Bacterial Morphology

• Bacteria display a wide diversity of shapes and sizes. Bacterial cells are about tenth-one the size of eukaryotic cells and are typically 0.5– 5.0 micrometers in length.

• Bacteria can be classified by direct examination with the light microscope according to their morphology and arrangement.

• Most bacterial shaped are either:

1-Spherical (coccus), (e.g. *Staphylococcus aureus*).

2-Rod shaped with round-ended cylinders (bacillus) (e.g. *Bacillus anthracis*)

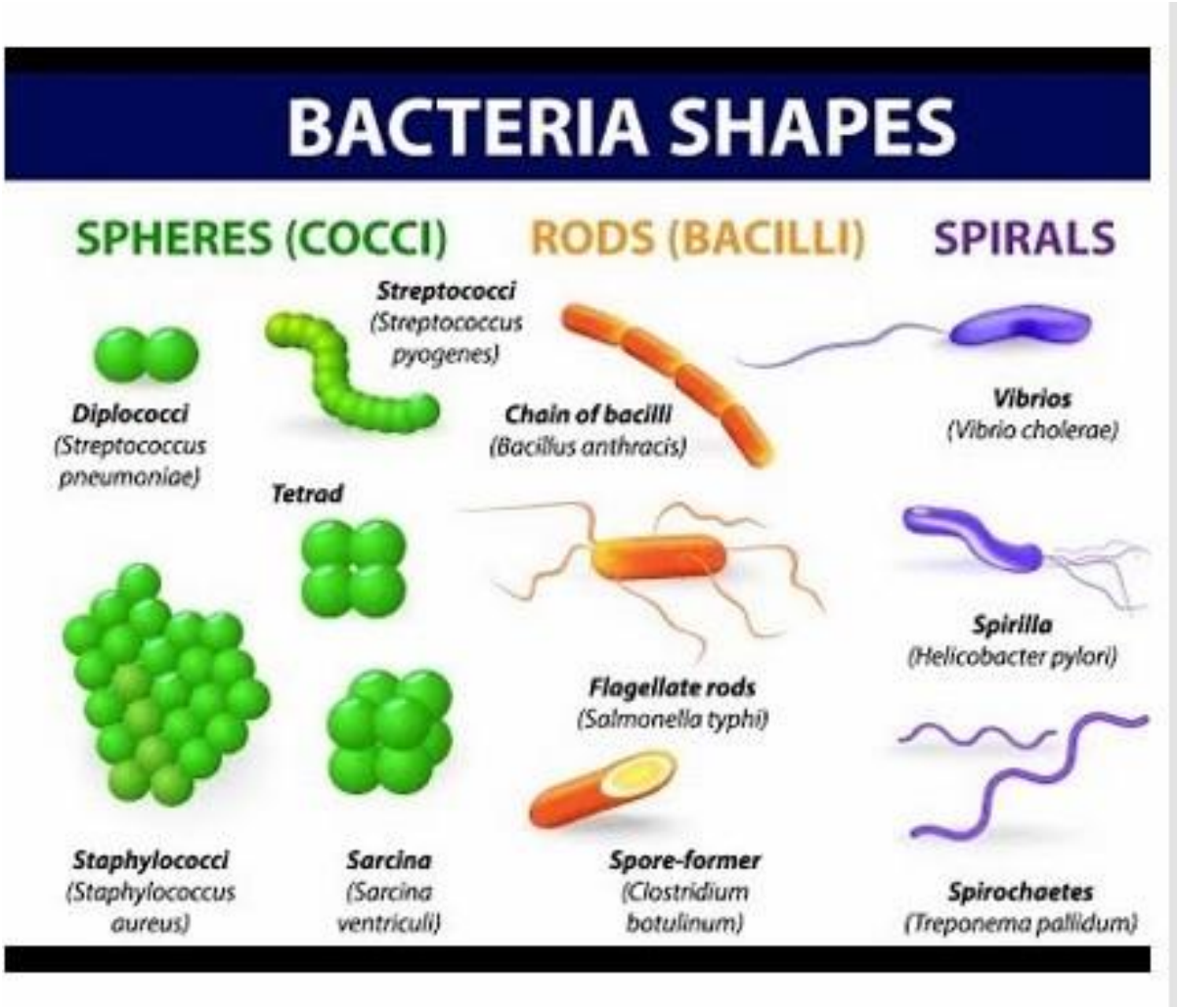
3- Slightly curved rods or comma-shaped (vibrio).

