**Microbiology**:

from  *mīkros*, "small";  *bios*, "[life](http://en.wikipedia.org/wiki/Life)"; and - [*logia*](http://en.wikipedia.org/wiki/-logy)) is the study of [microscopic](http://en.wikipedia.org/wiki/Microscopic) [organisms](http://en.wikipedia.org/wiki/Organisms), either [unicellular](http://en.wikipedia.org/wiki/Unicellular) (single cell), [multicellular](http://en.wikipedia.org/wiki/Multicellular) (cell colony), or [acellular](http://en.wikipedia.org/wiki/Acellular) (lacking cells).

**What are bacteria?**

Single celled organisms

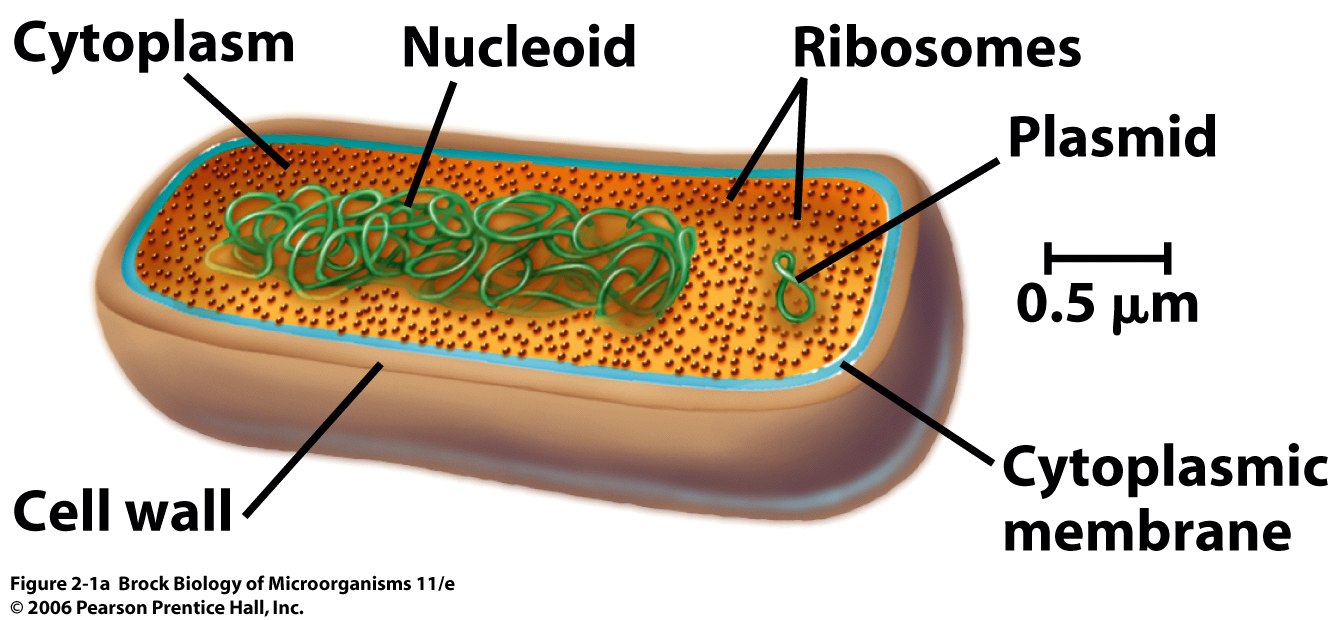
Very small

Need a microscope to see

Can be found on most materials and surfaces.

