CHAPTER 6 : PROKARYOTES

Q1) write down the pigment composition of cyanobacteria ?

Ans: following are the pigments present in cyanobacteria:

- Chlorophyll a (green)
- Phycocyanin (blue)
- Phycoerythrin (red)
- Allophycocyanin (blue)
- Carotenoids (yellow/orange/red)

→ **Pigment Function:** The combination of these pigments allows cyanobacteria to capture a wide range of light wavelengths, optimizing photosynthesis even in environments where light conditions vary, such as in aquatic habitats with different depths and light intensities. The presence of phycobilin's, such as phycocyanin and phycoerythrin, helps cyanobacteria absorb light at wavelengths that are less accessible to chlorophyll a alone.

Q2) do you know difference between bacteria and archaea ?

Ans: **1. Cell Wall Composition**

- **Bacteria**: Have a cell wall made of peptidoglycan (a complex polymer of sugars and amino acids).
- **Archaea**: Their cell wall lacks peptidoglycan and instead is made of other materials like pseudomurein or polysaccharides.

2. Habitat

- **Bacteria**: Live in many different environments, including soil, water, and inside the bodies of living organisms. Most bacteria thrive in moderate conditions (not too hot or cold).
- **Archaea**: Live in extreme environments like hot springs, salt lakes, and deep-sea vents. Some archaea are called extremophiles because they can survive extreme heat, acidity, or salinity.

3. Genetic Machinery

- **Bacteria**: The machinery for DNA replication, transcription, and translation is more similar to eukaryotes (organisms with cells that have a nucleus). However, it is generally simpler than in archaea.
- **Archaea**: Their genetic machinery is more similar to eukaryotes than bacteria. This includes how they replicate their DNA and start protein synthesis.

4. RNA Structure

- **Bacteria**: Their ribosomal RNA (rRNA) is different from that of archaea and eukaryotes. This difference is used by scientists to classify them separately.
- **Archaea**: Their ribosomal RNA is more similar to that of eukaryotes than to bacteria, which is one reason they are grouped separately.

Q3) what are morphological forms of bacteria ?

Ans: Following are the morphological forms of bacteria;

1. **Coccus (plural: Cocci)**:
   - These are spherical or round-shaped bacteria.
   - Example: *Streptococcus* (causes strep throat).

2. **Bacillus (plural: Bacilli)**:
   - These are rod-shaped bacteria.
   - Example: *Bacillus subtilis* (a soil bacterium).

3. **Spirillum (plural: Spirilla)**:
   - These bacteria are spiral or corkscrew-shaped.
   - Example: *Spirillum volutans*.

4. **Vibrio**:
   - These are comma-shaped or curved rods.
   - Example: *Vibrio cholerae* (causes cholera).

5. **Filamentous**:
   - These bacteria have long, thread-like structures.
   - Example: Some types of actinomycetes.

Q4) draw and label the structure of flagellum ?

Ans:

