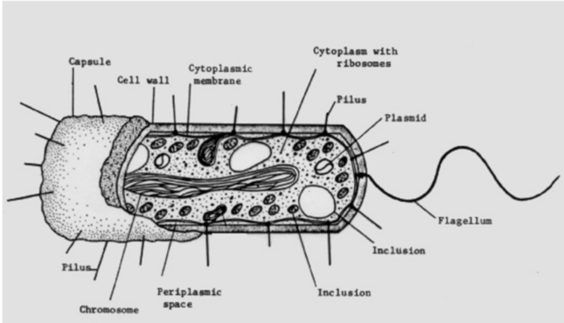
Microbiology

Semester 93-1

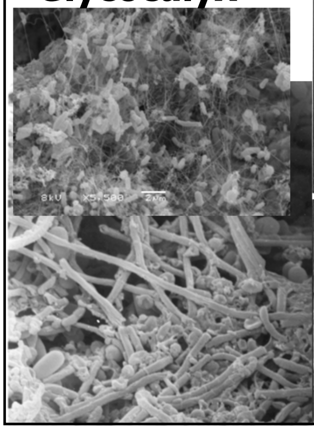
Lec3:
Cell structure

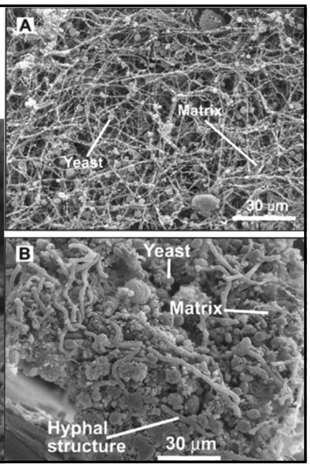
Zilouei Hamid

Cell structure

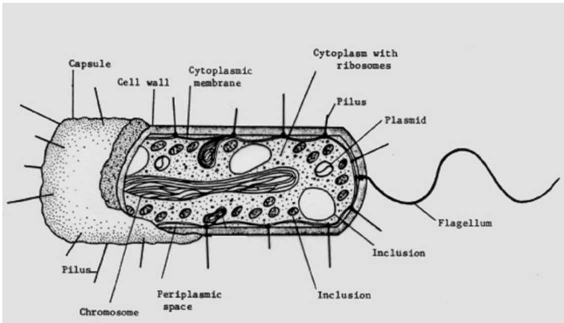


Glycocalyx

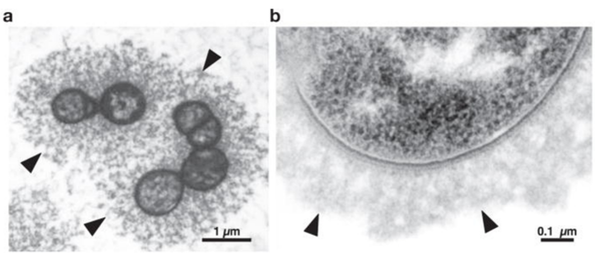




Capsule

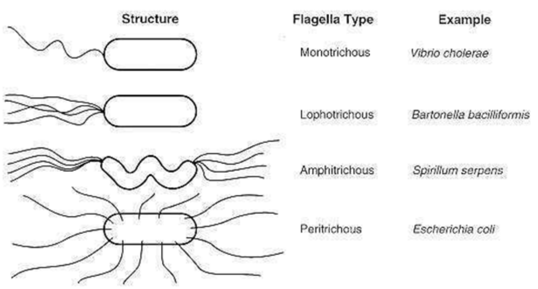


Capsule

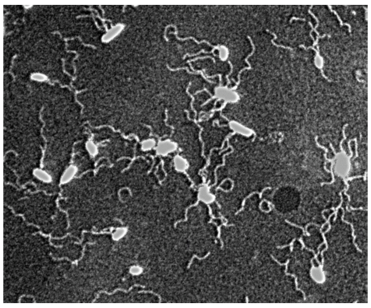


Sheath

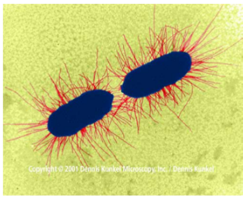
Flagella

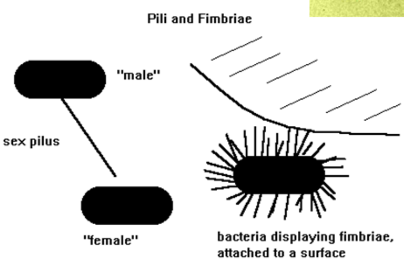


Flagella

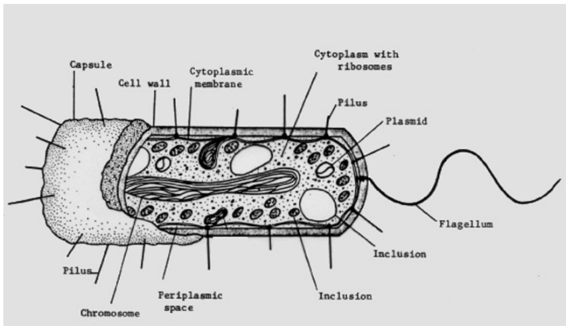


Pili



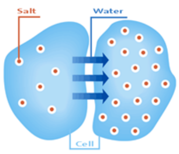


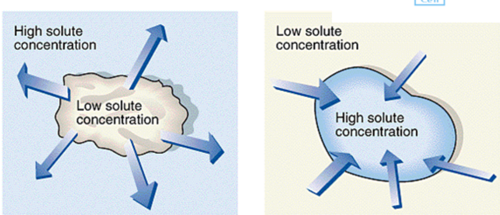
Cell wall



A typical bacterial cell

osmosis





(a) (b)

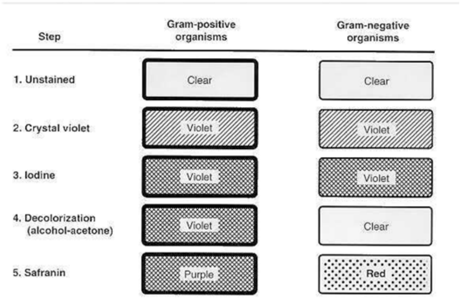
There are three possible relationships that cells can encounter when placed into a water solution.