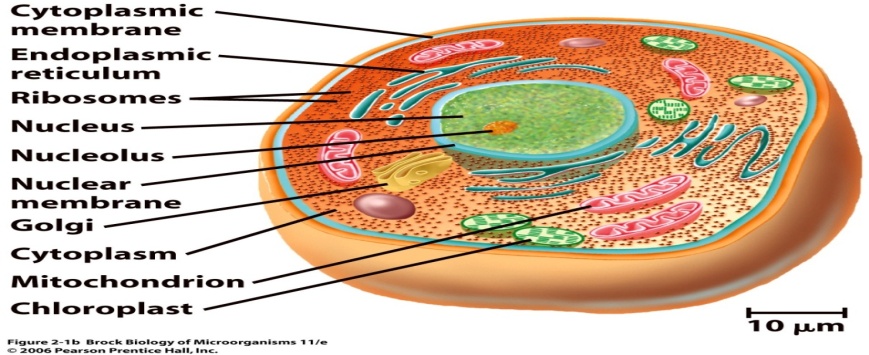
## Prokaryotic Cell

Prokaryotic cells are simpler and smaller than the eukaryotic cells. The term prokaryote is derived from the Greek word- ***“prokaryote”*** meaning before nuclei. These cells lack membrane bound organelles. Prokaryotic cells are unicellular organisms, which reproduce through binary fission. In some cases few prokaryotic organisms also reproduce by budding. Prokaryotic cells have a cell envelope, which generally consists of a capsule, cell wall, cytoplasm, plasma membrane, cytoplasm region or nuclei.



## Eukaryotic Cell

Eukaryotic cells are those cells, which are complex and larger than the prokaryotic cells. The term eukaryote is derived from the Greek word- eukaryote  meaning true or good nuclei. This cell includes all life kingdoms except monera. Eukaryotic cells can be easily distinguished through a membrane-bound nucleus. The life, which is present and visible by our naked eye, is all made up of these cells. Eukaryotic cells are membrane-bound organelles, which have a multiple membrane-bound organelles to carry out specific cell tasks. They have different internal membranes, which are known as organelles. These organelles play a vital role in cell maintenance and other functions. These organelles generally consist of cell wall, plasma membrane, nucleus, mitochondria, chloroplasts (plastids), endoplasmic reticulum, ribosome, Golgi apparatus, lysosomes, vacuoles, cytoplasm and chromosomes.



### Differences between Prokaryotic cells and Eukaryotic cells

|  |  |
| --- | --- |
| **Prokaryotic Cells** | **Eukaryotic Cells** |
| **1-**They are very minute in size. | They are comparatively larger in size. |
| **2-**Nuclear region (nucleoid) is not enveloped by a nuclear membrane. | Nucleus is surrounded by a double membrane layer. |
| **3-**Single chrmosome present. | More than one chromosome are present. |
| **4-**Nucleolus is absent. | Nucleolus is present. |
| **5-**Membrane bound organelles are absent. | Membrane bound organelles are present. |
| **6-**Multiplication of cell is by fission or budding. | Cell division by mitosis or meiosis. |
| **7-**Cell Walls presnt, which are chemically complex. | Cell walls seen in only plant cells, which are chemically simpler. |
| **8-**Cell type is usually unicellular. | Usually multicellular cells. |
| **9-**Cell size is 1-10μm | Cell size 10 - 100µm. |
| **10-**Example: Bacteria, archaea | Example: animal cells and plant cells. |

**Virus**:

A [virus](http://www.ncbi.nlm.nih.gov/books/n/mcb/A7315/def-item/A7862/) is a small parasite that cannot reproduce by itself. Once it infects a susceptible cell, however, a [virus](http://www.ncbi.nlm.nih.gov/books/n/mcb/A7315/def-item/A7862/) can direct the cell machinery to produce more viruses. Most viruses have either [RNA](http://www.ncbi.nlm.nih.gov/books/n/mcb/A7315/def-item/A7786/) or [DNA](http://www.ncbi.nlm.nih.gov/books/n/mcb/A7315/def-item/A7455/) as their genetic material.

The origins of viruses in the [evolutionary history of life](http://en.wikipedia.org/wiki/Evolutionary_history_of_life) are unclear: some may have [evolved](http://en.wikipedia.org/wiki/Evolution) from [plasmids](http://en.wikipedia.org/wiki/Plasmid)—pieces of DNA that can move between cells—while others may have evolved from bacteria.

**A complete virus particle, known as a virion, consists of: i-**The [genetic material](http://en.wikipedia.org/wiki/Genetic_material) made from either [DNA](http://en.wikipedia.org/wiki/DNA) or [RNA](http://en.wikipedia.org/wiki/RNA), long [molecules](http://en.wikipedia.org/wiki/Molecule) that carry genetic information.

