. Treatment of the disease by antimicrobial agents, e.g. antibiotics.

12. Prevention of infection: by vaccination & quarantine.

13. Control of infection: by isolation of human or animal, and by proper treatment.

Food Microbiology:

1. Microorganism (M.O.) used in food processing and ripening are not pathogenic.

2. M.O. can cause food infection & poisoned food,

   e.g. Staphylococcus aureus.

3. M.O. can cause Spoilage of food.

4. Preservation of food: drying, salting, freezing, jamming, canning &

   use of preservatives (chemicals such as sodium benzoate & sodium nitrite). The method of preservation must be suitable for the food type and must retain food quality and prevent its destruction by M.O.

Industrial Microbiology:

1. Deal with M.O. used in the industry.
2. Characteristics of the bacterial strains.
3. Maintain the bacterial strains unchanged.
4. Concern with quality of the products & its quantity.
5. Deal with storage condition of the products.
6. Shelf-life of the products: for how long the material will be stored under proper condition without being destructed or spoiled.
7. Mostly industrial microbiology use fermentation process to produce certain product.

Pharmaceutical Microbiology:

1. It’s the use of M.O. in the production of pharmaceutical products such as antibiotics, alcohols, enzymes and vitamins.

2. Deal with check of contamination and spoilage of pharmaceutical preparation by adding preservative.

3. Use different sterilization techniques and preservation of pharmaceutical products.

4. Proper use of antibiotic and chemotherapeutic agent (give proper type of antibiotic in proper time for proper organism in proper dose for proper duration).

Agricultural Microbiology:

1. Deal with the N (nitrogen), C (carbon) and S (sulfur) cycle in nature.
2. Fertility of soil.
3. Disease of plants.
4. M.O. in ruminants used for digestion in the rumen.

Sanitary Microbiology:

1. Deal with proper disposal of sewage and garbage.
2. Disposal of waste and wastewater.
3. Safety of water and food.
4. Control of flies and vectors, e.g. mosquitoes.

Microbial physiology and genetics:

1. Research in microbial physiology lead to better understanding of the functions of microbes
2. DNA structure and genetic manipulation with virus and bacteria

Environmental microbiology (microbial ecology):

- It becomes important branch because the concern about pollution of soil, air, water, sewage, food and dairy products
- Also cycling of elements by microbial, environmental and geochemical processes
- In addition, the biodegradation of toxic chemicals by various microorganisms is being used as method for cleaning up hazardous materials found in soil and water

What are Bacteria?

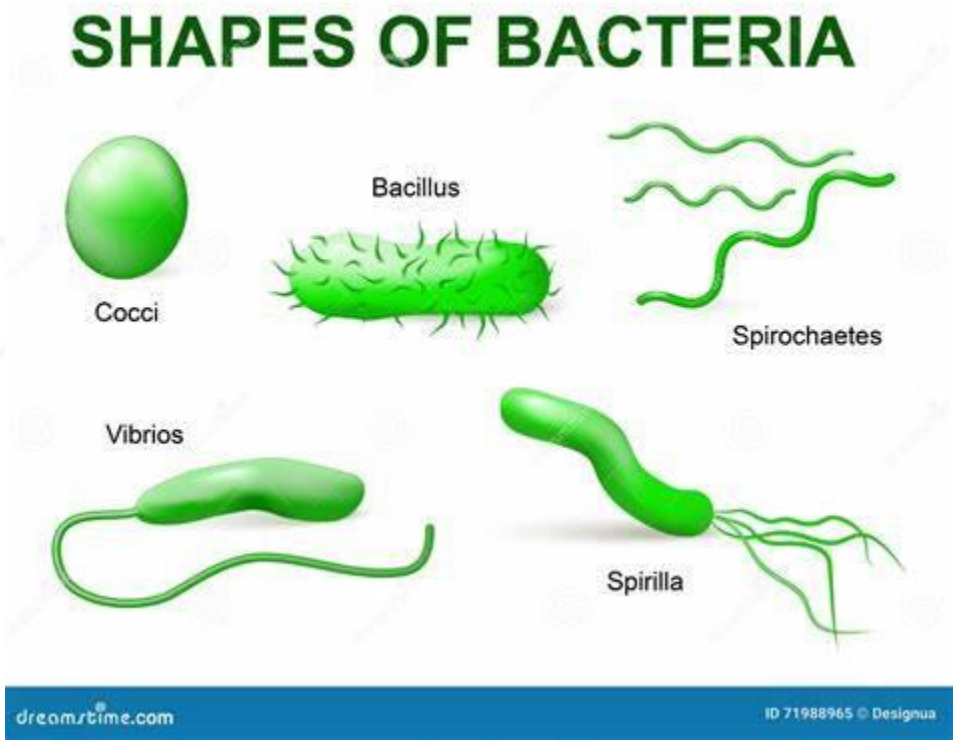
- Bacteria are tiny, single-celled living organisms. There are millions of different types of bacteria. Many can be found in and on your body and are beneficial to you. These bacteria make up your microbiome, which keeps your body healthy. Other bacteria can make you sick. Healthcare providers can treat many bacterial infections with antibiotics.

