BACTERIAL REPRODUCTION

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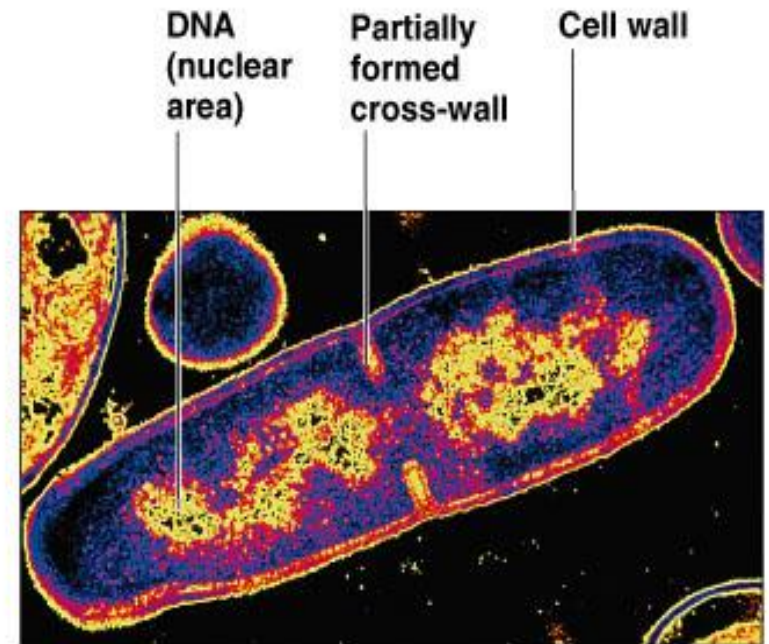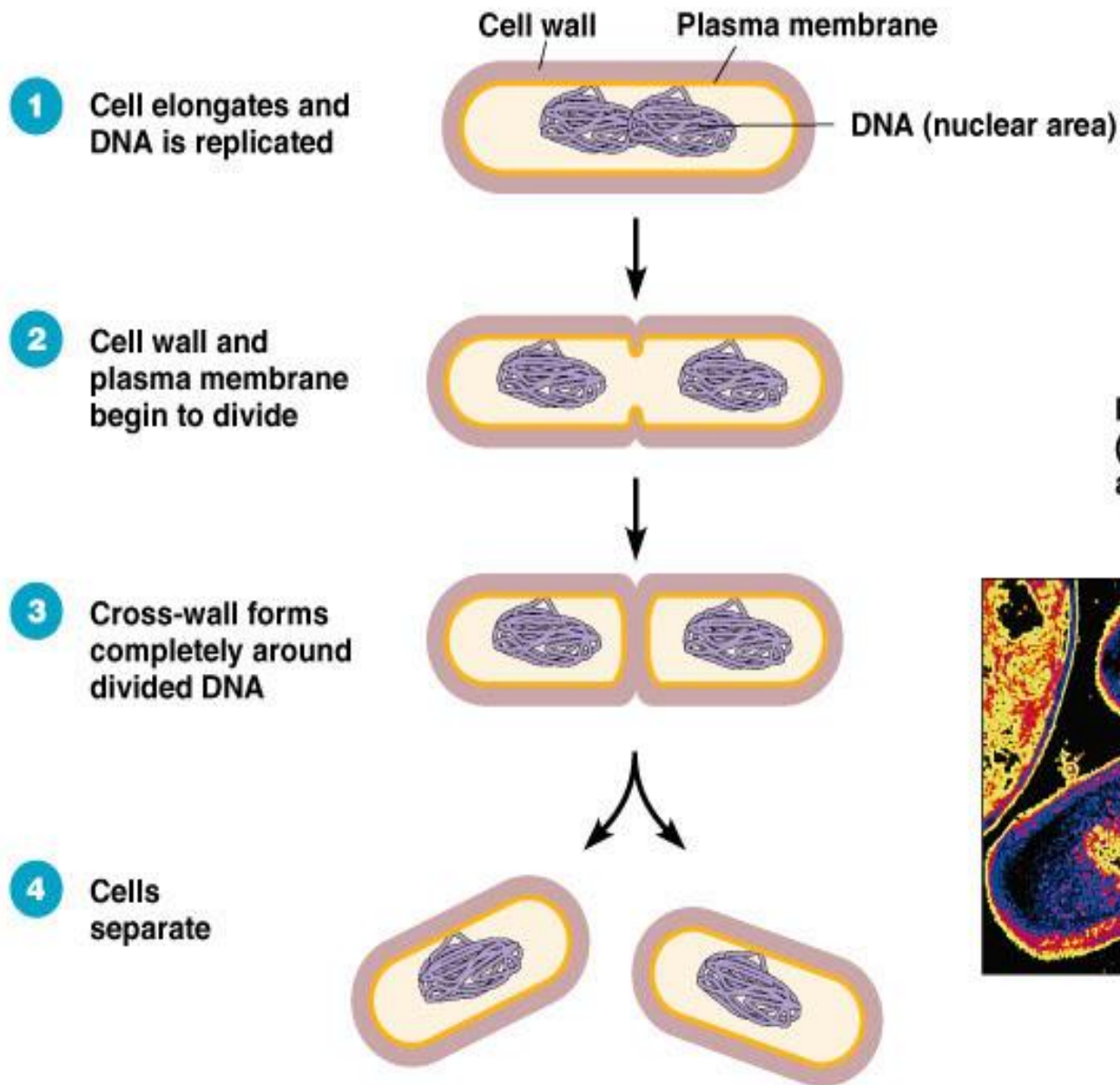
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Bacterial reproduction

