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CHEMISTRY AND HISTOCHEMISTRY OF GRAM STAINING OF DYES ON BACTERIAL PEPTIDOGLYCAN

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ABSTRACT

Mostly all dyes used for Gram staining have methyl group and peptidoglycan layer of bacterial cell wall also have methyl group. In 3D structure of methyl group has three hydrogen atoms bound with carbon atom in space which binds with peptidoglycan layer to make a stain to differentiate between Gram-positive and Gram-negative bacteric. The fixation of stain is activated by using mordant (iodine) which is then washed out by alcohol and crystal violet and safranin colours bind on peptidoglycan layer of bacterial cell wall.

KEYWORDS: Peptidoglycan, Glucosamine, N-acetylglucosamine, N-acetylmuramic acid, Coccus, Bacillus, Vibrio, Spirillum, Crystal violet, Safranin, Iodine, Fuchsine, Acid fuchsine, Basic fuchsine, New fuchsine.

INTRODUCTION

Peptidoglycan, also known as murein, is a polymer consisting of sugars and amino acids that forms a mesh-like layer outside the plasma membrane of most bacteria, forming the cell wall. The peptidoglycan layer in the bacterial cell wall is a crystal lattice structure formed from linear chains of two alternating amino sugars, namely N-acetylglucosamine (GlcNAc or NAGA) and N-acetylmuramic acid (MurNAc or NAMA).[1] The alternating sugars are connected by a β-(1,4)-glycosidic bond. Each MurNAc is attached to a short (4- to 5-residue) amino acid chain, containing L-alanine, D-glutamic acid, meso-diaminopimelic acid and D-alanine in the case of *Escherichia coli* (a Gram-negative bacterium) or L-alanine, D-glutamine, L-lysine, and D-alanine with a 5-glycine interbridge between tetra peptides in the

case of *Staphylococcus aureus* (a Gram-positive bacterium). Peptidoglycan is one of the most important sources of D-amino acids in nature.[2]

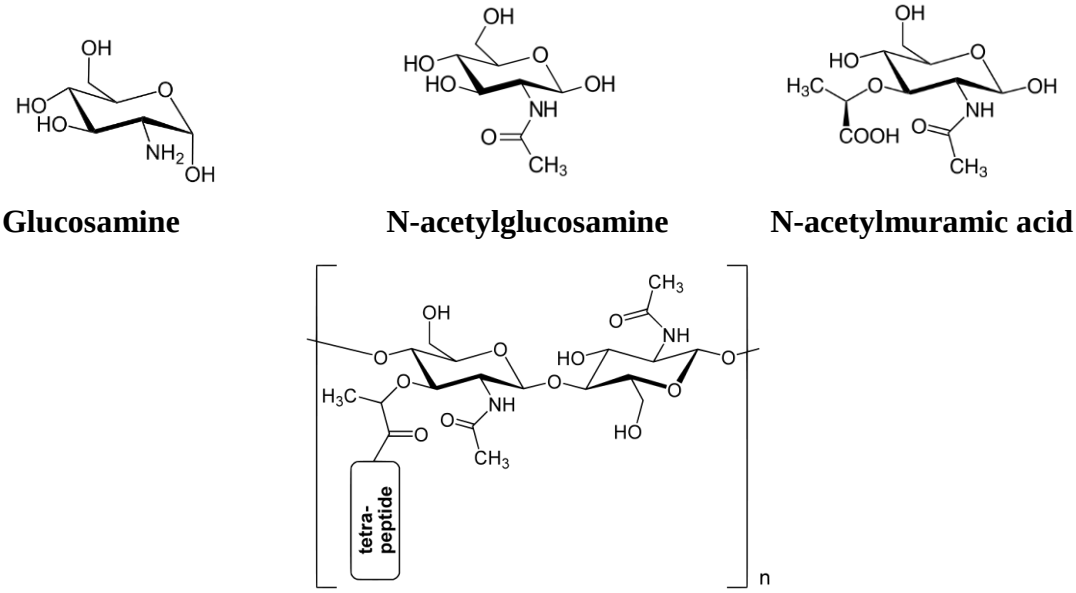
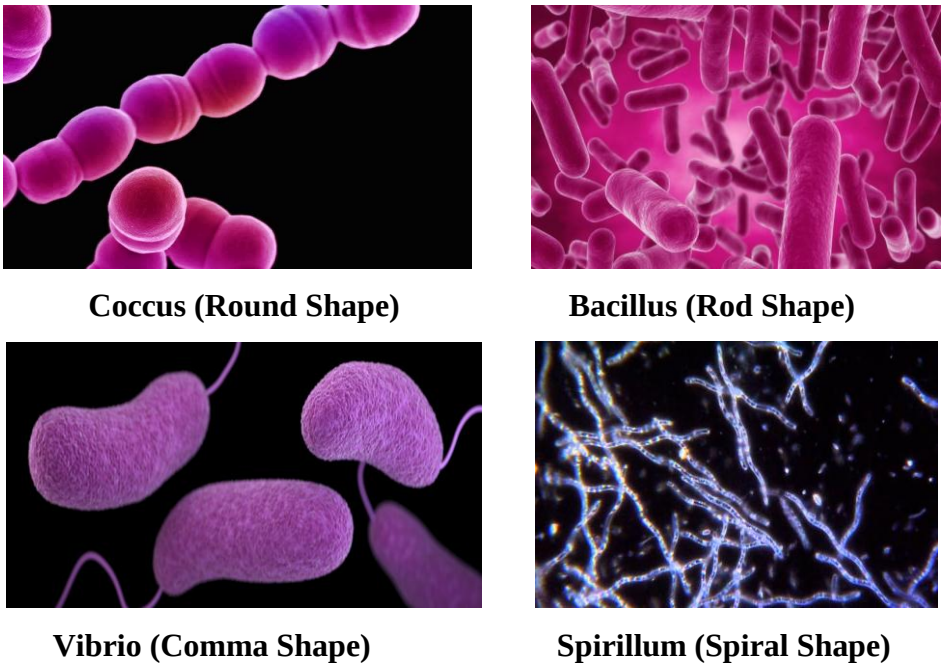


Figure-1: Building units of Peptidoglycan.

Cross-linking between amino acids in different linear amino sugar chains occurs with the help of the enzyme DD-transpeptidase and results in a 3-dimensional structure that is strong and rigid. The specific amino acid sequence and molecular structure vary with the bacterial species. Peptidoglycan serves a structural role in the bacterial cell wall, giving structural strength, as well as counteracting the osmotic pressure of the cytoplasm. A common misconception is that peptidoglycan gives the cell its shape; however, whereas peptidoglycan helps maintain the structural strength of the cell, it is actually the MreB protein that facilitates cell shape. Peptidoglycan is also involved in binary fission during bacterial cell reproduction. The peptidoglycan layer is substantially thicker in Gram-positive bacteria (20 to 80 nanometers) than in Gram-negative bacteria (7 to 8 nanometers), with the attachment of the S-layer.[3]

An S-layer (surface layer) is a part of the cell envelope found in almost all archaea, as well as in many types of bacteriActinomyces It consists of a monomolecular layer composed of identical proteins or glycoproteins. This structure is built via self-assembly and encloses the whole cell surface.[4] Thus, the S-layer protein can represent up to 15% of the whole protein content of a cell. S-layer proteins are poorly conserved or not conserved at all and can differ markedly even between related species. Depending on species, the S-layers have a thickness

between 5 and 25 nm and possess identical pores with 2–8 nm in diameter. The terminology "S-layer" was used the first time in 1976.



Coccus (Round Shape) **Bacillus (Rod Shape)**

Vibrio (Comma Shape) **Spirillum (Spiral Shape)**

Figure-2: Shapes of bacteria.

The general use was accepted at the "First International Workshop on Crystalline Bacterial Cell Surface Layers, Vienna (Austria)" in 1984, and in the year 1987 S-layers were defined at the European Molecular Biology Organization Workshop on "Crystalline Bacterial Cell Surface Layers", Vienna as "Two-dimensional arrays of proteinaceous subunits forming surface layers on prokaryotic cells".[5]

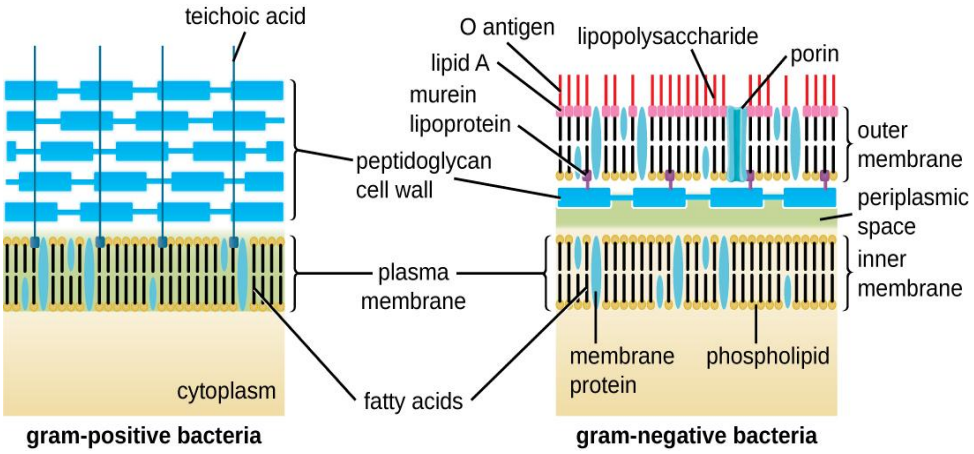


Figure-3: Peptidoglycan layer.

Location of S-layers

In Gram-negative bacteria, S-layers are associated to the lipopolysaccharides via ionic, carbohydrate–carbohydrate, protein–carbohydrate interactions and/or protein–protein interactions. In Gram-positive bacteria whose S-layers often contain surface layer homology (SLH) Kingdoms, the binding occurs to the peptidoglycan and to a secondary cell wall polymer (e.g., teichoic acids). In the absence of SLH Kingdoms, the binding occurs via electrostatic interactions between the positively charged N-terminus of the S-layer protein and a negatively charged secondary cell wall polymer. In Lactobacilli the binding Kingdom may be located at the C-terminus. In Gram-negative archaea, S-layer proteins possess a hydrophobic anchor that is associated with the underlying lipid membrane. In Gram-positive archaea, the S-layer proteins bind to pseudomurein or to methanochondroitin.[6]

Biological functions of the S-layer

For many bacteria, the S-layer represents the outermost interaction zone with their respective environment. Its functions are very diverse and vary from species to species. In many archaeal species the S-layer is the only cell wall component and therefore, is important for mechanical and osmotic stabilization. Additional functions associated with S-layers include: (1) Protection against bacteriophages, Bdellovibrios and phagocytosis (2) Resistance against low pH (3) Barrier against high-molecular-weight substances (e.g., lytic enzymes) (4) Adhesion (for glycosylated S-layers) (5) Stabilization of the membrane (6) Provision of adhesion sites for exoproteins (7) Provision of a periplasmic compartment in Gram-positive prokaryotes together with the peptidoglycan and the cytoplasmic membranes (8) Anti-fouling properties (9) Biomineralization (10) Molecular sieve and barrier function.

Figure-4: Hans Christian Joachim Gram (September 13, 1853 – November 14, 1938) was a Danish bacteriologist noted for his development of the Gram stain.

Peptidoglycan forms around 90% of the dry weight of Gram-positive bacteria but only 10% of Gram-negative strains. Thus, presence of high levels of peptidoglycan is the primary

determinant of the characterization of bacteria as Gram-positive. In Gram-positive strains, it is important in attachment roles and stereotyping purposes. For both Gram-positive and Gram-negative bacteria, particles of approximately 2 nm can pass through the peptidoglycan.[7]

Gram stain or Gram staining, also called Gram's method, is a method of staining used to distinguish and classify bacterial species into two large groups (Gram-positive and Gram-negative). The name comes from the Danish bacteriologist **Hans Christian Gram**, who developed the technique. Gram staining differentiates bacteria by the chemical and physical properties of their cell walls by detecting peptidoglycan, which is present in the cell wall of Gram-positive bacteriActinomyces Gram-negative cells also contain peptidoglycan, but a very small layer of it that is dissolved when the alcohol is added. This is why the cell loses its initial color from the primary stain. Gram-positive bacteria retain the crystal violet dye and thus are stained violet, while the Gram-negative bacteria do not; after washing, a counter stain is added (commonly safranin or fuchsine) that will stain these Gram-negative bacteria a pink color. Both Gram-positive bacteria and Gram-negative bacteria pick up the counter stain. The counter stain, however, is unseen on Gram-positive bacteria because of the darker crystal violet stain.[8]

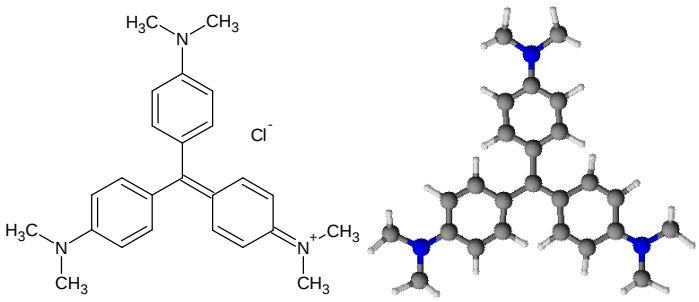


Figure-5: Crystal violet: Tris(4-(dimethylamino)phenyl)methylium chloride.

Crystal violet ($C_{25}H_{30}ClN_3$) or gentian violet (also known as methyl violet 10B or hexamethyl pararosaniline chloride) is a triarylmethane dye used as a histological stain and in Gram's method of classifying bacteriActinomyces Crystal violet has antibacterial, antifungal and anthelmintic properties and was formerly important as a topical antiseptic. The medical use of the dye has been largely superseded by more modern drugs, although it is still listed by the World Health Organization.

Gentian violet was originally used for a mixture of methyl pararosaniline dyes (methyl violet), but is now often considered a synonym for crystal violet. The name refers to its colour, being like that of the petals of a gentian flower; it is not made from gentians or from violets.

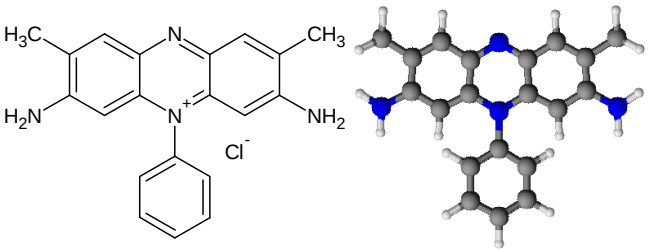


Figure-6: Safranin: 3,7-diamino-2,8-dimethyl-5-phenylphenazin-5-ium chloride.

Safranin ($C_{20}H_{19}ClN_4$) (also Safranin O or basic red 2) is a biological stain used in histology and cytology. Safranin is used as a counter stain in some staining protocols, colouring all cell nuclei red. This is the classic counter stain in both Gram stains and endospore staining. It can also be used for the detection of cartilage, mucin and mast cell granules.[9]

Safranin typically has the chemical structure (sometimes described as dimethyl safranin). There is also trimethyl safranin, which has an added methyl group in the ortho- position of the lower ring. Both compounds behave essentially identically in biological staining applications, and most manufacturers of safranin do not distinguish between the two. Commercial safranin preparations often contain a blend of both types. Safranin is also used as redox indicator in analytical chemistry.

