**أعلى النموذج**

**مممم**

**Applied Microbiology**

Microbiology is the study of microbes, which affect almost every aspect of life on the earth. In addition, there are huge commercial and medicinal benefits in understanding microbes. The application of this understanding is known as applied microbiology. There are many different types of applied microbiology which can be briefly defined as follows:

**Medical Microbiology**

Medical microbiology is the study of the [pathogenic](https://www.boundless.com/microbiology/definition/pathogenic) microbes and the role of microbes in human illness. This includes the study of microbial pathogenesis and [epidemiology](https://www.boundless.com/microbiology/definition/epidemiology) and is related to the study of disease pathology and [immunology](https://www.boundless.com/microbiology/definition/immunology).

**Pharmaceutical Microbiology**

The study of [microorganisms](https://www.boundless.com/microbiology/definition/microorganisms) that are related to the production of [antibiotics](https://www.boundless.com/microbiology/definition/antibiotics), [enzymes](https://www.boundless.com/microbiology/definition/enzymes),[vitamins](https://www.boundless.com/microbiology/definition/vitamin), [vaccines](https://www.boundless.com/microbiology/definition/vaccine), and other pharmaceutical products. Pharmaceutical microbiology also studies the causes of pharmaceutical contamination and spoil.

**Industrial Microbiology**

The exploitation of microbes for use in industrial processes. Examples include industrial [fermentation](https://www.boundless.com/microbiology/definition/fermentation) and waste-water treatment. Closely linked to the [biotechnology](https://www.boundless.com/microbiology/definition/biotechnology) industry. This field also includes brewing, an important application of microbiology.

**Microbial Biotechnology**

The manipulation of microorganisms at the [genetic](https://www.boundless.com/microbiology/definition/genetics) and molecular level to generate useful products.

**Food Microbiology and Dairy Microbiology**

The study of microorganisms causing [food spoilage](https://www.boundless.com/microbiology/definition/food-spoilage) and food-borne illness. Microorganisms can produce foods, for example by fermentation .

**Agricultural Microbiology**

The study of agriculturally relevant microorganisms. This field can be further classified into the following subfields:

* Plant microbiology and plant pathology - The study of the interactions between microorganisms and plants and plant [pathogens](https://www.boundless.com/microbiology/definition/pathogens).
* Soil microbiology - The study of those microorganisms that are found in soil.
* Veterinary microbiology - The study of the role in microbes in veterinary medicine or animal [taxonomy](https://www.boundless.com/microbiology/definition/taxonomy).
* Environmental microbiology - The study of the function and diversity of microbes in their natural environments. This involves the characterization of key bacterial [habitats](https://www.boundless.com/microbiology/definition/habitat) such as the [rhizosphere](https://www.boundless.com/microbiology/definition/rhizosphere) and phyllosphere, soil and ground water[e cosystems](https://www.boundless.com/microbiology/definition/ecosystems), open oceans or extreme environments (extremophiles). This field includes other [branches](https://www.boundless.com/microbiology/definition/branch) of microbiology such as: microbial ecology (microbially-mediated nutrient cycling), geomicrobiology, (microbial diversity), water microbiology (the study of those microorganisms that are found in water), aeromicrobiology (the study of airborne microorganisms) and epidemiology (the study of the [incidence](https://www.boundless.com/microbiology/definition/incidence), spread, and control of disease).

**Soil microbiology**

Soil microbiology is the study of organisms in soil, their functions, and how they affect soil properties. It is believed that between two and four billion years ago, the first ancient [bacteria](https://en.wikipedia.org/wiki/Bacteria) and microorganisms came about in Earth's oceans. These bacteria could [fix nitrogen](https://en.wikipedia.org/wiki/Nitrogen_fixation), in time multiplied and as a result released oxygen into the atmosphere. This led to more advanced microorganisms. Microorganisms in soil are important because they affect soil structure and fertility. Soil microorganisms can

be classified as [bacteria](https://en.wikipedia.org/wiki/Bacteria), [actinomycetes](https://en.wikipedia.org/wiki/Actinobacteria" \o "Actinobacteria), [fungi](https://en.wikipedia.org/wiki/Fungus), [algae](https://en.wikipedia.org/wiki/Algae) and [protozoa](https://en.wikipedia.org/wiki/Protozoa). Each of these groups has characteristics that define them and their functions in soil.