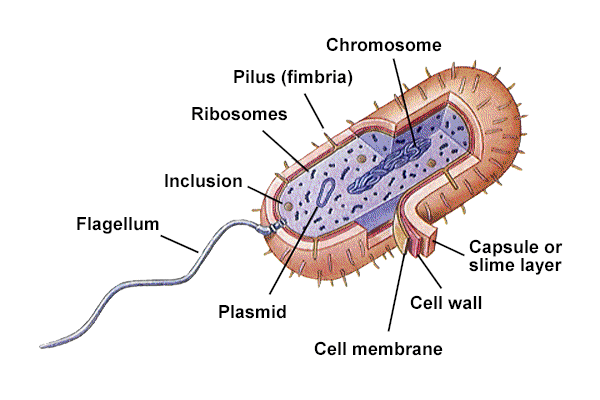
**ii-** A [protein](http://en.wikipedia.org/wiki/Protein) coat that protects these genes called a [capsid](http://en.wikipedia.org/wiki/Capsid). **iii**- An [envelope](http://en.wikipedia.org/wiki/Viral_envelope) of [lipids](http://en.wikipedia.org/wiki/Lipid) derived from the host [cell membrane](http://en.wikipedia.org/wiki/Cell_membrane) that surrounds the protein coat when they are outside a cell.

**The shapes of viruses range from**

1-simple [helical](http://en.wikipedia.org/wiki/Helix) .

2- [icosahedral](http://en.wikipedia.org/wiki/Icosahedron) form.

3- complex form.