Safranines are the azonium compounds of symmetrical 2,8-dimethyl-3,7-diaminophenazine. They are obtained by the joint oxidation of one molecule of a para-diamine with two molecules of a primary amine; by the condensation of para-aminoazo compounds with primary amines and by the action of para-nitrosodialkylanilines with secondary bases such as diphenylmetaphenylenediamine. They are crystalline solids showing a characteristic green metallic lustre; they are readily soluble in water and dye blue or violet. They are strong bases and form stable monacid salts. Their alcoholic solution shows a yellow-red fluorescence. Phenosafranine is not very stable in the free state; its chloride forms green plates. It can be readily diazotized and the diazonium salt when boiled with alcohol yields aposafranine or benzene induline, $C_{18}H_{12}N_3$. F. Kehrmann showed that aposafranine could be diazotized in

the presence of cold concentrated sulfuric acid, and the diazonium salt on boiling with alcohol yielded phenylphenazonium salts.[10]

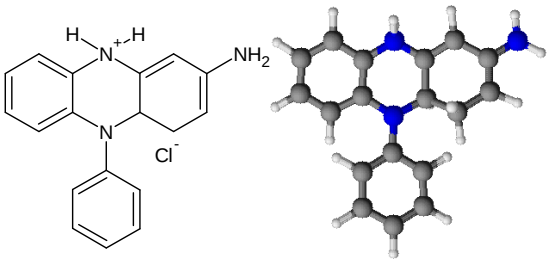


Figure-7: Aposafranine.

Aposafranone, $C_{18}H_{12}N_2O$, is formed by heating aposafranine with concentrated hydrochloric acid. These three compounds are perhaps to be represented as ortho- or as para-quinones. The "safranine" of commerce is an ortho-tolusafranine. The first aniline dye-stuff to be prepared on a manufacturing scale was mauveine, which was obtained by Sir William Henry Perkin by heating crude aniline with potassium bichromate and sulfuric acid. Mauveine was converted to parasafranine (1,8-dimethylsafranine) by Perkin in 1878 by oxidative/reductive loss of the 7N-para-tolyl group. Another well known safranin is phenosafranine (C.I. 50200, 3,7-diamino-5-phenylphenazinium chloride) widely used as a histological dye, photosensitizer and redox probe.[11]

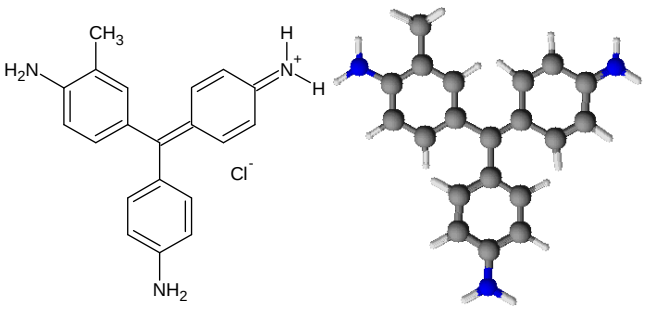


Figure-8: Fuchsine.

Fuchsine: 4-[(4-amino-3-methylphenyl)(4-aminophenyl)methylene]cyclohexa-2,5-dien-1-iminium chloride.

Fuchsine (sometimes spelled fuchsin) or rosaniline hydrochloride is a magenta dye with chemical formula $C_{20}H_{19}N_3 \cdot HCl$. There are other similar chemical formulations of products sold as fuchsine, and several dozen other synonyms of this molecule. It becomes magenta when dissolved in water; as a solid, it forms dark green crystals. As well as dying textiles, fuchsine is used to stain bacteria and sometimes as a disinfectant. In the literature of

biological stains the name of this dye is frequently misspelled, with omission of the terminal -e, which indicates an amine. American and English dictionaries (Webster's, Oxford, Chambers, etc.) give the correct spelling, which is also used in the literature of industrial dyeing. It is well established that production of fuchsine results in development of bladder cancers by production workers. Production of magenta is listed as a circumstance known to result in cancer.[12] Fuchsine was first prepared by August Wilhelm von Hofmann from aniline and carbon tetrachloride in 1858. François-Emmanuel Verguin discovered the substance independently of Hofmann the same year and patented it. Fuchsine was named by its original manufacturer Renard frères et Franc, is usually cited with one of two etymologies: from the color of the flowers of the plant genus Fuchsia, named in honor of botanist Leonhart Fuchs, or as the German translation Fuchs of the French name Renard, which means fox. An 1861 article in Répertoire de Pharmacie said that the name was chosen for both reasons.

Acid fuchsine ($C_{20}H_{17}N_3Na_2O_9S_3$) is a mixture of homologues of basic fuchsine, modified by addition of sulfonic groups. While this yields twelve possible isomers, all of them are satisfactory despite slight differences in their properties.[13]

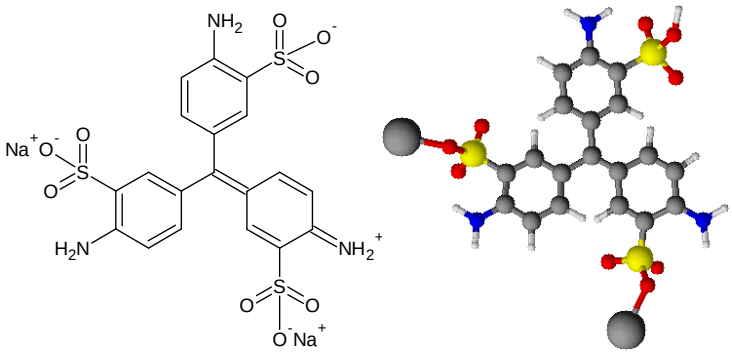


Figure-9: Acid Fuchsine.

Acid fuchsine: Disodium 2-amino-5-[(Z)-(4-amino-3-sulfonatophenyl)(4-iminio-3-sulfonato-2,5-cyclohexadien-1-ylidene)methyl]-3-methylbenzenesulfonate.

Acid fuchsin or fuchsine acid is an acidic magenta dye. It has wide use in histology. It is one of the dyes used in Masson's trichrome stain. This method is commonly used to stain cytoplasm and nuclei of tissue sections in the histology laboratory in order to distinguish muscle from collagen. The muscle stains red with the acid fuchsin, and the collagen is stained green or blue with light green SF yellowish or methyl blue.

Basic fuchsine ($C_{19}H_{18}ClN_3$) is a mixture of rosaniline, pararosaniline, new fuchsine and Magenta II. Formulations usable for making of Schiff reagent must have high content of pararosaniline. The actual composition of basic fuchsine tends to somewhat vary by vendor and batch, making the batches differently suitable for different purposes.

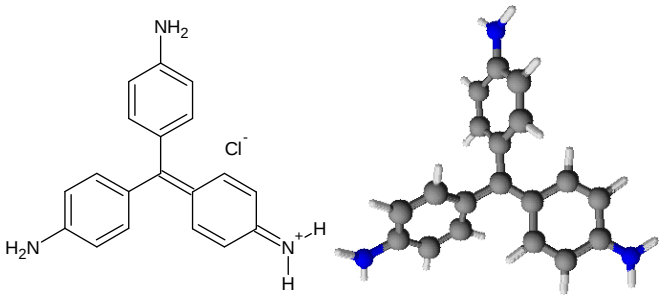


Figure-10: Pararosaniline: 4-[bis(4-aminophenyl)methylene]cyclohexa-2,5-dien-1-iminium chloride.

Pararosaniline ($C_{19}H_{18}ClN_3$), Basic Red 9, or C.I. 42500 is an organic compound with the formula $[(H_2NC_6H_4)_3C]Cl$. It is a magenta solid with a variety of uses as a dye. It is one of the four components of basic fuchsine. (The others are rosaniline, new fuchsine and magenta II.) It is structurally related to other triarylmethane dyes called methyl violets including crystal violet, which feature methyl groups on nitrogen. It is prepared by the condensation of aniline and para-aminobenzaldehyde. Alternative it arises from the oxidation of 4,4'-bis(aminophenyl)methane in the presence of aniline.[14]

Uses

It is used to dye polyacrylonitrile fibers. Pararosaniline is used as a colorimetric test for aldehydes, in the Schiff test. It is the only basic fuchsine component suitable for making the aldehyde-fuchsine stain for pancreatic islet beta cells. It has use as a Antischistosomal GB 908634 (1962 to Parke Davis & Co). In solution with phenol (also called carbolic acid) as an accentuator it is called carbol fuchsin and is used for the Ziehl–Neelsen and other similar acid-fast staining of the mycobacteria which cause tuberculosis, leprosy etc. Basic fuchsine is widely used in biology to stain the nucleus, and is also a component of Lactofuchsin, used for Lactofuchsin mounting.

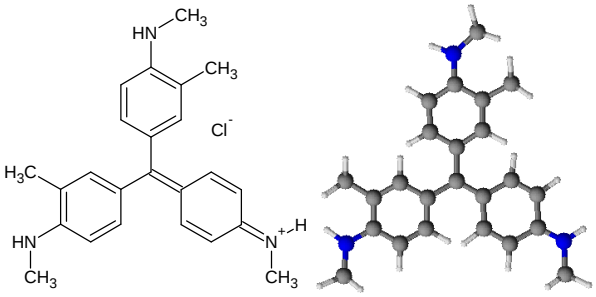


Figure-11: New fuchsine.

New fuchsine ($C_{25}H_{30}ClN_3$) (from German "fuchs", fox) is an organic. It is a green-colored solid that is used as a dye. It is one of the four components of basic fuchsine, and one of the two that are available as single dyes. The other is pararosaniline. It is prepared by condensation of N-methyltoluidine with xylidene in the presence of hydrochloric acid. It is used as dye and stain and used to dye polyacrylonitrile, paper and leather. New fuchsine can be used for staining acid-fast organisms, e.g. by Ziehl-Neelsen stain, and for making Schiff's reagent. As a primary amine, the dye can be diazotized in the laboratory, and the resulting diazonium salt used as a trapping agent in enzyme histochemistry.[15]

Chemical structure

Fuchsine is an amine salt and has three amine groups, two primary amines and a secondary amine. If one of these is protonated to form $ABCNH^+$, the positive charge is delocalized across the whole symmetrical molecule due to π cloud electron movement. The positive charge can be thought of as residing on the central carbon atom and all three "wings" becoming identical aromatic rings terminated by a primary amine group. Other resonance structures can be conceived, where the positive charge "moves" from one amine group to the next, or one third of the positive charge resides on each amine group. The ability of fuchsine to be protonated by a stronger acid gives it its basic property. The positive charge is neutralized by the negative charge on the chloride ion. The positive "basic fuchsinium ions" and negative chloride ions stack to form the salt "crystals" depicted above.[16]

The Gram stain is almost always the first step in the preliminary identification of a bacterial organism. While Gram staining is a valuable diagnostic tool in both clinical and research settings, not all bacteria can be definitively classified by this technique. This gives rise to Gram-variable and Gram-indeterminate groups. The method is named after its inventor, the Danish scientist Hans Christian Gram (1853–1938), who developed the technique while working with Carl Friedländer in the morgue of the city hospital in Berlin in 1884. Gram

devised his technique not for the purpose of distinguishing one type of bacterium from another but to make bacteria more visible in stained sections of lung tissue. He published his method in 1884, and included in his short report the observation that the typhus Bacillus did not retain the stain.[17]

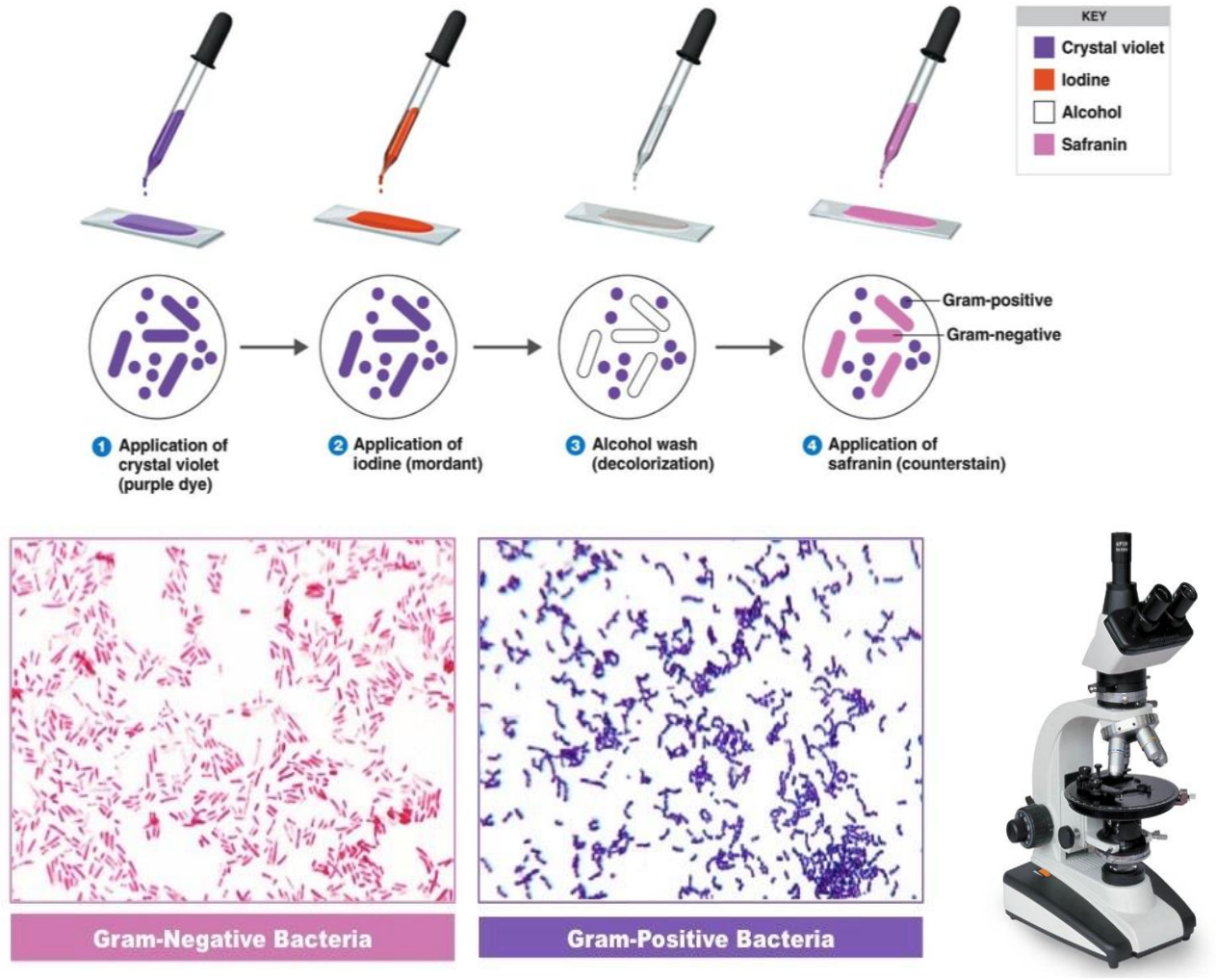


Figure-12: Gram staining.