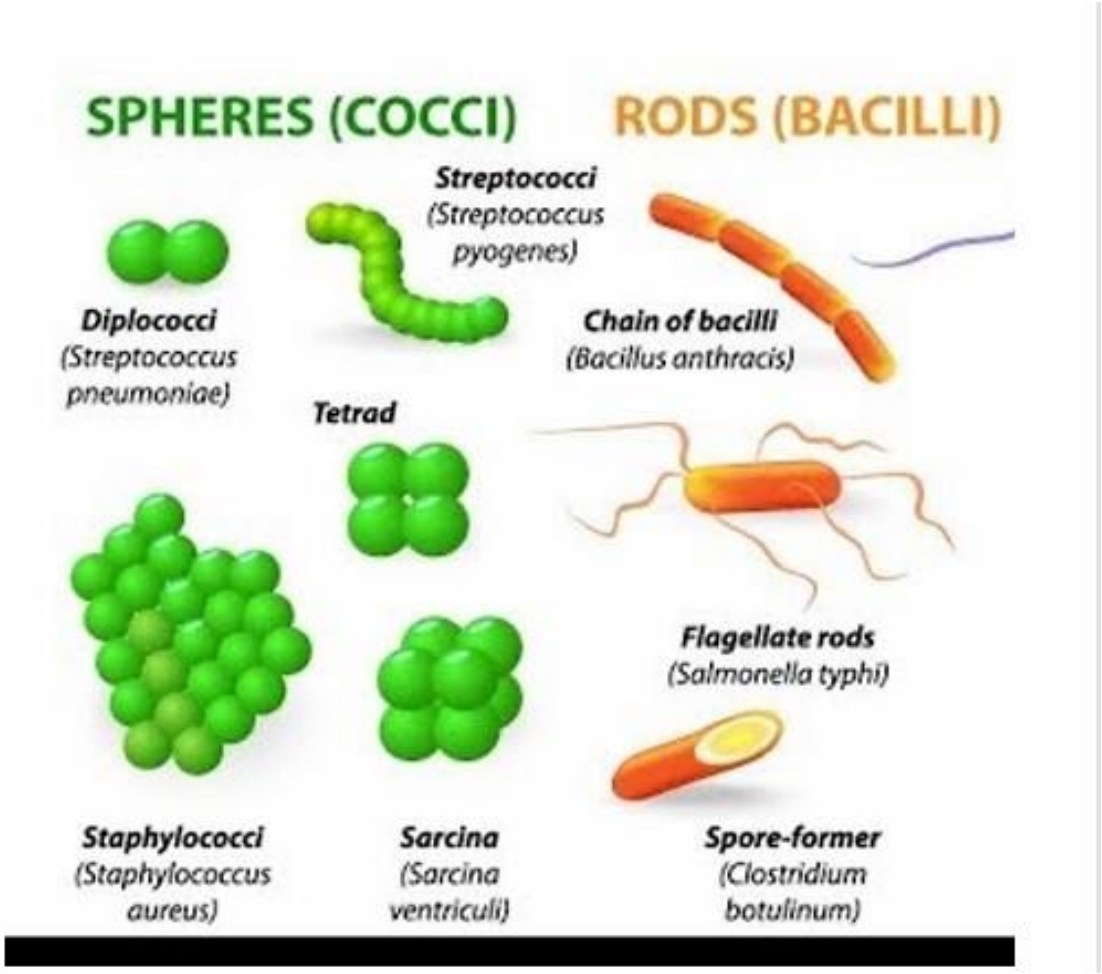
4- Spiral-shaped, called spirilla (e.g. *Helicobacter pylori*)

5-Tightly coiled, called spirochetes (e.g. *Treponema pallidum*) .

• This wide variety of shapes is determined by the bacterial cell wall and cytoskeleton, and is important because it can influence the ability of bacteria to acquire nutrients, attach to surfaces, swim through liquids and escape predators.

• Arrangements of cells are based on the number of planes in which a given cell divides. Cocci can divide in many planes to form pairs (diplococci) (Streptococcus pneumonia) , chains (streptococci), packets or clusters (micrococci or staphylococci). Bacilli divide only in the transverse plan. If they remain attached, they form pairs, chains, or palisades arrangements.


BACTERIA SHAPES
SPHERES (COCCI)
RODS (BACILLI)
SPIRALS
Streptococci
(Streptococcus pyogenes)
Diplococci
(Streptococcus pneumoniae)
Chain of bacilli
(Bacillus anthracis)
Vibrios
(Vibrio cholerae)
Tetrad
Spirilla
(Helicobacter pylori)
Flagellate rods
(Salmonella typhi)
Staphylococci
(Staphylococcus aureus)
Sarcina
(Sarcina ventriculi)
Spore-former
(Clostridium botulinum)
Spirochaetes
(Treponema pallidum)



Microbial Taxonomy

- Taxonomy (Gk. taxon =arrangement; eg, the classification of organisms in an ordered system that indicates a natural relationship).

- A taxon is a collection of related organisms grouped together for purposes of classification. Thus, genus, family, etc. are taxons.

- Microbial taxonomy is a means by which microorganisms can be grouped together. Organisms having similarities with respect to the criteria used are in the same group, and are separated from the other groups of microorganisms that have different characteristics.

• Linnaean taxonomy is the system most familiar to biologists. It uses the formal taxonomic ranks of kingdom, phylum, class, order, family, genus, and species. The lower ranks are approved by a consensus of experts in the scientific community. Of these ranks, the family, genus, and species are the most useful.

• Microorganisms have wide taxonomic distribution and include organisms such as protozoa, algae, fungi, bacteria and virus.