**The basic structure of bacteria :**

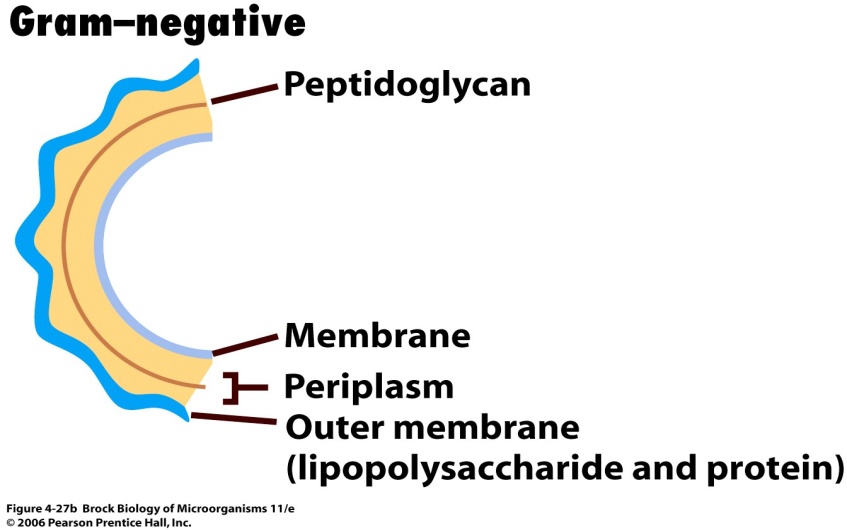
**Extracellular structures**

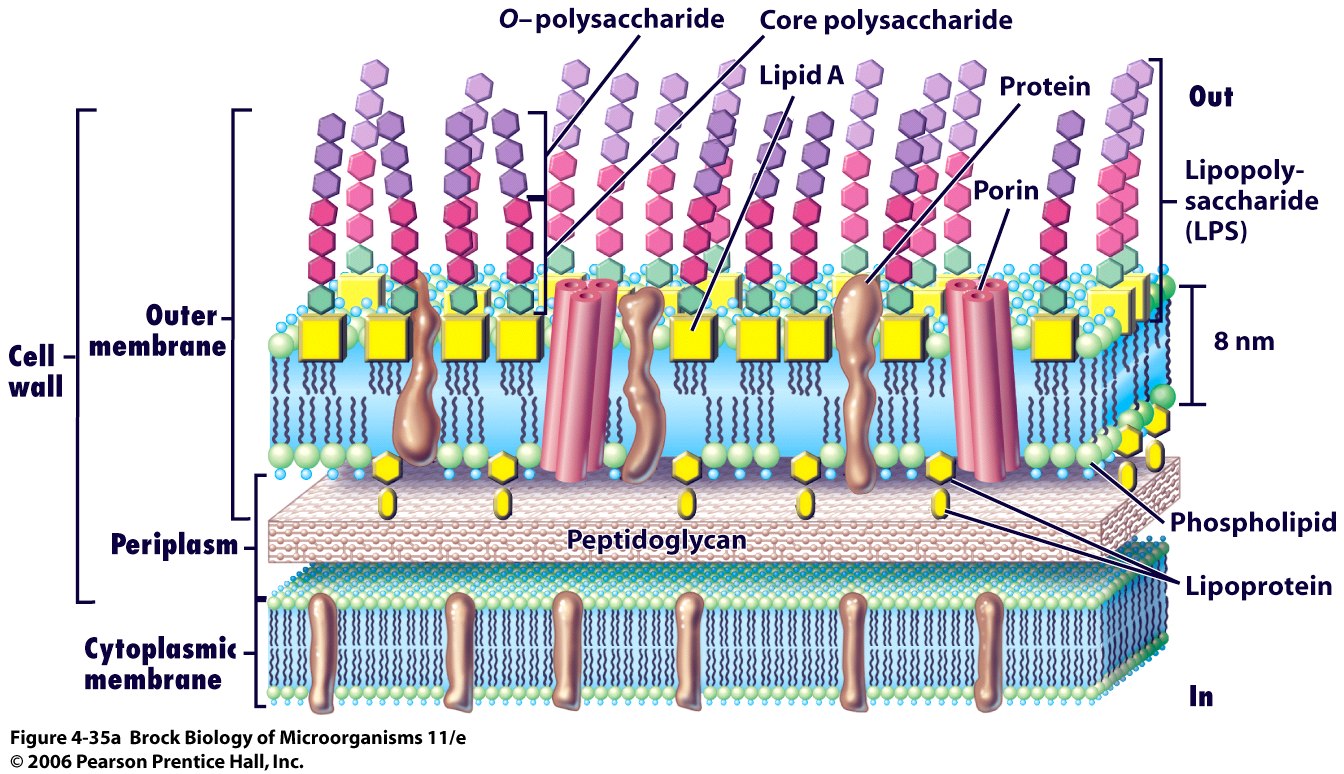
[**capsule**](http://en.wikipedia.org/wiki/Bacterial_capsule). These structures can protect cells from engulfment by eukaryotic cells such as[macrophages](http://en.wikipedia.org/wiki/Macrophage) (part of the human [immune system](http://en.wikipedia.org/wiki/Immune_system)). They can also act as [antigens](http://en.wikipedia.org/wiki/Antigen) and be involved in cell recognition, as well as aiding attachment to surfaces .

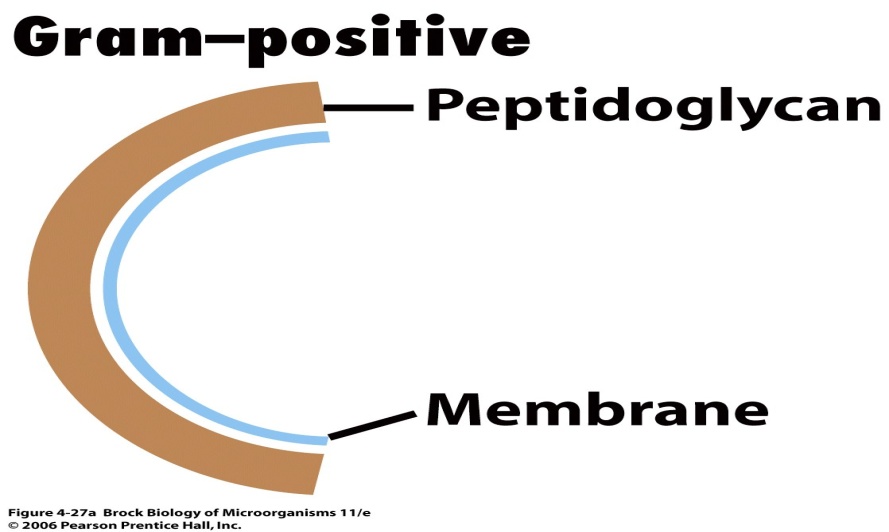
[**cell wall**](http://en.wikipedia.org/wiki/Cell_wall#Bacterial_cell_walls): A common bacterial cell wall material is [**peptidoglycan**](http://en.wikipedia.org/wiki/Peptidoglycan). The cell wall is essential to the survival of many bacteria, There are broadly speaking two different types of cell wall in bacteria, a thick one in the [Gram-positives](http://en.wikipedia.org/wiki/Gram-positive) and a thinner one in the [Gram-negatives](http://en.wikipedia.org/wiki/Gram-negative). The names originate from the reaction of cells to the [Gram stain](http://en.wikipedia.org/wiki/Gram_stain).

