

Spore or Endospore

Definition

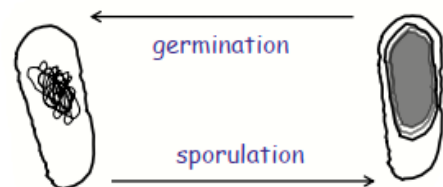
- Optional organelle
- Forms within the cytoplasm of certain bacteria
- A dormant, tough, and non-reproductive structure
- Produced by a small number of bacteria from the Firmicutes group
- **Primary function:** Ensures bacterial survival during environmental stress.

Differences from Vegetative Cells

- Shape and structure
- Enzymatic composition
- Extreme resistance
- Ability to survive unfavorable conditions

Sporulation

- Differentiation process opposite to germination
- Example: *Bacillus*, *Clostridium*, *Sporosarcina*



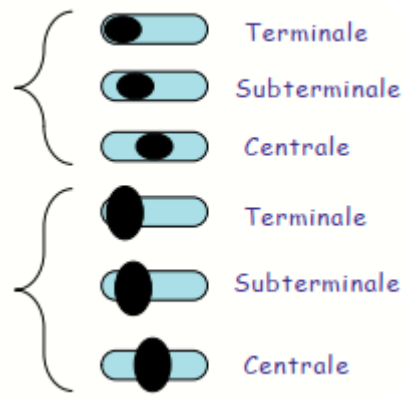
Positioning

➔ Non-deforming spore

- Terminal
- Subterminal
- Central

➔ Deforming spore

- Terminal
- Subterminal
- Central



Spore Structure

□ Spore Cytoplasm

- Low in RNA, enzymes, and water
- DNA quantity similar to vegetative cells

□ Spore Membrane

- Similar structure to vegetative cell membrane

□ Spore Wall

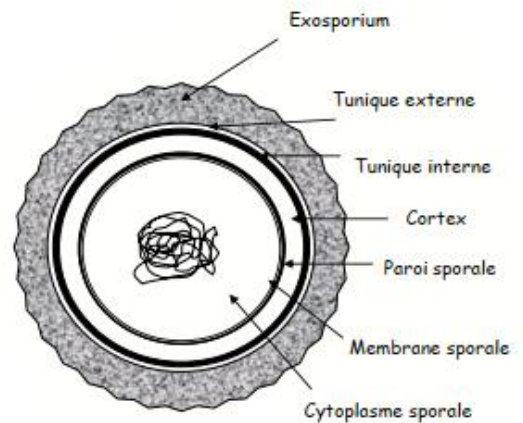
□ Cortex

- Highly transparent to electrons
- Contains calcium dipicolinate

□ Coats (Intine & Exine)

- Rich in disulfide bonds

□ Sometimes covered by an **exosporium**



Detection Methods

□ Observation Techniques

- Malachite green staining

Spore Properties

□ Dehydrated, metabolically **inactive**

□ Extreme Survival

- Exceptional longevity (up to several thousand years in some *Bacillus* species)

Longevity verges on immortality, 250 million years.

□ Resistance Factors

- **Temperature:** Varies depending on species and culture age
- **Chemical agents:** Antibiotics, antiseptics, disinfectants
- **Extreme conditions:** Radiation, pressure, desiccation, lysozyme and mechanical damage

Sporulation Process

□ Triggered by nutrient depletion

may require special conditions:

- □ **Anaerobic conditions** required for *Clostridium*
- □ **Oxygen** required for *Bacillus anthracis*