1. **Bacteria**

Bacteria and [Archaea](https://en.wikipedia.org/wiki/Archaea" \o "Archaea) are the smallest organisms in soil . Bacteria and Archaea are [prokaryotic](https://en.wikipedia.org/wiki/Prokaryote). All of the *other* microorganisms are [eukaryotic](https://en.wikipedia.org/wiki/Eukaryote), which means they have a more advanced cell structure with internal [organelles](https://en.wikipedia.org/wiki/Organelle) and the ability to reproduce sexually. A prokaryote has a very simple cell structure with no internal organelles. Bacteria and archaea are the most abundant microorganisms in the soil, and serve many important purposes, including nitrogen fixation.

**Biochemical processes**

One of the most distinguished features of bacteria is their biochemical versatility. A bacterial genera called [*Pseudomonas*](https://en.wikipedia.org/wiki/Pseudomonas) can metabolize a wide range of chemicals and fertilizers.

**Nitrogen fixation**

Bacteria are responsible for the process of [nitrogen fixation](https://en.wikipedia.org/wiki/Nitrogen_fixation), which is the conversion of atmospheric nitrogen into nitrogen-containing compounds (such as [ammonia](https://en.wikipedia.org/wiki/Ammonia)) that can be used by plants , like the *Nitrobacters* species, rather than feeding on plants or other organisms.

1. [**Actinomycetes**](https://en.wikipedia.org/wiki/Actinobacteria)

[Actinomycetes](https://en.wikipedia.org/wiki/Actinobacteria) are soil microorganisms. They are a type of bacteria, but they share some characteristics with fungi that are most likely a result of convergent evolution due to a common habitat and lifestyle.

**-Similarities to fungi**

Although they are members of the Bacteria kingdom, many actinomycetes share characteristics with fungi, including shape and

branching properties, spore formation and secondary [metabolite](https://en.wikipedia.org/wiki/Metabolite) production.

**-Antibiotics**

One of the most notable characteristics of the actinomycetes is their ability to produce antibiotics.  [Streptomycin](https://en.wikipedia.org/wiki/Streptomycin), [neomycin](https://en.wikipedia.org/wiki/Neomycin), [erythromycin](https://en.wikipedia.org/wiki/Erythromycin) and [tetracycline](https://en.wikipedia.org/wiki/Tetracycline_antibiotics) are only a few examples of these antibiotics.

1. **Fungi**

Fungi are abundant in soil, but bacteria are more abundant. Fungi are important in the soil as food sources for other, larger organisms, pathogens, beneficial symbiotic relationships with plants or other organisms and soil health. Fungi can be split into species based primarily on the size, shape and color of their reproductive spores, which are used to reproduce. Most of the environmental factors that influence the growth and distribution of bacteria and actinomycetes also influence fungi. The quality as well as quantity of organic matter in the soil has a direct correlation to the growth of fungi, because most fungi consume organic matter for nutrition. Fungi thrive in acidic environments, while bacteria and actinomycetes cannot survive in acid, which results in an abundance of fungi in acidic areas. Fungi also grows well in dry, arid soils because fungi are aerobic, or dependent on oxygen, and the higher the moisture content in the soil, the less oxygen is present for them.

**4-**[**Algae**](https://en.wikipedia.org/wiki/Algae)

[Algae](https://en.wikipedia.org/wiki/Algae) can make their own nutrients through [photosynthesis](https://en.wikipedia.org/wiki/Photosynthesis). Photosynthesis converts light energy to chemical energy that can be

stored as nutrients. Algae, do not have to be directly exposed to the Sun, but can live below the soil surface given uniform temperature and moisture conditions .

**Types**

Algae can be split up into three main groups: the [Cyanophyceae](https://en.wikipedia.org/wiki/Cyanobacteria" \o "Cyanobacteria), the [Chlorophyceae](https://en.wikipedia.org/wiki/Chlorophyceae" \o "Chlorophyceae) and the [Bacillariaceae](https://en.wikipedia.org/wiki/Bacillariaceae" \o "Bacillariaceae). The Cyanophyceae contain [chlorophyl](https://en.wikipedia.org/wiki/Chlorophyll" \o "Chlorophyll) , which is the molecule that absorbs sunlight and uses that energy to make carbohydrates from carbon dioxide and water and also pigments that make it blue-green to violet in color. The Chlorophyceae usually only have chlorophyll in it which makes it green, and the Bacillariaceae contain chlorophyll as well as pigments that make the algae brown in color.