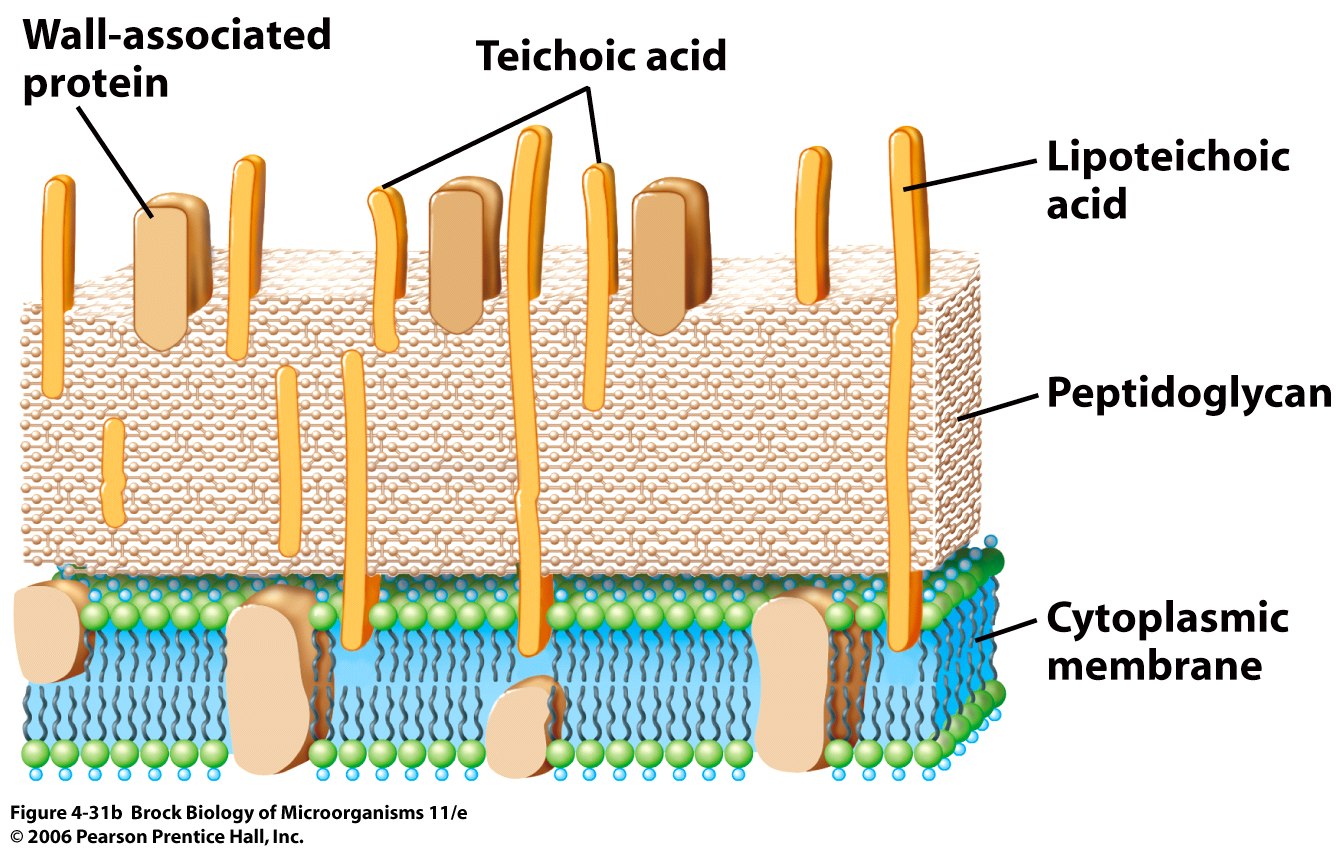
[**Gram-positive bacteria**](http://en.wikipedia.org/wiki/Gram-positive_bacteria) possess a thick cell wall containing many layers of peptidoglycan and [**teichoic acids**](http://en.wikipedia.org/wiki/Teichoic_acid). In contrast, [**Gram-negative bacteria**](http://en.wikipedia.org/wiki/Gram-negative_bacteria) have a relatively thin cell wall consisting of a few layers of peptidoglycan surrounded by a second [lipid membrane](http://en.wikipedia.org/wiki/Lipid_bilayer) containing [**lipopolysaccharides**](http://en.wikipedia.org/wiki/Lipopolysaccharide) and [lipoproteins](http://en.wikipedia.org/wiki/Lipoprotein) .