Staining mechanism

Gram-positive bacteria have a thick mesh-like cell wall made of peptidoglycan (50–90% of cell envelope) and as a result are stained purple by crystal violet, whereas Gram-negative bacteria have a thinner layer (10% of cell envelope), so do not retain the purple stain and are counter-stained pink by safranin. There are four basic steps of the Gram stain:

(a) Applying a primary stain (crystal violet) to a heat-fixed smear of a bacterial culture then heat fixation kills some bacteria but is mostly used to affix the bacteria to the slide so that they don't rinse out during the staining procedure. (b) The addition of iodide, which binds to

crystal violet and traps it in the cell. (c) Rapid decolorization with ethanol or acetone. (d) Counterstaining with safranin. Carbol fuchsin is sometimes substituted for safranin since it more intensely stains anaerobic bacteria, but it is less commonly used as a counter stain.[18]

Crystal violet (CV) dissociates in aqueous solutions into CV^+ and chloride (Cl^-) ions. These ions penetrate through the cell wall and cell membrane of both Gram-positive and Gram-negative cells. The CV^+ ion interacts with negatively charged components of bacterial cells and stains the cells purple. Iodide (I^- or I_3^-) interacts with CV^+ and forms large complexes of crystal violet and iodine (CV–I) within the inner and outer layers of the cell. Iodine is often referred to as a mordant, but is a trapping agent that prevents the removal of the CV–I complex and therefore, colors the cell. When a decolorizer such as alcohol or acetone is added, it interacts with the lipids of the cell membrane. A Gram-negative cell loses its outer lipopolysaccharide membrane, and the inner peptidoglycan layer is left exposed. The CV–I complexes are washed from the Gram-negative cell along with the outer membrane. In contrast, a Gram-positive cell becomes dehydrated from an ethanol treatment. The large CV–I complexes become trapped within the Gram-positive cell due to the multilayered nature of its peptidoglycan. The decolorization step is critical and must be timed correctly; the crystal violet stain is removed from both Gram-positive and negative cells if the decolorizing agent is left on too long (a matter of seconds). After decolorization, the Gram-positive cell remains purple and the Gram-negative cell loses its purple color. Counter stain, which is usually positively charged safranin or basic fuchsine, is applied last to give decolorized Gram-negative bacteria a pink or red color.

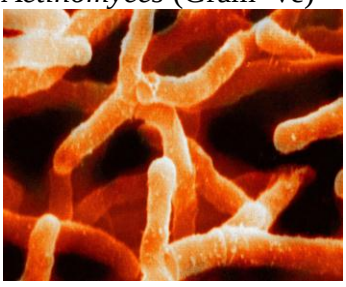
Gram-positive bacteria generally have a single membrane (monoderm) surrounded by a thick peptidoglycan. This rule is followed by two phyla: Firmicutes (except for the classes Mollicutes and Negativicutes) and the ActinobacteriActinomyces In contrast, members of the Chloroflexi (green non-sulfur bacteria) are monoderms but possess a thin or absent (class Dehalococcoidetes) peptidoglycan and can stain negative, positive or indeterminate; members of the Deinococcus-Thermus group, stain positive but are diderms with a thick peptidoglycan. Historically, the Gram-positive forms made up the phylum Firmicutes, a name now used for the largest group. It includes many well-known genera such as *Bacillus, Listeria, Staphylococcus, Streptococcus, Enterococcus and Clostridium*. It has also been expanded to include the Mollicutes, bacteria like Mycoplasma that lack cell walls and so cannot be stained by Gram, but are derived from such forms. Some bacteria have cell walls which are

particularly adept at retaining stains. These will appear positive by Gram stain even though they are not closely related to other Gram-positive bacteriActinomyces. These are called acid fast bacteria and can only be differentiated from other Gram-positive bacteria by special staining procedures.[19]

Gram-negative bacteria generally possess a thin layer of peptidoglycan between two membranes (diderms). Most bacterial phyla are Gram-negative, including the cyanobacteria, green sulfur bacteria, and most Proteobacteria (exceptions being some members of the Rickettsiales and the insect-endosymbionts of the Enterobacteriales).

Gram variable and Gram-indeterminate bacteria

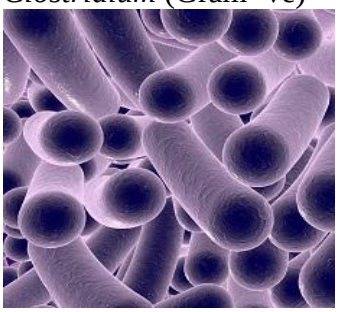
Some bacteria, after staining with the Gram stain, yield a Gram-variable pattern: a mix of pink and purple cells is seen. In cultures of *Bacillus, Butyrivibrio and Clostridium*, a decrease in peptidoglycan thickness during growth coincides with an increase in the number of cells that stain Gram-negative. In addition, in all bacteria stained using the Gram stain, the age of the culture may influence the results of the stain. Gram-indeterminate bacteria do not respond predictably to Gram staining and, therefore, cannot be determined as either Gram-positive or Gram-negative. Examples include many species of *Mycobacterium*, including *Mycobacterium tuberculosis* and *Mycobacterium leprae*.[20]

Bacteria	Shape & Taxonomy	Microorganisms & Disease
Actinomyces (Gram+ve) 	**Shape:** Filamentous **Taxonomy:** Kingdom: Bacteria Phylum: Actinobacteria Class: Actinobacteria Order: Actinomycetales Family: Actinomycetaceae Genus: *Actinomyces*	***Microorganisms:*** *Actinomyces bovis, Actinomyces bowdenii, Actinomyces canis, Actinomyces cardiffensis, Actinomyces catuli, Actinomyces coleocanis, Actinomyces dentalis, Actinomyces denticolens, Actinomyces europaeus, Actinomyces funkei, Actinomyces georgiae, Actinomyces gerencseriae, Actinomyces graevenitzii, Actinomyces hongkongensis, Actinomyces hordeovulneris, Actinomyces howellii, Actinomyces humiferus, Actinomyces hyovaginalis, Actinomyces israelii, Actinomyces marimammalium, Actinomyces meyeri, Actinomyces naeslundii, Actinomyces nasicola, Actinomyces neuii, Actinomyces odontolyticus, Actinomyces oricola, Actinomyces radicidentis, Actinomyces radingae, Actinomyces slackii, Actinomyces streptomycini, Actinomyces suimastitidis, Actinomyces suis, Actinomyces turicensis, A Actinomyces urogenitalis, Actinomyces*

		vaccimaxillae, Actinomyces viscosus **Disease:** Respiratory Diseases, cavities
Bacillus (Gram+ve) 	**Shape:** Endospore **Taxonomy:** Kingdom: Bacteria Phylum: Firmicutes Class: Bacilli Order: Bacillales Family: Bacillaceae Genus: *Bacillus*	***Microorganisms:*** *Bacillus acidiceler, Bacillus acidicola, Bacillus acidiproducens, Bacillus acidocaldarius, Bacillus acidoterrestris, Bacillus aeolius, Bacillus aerius, Bacillus aerophilus, Bacillus agaradhaerens, Bacillus agri, Bacillus aidingensis, Bacillus akibai, Bacillus alcalophilus, Bacillus algicola, Bacillus alginolyticus, Bacillus alkalidiazotrophicus, Bacillus alkalinitrilicus, Bacillus alkalisediminis, Bacillus alkalitelluris, Bacillus altitudinis, Bacillus alveayuensis, Bacillus alvei, Bacillus amyloliquefaciens, Bacillus a. subsp. Amyloliquefaciens, Bacillus a. subsp. Plantarum, Bacillus aminovorans, Bacillus amylolyticus, Bacillus andreesenii, Bacillus aneurinilyticus, Bacillus anthracis, Bacillus aquimaris, Bacillus arenosi, Bacillus arseniciselenatis, Bacillus arsenicus, Bacillus aurantiacus, Bacillus arvi, Bacillus aryabhattai, Bacillus asahii, Bacillus atrophaeus, Bacillus axarquiensis, Bacillus azotofixans, Bacillus azotoformans, Bacillus badius, Bacillus barbaricus, Bacillus bataviensis, Bacillus beijingensis, Bacillus benzoevorans, Bacillus beringensis, Bacillus berkeleyi, Bacillus beveridgei, Bacillus bogoriensis, Bacillus boroniphilus, Bacillus borstelensis, Bacillus brevis Migula, Bacillus butanolivorans, Bacillus canaveralius, Bacillus carboniphilus, Bacillus cecembensis, Bacillus cellulosilyticus, Bacillus centrosporus, Bacillus cereus, Bacillus chagannorensis, Bacillus chitinolyticus, Bacillus chondroitinus, Bacillus choshinensis, Bacillus chungangensis, Bacillus cibi, Bacillus circulans, Bacillus clarkia, Bacillus clausii, Bacillus coagulans, Bacillus coahuilensis, Bacillus cohnii, Bacillus composti, Bacillus curdlanolyticus, Bacillus cycloheptanicus, Bacillus cytotoxicus, Bacillus daliensis, Bacillus decisifrondis, Bacillus decolorationis, Bacillus deserti, Bacillus dipsosauri, Bacillus drentensis, Bacillus edaphicus, Bacillus ehimensis, Bacillus eiseniae, Bacillus enclensis, Bacillus endophyticus, Bacillus endoradicis, Bacillus farraginis, Bacillus fastidiosus, Bacillus fengqiuensis, Bacillus firmus, Bacillus flexus, Bacillus foraminis, Bacillus fordii, Bacillus*

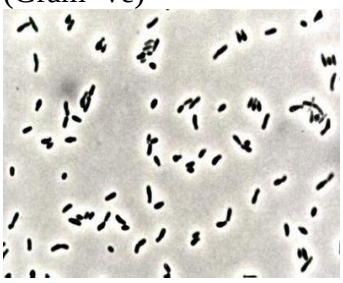
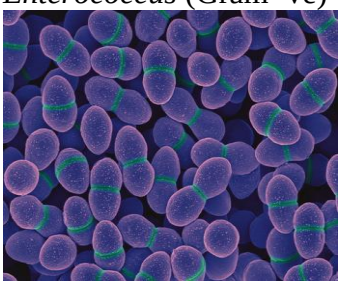
		formosus, Bacillus fortis, Bacillus fumarioli, Bacillus funiculus, Bacillus fusiformis, Bacillus galactophilus, Bacillus galactosidilyticus, Bacillus galliciensis, Bacillus gelatini, Bacillus gibsonii, Bacillus ginseng, Bacillus ginsengihumi, Bacillus ginsengisoli, Bacillus glucanolyticus, Bacillus gordonae, Bacillus gottheilii, Bacillus Graminis, Bacillus halmapalus, Bacillus haloalkaliphilus, Bacillus halochares, Bacillus halodenitrificans, Bacillus halodurans, Bacillus halophilus, Bacillus halosaccharovorans, Bacillus hemicellulosilyticus, Bacillus hemicentroti, Bacillus herbersteinensis, Bacillus horikoshii, Bacillus horneckiae, Bacillus horti, Bacillus huizhouensis, Bacillus humi, Bacillus hwajinpoensis, Bacillus idriensis, Bacillus indicus, Bacillus infantis, Bacillus infernus, Bacillus insolitus, Bacillus invictae, Bacillus iranensis, Bacillus isabeliae, Bacillus isronensis, Bacillus jeotgali, Bacillus kaustophilus, Bacillus kobensis, Bacillus kochii, Bacillus kokeshiiformis, Bacillus koreensis, Bacillus korlensis, Bacillus kribbensis, Bacillus krulwichiae, Bacillus laevolacticus, Bacillus larvae, Bacillus laterosporus, Bacillus lautus, Bacillus lehensis, Bacillus lentimorbus, Bacillus lentus, Bacillus licheniformis, Bacillus ligniniphilus, Bacillus litoralis, Bacillus locisalis, Bacillus luciferensis, Bacillus luteolus, Bacillus luteus, Bacillus macauensis, Bacillus macerans, Bacillus macquariensis, Bacillus macyae, Bacillus malacitensis, Bacillus mannanilyticus, Bacillus marisflavi, Bacillus marismortui, Bacillus marmarensis, Bacillus massiliensis, Bacillus megaterium, Bacillus mesonae, Bacillus methanolicus, Bacillus methylotrophicus, Bacillus migulanus, Bacillus mojavensis, Bacillus mucilaginosus, Bacillus muralis, Bacillus murimartini, Bacillus mycoides, Bacillus naganoensis, Bacillus nanhaiensis, Bacillus nanhaiisediminis, Bacillus nealsonii, Bacillus neidei, Bacillus neizhouensis, Bacillus niabensis, Bacillus niacin, Bacillus novalis, Bacillus oceanisediminis, Bacillus odyssey, Bacillus okhensis, Bacillus okuhidensis, Bacillus oleronius, Bacillus oryzaecorticis, Bacillus oshimensis, Bacillus pabuli, Bacillus pakistanensis, Bacillus pallidus, Bacillus

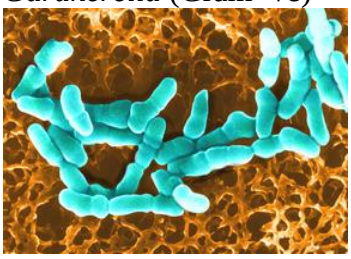
		pallidus, Bacillus panacisoli, Bacillus panaciterrae, Bacillus pantothenticus, Bacillus parabrevis, Bacillus paraflexus, Bacillus pasteurii, Bacillus patagoniensis, Bacillus peoriae, Bacillus persepolensis, Bacillus persicus, Bacillus pervagus, Bacillus plakortidis, Bacillus pocheonensis, Bacillus polygoni, Bacillus polymyxa, Bacillus popilliae, Bacillus pseudalcalophilus, Bacillus pseudofirmus, Bacillus pseudomycoides, Bacillus psychrodurans, Bacillus psychrophilus, Bacillus psychrosaccharolyticus, Bacillus psychrotolerans, Bacillus pulvifaciens, Bacillus pumilus, Bacillus purgationiresistens, Bacillus pycnus, Bacillus qingdaonensis, Bacillus qingshengii, Bacillus reuszeri, Bacillus rhizosphaerae, Bacillus rigui, Bacillus ruris, Bacillus safensis, Bacillus salaries, Bacillus salexigens, Bacillus saliphilus, Bacillus schlegelii, Bacillus sediminis, Bacillus selenatarsenatis, Bacillus selenitireducens, Bacillus seohaeanensis, Bacillus shacheensis, Bacillus shackletonii, Bacillus siamensis, Bacillus silvestris, Bacillus simplex, Bacillus siralis, Bacillus smithii, Bacillus soli, Bacillus solimangrovi, Bacillus solisalsi, Bacillus songklensis, Bacillus sonorensis, Bacillus sphaericus, Bacillus sporothermodurans, Bacillus stearothermophilus, Bacillus stratosphericus, Bacillus subterraneus, Bacillus subtilis, Bacillus s. subsp. Inaquosorum, Bacillus s. subsp. Spizizenii, Bacillus s. subsp. Subtilis, Bacillus taeanensis, Bacillus tequilensis, Bacillus thermantarcticus, Bacillus thermoaerophilus, Bacillus thermoamylovorans, Bacillus thermocatenulatus, Bacillus thermocloacae, Bacillus thermocopriae, Bacillus thermodenitrificans, Bacillus thermoglucosidasius, Bacillus thermolactis, Bacillus thermoleovorans, Bacillus thermophilus, Bacillus thermoruber, Bacillus thermosphaericus, Bacillus thiaminolyticus, Bacillus thioparans, Bacillus thuringiensis, Bacillus tianshenii, Bacillus trypoxylicola, Bacillus tusciae, Bacillus validus, Bacillus vallismortis, Bacillus vedderi, Bacillus velezensis, Bacillus vietnamensis, Bacillus vireti, Bacillus vulcani, Bacillus wakoensis,