**Blue-green algae and nitrogen fixation**

Blue-green algae, or Cyanophyceae, are responsible for nitrogen fixation. The amount of nitrogen they fix depends more on physiological and environmental factors rather than the organism’s abilities. These factors include intensity of sunlight, concentration of inorganic and organic nitrogen sources and ambient temperature and stability.

**5-**[**Protozoa**](https://en.wikipedia.org/wiki/Protozoa)

[Protozoa](https://en.wikipedia.org/wiki/Protozoa" \o "Protozoa) are eukaryotic organisms that were some of the first microorganisms to reproduce sexually, a significant evolutionary step from duplication of spores, like those that many other soil microorganisms depend on. Protozoa can be split up into three categories: [flagellates](https://en.wikipedia.org/wiki/Flagellates), [amoebae](https://en.wikipedia.org/wiki/Amoebae) and [ciliates](https://en.wikipedia.org/wiki/Ciliates).

**Flagellates**

Flagellates are the smallest members of the protozoa group, and can be divided further based on whether they can participate in photosynthesis. Nonchlorophyll-containing flagellates are not capable of photosynthesis because chlorophyll is the green pigment that absorbs sunlight. These flagellates are found mostly in soil. Flagellates that contain chlorophyll typically occur in aquatic conditions. Flagellates can be distinguished by their flagella, which is their means of movement. Some have several flagella, while other species only have one that resembles a long branch or appendage.

**Amoebae**

Amoebae are larger than flagellates and move in a different way. Amoebae can be distinguished from other protozoa by their slug-like properties and [pseudopodia](https://en.wikipedia.org/wiki/Pseudopodia). A pseudopodia or “false foot” is a temporary obtrusion from the body of the amoeba that helps pull it along surfaces for movement or helps to pull in food. The amoeba does not have permanent appendages and the pseudopodium is more of a slime-like consistency than a flagellum.

**Ciliates**

Ciliates are the largest of the protozoa group, and move by means of short, numerous cilia that produce beating movements. Cilia resemble small, short hairs. They can move in different directions to move the organism, giving it more mobility than flagellates or amoebae.

**Composition regulation**

[Plant hormones](https://en.wikipedia.org/wiki/Plant_hormones) [salicylic acid](https://en.wikipedia.org/wiki/Salicylic_acid), [jasmonic acid](https://en.wikipedia.org/wiki/Jasmonic_acid" \o "Jasmonic acid) and [ethylene](https://en.wikipedia.org/wiki/Ethylene) are key regulators of innate immunity in plant leaves. Mutants impaired in salicylic acid synthesis and signaling are hypersusceptible to microbes that colonize the host plant to obtain nutrients, whereas mutants impaired in jasmonic acid and ethylene synthesis and signaling are hypersusceptible to herbivorous insects and microbes that kill host cells to extract nutrients.The challenge of modulating a community of diverse microbes in plant roots is more involved than that of clearing a few pathogens from inside a plant leaf. Consequently, regulating root microbiome composition may require immune mechanisms other than those that control foliar microbes.

A 2015 study analyzed a panel of [*Arabidopsis*](https://en.wikipedia.org/wiki/Arabidopsis) [hormone](https://en.wikipedia.org/wiki/Hormone) mutants impaired in synthesis or signaling of individual or combinations of plant hormones, the microbial community in the soil adjacent to the root and in bacteria living within root tissue. Changes in salicylic acid signaling stimulated a reproducible shift in the relative abundance of bacterial phyla in the endophytic compartment. These changes were consistent across many [families](https://en.wikipedia.org/wiki/Family_(biology)) within the affected [phyla](https://en.wikipedia.org/wiki/Phylum), indicating that salicylic acid may be a key regulator of microbiome community structure.

Classical plant defense hormones also function in plant growth, metabolism and abiotic stress responses, obscuring the precise mechanism by which salicylic acid regulates this microbiome.

During plant domestication, humans selected for traits related to plant improvement, but not for plant associations with a beneficial microbiome. Even minor changes in abundance of certain bacteria can have a major effect on plant defenses and physiology, with only minimal effects on overall microbiome structure.