Bacteria usually reproduce by simply dividing called binary fission

Binary fission is a process of **asexual reproduction** in which a **cell grows to twice its normal size** and **divides in half** to **produce two identical daughter cells with exact same genetic information as parent.**

Cell wall   **Plasma membrane**

1. **Cell elongates and DNA is replicated**

   DNA (nuclear area)

2. **Cell wall and plasma membrane begin to divide**

3. **Cross-wall forms completely around divided DNA**

4. **Cells separate**

(a) A diagram of the sequence of cell division.

DNA (nuclear area)   Partially formed cross-wall   Cell wall

(b) A thin section of a cell of *Bacillus licheniformis* starting to divide.

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Steps of Binary fission

1. **Replication of DNA**: DNA molecule replicate its self.

2. **Growth of Cell**: the bacterial cell increases its size. At the same time, the two DNA strands migrate and attach themselves to plasma membrane.

3. **Segregation of DNA**: A division septum is created transversely in the cell

4. **Splitting of Cells**: Inward growth of the cell membrane is associated with development of a new cell wall.

5. **Daughter cells either separate or stay attached**

Bacterial growth curve
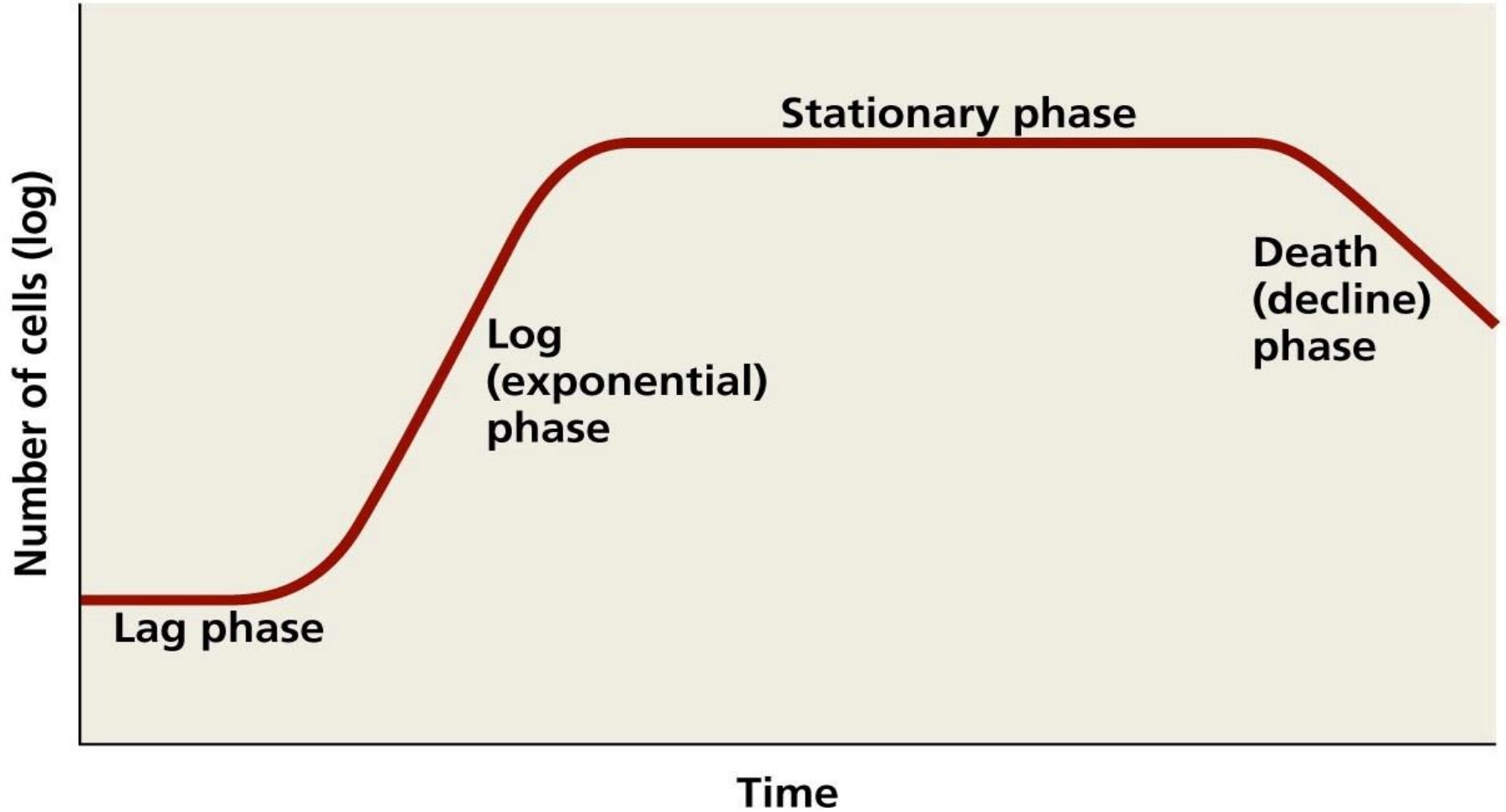
Standard growth curve
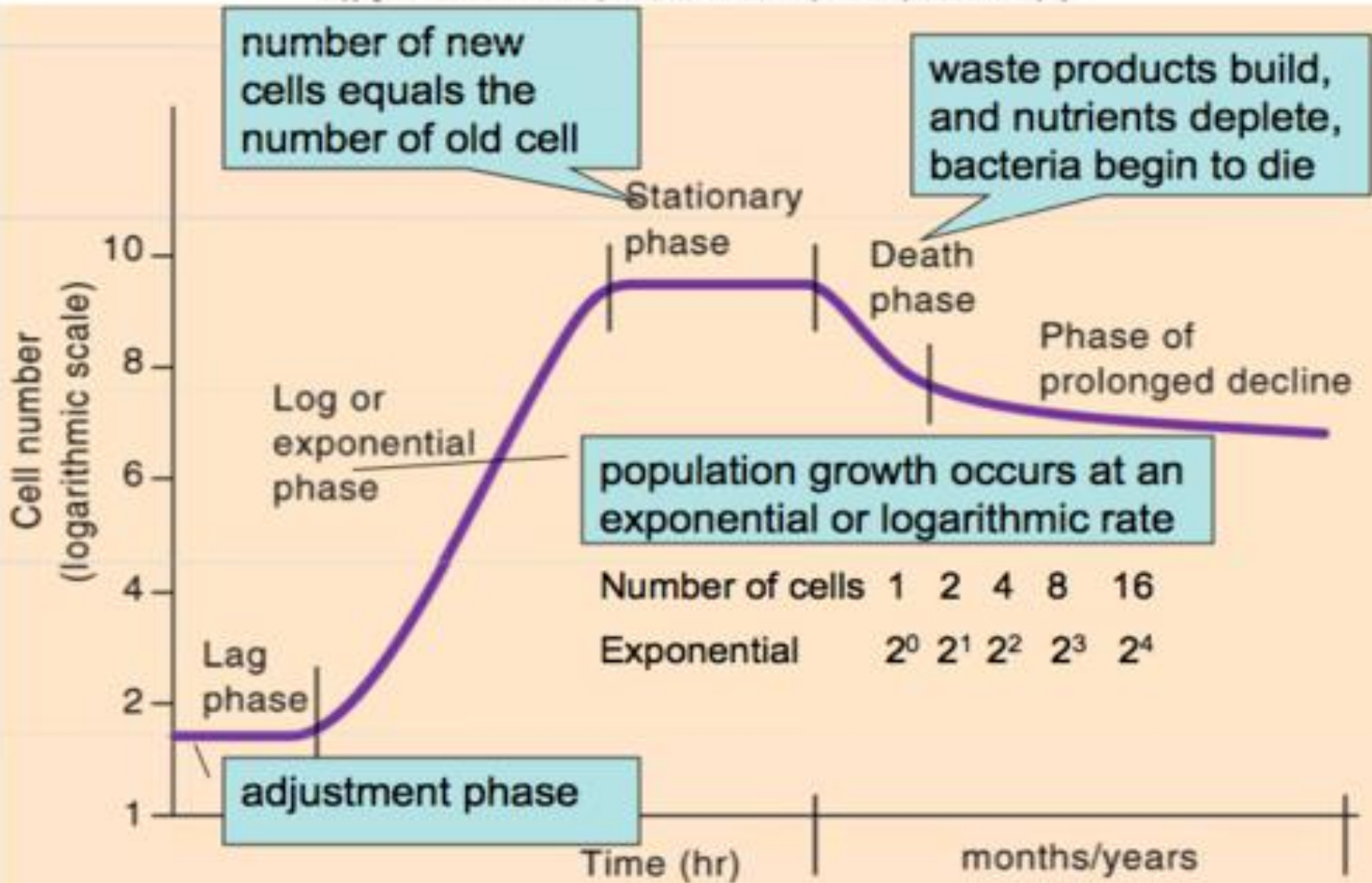
Standard growth curve