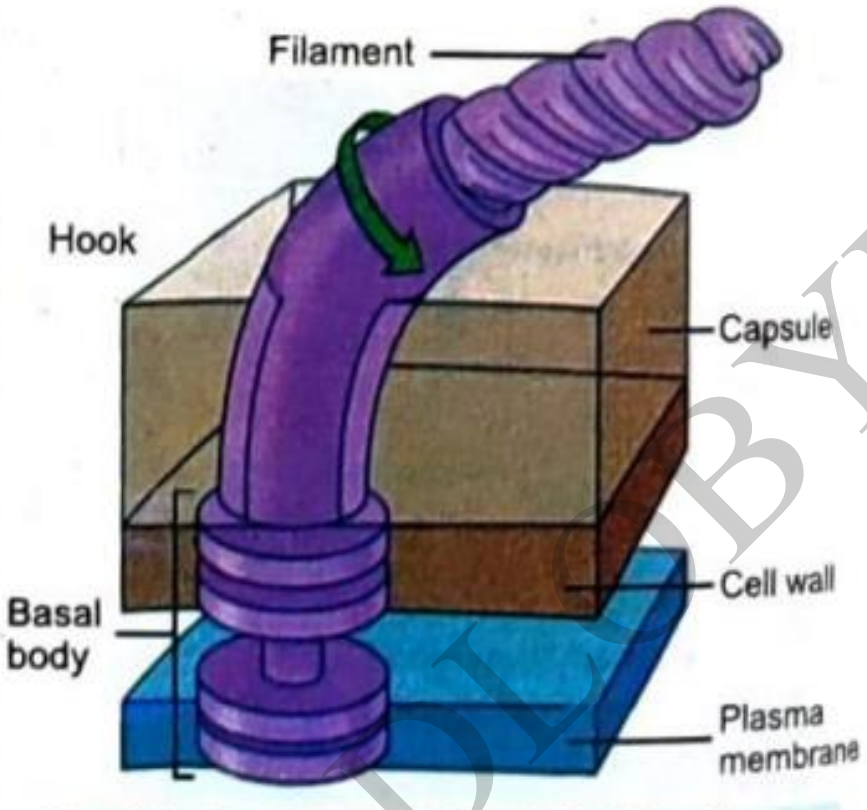

Fig: 6.7 Structure of Bacterial Flagellum

Q5) how chemosynthetic bacteria are autotrophic in nature ?

Ans: Chemosynthetic bacteria are autotrophic because they can produce their own food using chemical energy instead of sunlight, which is how photosynthetic organisms like plants get their energy. Autotrophic bacteria are organisms that can make their own food from simple inorganic substances. Chemosynthetic bacteria use energy derived from chemical reactions (not light) to convert carbon dioxide (CO_2) into organic compounds, like glucose. Since chemosynthetic bacteria can create organic compounds like glucose using energy from chemical reactions (and not from consuming other organisms), they are considered autotrophic.

Q6) give physical method to control microbes ?

Ans: you can write any of these points according to your wish.

Physical Methods to Control Bacteria

Sterilization Process: Sterilization employs physical agents like steam, dry heat, gas, filtration, and radiation to effectively control bacteria. This process is destructive to all life forms and finds application in sterilizing surgical instruments. Additionally, it is used on a large scale to preserve food items such as milk and meat.

High Temperature: High temperatures, both dry and moist heat, are employed in microbiological laboratories to control microbes. Moist heat causes protein coagulation and microbial death, while dry heat leads to the oxidation of microbial constituents, ultimately killing them.

Radiation: Certain electromagnetic radiations, particularly those below 300 nm, are effective in eradicating microorganisms. Gamma rays, for instance, are commonly used for sterilization purposes.

Membrane Filter: Heat-sensitive compounds like antibiotics and serums can be sterilized using membrane filters, ensuring their purity and safety.

Pasteurization: Louis Pasteur introduced pasteurization as a process to eliminate microorganisms through controlled heating. It's applied at temperatures sufficient to kill non-spore-forming bacteria, as seen in the pasteurization of milk at 71°C for 15 seconds or 62°C for 22 minutes. Importantly, pasteurization maintains the taste of the treated product while reducing the risk of diseases like typhoid and tuberculosis.

Low Temperature: Food preservation is achieved by storing it at temperatures between 10°C to 15°C. This method extends the shelf life of various items such as milk, vegetables, cheese, and meat.

Freezing: Food can be preserved for weeks to months by subjecting it to freezing temperatures ranging from -10°C to -18°C. Commonly frozen items include meat and vegetables.

Drying: Dehydration, or the removal of water, prevents bacterial growth in food items. Dried milk and dried meat are examples of products that undergo this preservation method, ensuring their long-term storage without spoiling.

Q7) name any 2 bacteria's that causes diseases in plants ?

Ans: you can write any of these points according to your wish.

Leaf spot

Symptoms: The most common symptoms of plant diseases are discrete or spreading type lesion on leaf blade. It is caused by bacterial pathogens through the action of toxins they produce.

Cause: It is caused by *Xanthomonas campestris* on tomato and pepper. *Pseudomonas syringae* on tobacco, *Aplanobacter sepedanium* causes ring disease of potato.

Prevention: Prevention of contact between the pathogen and the host, use of disease free seeds.

Blight

Symptoms: When the necrotic symptoms develop very rapidly damage the plant cell wall structure, and effect organ or shoot or even the whole plant soon gets killed. The symptom is called blight. In some cases, blight symptoms appear initially at or near the leaf tip, often at the margin then spread downwards and inwards drying up the leaf and the whole plant may get blighted soon e.g., maize, rice and oat etc.

