

8

Bakteri dan Archaea

Dosen Pengampu :

1. Prof. Dr. Ir. Wignyanto, MS
2. Dr. Ir. Nur Hidayat, MP
3. Irmia Nurika, STP, MP, PhD.
4. Nimas Mayang Sabrina, STP, MSc, PhD
5. Suprayogi, STP, MP, PhD
6. Vitta R. Permatasari, STP, MP
7. Tutut Arinda, Ssi, MSI

Agroindustrial Technology, Brawijaya University - 2020



Overview of Bacteria

- Bacteria are single celled microbes.
- The cell structure is simpler than that of other organisms as there is no nucleus or membrane bound organelles.
- Instead their control centre containing the genetic information is contained in a single loop of DNA.

Overview of Bacteria

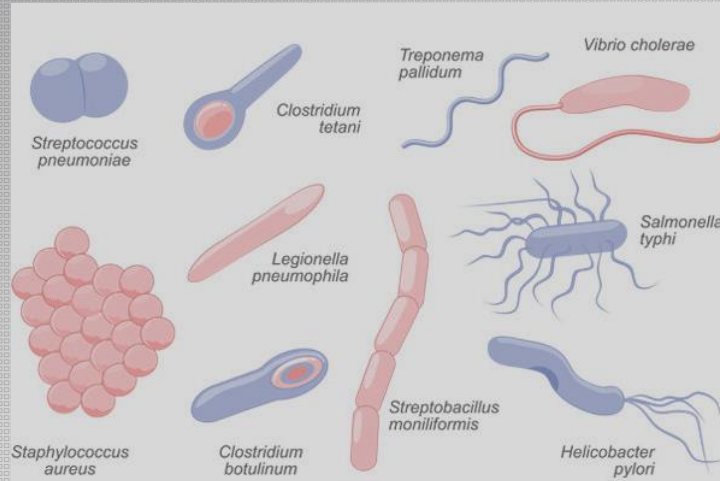
- Some bacteria have an extra circle of genetic material called a plasmid.
- The plasmid often contains genes that give the bacterium some advantage over other bacteria.
- For example it may contain a gene that makes the bacterium resistant to a certain antibiotic.

Bacteria

- Bacteria are classified into five groups according to their basic shapes:
 - spherical (cocci),
 - rod (bacilli),
 - spiral (spirilla),
 - comma (vibrios) or
 - corkscrew (spirochaetes).

They can exist as single cells, in pairs, chains or clusters.

Different bacterial shapes.



Overview of Bacteria

- Bacteria are found in every habitat on Earth: soil, rock, oceans and even arctic snow. Some live in or on other organisms including plants and animals including humans.
- There are approximately 10 times as many bacterial cells as human cells in the human body. A lot of these bacterial cells are found lining the digestive system.
- Some bacteria live in the soil or on dead plant matter where they play an important role in the cycling of nutrients.
- Some types cause food spoilage and crop damage but others are incredibly useful in the production of fermented foods such as yoghurt and soy sauce.
- Relatively few bacteria are parasites or pathogens that cause disease in animals and plants.

How do bacteria reproduce?

- Bacteria reproduce by binary fission.
- In this process the bacterium, which is a single cell, divides into two identical daughter cells.
- Binary fission begins when the DNA of the bacterium divides into two (replicates).
- The bacterial cell then elongates and splits into two daughter cells each with identical DNA to the parent cell. Each daughter cell is a clone of the parent cell.

fppt.com

THE PROCARYOTIC CELL CYCLE

(a) A young cell at early phase of cycle



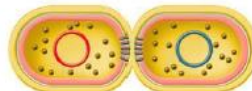
(b) A parent cell prepares for division by enlarging its cell wall, cell membrane, and overall volume.



(c) The septum begins to grow inward as the chromosomes move toward opposite ends of the cell. Other cytoplasmic components are distributed to the two developing cells.



(d) The septum is synthesized completely through the cell center, and the cell membrane patches itself so that there are two separate cell chambers.



(e) At this point, the daughter cells are divided. Some species separate completely as shown here, while others remain attached, forming chains, doublets, or other cellular arrangements.