The concentration of solute in the solution can be **equal to** the concentration of solute in the cells. The cell is in an **isotonic** solution. (*iso* = same as normal)

The concentration of solute in the solution can be **greater than** the concentration of solute in the cells. The cell is in an **hypertonic** solution. (*hyper* = more than normal)

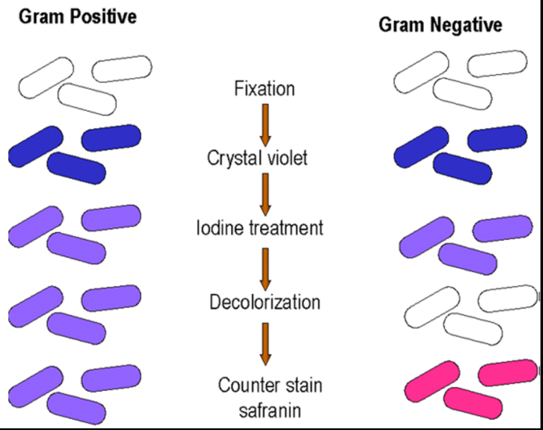
The concentration of solute in the solution can be l**ess than** the concentration of solute in the cells. The cell is in an **hypotonic** solution. (*hypo* = less than normal)

Gram staining

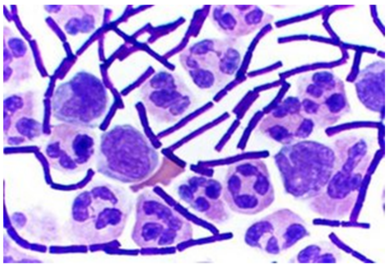


Step	Gram-positive organisms	Gram-negative organisms
1. Unstained	Clear	Clear
2. Crystal violet	Violet	Violet
3. Iodine	Violet	Violet
4. Decolorization (alcohol-acetone)	Violet	Clear
5. Safranin	Purple	Red