		Bacillus weihenstephanensis, Bacillus xiamenensis, Bacillus xiaoxiensis, Bacillus zhanjiangensis, Bacillus anthracis **Disease:** Other strains, food poisoning
Clostridium (Gram+ve) 	**Shape:** Obligate Anaerobe Endospore **Taxonomy:** Kingdom: Bacteria Phylum: Firmicutes Class: Clostridia Order: Clostridiales Family: Clostridiaceae Genus: *Clostridium*	***Microorganisms:*** *Clostridium absonum, Clostridium aceticum, Clostridium acetireducens, Clostridium acetobutylicum, Clostridium acidisoli, Clostridium aciditolerans, Clostridium acidurici, Clostridium aerotolerans, Clostridium aestuarii, Clostridium akagii, Clostridium aldenense, Clostridium aldrichii, Clostridium algidicarnis, Clostridium algidixylanolyticum, Clostridium algifaecis, Clostridium algoriphilum, Clostridium alkalicellulosi, Clostridium amazonense, Clostridium aminophilum, Clostridium aminovalericum, Clostridium amygdalinum, Clostridium amylolyticum, Clostridium arbusti, Clostridium arcticum, Clostridium argentinense, Clostridium asparagiforme, Clostridium aurantibutyricum, Clostridium autoethanogenum, Clostridium baratii, Clostridium barkeri, Clostridium bartlettii, Clostridium beijerinckii, Clostridium bifermentans, Clostridium bolteae, Clostridium bornimense, Clostridium botulinum, Clostridium bowmanii, Clostridium bryantii, Clostridium butyricum, Clostridium cadaveris, Clostridium caenicola, Clostridium caminithermale, Clostridium carboxidivorans, Clostridium carnis, Clostridium cavendishii, Clostridium celatum, Clostridium celerecrescens, Clostridium cellobioparum, Clostridium cellulofermentans, Clostridium cellulolyticum, Clostridium cellulosi, Clostridium cellulovorans, Clostridium chartatabidum, Clostridium chauvoei, Clostridium chromiireducens, Clostridium citroniae, Clostridium clariflavum, Clostridium clostridioforme, Clostridium coccoides, Clostridium cochlearium, Clostridium colletant, Clostridium cocleatum, Clostridium colicanis, Clostridium colinum, Clostridium collagenovorans, Clostridium cylindrosporum, Clostridium difficile, Clostridium diolis, Clostridium disporicum, Clostridium drakei, Clostridium durum, Clostridium estertheticum, Clostridium estertheticum estertheticum, Clostridium estertheticum laramiense,*

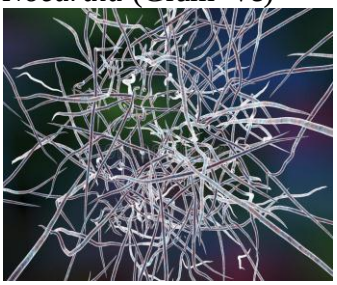
		Clostridium fallax, Clostridium felsineum, Clostridium fervidum, Clostridium fimetarium, Clostridium formicaceticum, Clostridium frigidicarnis, Clostridium frigoris, Clostridium ganghwense, Clostridium gasigenes, Clostridium ghonii, Clostridium glycolicum, Clostridium glycyrrhizinilyticum, Clostridium grantii, Clostridium haemolyticum, Clostridium halophilum, Clostridium hastiforme, Clostridium hathewayi, Clostridium herbivorans, Clostridium hiranonis, Clostridium histolyticum, Clostridium homopropionicum, Clostridium huakuii, Clostridium hungatei, Clostridium hydrogeniformans, Clostridium hydroxybenzoicum, Clostridium hylemonae, Clostridium jeddahense, Clostridium jejuense, Clostridium indolis, Clostridium innocuum, Clostridium intestinale, Clostridium irregulare, Clostridium isatidis, Clostridium josui, Clostridium kluyveri, Clostridium lactatifermentans, Clostridium lacusfryxellense, Clostridium laramiense, Clostridium lavalense, Clostridium lentocellum, Clostridium lentoputrescens, Clostridium leptum, Clostridium limosum, Clostridium litorale, Clostridium liquoris, Clostridium lituseburense, Clostridium ljungdahlii, Clostridium lortetii, Clostridium lundense, Clostridium luticellarii Clostridium magnum, Clostridium malenominatum, Clostridium mangenotii, Clostridium mayombei, Clostridium maximum, Clostridium methoxybenzovorans, Clostridium methylpentosum, Clostridium moniliforme, Clostridium neopropionicum, Clostridium nexile, Clostridium nitrophenolicum, Clostridium novyi, Clostridium oceanicum, Clostridium orbiscindens, Clostridium oroticum, Clostridium oryzae, Clostridium oxalicum, Clostridium papyrosolvens, Clostridium paradoxum, Clostridium paraperfringens, Clostridium welchii, Clostridium paraputrificum, Clostridium pascui, Clostridium pasteurianum, Clostridium peptidivorans, Clostridium perenne, Clostridium perfringens, Clostridium pfennigii, Clostridium phytofermentans, Clostridium piliforme, Clostridium polysaccharolyticum, Clostridium polyendosporum, Clostridium populeti, Clostridium propionicum, Clostridium

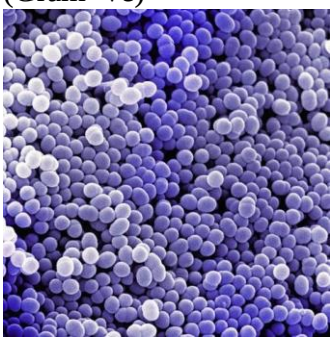
		proteoclasticum, Clostridium proteolyticum, Clostridium psychrophilum, Clostridium puniceum, Clostridium punense, Clostridium purinilyticum, Clostridium putrefaciens, Clostridium putrificum, Clostridium quercicolum, Clostridium quinii, Clostridium ramosum, Clostridium rectum, Clostridium roseum, Clostridium saccharobutylicum, Clostridium saccharogumia, Clostridium saccharolyticum, Clostridium saccharoperbutylacetonicum, Clostridium sardiniense, Clostridium sartagoforme, Clostridium saudiense, Clostridium senegalense, Clostridium scatologenes, Clostridium schirmacherense, Clostridium scindens, Clostridium septicum, Clostridium sordellii, Clostridium sphenoides, Clostridium spiroforme, Clostridium sporogenes, Clostridium sporosphaeroides, Clostridium stercorarium, Clostridium stercorarium leptospartum, Clostridium stercorarium stercorarium, Clostridium stercorarium thermolacticum, Clostridium sticklandii, Clostridium straminisolvens, Clostridium subterminale, Clostridium sufflavum, Clostridium sulfidigenes, Clostridium swellfunianum, Clostridium symbiosum, Clostridium tagluense, Clostridium tarantellae, Clostridium tepidiprofundi, Clostridium termitidis, Clostridium tertium, Clostridium tetani, Clostridium tetanomorphum, Clostridium thermaceticum, Clostridium thermautotrophicum, Clostridium thermoalcaliphilum, Clostridium thermobutyricum, Clostridium thermocellum, Clostridium thermocopriae, Clostridium thermohydrosulfuricum, Clostridium thermolacticum, Clostridium thermopalmarium, Clostridium thermopapyrolyticum, Clostridium thermosaccharolyticum, Clostridium thermosuccinogenes, Clostridium thermosulfurigenes, Clostridium thiosulfatireducens, Clostridium tyrobutyricum, Clostridium uliginosum, Clostridium ultunense, Clostridium ventriculi, Clostridium villosum, Clostridium vincentii, Clostridium viride, Clostridium vulturis, Clostridium xylanolyticum, Clostridium xylanovorans, Clostridium tetani: tetanus; *Clostridium perfringens*: food poison, gas gangrene;

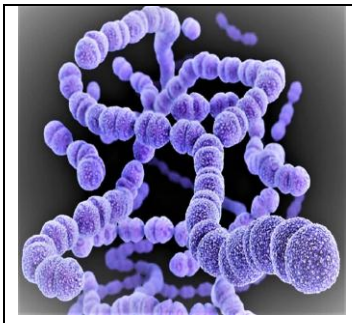
		Clostridium botulinum **Disease:** Botulism
Corynebacterium (Gram+ve) 	**Shape:** Pleiomorphic **Taxonomy:** Kingdom: Bacteria Phylum: Actinobacteria Order: Actinomycetales Suborder: Corynebacterineae Family: Corynebacteriaceae Genus: *Corynebacterium*	***Microorganisms:*** *Corynebacterium accolens, Corynebacterium afermentans, Corynebacterium ammoniagenes, Corynebacterium amycolatum, Corynebacterium argentoratense, Corynebacterium aquaticum, Corynebacterium auris, Corynebacterium bovis, Corynebacterium diphtheria, Corynebacterium equi, Corynebacterium efficiens, Corynebacterium flavescens, Corynebacterium glucuronolyticum, Corynebacterium glutamicum, Corynebacterium granulosum, Corynebacterium haemolyticum, Corynebacterium halofytica, Corynebacterium kroppenstedtii, Corynebacterium jeikeium, Corynebacterium macginleyi, Corynebacterium matruchotii, Corynebacterium minutissimum, Corynebacterium parvum, Corynebacterium paurometabolum, Corynebacterium propinquum, Corynebacterium pseudodiphtheriticum, Corynebacterium hofmannii, Corynebacterium pseudotuberculosis, Corynebacterium ovis, Corynebacterium pyogenes, Corynebacterium urealyticum, Corynebacterium renale, Corynebacterium resistens, Corynebacterium spec, Corynebacterium striatum, Corynebacterium tenuis, Corynebacterium ulcerans, Corynebacterium urealyticum, Corynebacterium uropygiale, Corynebacterium xerosis, Corynebacterium diphtheria* **Disease:** Diptheria
Enterococcus (Gram+ve) 	**Shape:** Cocci **Taxonomy:** Kingdom: Bacteria Division: Firmicutes Class: Bacilli Order: Lactobacillales Family: Enterococcaceae Genus: *Enterococcus*	***Microorganisms:*** *Enterococcus alcedinis, Enterococcus aquimarinus, Enterococcus asini, Enterococcus avium, Enterococcus bulliens, Enterococcus caccae, Enterococcus camelliae, Enterococcus canintestini, Enterococcus canis, Enterococcus casseliflavus, Enterococcus cecorum, Enterococcus columbae, Enterococcus devriesei, Enterococcus diestrammenae, Enterococcus dispar, Enterococcus durans, Enterococcus eurekensis, Enterococcus faecalis, Enterococcus faecium, Enterococcus gallinarum, Enterococcus gilvus, Enterococcus haemoperoxidus, Enterococcus hermanniensis, Enterococcus hirae, Enterococcus italicus, Enterococcus lactis, Enterococcus lemanii, Enterococcus*

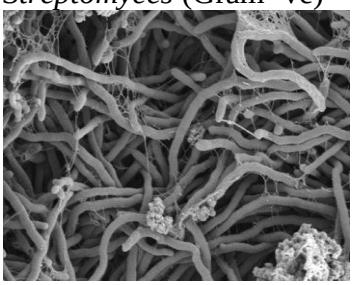
		malodoratus, Enterococcus moraviensis, Enterococcus mundtii, Enterococcus olivae, Enterococcus pallens, Enterococcus phoeniculicola, Enterococcus plantarum, Enterococcus pseudoavium, Enterococcus quebecensis, Enterococcus raffinosus, Enterococcus ratti, Enterococcus rivorum, Enterococcus rotai, Enterococcus saccharolyticus, Enterococcus saigonensis, Enterococcus silesiacus, Enterococcus sulfurous, Enterococcus solitaries, Enterococcus termitis, Enterococcus thailandicus, Enterococcus ureasiticus, Enterococcus ureilyticus, Enterococcus viikkiensis, Enterococcus villorum, Enterococcus xiangfangensis **Disease:** Gastrointestinal infection
Gardnerella (Gram+ve) 	**Shape:** Rods **Taxonomy:** Kingdom: Bacteria Phylum: Actinobacteria Class: Actinobacteria Order: Bifidobacteriales Family: Bifidobacteriaceae Genus: *Gardnerella*	***Microorganism:*** *Gardnerella vaginali* **Disease:** Vaginitis
Lactobacillus (Gram+ve) 	**Shape:** Facultative anaerobic or microaerophilic, rod-shaped, non-spore-forming bacteria **Taxonomy:** Kingdom: Bacteria Phylum: Firmicutes Class: Bacilli Order: Lactobacillales Family: Lactobacillaceae Genus: *Lactobacillus*	***Microorganisms:*** *Lactobacillus acetotolerans, Lactobacillus acidifarinae, Lactobacillus acidipiscis, Lactobacillus acidophilus, Lactobacillus agilis, Lactobacillus algidus, Lactobacillus alimentarius, Lactobacillus amylolyticus, Lactobacillus amylophilus, Lactobacillus amylotrophicus, Lactobacillus amylovorus, Lactobacillus animalis, Lactobacillus antri, Lactobacillus apodemi, Lactobacillus aviaries, Lactobacillus bifermentans, Lactobacillus brevis, Lactobacillus buchneri, Lactobacillus camelliae, Lactobacillus casei, Lactobacillus catenaformis, Lactobacillus ceti, Lactobacillus coleohominis, Lactobacillus collinoides, Lactobacillus composti, Lactobacillus concavus, Lactobacillus coryniformis, Lactobacillus crispatus, Lactobacillus crustorum, Lactobacillus curvatus, Lactobacillus delbrueckii, Lactobacillus delbrueckii subsp. Bulgaricus, Lactobacillus delbrueckii subsp. Delbrueckii, Lactobacillus delbrueckii subsp. Lactis, Lactobacillus dextrinicus, Lactobacillus diolivorans, Lactobacillus equi, Lactobacillus equigenerosi,*

		Lactobacillus farraginis, Lactobacillus farciminis, Lactobacillus fermentum, Lactobacillus fornicalis, Lactobacillus fructivorans, Lactobacillus frumenti, Lactobacillus fuchuensis, Lactobacillus gallinarum, Lactobacillus gasseri, Lactobacillus gastricus, Lactobacillus ghanensis, Lactobacillus Graminis, Lactobacillus hammesii, Lactobacillus hamster, Lactobacillus harbinensis, Lactobacillus hayakitensis, Lactobacillus helveticus, Lactobacillus hilgardii, Lactobacillus homohiochii, Lactobacillus iners, Lactobacillus ingluviei, Lactobacillus intestinalis, Lactobacillus jensenii, Lactobacillus johnsonii, Lactobacillus kalixensis, Lactobacillus kefiranofaciens, Lactobacillus kefiri, Lactobacillus kimchii, Lactobacillus kitasatonis, Lactobacillus kunkeei, Lactobacillus leichmannii, Lactobacillus lindneri, Lactobacillus malefermentans, Lactobacillus mali, Lactobacillus manihotivorans, Lactobacillus mindensis, Lactobacillus mucosae, Lactobacillus murinus, Lactobacillus nagelii, Lactobacillus namurensis, Lactobacillus nantensis, Lactobacillus oligofermentans, Lactobacillus oris, Lactobacillus panis, Lactobacillus pantheris, Lactobacillus parabrevis, Lactobacillus parabuchneri, Lactobacillus paracasei, Lactobacillus paracollinoides, Lactobacillus parafarraginis, Lactobacillus parakefiri, Lactobacillus paralimentarius, Lactobacillus paraplantarum, Lactobacillus pentosus, Lactobacillus perolens, Lactobacillus plantarum, Lactobacillus pontis, Lactobacillus protectus, Lactobacillus psittaci, Lactobacillus rennin, Lactobacillus reuteri, Lactobacillus rhamnosus, Lactobacillus rimae, Lactobacillus rogosae, Lactobacillus rossiae, Lactobacillus ruminis, Lactobacillus saerimneri, Lactobacillus sakei, Lactobacillus salivarius, Lactobacillus sanfranciscensis, Lactobacillus satsumensis, Lactobacillus secaliphilus, Lactobacillus sharpeae, Lactobacillus siliginis, Lactobacillus spicheri, Lactobacillus suebicus, Lactobacillus thailandensis, Lactobacillus ultunensis, Lactobacillus vaccinostercus, Lactobacillus vaginalis, Lactobacillus versmoldensis, Lactobacillus vini,