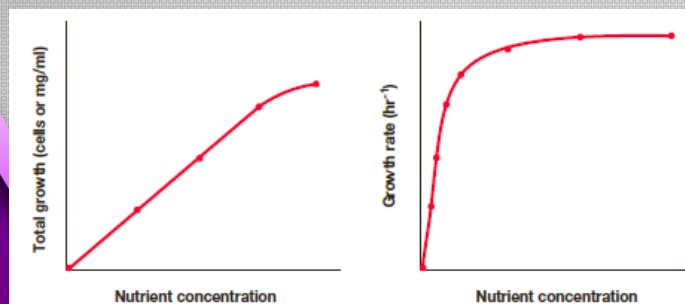
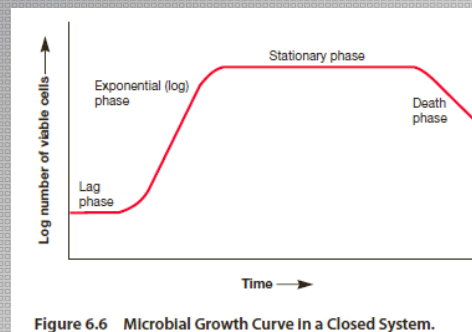
- Cell wall
- Cell membrane
- Chromosome 1
- Chromosome 2
- Ribosomes

fppt.com

How do bacteria reproduce?

- When conditions are favourable such as the right temperature and nutrients are available, some bacteria like *Escherichia coli* can divide every 20 minutes.
- This means that in just seven hours one bacterium can generate 2,097,152 bacteria. After one more hour the number of bacteria will have risen to a colossal 16,777,216.
- That's why we can quickly become ill when pathogenic microbes invade our bodies.

fppt.com



THE GROWTH CURVE

fppt.com

Survival mechanism

- Some bacteria can form endospores.
- These are dormant structures, which are extremely resistant to hostile physical and chemical conditions such as heat, UV radiation and disinfectants.
- This makes destroying them very difficult. Many endospore-producing bacteria are nasty pathogens, for example *Bacillus anthracis*, the cause of anthrax.

fppt.com

Table 7. Some Proteobacteria involved in industrial and biotechnological processes.

Proteobacterial class, genus or species	Family ^a	Industrial product or process
"Alphaproteobacteria"		
<i>Acetobacter aceti</i>	Acetobacteraceae	Vinegar
<i>Acetobacter xylinus</i>	Acetobacteraceae	Cellulose membranes
<i>Agrobacterium</i>	Rhizobiaceae	Plant engineering (Ti-plasmid)
<i>Gluconobacter oxydans</i>	Acetobacteraceae	Oxidation of sorbitol (for vitamin C production)
<i>Rhizobium</i>	Rhizobiaceae	Inoculants for nodule formation on leguminous plants (N ₂ -fixation)
<i>Rhodobacter capsulatus</i>	"Rhodobacteraceae"	Production of hydrogen gas
<i>Zymomonas mobilis</i>	Sphingomonadaceae	Ethanol
"Betaproteobacteria"		
<i>Ralstonia eutropha</i>	"Ralstoniaceae"	Poly-β-hydroxybutyrate (bioplastics) and single-cell protein
"Gammaproteobacteria"		
<i>Azotobacter</i>	Pseudomonadaceae	Alginates (polysaccharide) and poly-β-hydroxybutyrate (bioplastics)
<i>Chromatium</i>	Chromatiaceae	Production of hydrogen gas
<i>Erwinia herbicola</i>	Enterobacteriaceae	Biological control of frost damage
<i>Escherichia coli</i>	Enterobacteriaceae	Production of heterologous proteins (e.g., insulin, interferon, and antiviral vaccines)
<i>Photobacterium</i>	Vibrionaceae	Luciferase (<i>lux</i> -genes)
<i>Pseudomonas</i>	Pseudomonadaceae	Oxidation of aliphatic and aromatic compounds
<i>Acidithiobacillus ferrooxidans</i>	Acidithiobacillus group	Active metal mining (bioleaching)
<i>Xanthomonas campestris</i>	"Xanthomonadaceae"	Xanthan (polysaccharide)

^aAccording to *Bergey's Manual of Systematic Bacteriology* (Garrity and Holt, 2001). See also Fig. 1. Quotation marks are used for names which have not yet been validated (as of mid 2002).

fppt.com

A. Acetic Acid Bacteria

Ecology and Industrial Uses

- The acetic acid bacteria are commonly found in fermenting fruit juices, such as hard cider or wine, or in beer.
- Cultures of acetic acid bacteria are used in the commercial production of vinegar
- In addition to ethanol, the acetic acid bacteria carry out an incomplete oxidation of some higher alcohols and sugars.
- For instance, glucose is oxidized to gluconic acid, galactose to galactonic acid, arabinose to arabonic acid, and so on. This property of “underoxidation” is exploited in the industrial manufacture of ascorbic acid (vitamin C).

