1. MICROORGANISMS AND MICROBIOLOGY

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Teknologi Industri Pertanian
Fakultas Teknologi Pertanian
Universitas Brawijaya
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COURSE CONTRACT

- Come on time
- Silent your cell phone
- Manage your tasks & assignment
- Actively participate, Think creatively
- Read, Read more and more
- No plagiarism
Score Grading

Assignment 10%

Practicum 30%

Midterm Test 30%

Final Test 30%

Range | Grade
--- | ---
>80-100 | A
>75-<80 | B+
>70-<75 | B
>60-<70 | C+
>55-<60 | C
>50-<55 | D+
>45-<50 | D
<45 | E

Cheating students will be punished with “E” grade
## COURSE TOPICS

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<th>Lecturer</th>
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Midterm Test (UTS)

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## COURSE TOPICS

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Final Test (UAS)
Microbiology is the study of microorganisms. Microorganisms are all single-celled microscopic organisms and include the viruses, which are microscopic but not cellular.

It is about microbial cells and how they work, especially the bacteria, a very large group of very small cells that, collectively, have enormous basic and practical importance.

It is about diversity and evolution of microbial cells, about how different kinds of microorganisms arose and why. It is also about what microorganisms do in the world at large, in soils and waters, in the human body, and in animals and plants. One way or another, microorganisms affect and support all other forms of life, and thus microbiology can be considered the most fundamental of the biological sciences.
A basic tenet of biology is that the cell is the fundamental unit of life. A single cell is an entity isolated from other such entities by a membrane; many cells also have a cell wall outside the membrane (Figure 1).

Figure 1. Bacterial cells and some cell structures.  
(a) Rod-shaped cells of the bacterium Heliobacterium modesticaldum as seen in the light microscope; (b) Scanning electron micrograph of the same cells as in part a showing flagella, structures that rotate like a propeller and allow cells to swim. (c) Electron micrograph of a sectioned cell of H. modesticaldum. The light area is aggregated DNA, the nucleoid of the cell.
Microorganisms as Cells

Cells as Biochemical Catalysts and as Genetic Entities

The catalytic and genetic functions of the cell.

For a cell to reproduce itself there must be energy and precursors for the synthesis of new macromolecules, the genetic instructions must be replicated such that upon division each cell receives a copy, and genes must be expressed (transcribed and translated) to produce proteins and other macromolecules. Replication, transcription, and translation are the key molecular processes in cells.

The Historical Roots of Microbiology

✓ Antoni van Leeuwenhoek (1632–1723)

Antoni van Leeuwenhoek was the first to describe bacteria. Van Leeuwenhoek’s microscopes were crude by today’s standards, but by careful manipulation and focusing he was able to see bacteria, microorganisms considerably smaller than molds (molds are fungi). He discovered bacteria in 1676 while studying pepper–water infusions. Drawings of some of van Leeuwenhoek’s “wee animalcules,” as he referred to them, are shown in Figure 1, and a photo taken through such a microscope is shown in Figure 2.
The Historical Roots of Microbiology

✓ Louis Pasteur (1822-1895)
- discovered fermentations
- discovered anaerobic life
- sterilization, pasteurization
- vaccination (smallpox)
- isolation and identification of causers of some infection diseases

The defeat of spontaneous generation: Pasteur’s swan-necked flask experiment.
In (c) the liquid putrefies because microorganisms enter with the dust.

✓ Robert Koch (1843-1910)
- solidifying of liquid cultivation media (gelatine, agar)
- construction of Petri dish
- new cultivation media
- colouring of bacteria by aniline colours
- isolation and identification of causers of cholera, anthrax and tuberculosis

Robert Koch’s drawings of *Mycobacterium tuberculosis*.
(a) Section through infected lung tissue showing cells of *M. Tuberculosis* (blue). (b) *M. tuberculosis* cells in a sputum sample from a tubercular patient. (c) Growth of *M. tuberculosis* on a glass plate of coagulated blood serum stored inside a glass box to prevent contamination. (d) *M. Tuberculosis* cells taken from the plate in part c and observed microscopically; cells appear as long cordlike forms. Original drawings from Koch, R. 1884.
As microbiology moved into the twentieth century, its initial focus on basic principles, methods, and medical aspects broadened to include studies of the microbial diversity of soil and water and the metabolic processes that organisms in these habitats carried out. Two giants of this era included the Dutchman Martinus Beijerinck and the Russian Sergei Winogradsky.

Beijerinck and Winogradsky studied bacteria that inhabit soil and water. Out of their work came the enrichment culture technique and the concepts of chemolithotrophy and nitrogen fixation.
The major subdisciplines of microbiology

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<td>I. Basic emphases*</td>
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<tr>
<td>Microbial physiology</td>
<td>Nutrition, metabolism</td>
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<tr>
<td>Microbial genetics</td>
<td>Genes, heredity, and genetic variation</td>
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<tr>
<td>Microbial biochemistry</td>
<td>Enzymes and chemical reactions in cells</td>
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<td>Microbial systematics</td>
<td>Classification and nomenclature</td>
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<td>Virology</td>
<td>Viruses and subviral particles</td>
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<td>Molecular biology</td>
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<td>Microbial ecology</td>
<td>Microbial diversity and activity in natural habitats; biogeochemistry</td>
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<td>II. Applied emphases*</td>
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<td>Immunology</td>
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<tr>
<td>Agricultural/soil microbiology</td>
<td>Microbial diversity and processes in soil</td>
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<tr>
<td>Industrial microbiology</td>
<td>Large-scale production of antibiotics, alcohol, and other chemicals</td>
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<tr>
<td>Biotechnology</td>
<td>Production of human proteins by genetically engineered microorganisms</td>
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<tr>
<td>Aquatic microbiology</td>
<td>Microbial processes in waters and wastewaters, drinking water safety</td>
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*None of these subdisciplines are devoted entirely to basic science or applied science. However, the subdisciplines listed in I tend to be more focused on discovery and those in II more focused on solving specific problems or synthesizing commercial products from microbial sources.

Penggolongan Makhluk Hidup (Carl Woose)

- Domain Bakteri (Dinding sel memiliki peptidoglikan)
- Archae (jika ada dinding sel maka tidak terdapat peptidoglikan)
- Eukariot (memiliki inti sejati)
  - Protista (jamur lendir, protozoa, alga)
  - Jamur (cendawan, kapang, khamir)
  - Tanaman
  - Hewan
Terimakasih