		Lactobacillus vitulinus, Lactobacillus zeae, Lactobacillus zymae **Disease:** Vaginal Flora
Listeria (Gram+ve) 	**Shape:** Rods Kingdom: Bacteria Division: Firmicutes Class: Bacilli Order: Bacillales Family: Listeriaceae Genus: *Listeria*	***Microorganisms:*** *Listeria monocytogenes* **Disease:** Fetal Pathogens, Newborn meningitis
Mycobacterium (Gram+ve) 	**Shape:** Acid Fast **Taxonomy:** Kingdom: Bacteria Phylum: Actinobacteria Order: Actinomycetales Suborder: Corynebacterineae Family: Mycobacteriaceae Genus: *Mycobacterium*	***Microorganisms*** *Mycobacterium leprae* **Disease:** Leprosy ***Microorganism:*** *Mycobacterium tuberculosis* **Disease:** Tuberculosis
Mycoplasma (Gram+ve) 	**Shape:** No cell wall **Taxonomy:** Kingdom: Bacteria Phylum: Tenericutes Class: Mollicutes Order: Mycoplasmatales Family: Mycoplasmataceae Genus: *Mycoplasma*	***Microorganism:*** *Mycoplasma pneumonia* **Disease:** Walking pneumonia
Nocardia (Gram+ve) 	**Shape:** Filamentous rod **Taxonomy:** Kingdom: Bacteria Phylum: Actinobacteria Class: Actinobacteria Order: Actinomycetales Suborder: Corynebacterineae Family: Nocardiaceae Genus: *Nocardia*	***Microorganisms:*** *Nocardia aerocolonigenes, Nocardia africana, Nocardia argentinensis, Nocardia asteroids, Nocardia blackwellii, Nocardia brasiliensis, Nocardia brevicatena, Nocardia carnea, Nocardia cerradoensis, Nocardia coralline, Nocardia cyriacigeorgica, Nocardia dassonvillei, Nocardia elegans, Nocardia farcinica, Nocardia ignorata, Nocardia nigiitansis, Nocardia nova, Nocardia opaca, Nocardia otitidis-cavarium, Nocardia caviae, Nocardia paucivorans, Nocardia pseudobrasiliensis, Nocardia rubra, Nocardia seriolae, Nocardia transvelencesis, Nocardia uniformis, Nocardia vaccinii, Nocardia veteran* **Disease:** Respiratory Diseases
Propionibacterium (Gram+ve)	**Shape:** Rods **Taxonomy:** Kingdom: Bacteria Phylum: Actinobacteria Class: Actinobacteria Order: Propionibacteriales Family: Propionibacteriaceae Genus: *Propionibacterium*	***Microorganisms:*** *Propionibacterium acidifaciens, Propionibacterium acidipropionici, Propionibacterium acnes, Propionibacterium australiense, Propionibacterium avidum, Propionibacterium cyclohexanicum, Propionibacterium damnosum, Propionibacterium freudenreichii, Propionibacterium granulosum,*

		*Propionibacterium jensenii, Propionibacterium lymphophilum, Propionibacterium microaerophilu, Propionibacterium namnetense, Propionibacterium olivae, Propionibacterium propionicus, Propionibacterium thoenii* **Disease:** Acne
Staphylococcus (Gram+ve) 	**Shape:** Cocci in clusters **Taxonomy:** Kingdom: Bacteria Phylum: Firmicutes Class: Bacilli Order: Bacillales Family: Staphylococcaceae Genus: *Staphylococcus*	***Microorganisms:*** *Staphylococcus argenteus, Staphylococcus arlettae, Staphylococcus agnetis, Staphylococcus aureus, Staphylococcus auricularis, Staphylococcus capitis, Staphylococcus caprae, Staphylococcus carnosus, Staphylococcus caseolyticus, Staphylococcus chromogenes, Staphylococcus cohnii, Staphylococcus condiment, Staphylococcus delphini, Staphylococcus devriesei, Staphylococcus edaphicus, Staphylococcus epidermidis, Staphylococcus equorum, Staphylococcus felis, Staphylococcus fleurettii, Staphylococcus gallinarum, Staphylococcus haemolyticus, Staphylococcus hominis, Staphylococcus hyicus, Staphylococcus intermedius, Staphylococcus kloosii, Staphylococcus leei, Staphylococcus lentus, Staphylococcus lugdunensis, Staphylococcus lutrae, Staphylococcus lyticans, Staphylococcus massiliensis, Staphylococcus microti, Staphylococcus muscae, Staphylococcus nepalensis, Staphylococcus pasteuri, Staphylococcus petrasii, Staphylococcus pettenkoferi, Staphylococcus piscifermentans, Staphylococcus pseudintermedius, Staphylococcus pseudolugdunensis, Staphylococcus pulvereri, Staphylococcus rostra, Staphylococcus saccharolyticus, Staphylococcus saprophyticus, Staphylococcus schleiferi, Staphylococcus schweitzeri, Staphylococcus sciuri, Staphylococcus simiae, Staphylococcus simulans, Staphylococcus stepanovicii, Staphylococcus succinus, Staphylococcus vitulinus, Staphylococcus warneri, Staphylococcus xylosus, Staphylococcus epidermidis, Staphylococcus aureus* **Disease:** Food poisioning
Streptococcus (Gram+ve)	**Shape:** Cocci in chains **Taxonomy:** Kingdom: Bacteria Phylum: Firmicutes Class: Bacilli	***Microorganisms:*** *Streptococcus acidominimus, Streptococcus agalactiae, Streptococcus alactolyticus, Streptococcus anginosus, Streptococcus australis, Streptococcus bovis, Streptococcus caballi, Streptococcus cameli,*

	Order: Lactobacillales Family: Streptococcaceae Genus: *Streptococcus*	*Streptococcus canis, Streptococcus caprae, Streptococcus castoreus, Streptococcus criceti, Streptococcus constellatus, Streptococcus cuniculi, Streptococcus danieliae, Streptococcus dentasini, Streptococcus dentiloxodontae, Streptococcus dentirousetti, Streptococcus devriesei, Streptococcus didelphis, Streptococcus downei, Streptococcus dysgalactiae, Streptococcus entericus, Streptococcus equi, Streptococcus equines, Streptococcus ferus, Streptococcus gallinaceus, Streptococcus gallolyticus, Streptococcus gordonii, Streptococcus halichoeri, Streptococcus halotolerans, Streptococcus henryi, Streptococcus himalayensis, Streptococcus hongkongensis, Streptococcus hyointestinalis, Streptococcus hyovaginalis, Streptococcus ictaluri, Streptococcus infantarius, Streptococcus infantis, Streptococcus lactarius, Streptococcus iniae, Streptococcus intermedius, Streptococcus lactarius, Streptococcus loxodontisalivarius, Streptococcus lutetiensis, Streptococcus macacae, Streptococcus marimammalium, Streptococcus marmotae, Streptococcus massiliensis, Streptococcus merionis, Streptococcus minor, Streptococcus milleri, Streptococcus mitis, Streptococcus moroccensis, Streptococcus mutans, Streptococcus oligofermentans, Streptococcus oralis, Streptococcus oricebi, Streptococcus oriloxodontae, Streptococcus orisasini, Streptococcus orisratti, Streptococcus orisuis, Streptococcus ovis, Streptococcus panodentis, Streptococcus pantholopis, Streptococcus parasanguinis, Streptococcus parasuis, Streptococcus parauberis, Streptococcus peroris, Streptococcus pharyngis, Streptococcus phocae, Streptococcus pluranimalium, Streptococcus plurextorum, Streptococcus pneumonia, Streptococcus porci, Streptococcus porcinus, Streptococcus porcorum, Streptococcus pseudopneumoniae, Streptococcus pseudoporcinus, Streptococcus pyogenes, Streptococcus ratti, Streptococcus rifensis, Streptococcus rubneri, Streptococcus rupicaprae, Streptococcus salivarius, Streptococcus saliviloxodontae, Streptococcus sanguinis, Streptococcus sinensis, Streptococcus sobrinus, Streptococcus*

		tangierensis, Streptococcus thoraltensis, Streptococcus troglodytae, Streptococcus troglodytidis, Streptococcus tigurinus, Streptococcus thermophilus, Streptococcus sanguinis, Streptococcus sobrinus, Streptococcus suis, Streptococcus uberis, Streptococcus urinalis, Streptococcus ursoris, Streptococcus vestibularis, Streptococcus viridians, Streptococcus zooepidemicus **Disease:** Alpha hemolysis, Beta hemolysis, Cavities
Streptomyces (Gram+ve) 	**Shape:** Filamentous **Taxonomy:** Kingdom: Bacteria Phylum: Actinobacteria Class: Actinobacteria Order: Actinomycetales Family: Streptomycetaceae Genus: *Streptomyces*	***Microorganisms:*** *Streptomyces abietis, Streptomyces abikoensis, Streptomyces aburaviensis, Streptomyces achromogenes, Streptomyces acidiscabies, Streptomyces actinomycinicus, Streptomyces acrimycini, Streptomyces actuosus, Streptomyces aculeolatus, Streptomyces adustus, Streptomyces abyssalis, Streptomyces afghaniensis, Streptomyces aidingensis', Streptomyces africanus, Streptomyces alanosinicus, Streptomyces albaduncus, Streptomyces albiaxialis, Streptomyces albidochromogenes, Streptomyces albiflavescens, Streptomyces albiflaviniger, Streptomyces albidoflavus, Streptomyces albofaciens, Streptomyces alboflavus, Streptomyces albogriseolus, Streptomyces albolongus, Streptomyces alboniger, Streptomyces albospinus, Streptomyces albulus, Streptomyces albus, Streptomyces aldersoniae, Streptomyces alfalfa, Streptomyces alkaliphilus, Streptomyces alkalithermotolerans, Streptomyces almquistii, Streptomyces alni, Streptomyces althioticus, Streptomyces amakusaensis, Streptomyces ambofaciens, Streptomyces amphotericinicus, Streptomyces amritsarensis, Streptomyces anandii, Streptomyces andamanensis, Streptomyces angustmyceticus, Streptomyces anthocyanicus, Streptomyces antibioticus, Streptomyces antimycoticus, Streptomyces anulatus, Streptomyces aomiensis, Streptomyces araujoniae, Streptomyces ardus, Streptomyces aridus, Streptomyces arenae, Streptomyces armeniacus, Streptomyces artemisiae, Streptomyces arcticus, Streptomyces ascomycinicus, Streptomyces asenjonii, Streptomyces asiaticus, Streptomyces asterosporus, Streptomyces atacamensis,*

		Streptomyces atratus, Streptomyces atriruber, Streptomyces atroolivaceus, Streptomyces atrovirens, Streptomyces aurantiacus, Streptomyces aurantiogriseus, Streptomyces auratus, Streptomyces aureocirculatus, Streptomyces aureofaciens, Streptomyces aureorectus, Streptomyces aureoverticillatus, Streptomyces aureus, Streptomyces avellaneus, Streptomyces avermitilis, Streptomyces avicenniae, Streptomyces avidinii, Streptomyces axinellae, Streptomyces azureus, Streptomyces bacillaris, Streptomyces badius, Streptomyces bambergiensis, Streptomyces bambusae, Streptomyces bangladeshensis, Streptomyces baliensis, Streptomyces barkulensis, Streptomyces beijiangensis, Streptomyces bellus, Streptomyces bikiniensis, Streptomyces blastmyceticus, Streptomyces bluensis, Streptomyces bobili, Streptomyces bohaiensis, Streptomyces boninensis, Streptomyces bottropensis, Streptomyces brasiliensis, Streptomyces brevispora, Streptomyces bullii, Streptomyces bungoensis, Streptomyces burgazadensis, Streptomyces bryophytorum, Streptomyces cacaoi, Streptomyces caelestis, Streptomyces caeruleatus, Streptomyces caldifontis, Streptomyces calidiresistens, Streptomyces calvus, Streptomyces camponoticapitis, Streptomyces canalis, Streptomyces canaries, Streptomyces canchipurensis, Streptomyces candidus, Streptomyces cangkringensis, Streptomyces caniferus, Streptomyces canus, Streptomyces capparidis, Streptomyces capillispiralis, Streptomyces capoamus, Streptomyces carpaticus, Streptomyces carpinensis, Streptomyces castelarensis, Streptomyces catbensis, Streptomyces catenulae, Streptomyces cavourensis, Streptomyces cellostaticus, Streptomyces celluloflavus, Streptomyces cellulolyticus, Streptomyces cellulosae, Streptomyces capitiformicae, Streptomyces cerasinus, Streptomyces chartreusis, Streptomyces chattanoogensis, Streptomyces cheonanensis, Streptomyces chiangmaiensis, Streptomyces chitinivorans, Streptomyces chrestomyceticus, Streptomyces chromofuscus, Streptomyces chryseus, Streptomyces chilikensis, Streptomyces chlorus, Streptomyces

		chumphonensis, Streptomyces cinereorectus, Streptomyces cinereoruber, Streptomyces cinereospinus, Streptomyces cinereus, Streptomyces cinerochromogenes, Streptomyces cinnabarinus, Streptomyces cinnabarigriseus, Streptomyces cinnamonensis, Streptomyces cinnamoneus, Streptomyces cirratus, Streptomyces ciscaucasicus, Streptomyces clavifer, Streptomyces clavuligerus, Streptomyces coacervatus, Streptomyces cocklensis, Streptomyces coelescens, Streptomyces coelicoflavus, Streptomyces coelicolor, Streptomyces coeruleoflavus, Streptomyces coeruleofuscus, Streptomyces coeruleoprunus, Streptomyces coeruleorubidus, Streptomyces coerulescens, Streptomyces collinus, Streptomyces colombiensis, Streptomyces corchorusii, Streptomyces costaricanus, Streptomyces cremeus, Streptomyces crystallinus, Streptomyces cuspidosporus, Streptomyces cyaneofuscatus, Streptomyces cyaneus, Streptomyces cyanoalbus, Streptomyces cyslabdanicus, Streptomyces daghestanicus, Streptomyces daliensi, Streptomyces daqingensis, Streptomyces davaonensis, Streptomyces deccanensis, Streptomyces decoyicus, Streptomyces demainii, Streptomyces deserti, Streptomyces diastaticus, Streptomyces diastatochromogenes, Streptomyces djakartensis, Streptomyces drozdowiczii, Streptomyces durhamensis, Streptomyces durmitorensis, Streptomyces echinatus, Streptomyces echinoruber, Streptomyces ederensis, Streptomyces emeiensis, Streptomyces endophyticus, Streptomyces endus, Streptomyces enissocaesilis, Streptomyces erythrogriseus, Streptomyces erringtonii, Streptomyces eurocidicus, Streptomyces europaeiscabiei, Streptomyces eurythermus, Streptomyces exfoliates, Streptomyces fabae, Streptomyces fenghuangensis, Streptomyces ferralitis, Streptomyces filamentosus, Streptomyces fildesensis, Streptomyces filipinensis, Streptomyces fimbriatus, Streptomyces finlayi, Streptomyces flaveolus, Streptomyces flaveus, Streptomyces flavofungini, Streptomyces flavotricini, Streptomyces flavovariabilis, Streptomyces flavovirens, Streptomyces