Cause: *Xanthomonas oryzae* cause blight disease in rice, *Eriwinia anylovora* causes fire blight of pears and apples

Prevention: Disease free seeds, suitable location and removal of diseased plant by physical method.

Soft Rot

Symptoms: When the cells of plant tissue die because of the action of pathogen, produce pectolytic and cellulolytic, rot type symptoms. Rotting may affect any organ of a plant including flowers and fruits. When the pathogen produces peptolytic enzyme, plant cell soon separates from one another because of maceration and the affected host tissue loses its coherence and leakage of water takes place from the effected cells, which are killed soon. The necrotized tissue becomes wet to touch and soft inconsistency hence termed soft rot. Such rot is of fast spreading nature and damage plant organs very rapidly.

Cause: *Erwinia atroseptica* in potato, *Corynebacterium* causes ear rot of wheat.

Prevention: Removal of diseased plants by physical method.

Wilting

Symptoms: Interference with the upward transport of water with dissolved nutrients from roots through the stem into the leaves leads to loses of turgidity in the leaf blade, which becomes limp. Such loss of turgidity in the leaf blade increased with time and ultimately leads to wilting of leaf and drying.

Cause: *Pseudomonas solanacaerum* causes wilt disease of potato.

Xanthomonas campestris causes important wilt diseases.

Prevention: Selection of disease free seeds, selecting proper dates for planting and suitable location and allowing proper spacing between the plants.

Galls

Symptoms: These are localised outgrowth mostly small but may be very large in some diseases.

Cause: *Rhizobium leguminosarum* causes small galls called **root nodule** in legumes. *Pseudomonas savastonoi* cause a small gall in olive plant known as olive knot. *Agrobacterium tumifaciens* causes large galls in many plants. *Xanthomonas campestris* causes galls on cotton.

Prevention: Crop rotation, removal of disease plants and use of disease free seeds.

Q8) which chemical methods are used to control microbes ?

Ans: you can write any of these points according to your wish.

Chemical Methods to Control Bacteria

Chemical methods to control bacteria are essential in various settings, including healthcare, food production, and sanitation. These methods involve the use of chemical agents to inhibit the growth or kill bacteria. Here are common chemical methods for bacterial control:

1. **Disinfectants:** Disinfectants are chemicals used to kill or inhibit the growth of bacteria on surfaces and inanimate objects. They are commonly used in hospitals, laboratories, and households. Common disinfectants include bleach (sodium hypochlorite), hydrogen peroxide, and quaternary ammonium compounds.
2. **Antiseptics:** Antiseptics are similar to disinfectants but are designed for use on living tissues, such as skin and mucous membranes, to prevent or treat bacterial infections. Examples include alcohol-based hand sanitizers, iodine-based antiseptics, and hydrogen peroxide.
3. **Preservatives:** Chemical preservatives are used in food and cosmetic products to inhibit the growth of bacteria and other microorganisms, prolonging the product's shelf life. Examples include sodium benzoate, potassium sorbate, and parabens.
4. **Chemical Agents in Water Treatment:** Chlorine and chloramine are commonly used chemicals in water treatment facilities to disinfect drinking water and control bacterial growth in water distribution systems.
5. **Chemotherapy:** Chemotherapy involves the use of chemicals to treat bacterial infections. It is often used when antibiotics are ineffective, and it may include drugs like sulfonamides or nitrofurans.

Q9) name any 2 bacteria's that causes diseases in man?

Ans: you can write any of these points according to your wish

Important Bacterial Diseases in Man

Bacteria cause many diseases in man such as pneumonia, anthrax, tetanus, botulism, diphtheria, meningitis, gonorrhea, whooping cough, pneumonia, plague, urinary tract infection, typhoid fever, gastritis, peptic ulcer, cholera, tuberculosis, syphilis, etc. Here we will discuss only cholera, typhoid, tuberculosis and pneumonia.

Cholera

Symptoms: The primary symptom of cholera is profuse watery diarrhea.

Causative Agent: Cholera is caused by the bacteria *Vibrio cholerae*.

Treatment: The treatment primarily involves the timely and sufficient replenishment of fluids and electrolytes, either through oral or intravenous means. While antibiotics like tetracycline are not mandatory, they can help shorten symptom duration and reduce the time of excretion of the organisms.

