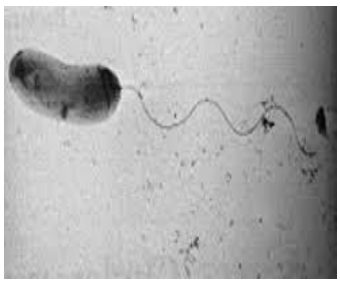
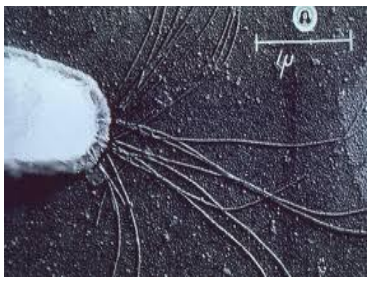
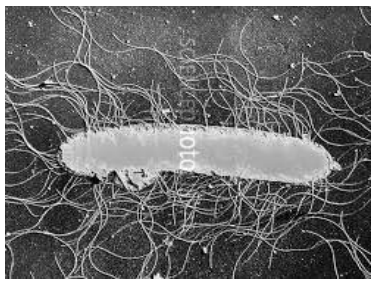
Other Prokaryotic Organelles

Flagella

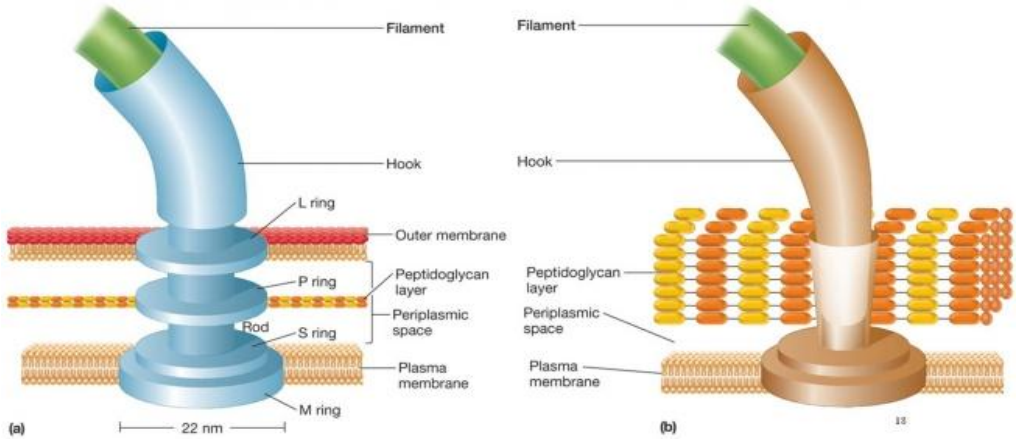
Bacterial flagella are threat-like appendages composed entirely of protein, 12-30 nm in diameter. They are the organs of locomotion for the forms that possess them. Three types of arrangement are known: **monotrichous** (single polar flagellum), **lophotrichous** (multiple polar flagella), and **peritrichous** (flagella distributed over the entire cell).

A bacterial flagellum is made up of several thousand molecules of a protein subunit called **flagellin**. Bacterial flagella are semi rigid helical rotors to which the cell imparts a spinning movement.

A cell that is moving away from the source of a chemical attractant tumbles and reorients itself more frequently than one that is moving toward the attractant, the result being the net movement of the cell toward the source, this behavior is called **chemotaxis**. The mechanism by which a change in cell behavior is brought about in response to a change in the environment is called **sensory transduction**. Sensory transduction is responsible not only for chemotaxis but also for **aerotaxis** (movement toward the optimal oxygen concentration), **phototaxis** (movement of photosynthetic bacteria toward the light), and **electron acceptor taxis** (movement

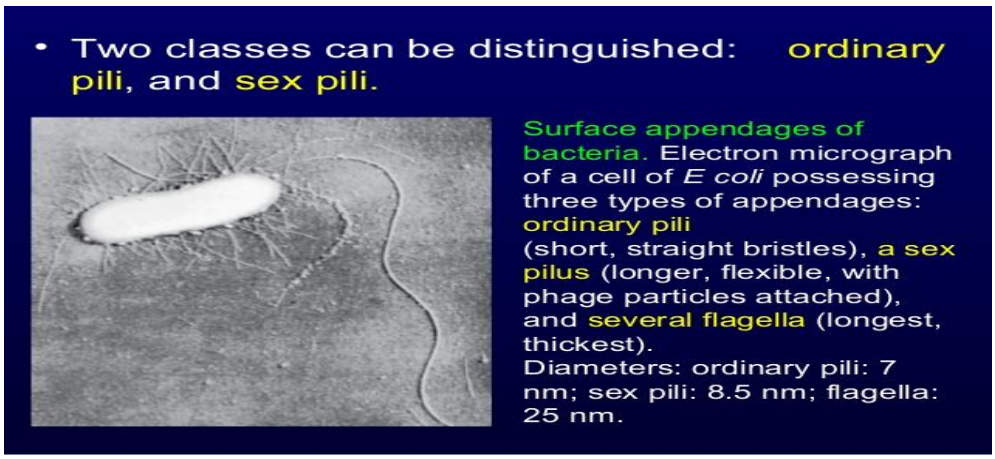
of respiratory bacteria toward alternative electron acceptors, such as nitrate and fumarate).



Pili (Fimbriae)

Many gram-negative bacteria possess rigid surface appendages called **pili** (L "hairs") or **fimbriae** (L "fringes"). They are shorter and finer than flagella, they are composed of structural protein subunits termed **pilins**. Minor proteins termed **adhesins** are located at the tips of pili and are responsible for the attachment properties.