		flavoviridis, Streptomyces formicae, Streptomyces fractus, Streptomyces fradiae, Streptomyces fragilis, Streptomyces fukangensis, Streptomyces fulvissimus, Streptomyces fulvorobeus, Streptomyces fumanus, Streptomyces fumigatiscleroticus, Streptomyces fuscichromogenes, Streptomyces fuscigenes, Streptomyces galbus, Streptomyces galilaeus, Streptomyces gamaensis, Streptomyces gancidicus, Streptomyces gardneri, Streptomyces gelaticus, Streptomyces geldanamycininus, Streptomyces geysiriensis, Streptomyces ghanaensis, Streptomyces gilvifuscus, Streptomyces glaucescens, Streptomyces glauciniger, Streptomyces glaucosporus, Streptomyces glaucus, Streptomyces globisporus, Streptomyces globosus, Streptomyces glomeratus, Streptomyces glomeroaurantiacus, Streptomyces glycovorans, Streptomyces gobitricini, Streptomyces goshikiensis, Streptomyces gougerotii, Streptomyces Graminearus, Streptomyces Gramineus, Streptomyces Graminifolii, Streptomyces Graminilatus, Streptomyces Graminisoli, Streptomyces griseiniger, Streptomyces griseoaurantiacus, Streptomyces griseocarneus, Streptomyces griseochromogenes, Streptomyces griseoflavus, Streptomyces griseofuscus, Streptomyces griseoincarnatus, Streptomyces griseoloalbus, Streptomyces griseolus, Streptomyces griseoluteus, Streptomyces griseomycini, Streptomyces griseoplanus, Streptomyces griseorubens, Streptomyces griseoruber, Streptomyces griseorubiginosus, Streptomyces griseosporeus, Streptomyces griseostramineus, Streptomyces griseoviridis, Streptomyces griseus, Streptomyces guanduensis, Streptomyces gulbargensis, Streptomyces hainanensis, Streptomyces haliclonae, Streptomyces halophytocola, Streptomyces halstedii, Streptomyces harbinensis, Streptomyces hawaiiensis, Streptomyces hebeiensis, Streptomyces heilongjiangensis, Streptomyces heliomycini, Streptomyces helvaticus, Streptomyces herbaceous, Streptomyces herbaricolor, Streptomyces himastatinicus, Streptomyces hiroshimensis, Streptomyces hirsutus, Streptomyces hokutonensis, Streptomyces

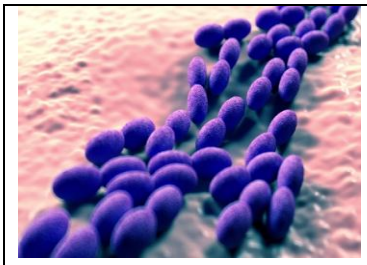
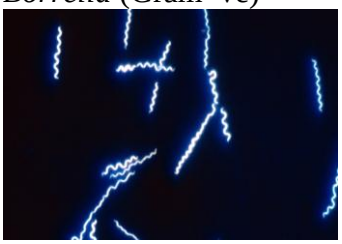
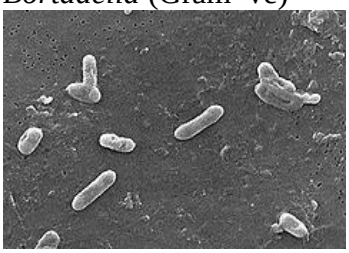
		hoynatensis, Streptomyces humidus, Streptomyces humiferus, Streptomyces hundungensis, Streptomyces hyaluromycini, Streptomyces hyderabadensis, Streptomyces hygroscopicus, Streptomyces hypolithicus, Streptomyces iakyrus, Streptomyces iconiensis, Streptomyces incanus, Streptomyces indiaensis, Streptomyces indigoferus, Streptomyces indicus, Streptomyces indoligenes, Streptomyces indonesiensis, Streptomyces intermedius, Streptomyces inusitatus, Streptomyces ipomoeae, Streptomyces iranensis, Streptomyces janthinus, Streptomyces javensis, Streptomyces jeddahensis, Streptomyces jietaisiensis, Streptomyces jiujiangensis, Streptomyces kaempferi, Streptomyces kanamyceticus, Streptomyces karpasiensis, Streptomyces kasugaensis, Streptomyces katrae, Streptomyces kalpinensis, Streptomyces kebangsaanensis, Streptomyces klenkii, Streptomyces koyangensis, Streptomyces kunmingensis, Streptomyces kurssanovii, Streptomyces kronopolitis, Streptomyces krungchingensis, Streptomyces labedae, Streptomyces lacrimifluminis, Streptomyces lactacystinicus, Streptomyces lacticiproducens, Streptomyces laculatispora, Streptomyces lanatus, Streptomyces lannensis, Streptomyces lasiicapitis, Streptomyces lateritius, Streptomyces laurentii, Streptomyces lavendofoliae, Streptomyces lavendulae, Streptomyces lavenduligriseus, Streptomyces leeuwenhoekii, Streptomyces lavendulocolor, Streptomyces levis, Streptomyces libani, Streptomyces lienomycini, Streptomyces lilacinus, Streptomyces lincolnensis, Streptomyces litmocidini, Streptomyces litoralis, Streptomyces lohii, Streptomyces lomondensis, Streptomyces longisporoflavus, Streptomyces longispororuber, Streptomyces lopnurensis, Streptomyces lonarensis, Streptomyces longisporus, Streptomyces longwoodensis, Streptomyces lucensis, Streptomyces lunaelactis, Streptomyces lunalinharesii, Streptomyces luridiscabiei, Streptomyces luridus, Streptomyces lusitanus, Streptomyces lushanensis, Streptomyces luteireticuli, Streptomyces luteogriseus, Streptomyces luteosporeus, Streptomyces

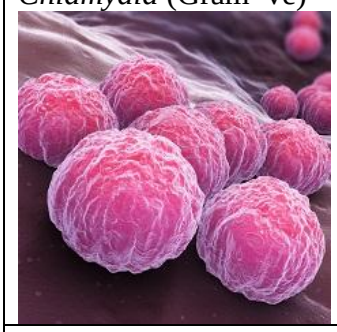
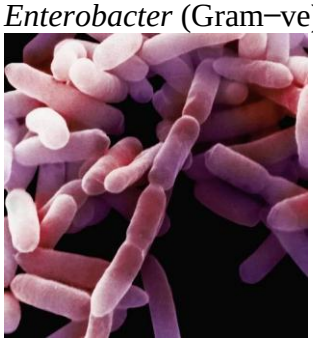
		luteus, Streptomyces lydicus, Streptomyces macrospores, Streptomyces malachitofuscus, Streptomyces malachitospinus, Streptomyces malaysiensis, Streptomyces mangrove, Streptomyces marinus, Streptomyces marokkonensis, Streptomyces mashuensis, Streptomyces massasporeus, Streptomyces matensis, Streptomyces mayteni, Streptomyces mauvecolor, Streptomyces megaspores, Streptomyces melanogenes, Streptomyces melanosporofaciens, Streptomyces mexicanus, Streptomyces michiganensis, Streptomyces microflavus, Streptomyces milbemycinicus, Streptomyces minutiscleroticus, Streptomyces mirabilis, Streptomyces misakiensis, Streptomyces misionensis, Streptomyces mobaraensis, Streptomyces monomycini, Streptomyces mordarskii, Streptomyces morookaense, Streptomyces muensis, Streptomyces murinus, Streptomyces mutabilis, Streptomyces mutomycini, Streptomyces naganishii, Streptomyces nanhaiensis, Streptomyces nanshensis, Streptomyces narbonensis, Streptomyces nashvillensis, Streptomyces netropsis, Streptomyces neyagawaensis, Streptomyces niger, Streptomyces nigrescens, Streptomyces nitrosporeus, Streptomyces niveiciscabiei, Streptomyces niveiscabiei, Streptomyces niveoruber, Streptomyces niveus, Streptomyces noboritoensis, Streptomyces nodosus, Streptomyces nogalater, Streptomyces nojiriensis, Streptomyces noursei, Streptomyces novaecaesareae, Streptomyces ochraceiscleroticus, Streptomyces odonnellii, Streptomyces olivaceiscleroticus, Streptomyces olivaceoviridis, Streptomyces olivaceus, Streptomyces olivicoloratus, Streptomyces olivochromogenes, Streptomyces olivomycini, Streptomyces olivoverticillatus, Streptomyces omiyaensis, Streptomyces osmaniensis, Streptomyces orinoci, Streptomyces oryzae, Streptomyces ovatisporus, Streptomyces pactum, Streptomyces palmae, Streptomyces panacagri, Streptomyces panaciradicis, Streptomyces paradoxus, Streptomyces parvulus, Streptomyces parvus, Streptomyces pathocidini, Streptomyces paucisporeus, Streptomyces peucetius, Streptomyces phaeochromogenes, Streptomyces

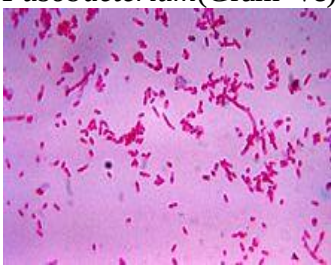
		phaeofaciens, Streptomyces phaeogriseichromatogenes, Streptomyces phaeoluteichromatogenes, Streptomyces phaeoluteigriseus, Streptomyces phaeopurpureus, Streptomyces pharetrae, Streptomyces pharmamarensis, Streptomyces phyllanthi, Streptomyces phytohabitans, Streptomyces pilosus, Streptomyces pini, Streptomyces platensis, Streptomyces plicatus, Streptomyces plumbiresistens, Streptomyces pluricolorescens, Streptomyces pluripotens, Streptomyces polyantibioticus, Streptomyces polychromogenes, Streptomyces polygonati, Streptomyces polymachus, Streptomyces poonensis, Streptomyces prasinopilosus, Streptomyces prasinosporus, Streptomyces prasinus, Streptomyces pratens, Streptomyces pratensis, Streptomyces prunicolor, Streptomyces psammoticus, Streptomyces pseudoechinosporeus, Streptomyces pseudogriseolus, Streptomyces pseudovenezuelae, Streptomyces pulveraceus, Streptomyces puniceus, Streptomyces puniciscabiei, Streptomyces purpeofuscus, Streptomyces purpurascens, Streptomyces purpureus, Streptomyces purpurogeneiscleroticus, Streptomyces qinglanensis, Streptomyces racemochromogenes, Streptomyces radiopugnans, Streptomyces rameus, Streptomyces ramulosus, Streptomyces rapamycinicus, Streptomyces recifensis, Streptomyces rectiviolaceus, Streptomyces regensis, Streptomyces resistomycificus, Streptomyces reticuliscabiei, Streptomyces rhizophilus, Streptomyces rhizosphaericus, Streptomyces rhizosphaerihabitans, Streptomyces rimosus, Streptomyces rishiriensis, Streptomyces rochei, Streptomyces roietensis, Streptomyces rosealbus, Streptomyces roseiscleroticus, Streptomyces roseofulvus, Streptomyces roseolilacinus, Streptomyces roseolus, Streptomyces roseosporus, Streptomyces roseoviolaceus, Streptomyces roseoviridis, Streptomyces ruber, Streptomyces rubidus, Streptomyces rubiginosohelvolus, Streptomyces rubiginosus, Streptomyces rubrisoli, Streptomyces rubrogriseus, Streptomyces rubrus, Streptomyces rutgersensis, Streptomyces

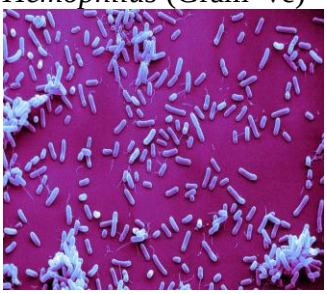
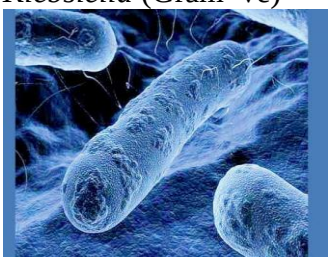
		salilacus, Streptomyces samsunensis, Streptomyces sanglieri, Streptomyces sannanensis, Streptomyces sanyensis, Streptomyces sasae, Streptomyces scabiei, Streptomyces scabrisporus, Streptomyces sclerotialus, Streptomyces scopiformis, Streptomyces scopuliridis, Streptomyces sedi, Streptomyces seoulensis, Streptomyces seranimatus, Streptomyces seymenliensis, Streptomyces shaanxiensis, Streptomyces shenzhenensis, Streptomyces showdoensis, Streptomyces silaceus, Streptomyces siamensis, Streptomyces similanensis, Streptomyces sindenensis, Streptomyces sioyaensis, Streptomyces smyrnaeus, Streptomyces sodiiphilus, Streptomyces solisilvae, Streptomyces somaliensis, Streptomyces sudanensis, Streptomyces sparsogenes, Streptomyces sparsus, Streptomyces specialis, Streptomyces spectabilis, Streptomyces speibonae, Streptomyces speleomycini, Streptomyces spinoverrucosus, Streptomyces spiralis, Streptomyces spiroverticillatus, Streptomyces spongiae, Streptomyces spongiicola, Streptomyces sporocinereus, Streptomyces sporoclivatus, Streptomyces spororaveus, Streptomyces sporoverrucosus, Streptomyces staurosporininus, Streptomyces stelliscabiei, Streptomyces stramineus, Streptomyces subrutilus, Streptomyces sulfonofaciens, Streptomyces sulphureus, Streptomyces sundarbansensis, Streptomyces synnematoformans, Streptomyces tacrolimicus, Streptomyces tanashiensis, Streptomyces tateyamensis, Streptomyces tauricus, Streptomyces tendae, Streptomyces termitum, Streptomyces thermoalcalitolerans, Streptomyces thermoautotrophicus, Streptomyces thermocarboxydovorans, Streptomyces thermocarboxydus, Streptomyces thermocoprophilus, Streptomyces thermodiastaticus, Streptomyces thermogriseus, Streptomyces thermolineatus, Streptomyces thermospinosisporus, Streptomyces thermoviolaceus, Streptomyces thermovulgaris, Streptomyces thinghirensis, Streptomyces thioluteus, Streptomyces tritici, Streptomyces torulosus, Streptomyces toxytricini, Streptomyces tremellae, Streptomyces tritolerans, Streptomyces tricolor, Streptomyces