Lipopolysaccharides, also called [**endotoxins**](http://en.wikipedia.org/wiki/Endotoxin), are composed of **polysaccharides** and [**lipid A**](http://en.wikipedia.org/wiki/Lipopolysaccharide#Composition) that is responsible for much of the toxicity of Gram-negative bacteria.

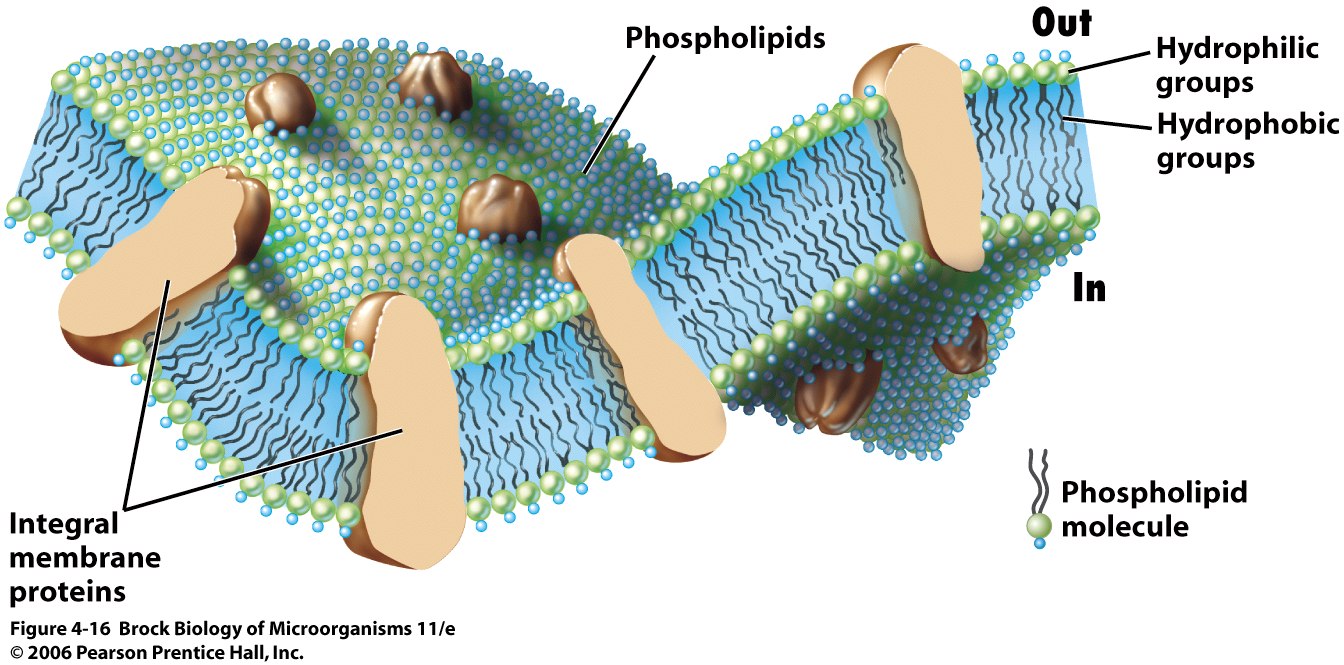








**Cytoplasmic Membrane:** The cytoplasmic membrane or [plasma membrane](http://en.wikipedia.org/wiki/Cell_membrane)  is a highly selective permeability barrier constructed of lipids and proteins that forms a bilayer with hydrophilic exteriors and a hydrophobic interior. The major function of the cytoplasmic membrane is to act as a permeability barrier, preventing leakage of cytoplasmic metabolites into the environment.