Components of taxonomy:

• Classification: is the categorization of organisms with like characteristics into taxonomic groups.

• Nomenclature: refers to the naming of an organism by international rules according to its characteristics, using binomial system of nomenclature.

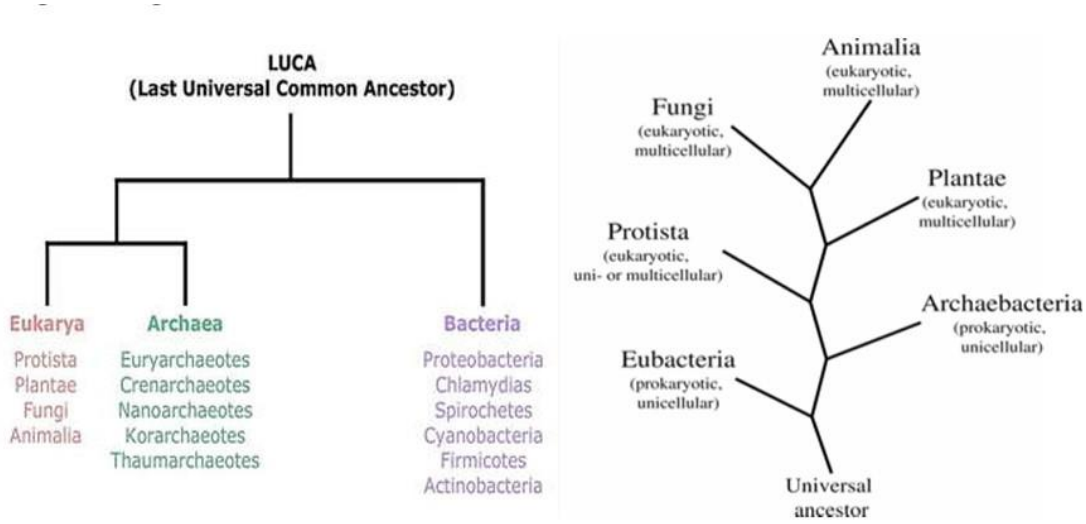
• Identification: is application of classification and nomenclature to assign proper name to unknown organism and place it in its proper position within classification system.

An important breakthrough in microbial taxonomy arose from studies of their cellular architecture, when it was discovered that cells exhibited one of two possible "floor plans", which are either prokaryotes (Greek pro, before, and karyon, nut or kernel; organisms with a primordial nucleus) or eukaryotes (Greek eu, true, and karyon, nut or kernel).

Organisms were divided into five kingdoms: Monera, Protista, Fungi, Animalia, and Plantae, but the five-kingdom system (proposed by Robert Whittaker in 1969) is no longer accepted by microbiologists. Why?

This is because not all "prokaryotes" are the same and therefore should not be grouped together in a single kingdom. Furthermore, it is currently argued that the term prokaryote is not meaningful and should be abandoned.

Three domains system Molecular phylogenies, divide all living organisms into three domains – Bacteria (“true bacteria”), Archaea (means ‘ancient’), and Eukarya (eukaryotes: protists, fungi, plants, animals). These domains represent a level of classification that goes even higher than the kingdoms.



Bacteria (sometimes referred to as true bacteria or eubacteria):

The techniques such as microscopic examination of specimens, culturing (growing) microbes in the laboratory and isolating pure cultures from mixed-culture populations, originally used for studying bacteria, have been modified for the study of all microorganisms—hence the transition from bacteriology to microbiology. Members of domain Bacteria are:

- Usually single-celled (unicellular) organisms and they are described as prokaryotic because they lack a nucleus.
- Few of bacteria are pathogens, most play beneficial roles; they break down dead plant and animal material and, in doing so, cycle elements in the biosphere. Furthermore, they are used extensively in industry to make bread, cheese, antibiotics, vitamins, enzymes, and other products.

In any discussion on biological classification, it is impossible to avoid mentioning Linnaeus, the Swedish botanist who attempted to bring order to the naming of living things by giving each type a Latin name. Linnaeus was responsible for introducing the binomial system of nomenclature, by which each organism was assigned a genus and a species. Note the following conventions, which apply to the naming of all living things (the naming of viruses is something of a special case):

¬ the generic (genus) name is always given a capital letter.

¬ the specific (species) name is given a small letter.

¬ the generic and specific name are italicized, or, if this isn't possible, underlined

Many species are named after people, either the discoverer or a famous person in the field of microbiology, for example Salmonella is after D.E. Salmon, who discovered it (albeit as "Bacillus typhi").

¬ For the generic epithet, all names derived from people must be in the female nominative case, either by changing the ending to -a or to the diminutive -ella, depending on the name.

¬ For the specific epithet, the names can be converted into either adjectival form (adding -nus (m.), -na (f.), -num (n.) according to the gender of the genus name).

Domain	Bacteria
Phylum	Proteobacteria
Class	Zymobacteria
Order	Enterobacteriales
Family	Enterobacteriaceae
Genus	*Escherichia*
Species	*coli*

Figure 2: A modern hierarchical classification for *E. coli*