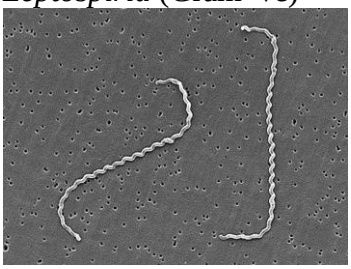
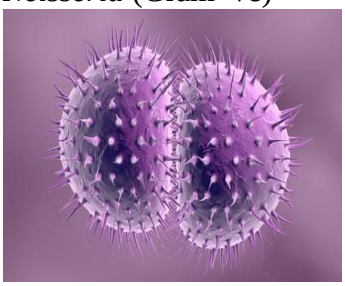
		tsukubensis, Streptomyces tubercidicus, Streptomyces tuirus, Streptomyces tunisiensis, Streptomyces turgidiscabies, Streptomyces tyrosinilyticus, Streptomyces umbrinus, Streptomyces variabilis, Streptomyces variegates, Streptomyces varsoviensis, Streptomyces verticillus, Streptomyces vastus, Streptomyces venezuelae, Streptomyces verrucosisporus, Streptomyces vietnamensis, Streptomyces vinaceus, Streptomyces vinaceusdrappus, Streptomyces violaceochromogenes, Streptomyces violaceolatus, Streptomyces violaceorectus, Streptomyces violaceoruber, Streptomyces violaceorubidus, Streptomyces violaceus, Streptomyces violaceusniger, Streptomyces violarus, Streptomyces violascens, Streptomyces violens, Streptomyces virens, Streptomyces virginiae, Streptomyces viridis, Streptomyces viridiviolaceus, Streptomyces viridobrunneus, Streptomyces viridochromogenes, Streptomyces viridodiastaticus, Streptomyces viridosporus, Streptomyces vitaminophilus, Streptomyces wedmorensis, Streptomyces wellingtoniae, Streptomyces werraensis, Streptomyces wuyuanensis, Streptomyces xanthochromogenes, Streptomyces xanthocidicus, Streptomyces xantholiticus, Streptomyces xanthophaeus, Streptomyces xiamenensis, Streptomyces xinghaiensis, Streptomyces xishensis, Streptomyces xylanilyticus, Streptomyces yaanensis, Streptomyces yanglinensis, Streptomyces yangpuensis, Streptomyces yanii, Streptomyces yatensis, Streptomyces yeochonensis, Streptomyces yerevanensis, Streptomyces yogyakartensis, Streptomyces yokosukanensis, Streptomyces youssoufiensis, Streptomyces yunnanensis, Streptomyces zagrosensis, Streptomyces zaomyceticus, Streptomyces zhaozhouensis, Streptomyces zhihengii, Streptomyces zinciresistens, Streptomyces ziwulingensis **Disease:** Infection
Acetobacter (Gram−ve)	**Shape:** Acetic acid bacteria **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Alphaproteobacteria	***Microorganisms:*** *Acetobacter aceti, Acetobacter cerevisiae, Acetobacter cibinongensis, Acetobacter estunensis, Acetobacter fabarum, Acetobacter farinalis, Acetobacter indonesiensis, Acetobacter*

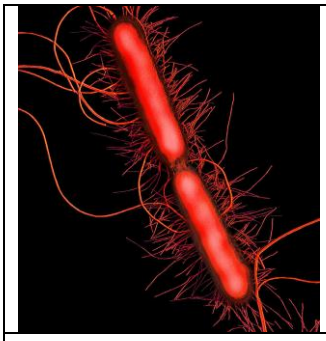
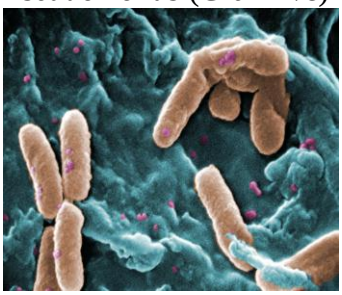
	Order: Rhodospirillales Family: Acetobacteraceae Genus: *Acetobacter*	*lambici, Acetobacter liquefaciens, Acetobacter lovaniensis, Acetobacter malorum, Acetobacter musti, Acetobacter nitrogenifigens, Acetobacter oeni, Acetobacter okinawensis, Acetobacter orientalis, Acetobacter orleanensis, Acetobacter papaya, Acetobacter pasteurianus, Acetobacter peroxydans, Acetobacter persici, Acetobacter pomorum. Acetobacter senegalensis, Acetobacter sicerae, Acetobacter suboxydans, Acetobacter suratthaniensis, Acetobacter syzygii, Acetobacter thailandicus, Acetobacter tropicalis, Acetobacter xylinus* **Use:** Acetic acid from ethanol
Borrelia (Gram−ve) 	**Shape:** Spirochete **Taxonomy:** Kingdom: Bacteria Phylum: Spirochaetes Class: Spirochaetes Order: Spirochaetales Family: Spirochaetaceae Genus: *Borrelia*	***Microorganisms:*** *Borrelia afzelii, Borrelia Americana, Borrelia andersonii, Borrelia anserine, Borrelia baltazardii, Borrelia bavariensis, Borrelia bissettii, Borrelia brasiliensis, Borrelia burgdorferi, Borrelia californiensis, Borrelia carolinensis, Borrelia caucasica, Borrelia coriaceae, Borrelia crocidurae, Borrelia dugesii, Borrelia duttonii, Borrelia garinii, Borrelia graingeri, Borrelia harveyi, Borrelia hermsii, Borrelia hispanica, Borrelia japonica Kawabata, Borrelia kurtenbachii, Borrelia latyschewii, Borrelia lonestari, Borrelia lusitaniae, Borrelia mazzottii, Borrelia merionesi, Borrelia microti, Borrelia miyamotoi, Borrelia parkeri, Borrelia persica, Borrelia queenslandica, Borrelia recurrentis, Borrelia sinica, Borrelia spielmanii Richter, Borrelia tanukii, Borrelia theileri, Borrelia tillae, Borrelia turcica, Borrelia turdi, Borrelia turicatae, Borrelia valaisiana, Borrelia venezuelensis, Borrelia vincentii* **Disease:** Lyme Disease, Arthropod borne
Bortadella (Gram−ve) 	**Shape:** Rod Aerobe **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Betaproteobacteria Order: Burkholderiales Family: Alcaligenaceae Genus: *Bordetella*	***Microorganisms:*** *Bortadella ansorpii, Bortadella avium, Bortadella bronchiseptica, Bortadella hinzii, Bortadella holmesii, Bortadella parapertussis, Bortadella pertussis, Bortadella petrii, Bortadella trematum, Bortadella pertussis* **Disease:** Whooping cough
Burkholderia (Gram−ve)	**Shape:** Rod Aerobe **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Betaproteobacteria Order: Burkholderiales Family: Burkholderiaceae	***Microorganism:*** *Burkholderia cepacia* **Disease:** Cystic Fibrosis

	Genus: *Burkholderia*	
Campylobacter(Gram−ve) 	**Shape:** Curved Rod **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Epsilonproteobacteria Order: Campylobacterales Family: Campylobacteraceae Genus: *Campylobacter*	***Microorganisms:*** *Campylobacter avium, Campylobacter butzleri, Campylobacter Canadensis, Campylobacter cinaedi, Campylobacter coli, Campylobacter concisus, Campylobacter corcagiensis, Campylobacter cryaerophilus, Campylobacter cuniculorum, Campylobacter curvus, Campylobacter fennelliae, Campylobacter fetus, Campylobacter gracilis, Campylobacter helveticus, Campylobacter hominis, Campylobacter hyoilei, Campylobacter hyointestinalis, Campylobacter insulaenigrae, Campylobacter jejuni, Campylobacter lanienae, Campylobacter lari, Campylobacter mucosalis, Campylobacter mustelae, Campylobacter nitrofigilis, Campylobacter peloridis, Campylobacter pylori, Campylobacter rectus, Campylobacter showae, Campylobacter sputorum, Campylobacter subantarcticus, Campylobacter upsaliensis, Campylobacter ureolyticus, Campylobacter volucris* **Disease:** GI infections
Chlamydia (Gram−ve) 	**Shape:** Obligate Intercellular Parasite **Taxonomy:** Kingdom: Bacteria Phylum: Chlamydiae Class: Chlamydiae Order: Chlamydiales Family: Chlamydiaceae Genus: *Chlamydia*	***Microorganisms:*** *Chlamydia trachomatis, Chlamydia muridarum, Chlamydia suis* **Disease:** Sexually Transmitted Diseases, Trachoma (blindness), Pneumonia
Enterobacter (Gram−ve) 	**Shape:** Rod **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Gammaproteobacteria Order: Enterobacteriales Family: Enterobacteriaceae Genus: *Enterobacter*	***Microorganisms:*** *Enterobacter aerogenes, Enterobacter amnigenus, Enterobacter agglomerans, Enterobacter arachidis, Enterobacter asburiae, Enterobacter cancerogenous, Enterobacter cloacae, Enterobacter cowanii, Enterobacter dissolvens, Enterobacter gergoviae, Enterobacter helveticus, Enterobacter hormaechei, Enterobacter intermedius, Enterobacter kobei, Enterobacter ludwigii, Enterobacter mori,*

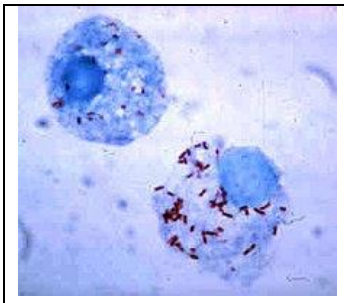
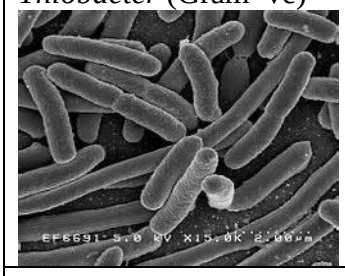
		Enterobacter nimipressuralis, Enterobacter oryzae, Enterobacter pulveris, Enterobacter pyrinus, Enterobacter radicincitans, Enterobacter taylorae, Enterobacter turicensis, Enterobacter sakazakii, Enterobacter soli **Disease:** Opportunistic UTI (urinary tract infections)
Escherichia (Gram−ve) 	**Shape:** Rod **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Gammaproteobacteria Order: Enterobacteriales Family: Enterobacteriaceae Genus: *Escherichia*	***Microorganisms:*** *Escherichia albertii, Escherichia coli, Escherichia fergusonii, Escherichia hermannii, Escherichia marmotae, Escherichia vulneris,* **Disease:** Normal GI tract
Fusobacterium(Gram−ve) 	**Shape:** Rod Anaerobe **Taxonomy:** Kingdom: Bacteria Phylum: Fusobacteria Order: Fusobacteriales Family: Fusobacteriaceae Genus: *Fusobacterium*	***Microorganisms:*** *Fusobacterium canifelinum, Fusobacterium equinum, Fusobacterium gonidiaformans, Fusobacterium mortiferum, Fusobacterium naviforme, Fusobacterium necrogenes, Fusobacterium necrophorum, Fusobacterium nucleatum, Fusobacterium perfoetens, Fusobacterium periodonticum, Fusobacterium prausnitzii, Fusobacterium russii, Fusobacterium simiae, Fusobacterium ulcerans, Fusobacterium varium* **Disease:** Gingivitis
Helicobacter (Gram−ve) 	**Shape:** Curved rod **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Epsilonproteobacteria Order: Campylobacterales Family: *Helicobacteraceae*	***Microorganisms:*** *Helicobacter acinonychis, Helicobacter anseris, Helicobacter aurati, Helicobacter baculiformis, Helicobacter bilis, Helicobacter bizzozeronii, Helicobacter brantae, Helicobacter Canadensis, Helicobacter canis, Helicobacter cetorum, Helicobacter cholecystus, Helicobacter cinaedi, Helicobacter cynogastricus, Helicobacter equorum, Helicobacter felis, Helicobacter fennelliae, Helicobacter ganmani, Helicobacter heilmannii, Helicobacter hepaticus, Helicobacter himalayensis, Helicobacter mesocricetorum, Helicobacter macacae, Helicobacter marmotae, Helicobacter mastomyrinus, Helicobacter mesocricetorum, Helicobacter muridarum, Helicobacter mustelae, Helicobacter pametensis, Helicobacter pullorum, Helicobacter pylori, Helicobacter rappini, Helicobacter rodentium, Helicobacter salomonis, Helicobacter suis, Helicobacter trogontum, Helicobacter typhlonius, H. valdiviensis, Helicobacter winghamensis*

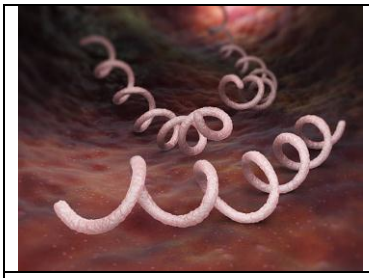
		Disease: Peptic Ulcer
Hemophilus (Gram−ve) 	**Shape:** Rod **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Gammaproteobacteria Order: Pasteurellales Family: Pasteurellaceae Genus: *Haemophilus*	***Microorganisms:*** *Hemophilus aegyptius, Hemophilus avium, Hemophilus ducreyi, Hemophilus felis, Hemophilus haemoglobinophilus, Hemophilus haemolyticus, Hemophilus influenza, Hemophilus parainfluenzae, Hemophilus paracuniculus, Hemophilus parahaemolyticus, Hemophilus paraphrohaemolyticus, Hemophilus parasuis, Hemophilus pittmaniae, Hemophilus piscium, Hemophilus segnis, Hemophilus sputorum* **Disease:** URI (upper respiratory infections), Epiglottitis, Meningitis, Otitis
Klebsiella (Gram−ve) 	**Shape:** Rod **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Gammaproteobacteria Order: Enterobacteriales Family: Enterobacteriaceae Genus: *Klebsiella*	***Microorganisms:*** *Klebsiella granulomatis, Klebsiella oxytoca, Klebsiella michiganensis, Klebsiella pneumonia, Klebsiella quasipneumoniae, Klebsiella grimontii, Klebsiella variicola* **Disease:** Hemorrhagic pneumoniae
Legionella (Gram−ve) 	**Shape:** Rod Aerobes **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Gammaproteobacteria Order: Legionellales Family: Legionellaceae Genus: *Legionella*	***Microorganisms:*** *Legionella adelaidensis, Legionella anisa, Legionella beliardensis, Legionella birminghamensis, Legionella bozemanae, Legionella brunensis, Legionella busanensis, Legionella cardiac, Legionella cherrii, Legionella cincinnatiensis, Legionella clemsonensis, Legionella donaldsonii, Legionella drancourtii, Legionella dresdenensis, Legionella drozanskii, Legionella dumoffii, Legionella erythra, Legionella fairfieldensis, Legionella fallonii, Legionella feeleii, Legionella geestiana, Legionella genomospecies, Legionella gormanii, Legionella gratiana, Legionella gresilensis, Legionella hackeliae, Legionella impletisoli, Legionella israelensis, Legionella jamestowniensis, Candidatus Legionella jeonii, Legionella jordanis, Legionella lansingensis, Legionella londiniensis, Legionella longbeachae, Legionella lytica, Legionella maceachernii, Legionella massiliensis, Legionella micdadei, Legionella monrovica, Legionella moravica, Legionella nagasakiensis, Legionella nautarum, Legionella norrlandica, Legionella oakridgensis, Legionella parisiensis, Legionella pittsburghensis, Legionella pneumophila, Legionella quateirensis, Legionella quinlivanii, Legionella rowbothamii, Legionella rubrilucens, Legionella sainthelensi,*