Bacteria

- Bacteria are microscopic living organisms that have only one cell. The word for just one is “bacterium.” Millions (if not billions) of different types of bacteria can be found all over the world, including in your body. They’re on your skin and in your airways and mouth. They’re also in your digestive system, reproductive system and urinary tract. Scientists estimate you have 10 times more bacterial cells than human cells in your body.

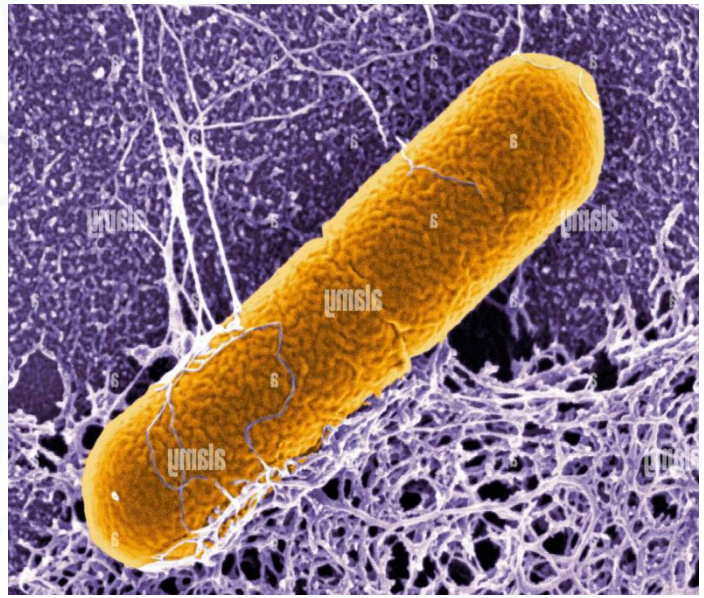
Bacteria

- that cause a sexually transmitted infection (STI) called chlamydia.Bordetella pertussis: Bacteria that cause whooping cough.Antibiotics can treat most types of bacterial infections. However, the more you take an antibiotic, the greater the chances your body will become resistant to it. Bacterial resistance is also more likely if you don’t finish or take your antibiotics as prescribed



What are the different types of bacteria?

- Scientific nameOne way scientists classify bacteria is by their scientific name. The scientific name includes their genus — based on the characteristics of the bacteria — and within the genus, their species. For example, “Clostridium botulinum” is the scientific name for the bacterium that causes botulism. Within a species, scientists may discover different types, or strains, of a bacterium.
- One way scientists classify bacteria is by their shape. The three basic bacterial shapes include spheres, rods and spirals.



What are gram-positive bacteria?