Gram staining

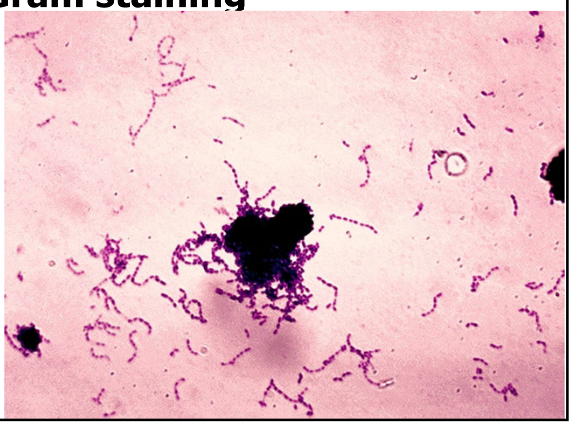


Gram staining



Gram staining

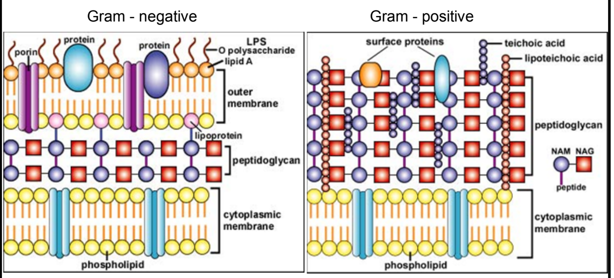
Gram staining



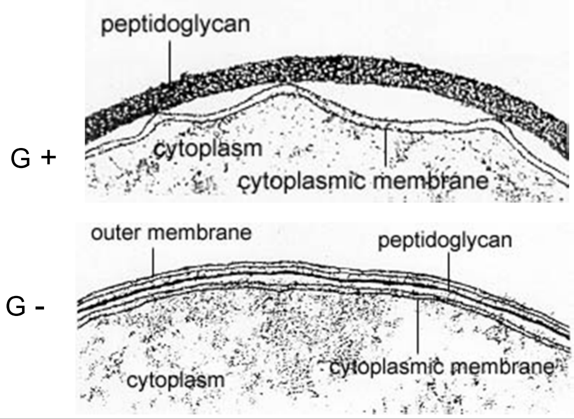
جدول. ترکیب شیمیایی دیواره سلولی باکتری‌های G^+ و G^-

ترکیب		G^+	G^-
پپتیدوگلیکان	peptidoglycan	۷۰–۸۰٪ وزن خشک	۱۰–۸٪ وزن خشک
اسیدتیکوئیک	Teichoic acid	+	-
اسیدآمینه قندی		+	+
لیپید	lipid	بصورت آزاد و بمقدار کم	حدود ۲۰–۱۰٪ وزن خشک
لیپوپلی‌ساکارید	lipopolysacchaaride	-	+

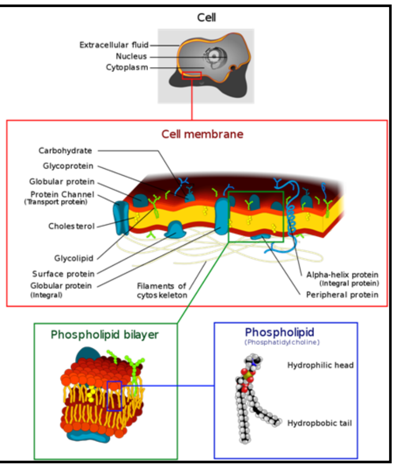
Cell wall



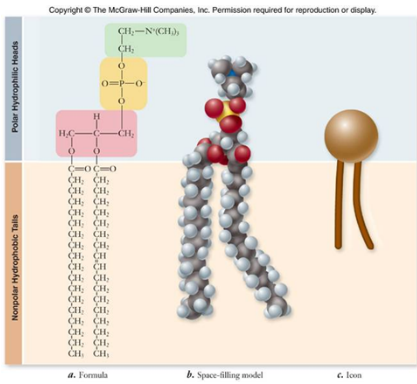
Cell wall



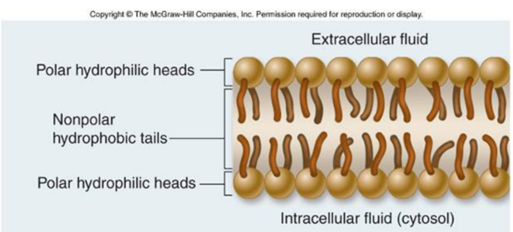
Membrane



Membrane

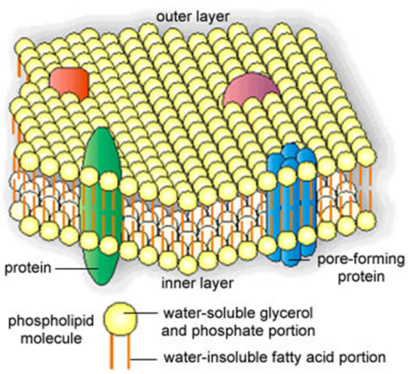


Membrane



Membrane

Membrane fluidity



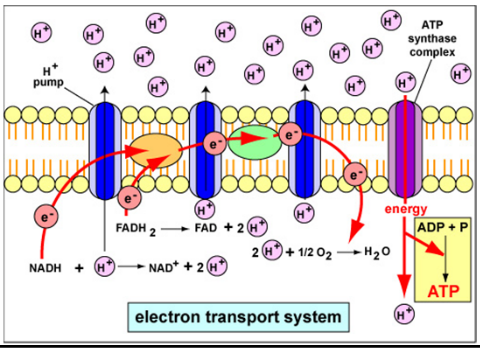
function

a. **channel proteins** to form pores for the free transport of small molecules and ions across the membrane