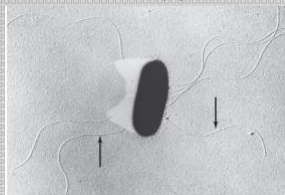


Aerobic and Facultatively Aerobic Chemoorganotrophic Proteobacteria

B. Enteric Bacteria

Key Genera: *Escherichia*, *Salmonella*, *Proteus*, *Enterobacter*

- The enteric bacteria comprise a relatively homogeneous phylogenetic group within the Gamma proteobacteria and consist of facultatively aerobic, gram-negative, non sporulating rods that are either non motile or motile by peritrichous flagella.



- Enteric bacteria are also oxidase-negative, have relatively simple nutritional requirements, and ferment sugars to a variety of end products.
- The defining phenotypic characteristics that distinguish enteric bacteria from other bacteria of similar morphology and physiology are given in Table 17.12.

Archaea

- Archaea can be spherical, rod, spiral, lobed, rectangular or irregular in shape.
- An unusual flat, square-shaped species that lives in salty pools has also been discovered.
- Some exist as single cells, others form filaments or clusters.
- Archaea are a group of micro-organisms that are similar to, but evolutionarily distinct from bacteria.

fppt.com

The Evolutionary Tree of Life

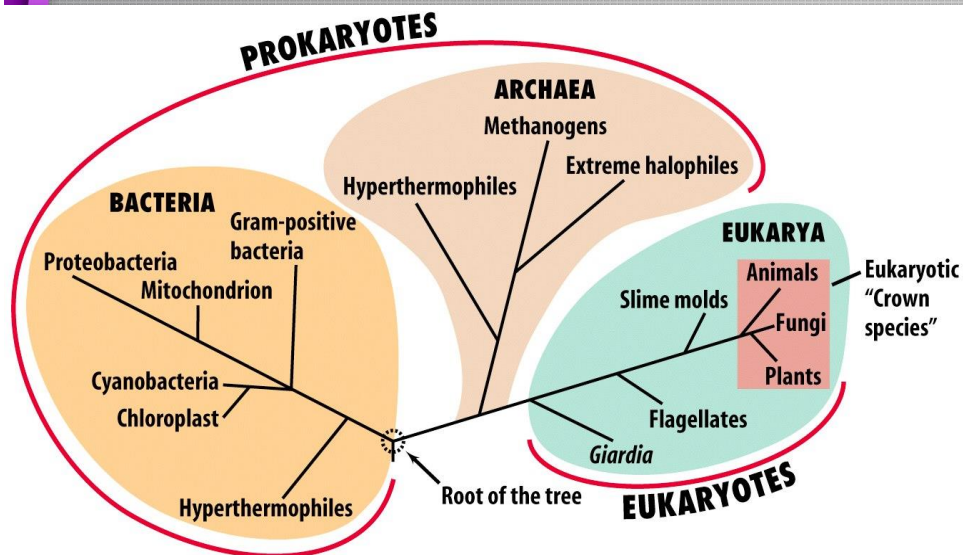


Figure 2-7 Brock Biology of Microorganisms 11/e
© 2006 Pearson Prentice Hall, Inc.

Archaea are prokaryotic cells



- Archaea are prokaryotic cells.
 - Cytoplasmic membrane: ether linked lipids to glycerol
 - 70S ribosomes,
 - 16S r-RNA.
 - Cell wall without peptidoglycan
 - histones-like proteins associated with the DNA.
- No true nucleus (nucleoid in the cytoplasm)
- No organelles.

fppt.com

Archaeal structures: membrane composition

Characteristics	Bacteria	Eukaryotic	Archaea
Protein content	High	Low	High
Lipid composition	Phospholipids	Phospholipids	Sulfolipids, glycolipids, nonpolar isoprenoid lipids, phospholipids
Lipid structure	Straight chain	Branched	Straight chain
Lipid linkage	Ester linked	Ester linked	Ether linked (di& tertaethers)
Sterols	Absent	Present	Absent

Archaea (Microbiology Today - Aug 2017)

Archaea
and the
nitrogen
cycle

Archaea in
activated sludge
systems

fppt.com

THANK YOU