- Scientists classify bacteria as gram-positive or gram-negative based on which color they turn under a Gram stain. They stain differently because their cell walls are different. “Positive” and “negative” don’t mean “good” or “bad.” Gram-positive bacteria look blue to purple under a Gram stain. Examples of gram-positive bacteria include:

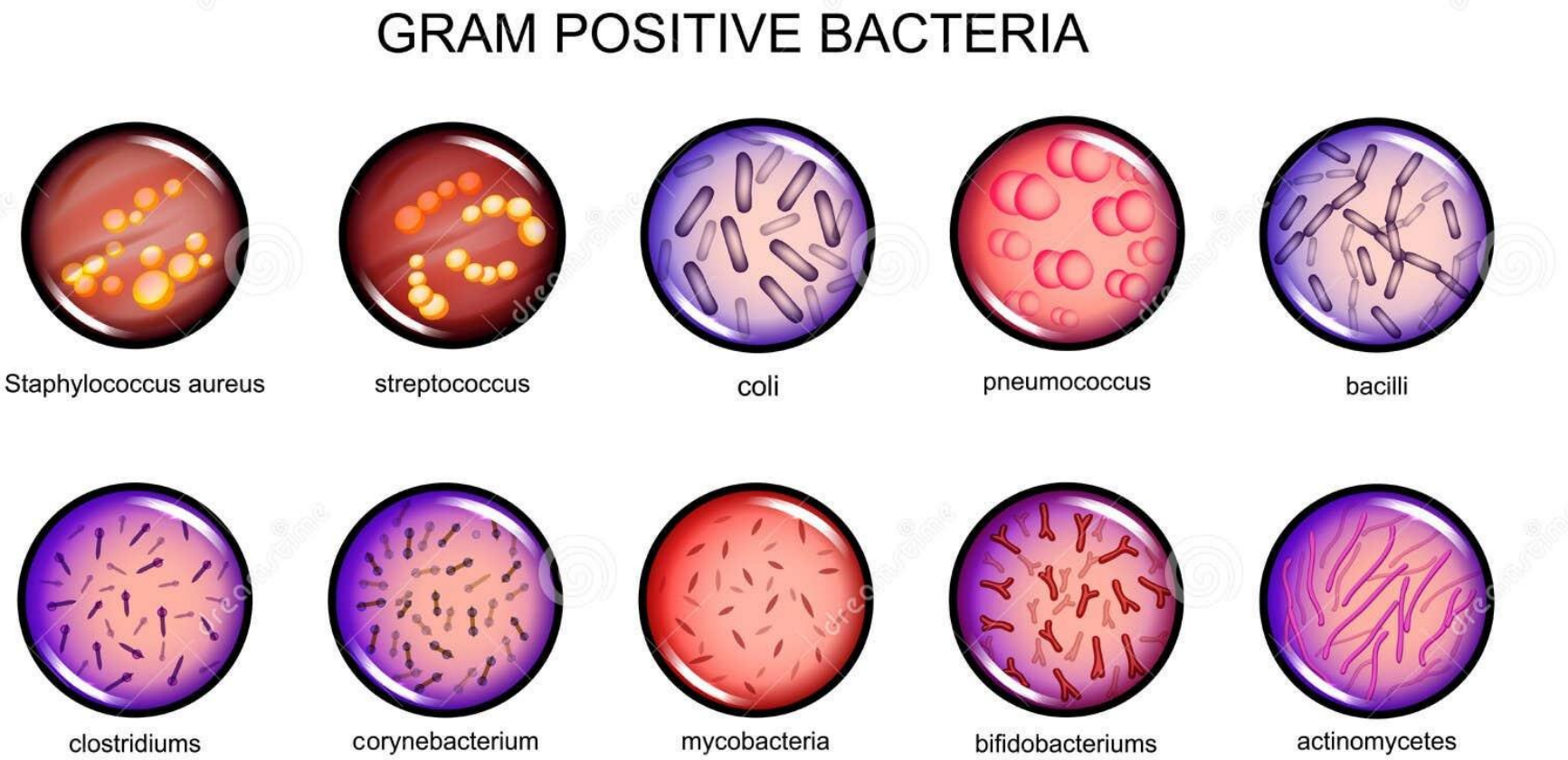
Corynebacterium.

Clostridium.

Listeria.

- that the bacteria will learn to resist it. An example of antibiotic-resistant bacteria is MRSA (methicillin-resistant Staphylococcus aureus).

What are gram-positive bacteria?