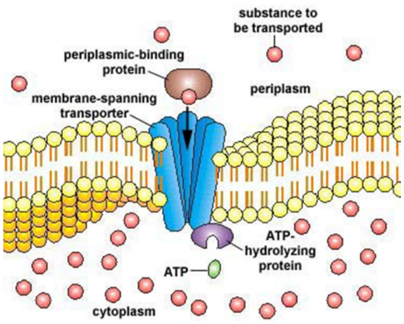
b. **carrier proteins** for facilitated diffusion and active transport of molecules and ions across the membrane

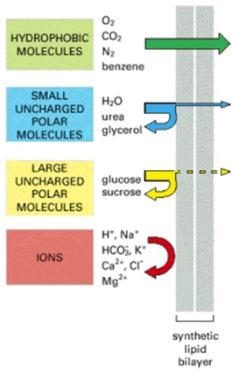
function

ATP Production during Aerobic Respiration by Electron Transport System

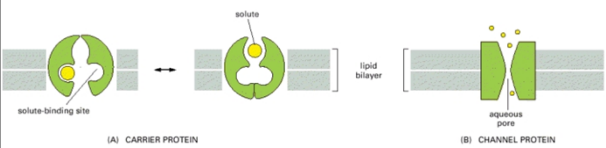


Transport across membrane





The relative permeability of a synthetic lipid bilayer to different classes of molecules
The smaller the molecule and, more importantly, the less strongly it associates with water, the more rapidly the molecule diffuses across the bilayer.



Carrier proteins and channel proteins

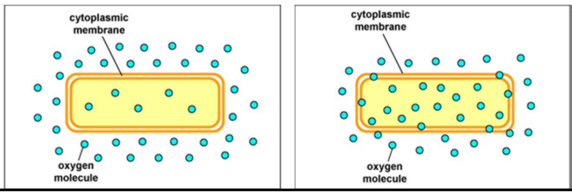
(A) A carrier protein alternates between two conformations, so that the solute-binding site is sequentially accessible on one side of the bilayer and then on the other.
(B) In contrast, a channel protein forms a water-filled pore across the bilayer through which specific solutes can diffuse.

Passive diffusion انتقال غیرفعال

the net movement of **gases or small uncharge polar** molecules across a phospholipid bilayer membrane

from an area of **higher concentration** to an area of **lower concentration** .

Examples of gases that cross membranes by passive diffusion include **N_2, O_2, and CO_2**; examples of small polar molecules include **ethanol, H_2O,** and **urea**.



Facilitated diffusion انتقال تسهیل شده

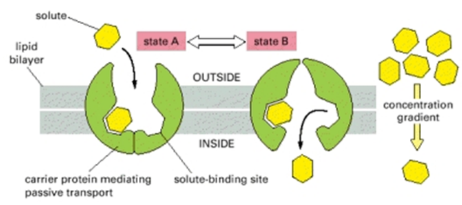
Facilitated diffusion is

the **transport of substances across a membrane**

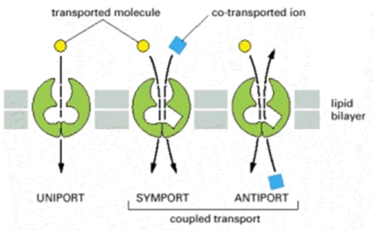
by transport proteins, such as uniporters and channel proteins,

along a concentration gradient **from an area of higher concentration to lower concentration**.

Facilitated diffusion is powered
by the potential energy of a **concentration gradient**
and does **not** require the expenditure of **metabolic energy**.