Lag phase

Lag phase occurs after microbes introduced into the fresh medium

Cells are increasing in size, but the bacteria are not able to replicate

The length of the lag phase depends directly on the previous growth condition of the organism

Microorganism growing in a rich medium and inoculated into poor medium	Microorganism growing in a poor medium and inoculated into rich medium
Long lag phase to adapt with new medium	Less lag phase and may be absent.

Exponential or Log phase

Bacteria multiply at the fastest rate possible and the number of bacteria logarithmically increases

Generation time

The time required for population of cells to double in number. Most bacteria have a doubling time of 1-3 hours

Logarithmic Representation of Bacterial Populations

Numbers of Cells	Numbers Expressed as a Power of 2	Visual Representation of Numbers
1	2^0	●
2	2^1	● ●
4	2^2	● ● ● ●
8	2^3	● ● ● ● ● ● ● ●
16	2^4	● ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●
32	2^5	● ●

Generation Number	Number of Cells	Log$_{10}$ of Number of Cells
0	1	0
5 (2^5) =	32	1.51
10 (2^{10}) =	1,024	3.01
15 (2^{15}) =	32,768	4.52
16 (2^{16}) =	65,536	4.82
17 (2^{17}) =	131,072	5.12
18 (2^{18}) =	262,144	5.42
19 (2^{19}) =	524,288	5.72
20 (2^{20}) =	1,048,576	6.02

Stationary phase

Division is equal to the number of cell death. The cell number is not increased

The nutrients in the medium are used up.

Conditions of the medium unfavorable for the growth

Accumulation of waste, toxic and inhibitory compounds such as antibiotics.