**Flagella**

– Flagellin (protein) subunits embedded in cell membrane

– project as strand

– move cell by propeller like action

**Pili**

Smaller than flagella

Adhere bacteria to surfaces

Used in conjugation for Exchange of genetic information

Aid Flotation by increasing buoyancy

### Endospores Certain [genera](http://en.wikipedia.org/wiki/Genus) of Gram-positive bacteria as [*Bacillus*](http://en.wikipedia.org/wiki/Bacillus), [*Clostridium*](http://en.wikipedia.org/wiki/Clostridium)

-Dormant cell (non-reproductive structure )

-A thick celled structure formed inside the cell,

-Encloses all the nuclear materials and some cytoplasm

**Resistant to adverse conditions**

Heat, irradiation, cold, organic solvents, extremely dry

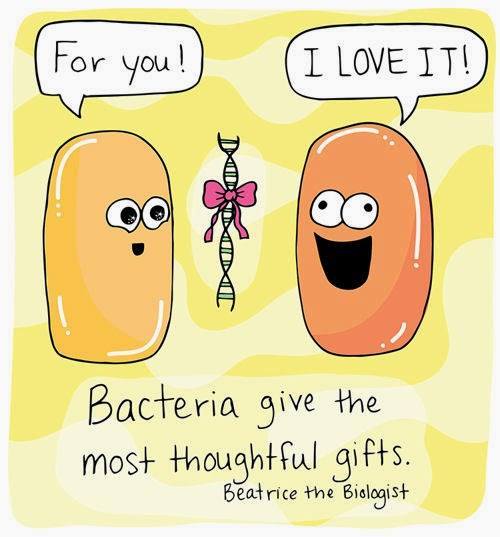
Boiling >1 hr still viable

Sterilization, autoclave

Intracellular (internal) structures

**The bacterial DNA and plasmids**

Unlike [eukaryotes](http://en.wikipedia.org/wiki/Eukaryote), the bacterial [DNA](http://en.wikipedia.org/wiki/DNA) is not enclosed inside of a membrane-bound [nucleus](http://en.wikipedia.org/wiki/Cell_nucleus) but instead resides inside the bacterial [cytoplasm](http://en.wikipedia.org/wiki/Cytoplasm). This means that the transfer of cellular information through the processes of [translation](http://en.wikipedia.org/wiki/Translation_(biology)), [transcription](http://en.wikipedia.org/wiki/Transcription_(genetics)) and [DNA replication](http://en.wikipedia.org/wiki/DNA_replication) all occur within the same compartment and can interact with other cytoplasmic structures, most bacteria also contain small independent pieces of DNA called [plasmids](http://en.wikipedia.org/wiki/Plasmid) that often encode for traits that are advantageous but not essential to their bacterial host. [Plasmids](http://en.wikipedia.org/wiki/Plasmid) can be easily gained or lost by a bacterium and can be transferred between bacteria as a form of [horizontal gene transfer](http://en.wikipedia.org/wiki/Horizontal_gene_transfer).So plasmids can be described as an extra chromosomal DNA in a bacterial cell.



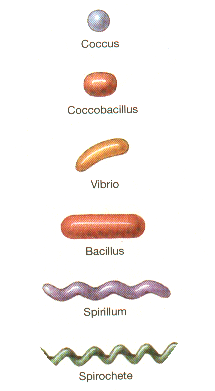
### Ribosomes and other multiprotein complexes:

In most [bacteria](http://en.wikipedia.org/wiki/Bacteria) the most numerous intracellular structure is the [ribosome](http://en.wikipedia.org/wiki/Ribosome), the site of [protein synthesis](http://en.wikipedia.org/wiki/Protein_biosynthesis) in all living organisms.

#### Inclusions:

are considered to be nonliving components of the cell that do not possess metabolic activity and are not bounded by membranes. The most common inclusions are glycogen, lipid droplets, responsible for Mineral storage of cells.

**Shapes of Bacteria:**



Coccus

Chain = Streptoccus

Cluster = Staphylococcus

Bacillus

Chain = Streptobacillus

Coccobacillus

Vibrio = curved

Spirillum

Spirochete