Prevention: It is achieved mainly by public health measures that ensure a clean water supply. The vaccine composed of killed organisms has limited usefulness. A live vaccine is available in certain countries. The use of tetracycline for prevention are effective. Prompt detection of carriers is important in limiting outbreaks.

Typhoid

Symptoms: In typhoid and other enteric (pertaining to intestine) fever infection begins in the small intestine. The onset of illness is slow, with fever and constipation. High fever, delirium, tender abdomen and enlarged spleen occur. "Rosy spots" i.e., rose colored macules on the abdomen, are associated with typhoid fever but occur rarely.

Causative Agent: It is caused by bacteria *Salmonella typhi*.

Treatment: Antibiotics should be used in patients who are chronic carriers of *S.typhi*.

Prevention: It is prevented mainly by public health and personal hygiene measures. Hand washing prior to food handling, pasteurization of milk, and proper cooking of poultry, eggs and meat are all important. Vaccines are available for the prevention of typhoid.

Tuberculosis

There are different types of tuberculosis e.g., meningeal TB, miliary TB, bone TB, skin TB, abdominal TB etc. Here we will discuss only pulmonary TB.**Symptoms:** Mild fever lasts for 7-14 days and mild dry cough. Bluish red raised tender cutaneous lesions on the shins and less commonly on the thighs may occur in primary tuberculosis. In secondary tuberculosis there is low-grade intermittent fever usually in the evening, night sweats, weight loss, anorexia, malaise and weakness, dry hacking cough with blood stained sputum, dull ache in the chest due to pleurisy etc.

Causative Agent: *Mycobacterium tuberculosis.*

Treatment: Multiple-drug therapy is used to prevent the emergence of drug resistant mutants during the long 6 to 9 month duration of treatment or DOTS (directly observed treatment short course) of only two months duration.

Prevention: Prevention of the spread of the organism depends largely on the prompt identification and adequate treatment of patients who are coughing up the organism. The use of masks and other respiratory isolation procedures to prevent spread to medical personnel is also important. A vaccine containing a strain of live *Mycobacterium bovis* (Bacillus Calmette-Guerin or BCG) can be used to induce partial resistance to tuberculosis.

Pneumonia

Symptoms: Pneumonia often begins with sudden chills, cough and pleuritic pain. Sputum is red brown "rusty" color.

Causative Agent: *Streptococcus pneumoniae.*

Treatment: Most pneumococci are susceptible to penicillin and erythromycin.

Q10) define the term normal flora ?

Ans: Normal flora is the term that is used to describe various bacteria (and fungi) that are permanent residents of certain body parts/regions. Normal flora refers to the population of microorganisms—such as bacteria, fungi, and viruses—that naturally live on or inside the human body without causing harm. These microbes are found in places like the skin, mouth, intestines, and respiratory tract. In fact, most of them are beneficial, helping with processes like digestion, protecting against harmful pathogens, and supporting the immune system. The normal flora is a key part of maintaining the body's health and balance.

Q11) what is chemical composition of bacterial cell wall ?

Ans: The bacterial cell wall is primarily composed of **peptidoglycan** (also called murein), a polymer consisting of sugars and amino acids. In Gram-positive bacteria, the cell wall is thick and retains a purple stain due to its high peptidoglycan content. Gram-negative bacteria have a thinner peptidoglycan layer and an additional outer membrane composed of lipopolysaccharides. {also just go through #pg154+155}

Q12) what are plasmids ?

Ans: Plasmids are small, circular DNA molecules found in bacteria (and sometimes in archaea and eukaryotic cells) that are separate from the chromosomal DNA. They can carry genes that provide advantages, such as antibiotic resistance, and can replicate independently of the bacterial chromosome. Plasmids can be transferred between bacteria, facilitating horizontal gene transfer.

Q13) how do bacteria survive under unfavorable conditions ?

Ans: Bacteria survive unfavorable conditions through spore formation by converting into highly resistant structures called endospores. When exposed to harsh conditions like heat, dehydration, or nutrient deprivation, certain bacteria such as ***Bacillus*** form spores, which have a tough outer coat, minimal metabolic activity, and are highly resistant to environmental stress. The spore can remain dormant for extended periods and "germinate" into a vegetative cell when conditions improve, allowing the bacteria to resume normal growth.