Decline phase

The bacterium completely loses its ability to reproduce and begin to die and the death is rapid
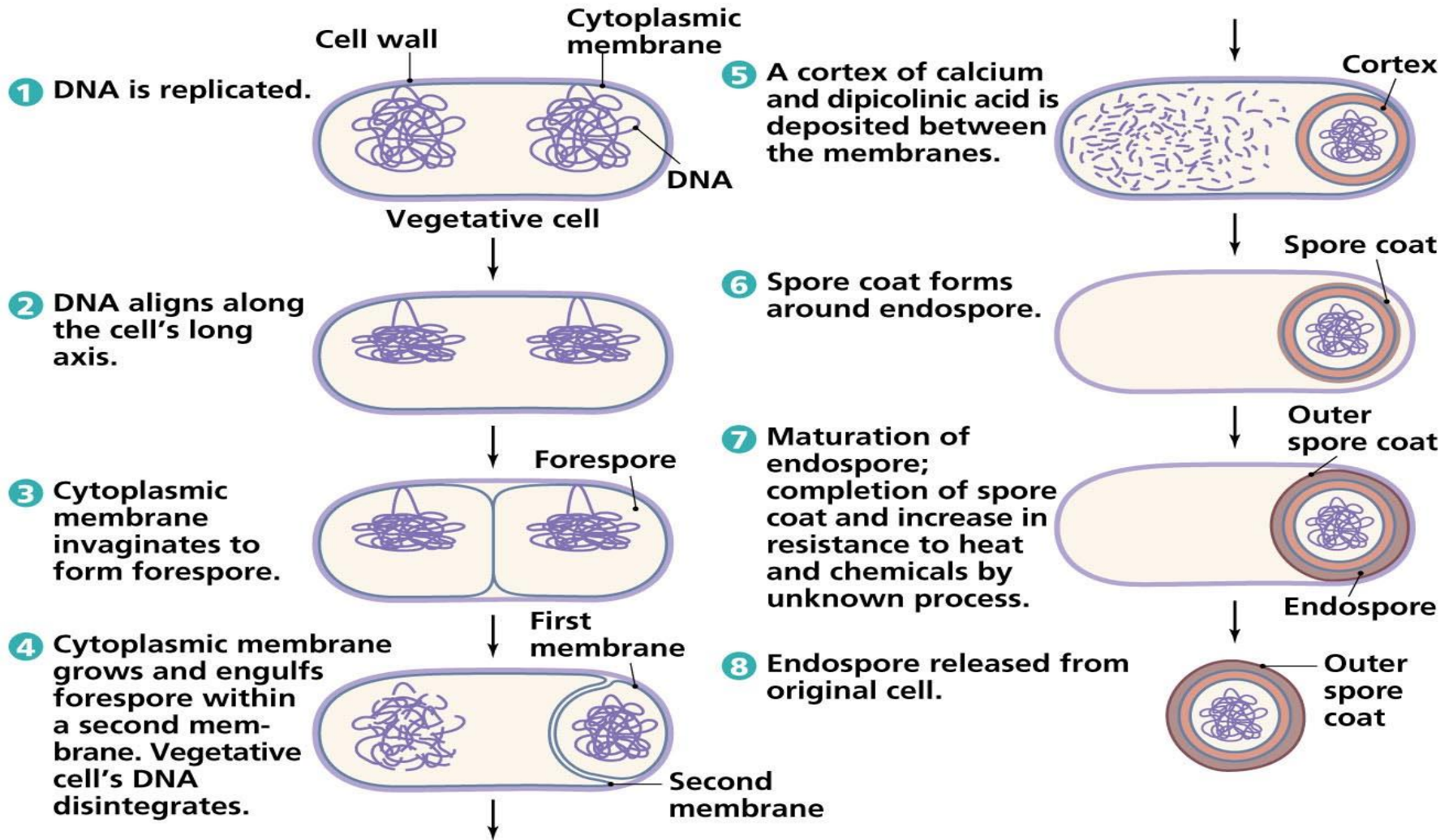
depletion of nutrients and the accumulation of metabolic waste products

Some microorganisms produce endospores

Sporulation

Some bacteria like *Bacillus and Clostridium*

Only one spore is formed inside each bacterial cell during sporulation

Cell wall

Cytoplasmic membrane

1 DNA is replicated.

DNA

Vegetative cell

2 DNA aligns along the cell's long axis.

3 Cytoplasmic membrane invaginates to form forespore.

Forespore

4 Cytoplasmic membrane grows and engulfs forespore within a second membrane. Vegetative cell's DNA disintegrates.

First membrane

Second membrane

5 A cortex of calcium and dipicolinic acid is deposited between the membranes.

Cortex

6 Spore coat forms around endospore.

Spore coat

7 Maturation of endospore; completion of spore coat and increase in resistance to heat and chemicals by unknown process.

Outer spore coat

Endospore

8 Endospore released from original cell.

Outer spore coat

Sporulation stages

1. DNA is replicated.

2. Plasma membrane starts to surround the DNA and cytoplasm.

3. Septum surrounds the isolate portion forming a **forespore**

4. A thick cortex of calcium, peptidoglycan, dipicolinic acids forms between the two membranes

5. The spore coat are able to resist the lethal effects of heat, dehydration, freezing, chemicals, and radiation. This may be due to low water content inside the spore.

6. The endospore is released.

Thanks