		Legionella santicrucis, Legionella shakespearei, Legionella spiritensis, Legionella steelei, Legionella steigerwaltii, Legionella saoudiensis, Legionella taurinensis, Legionella thermalis, Legionella tucsonensis, Legionella tunisiensis, Legionella wadsworthii, Legionella waltersii, Legionella worsleiensis, Legionella yabuuchiae **Disease:** Pneumonia
Leptospiria (Gram−ve) 	**Shape:** Spirochete **Taxonomy:** Kingdom: Bacteria Phylum: Spirochaetes Class: Spirochaetes Order: Leptospirales Family: *Leptospiraceae*	***Microorganisms:*** *Leptospiria alexanderi, Leptospiria alstoni, Leptospiria biflexa, Leptospiria borgpetersenii, Leptospiria broomii, Leptospiria fainei, Leptospiria idonii, Leptospiria inadai, Leptospiria interrogans, Leptospiria kirschneri, Leptospiria kmetyi, Leptospiria licerasiae, Leptospiria mayottensis, Leptospiria meyeri, Leptospiria noguchii, Leptospiria santarosai, Leptospiria terpstrae, Leptospiria weilii, Leptospiria wolbachii, Leptospiria wolffii, Leptospiria vanthielii, Leptospiria yanagawae* **Disease:** Leptospirosis
Neisseria (Gram−ve) 	**Shape:** Aerobe diplococcus **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Betaproteobacteria Order: Neisseriales Family: Neisseriaceae Genus: *Neisseria*	***Microorganisms:*** *Neisseria animalis, Neisseria animaloris, Neisseria bacilliformis, Neisseria canis, Neisseria cinerea, Neisseria dentiae, Neisseria elongate, Neisseria flava, Neisseria flavescens, Neisseria gonorrhoeae, Neisseria iguana, Neisseria lactamica, Neisseria macacae, Neisseria mucosa, Neisseria oralis, Neisseria perflava, Neisseria pharyngis, Neisseria polysaccharea, Neisseria shayeganii, Neisseria sicca, Neisseria subflava, Neisseria wadsworthii, Neisseria weaver, Neisseria zoodegmatis, Neisseria meningitides* **Disease:** Meningitis, Gonorrhea, Septicaemia
Nitrobacter (Gram−ve) 	**Shape:** Rod **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Alphaproteobacteria Order: Rhizobiales Family: Bradyrhizobiaceae Genus: *Nitrobacter*	***Microorganisms:*** *Nitrobacter alkalicus, Nitrobacter hamburgensis, Nitrobacter vulgaris, Nitrobacter winogradskyi* **Use:** Nitrogen fixing bacteria
Proteus (Gram−ve)	**Shape:** Rod **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Gammaproteobacteria	***Microorganisms:*** *Proteus hauseri, Proteus mirabilis, Proteus myxofaciens, Proteus penneri, Proteus vulgaris* **Disease:** Opportunistic UTI

	Order: Enterobacteriales Family: Morganellaceae Genus: *Proteus*	
Pseudomonas (Gram−ve) 	**Shape:** Rod Aerobes **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Gammaproteobacteria Order: Pseudomonadales Family: Pseudomonadaceae Genus: *Pseudomonas*	***Microorganisms:*** *Pseudomonas aeruginosa, Pseudomonas alcaligenes, Pseudomonas anguilliseptica, Pseudomonas argentinensis, Pseudomonas borbori, Pseudomonas citronellolis, Pseudomonas flavescens, Pseudomonas mendocina, Pseudomonas nitroreducens, Pseudomonas oleovorans, Pseudomonas pseudoalcaligenes, Pseudomonas resinovorans, Pseudomonas straminea, Pseudomonas asplenii, Pseudomonas aurantiaca, Pseudomonas aureofaciens, Pseudomonas chlororaphis, Pseudomonas corrugate, Pseudomonas fragi, Pseudomonas lundensis, Pseudomonas taetrolens, Pseudomonas Antarctica, Pseudomonas azotoformans, Pseudomonas blatchfordae, Pseudomonas brassicacearum, Pseudomonas brenneri, Pseudomonas cedrina, Pseudomonas corrugate, Pseudomonas fluorescens, Pseudomonas gessardii, Pseudomonas libanensis, Pseudomonas mandelii, Pseudomonas marginalis, Pseudomonas mediterranea, Pseudomonas meridian, Pseudomonas migulae, Pseudomonas mucidolens, Pseudomonas orientalis, Pseudomonas panacis, Pseudomonas protegens, Pseudomonas proteolytica, Pseudomonas rhodesiae, Pseudomonas synxantha, Pseudomonas thivervalensis, Pseudomonas tolaasii, Pseudomonas veronii, Pseudomonas denitrificans, Pseudomonas pertucinogena, Pseudomonas putida group, Pseudomonas cremoricolorata, Pseudomonas entomophila, Pseudomonas fulva, Pseudomonas monteilii, Pseudomonas mosselii, Pseudomonas oryzihabitans, Pseudomonas parafulva, Pseudomonas plecoglossicida, Pseudomonas putida, Pseudomonas balearica, Pseudomonas luteola, Pseudomonas stutzeri, Pseudomonas amygdale, Pseudomonas avellanae, Pseudomonas caricapapayae,*

		Pseudomonas cichorii, Pseudomonas coronafaciens, Pseudomonas ficuserectae, Pseudomonas helianthi, Pseudomonas meliae, Pseudomonas savastanoi, Pseudomonas syringae, Pseudomonas tomato, Pseudomonas viridiflava, Pseudomonas abietaniphila, Pseudomonas acidophila, Pseudomonas agarici, Pseudomonas alcaliphila, Pseudomonas alkanolytica, Pseudomonas amyloderamosa, Pseudomonas asplenii, Pseudomonas azotifigens, Pseudomonas cannabina, Pseudomonas coenobios, Pseudomonas congelans, Pseudomonas costantinii, Pseudomonas cruciviae, Pseudomonas delhiensis, Pseudomonas excibis, Pseudomonas extremorientalis, Pseudomonas frederiksbergensis, Pseudomonas fuscovaginae, Pseudomonas gelidicola, Pseudomonas grimontii, Pseudomonas indica, Pseudomonas jessenii, Pseudomonas jinjuensis, Pseudomonas kilonensis, Pseudomonas knackmussii, Pseudomonas koreensis, Pseudomonas lini, Pseudomonas lutea, Pseudomonas moraviensis, Pseudomonas otitidis, Pseudomonas pachastrellae, Pseudomonas palleroniana, Pseudomonas papaveris, Pseudomonas peli, Pseudomonas perolens, Pseudomonas poae, Pseudomonas pohangensis, Pseudomonas protegens, Pseudomonas psychrophila, Pseudomonas psychrotolerans, Pseudomonas rathonis, Pseudomonas reptilivora, Pseudomonas resiniphila, Pseudomonas rhizosphaerae, Pseudomonas rubescens, Pseudomonas salomonii, Pseudomonas segitis, Pseudomonas septic, Pseudomonas simiae, Pseudomonas suis, Pseudomonas teessidea, Pseudomonas thermotolerans, Pseudomonas toyotomiensis, Pseudomonas tremae, Pseudomonas trivialis, Pseudomonas turbinellae, Pseudomonas tuticorinensis, Pseudomonas umsongensis, Pseudomonas vancouverensis, Pseudomonas vranovensis, Pseudomonas xanthomarina **Disease:** Nosocomiel infections, Burn patients, Cystic Fibrosis patients
Rickettsia (Gram−ve)	**Shape:** Obligate Intercellular Parasite **Taxonomy:** Kingdom: Bacteria Phylum:	***Microorganisms:*** *Rickettsea aeschlimannii, Rickettsiae africae, Rickettsia akari, Rickettsia asiatica, Rickettsia australis, Rickettsia Canadensis, Rickettsia conorii, Rickettsia cooleyi, Rickettsia felis, Rickettsia*

	Proteobacteria Class: Alphaproteobacteria Subclass: Rickettsidae Order: Rickettsiales Family: Rickettsiaceae Genus: *Rickettsia*	*heilongjiangensis, Rickettsia Helvetica, Rickettsia honei, Rickettsia hulinii, Rickettsia japonica, Rickettsia massiliae, Rickettsia monacensis, Rickettsia montanensis, Rickettsia parkeri, Rickettsia peacockii, Rickettsia prowazekii, Rickettsia rhipicephali, Rickettsia rickettsii, Rickettsia sibirica, Rickettsia slovaca, Rickettsia tamurae, Rickettsia typhi* **Disease:** Rocky Mountain spotted fever
Salmonella (Gram−ve) 	**Shape:** Rod **Taxonomy:** Kingdom: Bacteria Kingdom: Eubacteria Phylum: Proteobacteria Class: Gammaproteobacteria Order: Enterobacteriales Family: *Enterobacteriaceae*	***Microorganisms:*** *Salmonella typhi, Salmonella bongori, Salmonella enteric* **Disease:** Typhus, Food poisoning
Serratia (Gram−ve) 	**Shape:** Rod **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Gammaproteobacteria Order: Enterobacteriales Family: Enterobacteriaceae Genus: *Serratia*	***Microorganisms:*** *Serratia aquatilis, Serratia entomophila, Serratia ficaria, Serratia fonticola, Serratia glossinae, Serratia grimesii, Serratia liquefaciens, Serratia marcescens, Serratia myotis, Serratia nematodiphila, Serratia odorifera, Serratia plymuthica, Serratia proteamaculans, Serratia quinivorans, Serratia rubidaea, Serratia symbiotica, Serratia ureilytica, Serratia vespertilionis* **Disease:** Opportunistic UTI, Respiratory Infections
Shigella (Gram−ve) 	**Shape:** Rod **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Gammaproteobacteria Order: Enterobacteriales Family: Enterobacteriaceae Genus: *Shigella*	***Microorganisms:*** *Shigella boydii, Shigella dysenteriae, Shigella flexneri, Shigella sonnei* **Disease:** Dysentery
Thiobacter (Gram−ve) 	**Shape:** Rod	***Microorganism:*** *Thiobacter subterraneus* **Use:** Sulfur reducing
Treponema (Gram−ve)	**Shape:** Spirochete **Taxonomy:** Kingdom: Bacteria Phylum: Spirochaetes Class: Spirochaetes	***Microorganism:*** *Treponema pallidum* **Disease:** Syphilis

	Order: Spirochaetales Family: Spirochaetaceae Genus: *Treponema*	
Vibrio (Gram−ve) 	**Shape:** Curved rod **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Gammaproteobacteria Order: Vibrionales Family: Vibrionaceae Genus: *Vibrio*	***Microorganisms:*** *Vibrio adaptatus, Vibrio aerogenes, Vibrio aestivus, Vibrio aestuarianus, Vibrio agarivorans, Vibrio albensis, Vibrio alfacsensis, Vibrio alginolyticus, Vibrio anguillarum, Vibrio areninigrae, Vibrio artabrorum, Vibrio atlanticus, Vibrio atypicus, Vibrio azureus, Vibrio brasiliensis, Vibrio bubulus, Vibrio calviensis, Vibrio campbellii, Vibrio casei, Vibrio chagasii, Vibrio cholera, Vibrio cincinnatiensis, Vibrio coralliilyticus, Vibrio crassostreae, Vibrio cyclitrophicus, Vibrio diabolicus, Vibrio diazotrophicus, Vibrio ezurae, Vibrio fluvialis, Vibrio fortis, Vibrio furnissii, Vibrio gallicus, Vibrio gazogenes, Vibrio gigantis, Vibrio halioticoli, Vibrio harveyi, Vibrio hepatarius, Vibrio hippocampi, Vibrio hispanicus, Vibrio ichthyoenteri, Vibrio indicus, Vibrio kanaloae, Vibrio lentus, Vibrio litoralis, Vibrio logei, Vibrio mediterranei, Vibrio metschnikovii, Vibrio mimicus, Vibrio mytili, Vibrio natriegens, Vibrio navarrensis, Vibrio neonates, Vibrio neptunius, Vibrio nereis, Vibrio nigripulchritudo, Vibrio ordalii, Vibrio orientalis, Vibrio pacinii, Vibrio parahaemolyticus, Vibrio pectenicida, Vibrio penaeicida, Vibrio pomeroyi, Vibrio ponticus, Vibrio proteolyticus, Vibrio rotiferianus, Vibrio ruber, Vibrio rumoiensis, Vibrio salmonicida, Vibrio scophthalmi, Vibrio splendidus, Vibrio superstes, Vibrio tapetis, Vibrio tasmaniensis, Vibrio tubiashii, Vibrio vulnificus, Vibrio wodanis, Vibrio xuii* **Disease:** Cholera, GI disease
Yersinia (Gram−ve) 	**Shape:** Rod **Taxonomy:** Kingdom: Bacteria Phylum: Proteobacteria Class: Gammaproteobacteria Order: Enterobacteriales Family: Yersiniaceae Genus: Yersinia	***Microorganisms:*** *Yersinia aldovae, Yersinia aleksiciae, Yersinia bercovieri, Yersinia enterocolitica, Yersinia enterocolitica, Yersinia enterocolitica, Yersinia entomophaga, Yersinia frederiksenii, Yersinia intermedia, Yersinia kristensenii, Yersinia massiliensis, Yersinia mollaretii, Yersinia nurmii, Yersinia pekkanenii, Yersinia pestis, Yersinia philomiragia, Yersinia pseudotuberculosis,*

		Yersinia pseudotuberculosis, Yersinia pseudotuberculosis, Yersinia rohdei, Yersinia ruckeri, Yersinia similis **Disease:** Plague

CONCLUSION

The Gram staining method, named after the Danish bacteriologist who originally devised it in 1882 (published 1884), **Hans Christian Gram**, is one of the most important staining techniques in microbiology. It is almost always the first test performed for the identification of bacteria. The primary stain of the Gram's method is crystal violet. Crystal violet is sometimes substituted with methylene blue, which is equally effective. The microorganisms that retain the crystal violet-iodine complex appear purple brown under microscopic examination. These microorganisms that are stained by the Gram's method are commonly classified as Gram-positive or Gram non-negative. Others that are not stained by crystal violet are referred to as Gram negative and appear red. Gram staining is based on the ability of bacteria cell wall to retaining the crystal violet dye during solvent treatment. The cell walls for Gram-positive microorganisms have a higher peptidoglycan and lower lipid content than Gram-negative bacteria. Bacterial cell walls are stained by the crystal violet. Iodine is subsequently added as a mordant to form the crystal violet-iodine complex so that the dye cannot be removed easily. This step is commonly referred to as fixing the dye. However, subsequent treatment with a decolorizer, which is a mixed solvent of ethanol and acetone, dissolves the lipid layer from the Gram-negative cells. The removal of the lipid layer enhances the leaching of the primary stain from the cells into the surrounding solvent. In contrast, the solvent dehydrates the thicker Gram-positive cell walls, closing the pores as the cell wall shrinks during dehydration. As a result, the diffusion of the violet-iodine complex is blocked and the bacteria remain stained. The length of the decolorization is critical in differentiating the Gram-positive bacteria from the Gram-negative bacteriActinomyces A prolonged exposure to the decolorizing agent will remove all the stain from both types of bacteriActinomyces Some Gram-positive bacteria may lose the stain easily and therefore appear as a mixture of Gram-positive and Gram-negative bacteria (Gram-variable). Finally, a counter stain of basic fuchsin is applied to the smear to give decolorized Gram-negative bacteria a pink color. Some laboratories use safranin as a counterstain instead. Basic fuchsin stains many Gram-negative bacteria more intensely than does safranin, making them easier to see. Some bacteria which are poorly stained by safranin, such as *Haemophilus* spp., *Legionella* spp. and some anaerobic bacteria are readily stained by basic fuchsin, but not

safranin. The polychromatic nature of the Gram stain enables determination of the size and shape of both Gram-negative and Gram-positive bacteria.

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