Two classes can be distinguished: **ordinary pili**, which play a role in the adherence of symbiotic and pathogenic bacteria to host cells, and **sex pili**, which are responsible for the attachment of donor and recipient cells in bacterial conjugation.

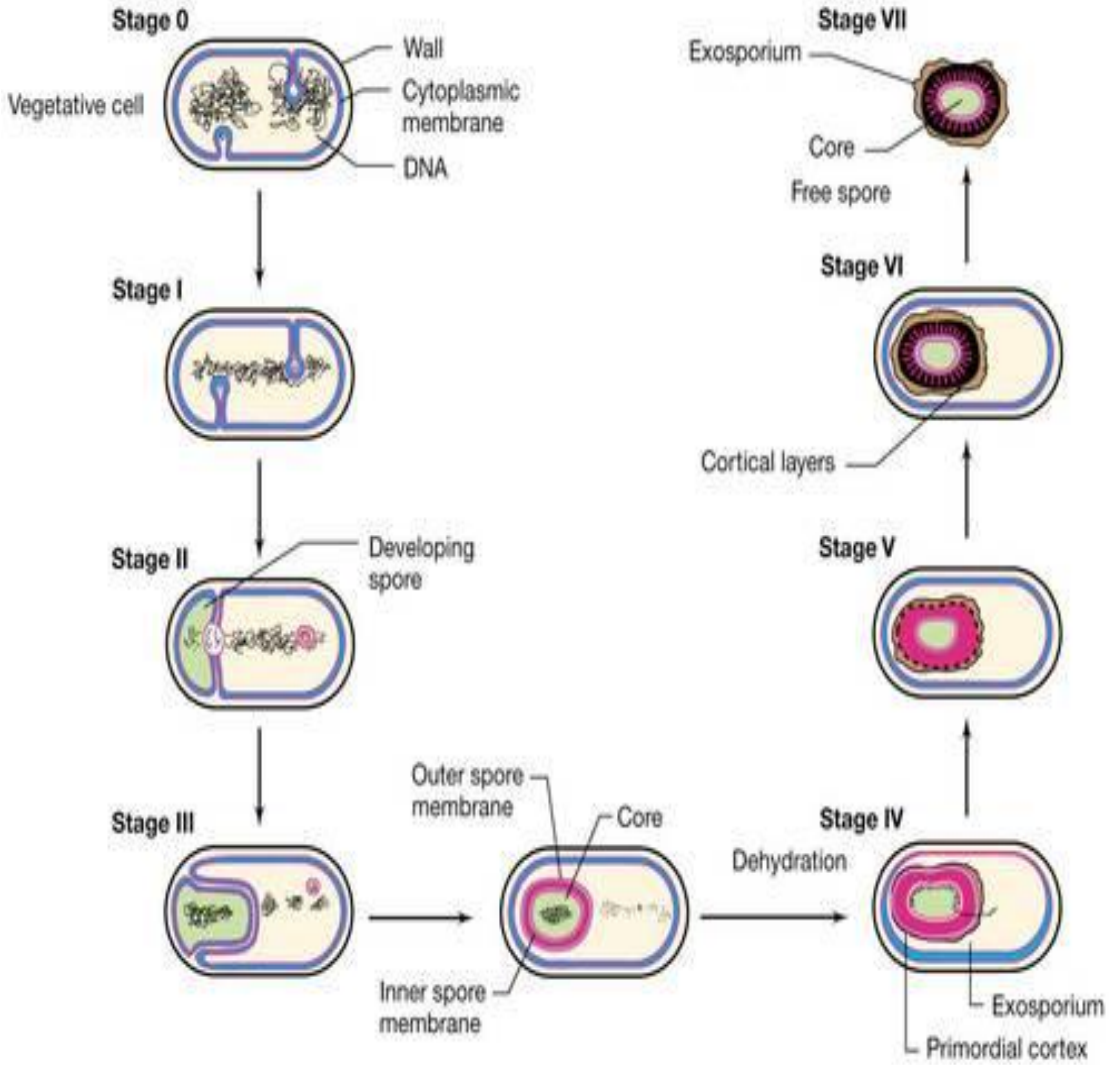


Endospores

Members of several bacterial genera are capable of forming **endospores**. The two most common are gram-positive rods: the obligately aerobic genus ***Bacillus*** and the obligately anaerobic genus ***Clostridium***.

Properties of Endospores

1. **Core-** The core is the spore protoplast. It contains a complete nucleus (chromosome). The heat resistance of spores is due in part to their dehydrated state and in part to the presence in the core of large amounts (5-15% of the spore dry weight) of **calcium dipicolinate** .
2. **Spore wall-** is the innermost layer surrounding the inner spore membrane. It contains normal peptidoglycan and becomes the cell wall of the germinating vegetative cell.
3. **Cortex-** The cortex is the thickest layer of the spore envelope. It contains an unusual type of peptidoglycan, with many fewer cross-links than are found in cell wall peptidoglycan. Cortex peptidoglycan is extremely sensitive to lysozyme, and its autolysis plays a role in spores germination.
4. **Coat-** the coat is composed of a keratin-like protein containing many intermolecular disulfide bonds. The impermeability of this layer confers on spores their relative resistance to antibacterial chemical agents.
5. **Exosporium-** The exosporium is composed of proteins, lipids, and carbohydrates. It consists of a paracrystalline basal layer and a hair-like outer region. The function of the exosporium is unclear.


Stage 0
Vegetative cell
Wall
Cytoplasmic membrane
DNA
Stage I
Stage II
Developing spore
Stage III
Outer spore membrane
Core
Inner spore membrane
Stage IV
Dehydration
Stage V
Stage VI
Cortical layers
Stage VII
Exosporium
Core
Free spore
Exosporium
Primordial cortex