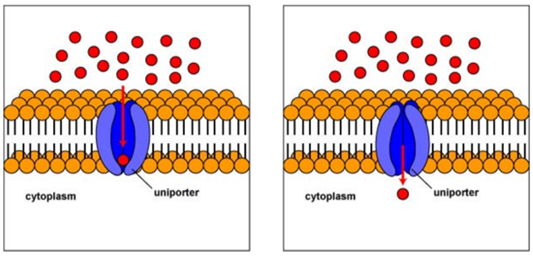
A model of how a conformational change in a carrier protein could mediate the passive transport of a solute
The carrier protein shown can exist in two conformational states: in state A, the binding sites for solute are exposed on the outside of the lipid bilayer; in state B, the same sites are exposed on the other side of the bilayer. The transition between the two states can occur randomly. It is completely reversible and does not depend on whether the solute binding site is occupied. Therefore, if the solute concentration is higher on the outside of the bilayer, more solute binds to the carrier protein in the A conformation than in the B conformation, and there is a net transport of solute down its concentration gradient (or, if the solute is an ion, down its electrochemical gradient).

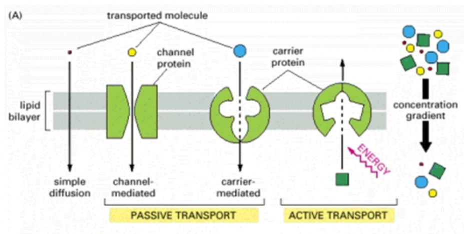


Three types of carrier-mediated transport
This schematic diagram shows carrier proteins functioning as uniporters, symporters, and antiporters

Facilitated diffusion

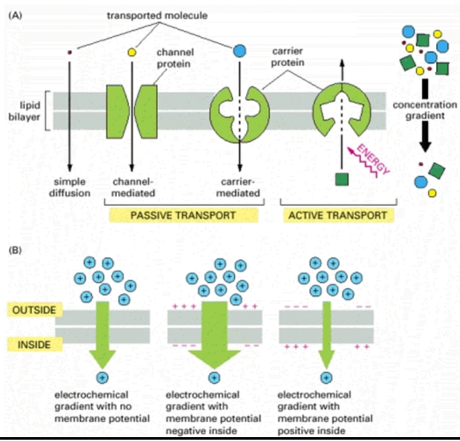
Uniporters
are transport proteins that transport a substance across a membrane down a concentration gradient from an area of greater concentration to lesser concentration. The transport is powered by the potential energy of a concentration gradient and does not require metabolic energy.

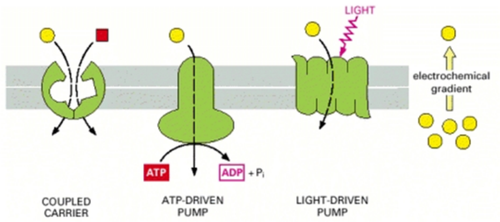




Passive and active transport compared

(A) Passive transport down an electrochemical gradient occurs spontaneously, either by simple diffusion through the lipid bilayer or by facilitated diffusion through channels and passive carriers. By contrast, active transport requires an input of metabolic energy and is always mediated by carriers that harvest metabolic energy to pump the solute against its electrochemical gradient.
(B) An electrochemical gradient combines the membrane potential and the concentration gradient, which can work additively to increase the driving force on an ion across the membrane *(middle)* or can work against each other *(right)*.

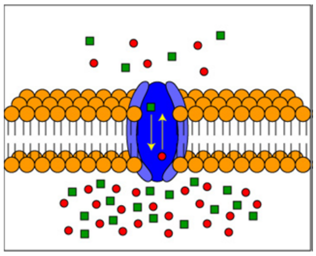




Three ways of driving active transport
The actively transported molecule is shown in *yellow*, and the energy source is shown in *red*.

Active transport انتقال فعال

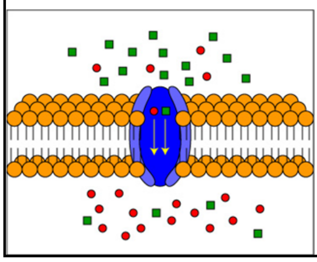
Antiporters are transport proteins that simultaneously transport two substances across the membrane in opposite directions; one against the concentration gradient and one with the concentration gradient.
Metabolic energy is required for this type of transport .



Transport of Substances Across a Membrane by Antiporters

Active transport انتقال فعال

Symporters are transport proteins that simultaneously transport two substances across the membrane in the **same direction**; one against the concentration gradient and one with the concentration gradient.
Metabolic energy is required for this type of transport .