Q14) list 5 ways in which bacteria are beneficial to man ?

Ans: Bacteria are beneficial to humans in several ways:

1. **Digestion**: Gut bacteria help break down complex foods and synthesize essential vitamins like B12 and K.
2. **Antibiotic production**: Certain bacteria, such as *Streptomyces*, produce antibiotics like streptomycin that treat bacterial infections.
3. **Bioremediation**: Bacteria can degrade pollutants and toxins in the environment, aiding in cleaning up oil spills and waste.
4. **Fermentation**: Bacteria are used in the production of foods like yogurt, cheese, and sauerkraut by fermenting sugars into acids.
5. **Nitrogen fixation**: Some bacteria convert atmospheric nitrogen into forms that plants can use, enriching soil fertility.

Q15) what are the benefits of bacterial flora to humans ?

Ans: you can write any of these points according to your wish

Benefits of the Bacterial Flora to Humans

Digestive Health: Bacterial flora in the gut aid in digestion and the absorption of nutrients. They break down complex carbohydrates and produce essential vitamins like B vitamins and vitamin K.

Immune System Support: Beneficial bacteria help stimulate the immune system, making it more resilient against harmful pathogens. They also help regulate the immune response, preventing excessive inflammation.

Protection Against Pathogens: The microbiota acts as a protective barrier, preventing harmful bacteria from colonizing the gut. This competitive exclusion helps maintain a healthy balance.

Synthesis of Beneficial Compounds: Gut bacteria produce short-chain fatty acids (SCFAs) like butyrate, which can have anti-inflammatory and metabolic benefits.

Mood and Brain Health: Emerging research suggests a connection between the gut microbiome and mental health. Some gut bacteria may influence mood and behavior through the gut-brain axis.

Vaginal Health: Lactobacilli in the vaginal microbiota help maintain an acidic environment, preventing the overgrowth of harmful bacteria and yeast infections.

Detoxification: Gut bacteria can help metabolize and detoxify certain compounds, contributing to overall health.

Metabolism and Weight Regulation: The composition of the gut microbiome may play a role in metabolism and weight management.

Development of the Immune System: Exposure to microbes early in life helps shape the developing immune system, potentially reducing the risk of allergies and autoimmune diseases.

Protection Against Antibiotic-Associated Issues: Beneficial bacteria can help restore balance in the gut following antibiotic treatment, reducing the risk of antibiotic-associated diarrhea and infections.

Synthesis of Essential Nutrients: Some gut bacteria are involved in the synthesis of essential nutrients like biotin and folate.

Maintaining Homeostasis: The microbiota contributes to the overall balance and stability of various bodily systems, promoting health and well-being.

Table 6.3 Some of the Member of Normal Location

Members of the Normal Flora	Anatomic Location
Clostridium species	Colon
Escherichia coli and other coliforms	Colon, vagina, outer urethra
Lactobacillus species	Mouth, colon, vagina
Staphylococcus aureus	Nose, skin
Enterococcus faecalis	Colon
Viridans streptococci	Mouth, nasopharynx

Q16) what is the primary function of ‘F’ factor in bacteria ?

Ans: The primary function of the **F factor** (fertility factor) in bacteria is to enable **conjugation**, a form of horizontal gene transfer. The F factor is a plasmid that carries genes for the formation of a **pilus** (a bridge-like structure), allowing an F+ donor bacterium to transfer genetic material to an F- recipient bacterium. This process can transfer genes, including those for antibiotic resistance, and plays a key role in genetic diversity and adaptation in bacterial populations.

Q17) how the mechanism of photosynthesis in bacteria is similar and different that of plants ?

Ans: Bacterial photosynthesis and plant photosynthesis both involve light energy to produce chemical energy, but they differ in their mechanisms. In plants, photosynthesis occurs in chloroplasts and involves **chlorophyll** to capture light energy and produce oxygen as a byproduct. In bacteria, photosynthesis can occur in the cell membrane or specialized structures like chromatophores, using bacteriochlorophyll and often does not produce oxygen (anoxygenic photosynthesis). While both processes use light to produce ATP and reduce carbon, the electron donors and the byproducts vary.