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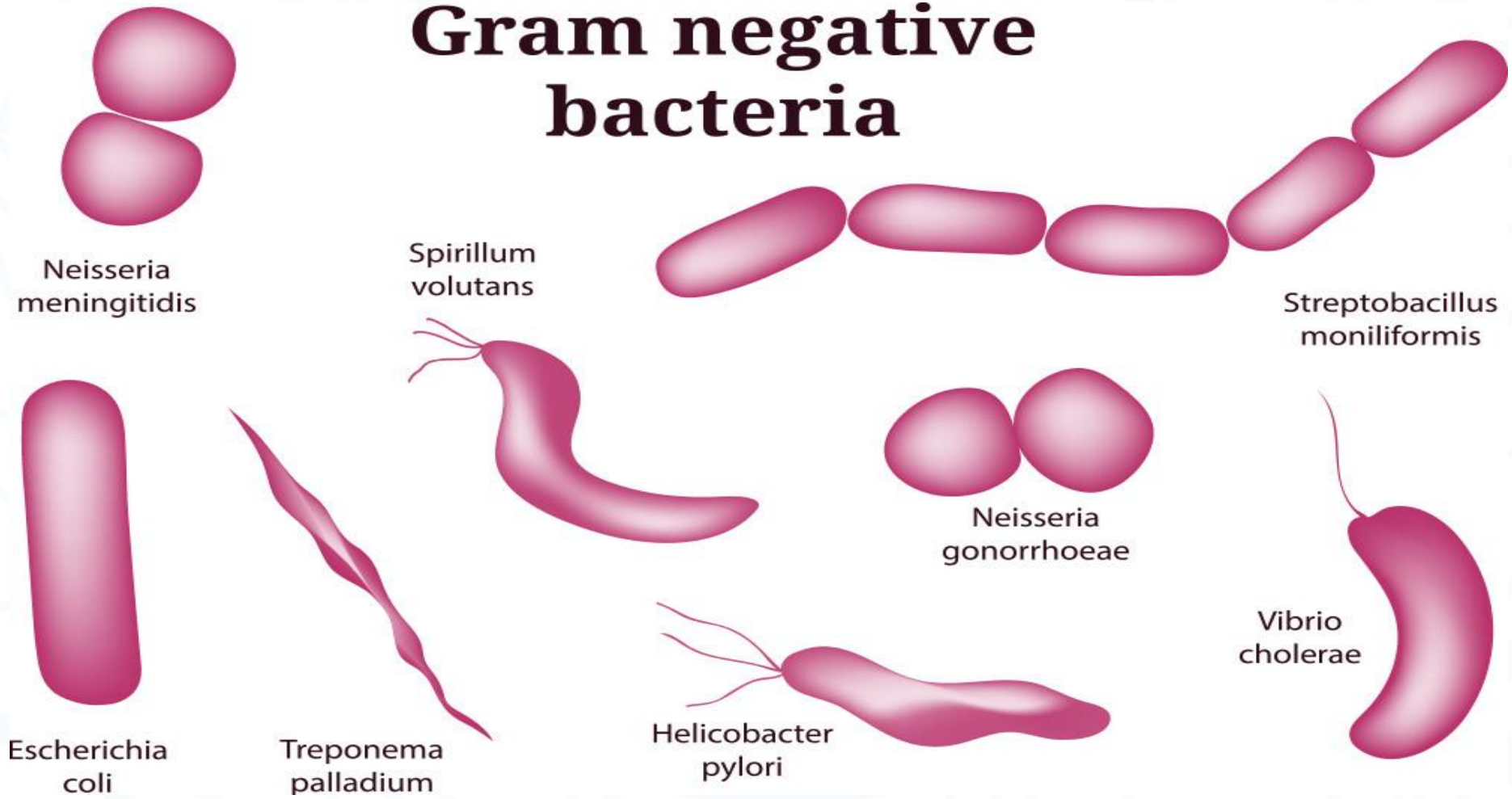
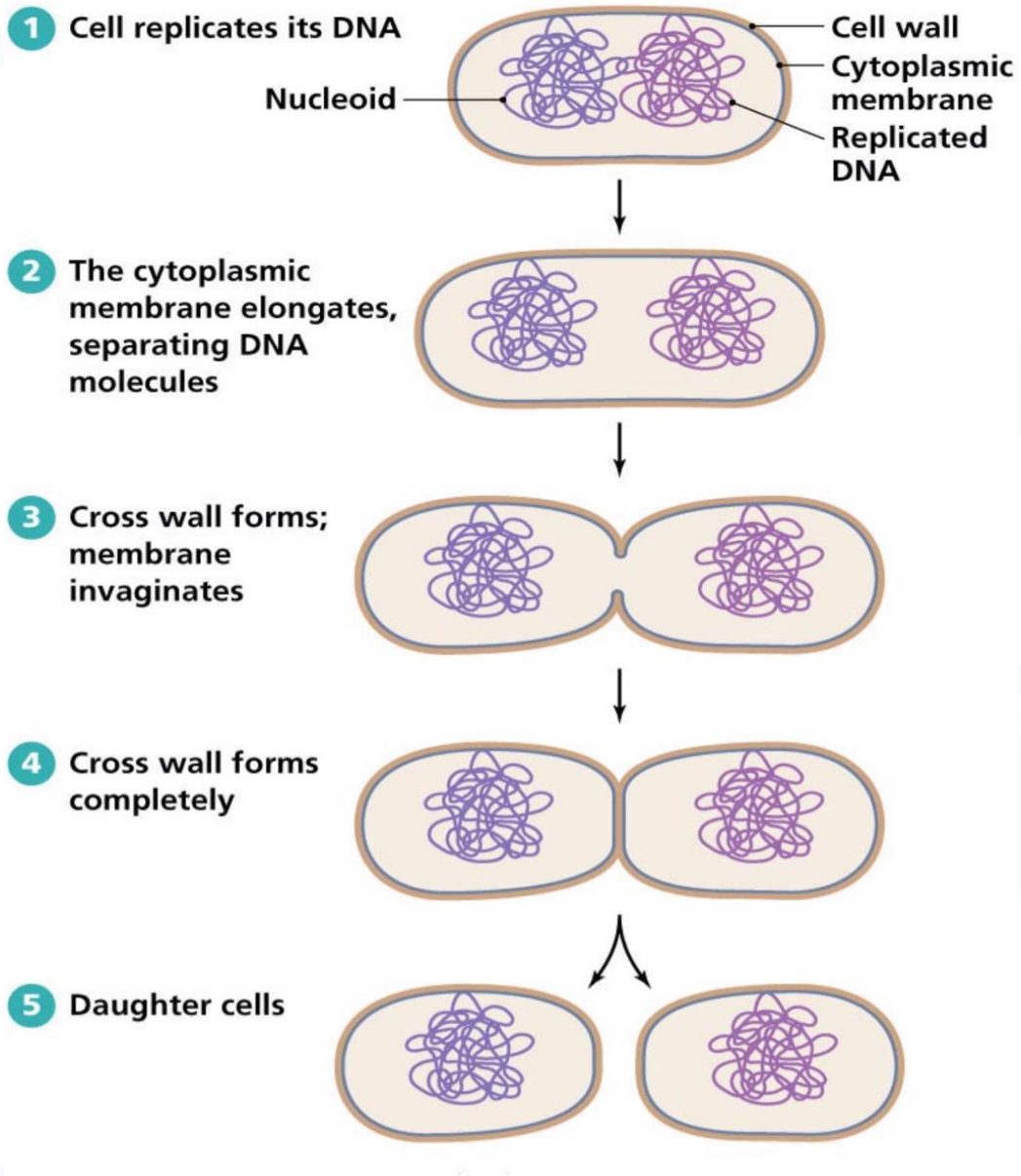


How do bacteria reproduce?

- Most bacteria reproduce through binary fission. This means that each bacterium cell duplicates its DNA and then divides into two parts, with each new cell receiving one copy of DNA.



Are bacteria prokaryotic or eukaryotic?

- Bacteria don’t have a nucleus, so they’re classified as prokaryotes. They’re microbes with a very simple cell structure. Bacteria have cell walls. Within the cell walls, a bacteria diagram would show the structure of each cell. Each bacterium contains cytoplasm, ribosomes and DNA. Outside the cell wall, one or more bacteria flagella help the bacterium move.