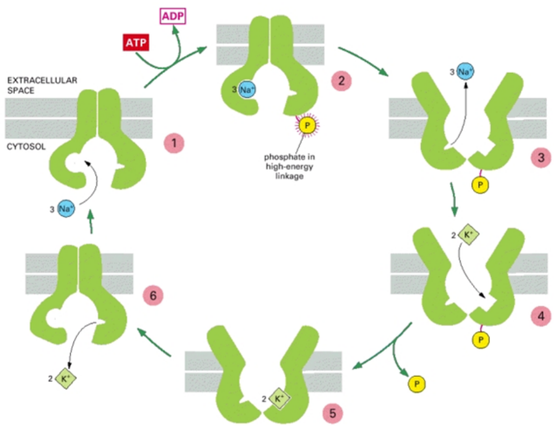
Transport of Substances Across a Membrane by Symporters

Active transport انتقال فعال

پمپ سدیم – پتاسیم – ATPآز

ATP- powered pumps **couple the energy released from the hydrolysis of ATP with the transport of substances across the cytoplasmic membrane**.

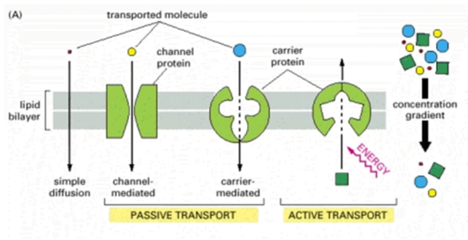
ATP- powered pumps are used to transport ions such as Na^+, Ca^{2+}, K^+, and H^+ across membranes against their concentration gradient.



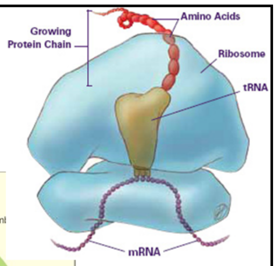
A model of the pumping cycle of the Na^+ -K^+ pump.

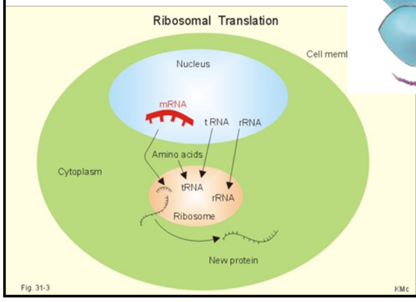
(1) The binding of Na^+ and
(2) the subsequent phosphorylation by ATP of the cytoplasmic face of the pump induce the protein to undergo a conformational change that
(3) transfers the Na^+ across the membrane and releases it on the outside.
(4) Then, the binding of K^+ on the extracellular surface and
(5) the subsequent dephosphorylation return the protein to its original conformation, which
(6) transfers the K^+ across the membrane and releases it into the cytosol.

These changes in conformation are analogous to the A ↔ B transitions shown in Figure 11-6, except that here the Na^+ -dependent phosphorylation and the K^+ -dependent dephosphorylation of the protein cause the conformational transitions to occur in an orderly manner, enabling the protein to do useful work. Although for simplicity only one Na^+ - and one K^+ -binding site are shown, in the real pump there are thought to be three Na^+ - and two K^+ -binding sites. Moreover, although the pump is shown as alternating between two conformational states only, there is evidence that it goes through a more complex series of conformational changes during the pumping cycle.



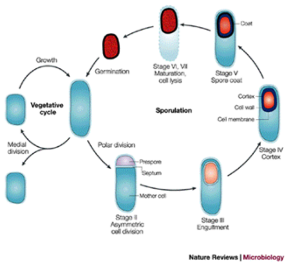
ribosome



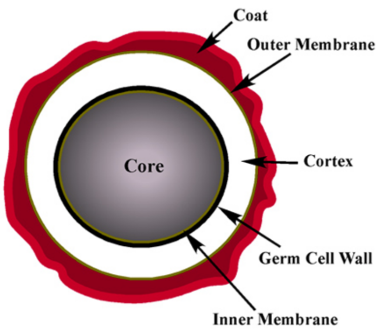


Vegetative form

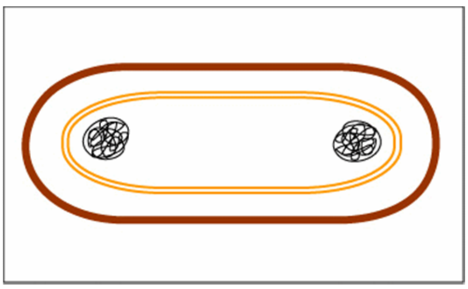
Dormant , non-reproductive



endospore structure



endospore formation



endospore germination