□ Production of Specific Molecules

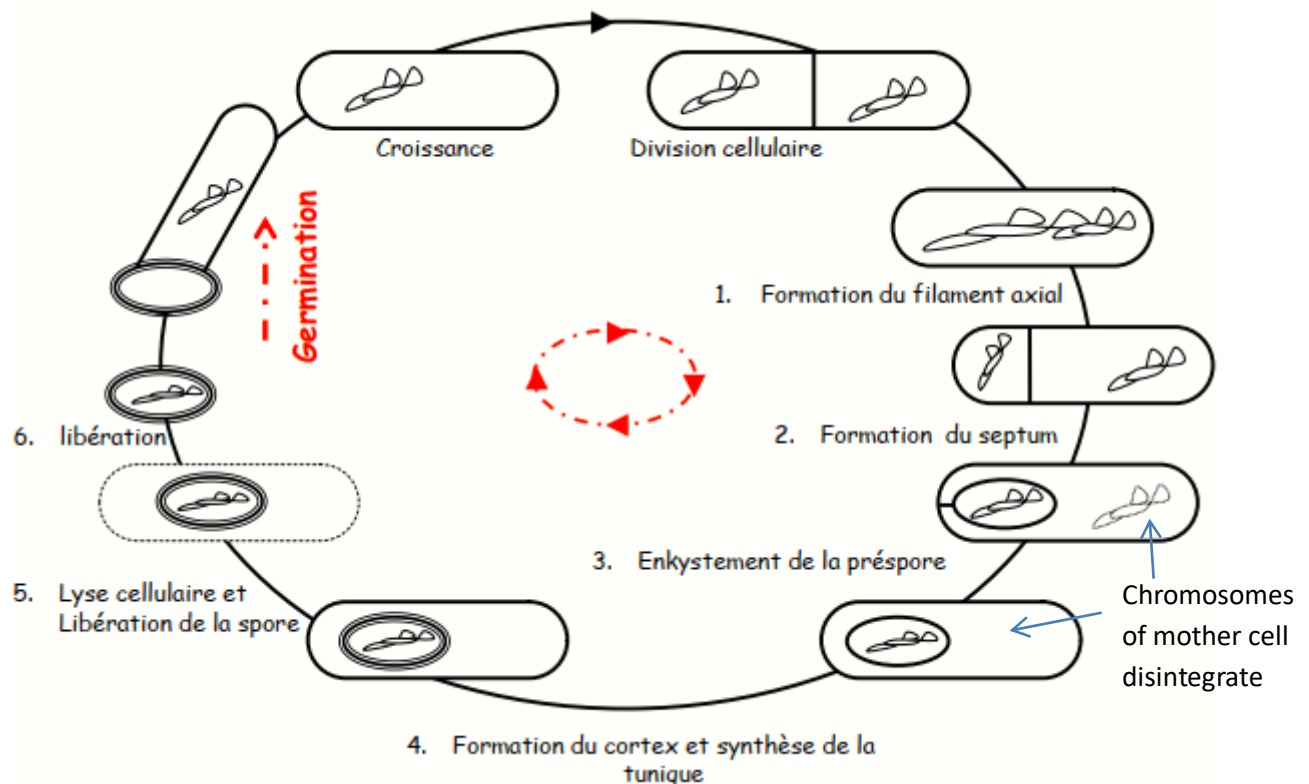
During sporulation, different substances can be synthesised :

- Antibiotics
- Toxins (e.g., enterotoxin of *Clostridium perfringens*)
- Parasitic toxic bodies for insects (*B. thuringiensis*, *B. sphaericus*)

□ Sporulation in 6 Steps (Diagram)

1. Formation of the axial filament ; 2. Formation of the septum ; 3. Engulfment of the forespore .

4. Formation of the cortex and synthesis of the tunica ; 5. Cell lysis ; 6. spore release .



Germination

- Return to a vegetative cell under favorable conditions**

1 Activation

- Alteration of spore envelopes
- Triggered by agents:
 - **Mechanical:** Shock, abrasion
 - **Physical:** Heat shock
 - **Chemical:** Lysozyme, acids

2 Initiation

- **Conditions:** High water content + metabolites (alanine, adenosine, magnesium...)
- Autolytic process leading to:
 - Degradation of cortex peptidoglycan
 - Release of calcium dipicolinate
 - Spore hydration → loss of resistance properties

3 Outgrowth

- Emergence of a **new vegetative cell**
- **Gradual resumption of growth**