What are Viruses?

A virus is a non-cellular particle made up of genetic material and protein that can invade living cells.

Also virus are particles or fragments with a core of nucleic acid (DNA or RNA) surrounded by a protein coat. An individual viruses is known as a VIRON

GENERAL AND DISTINCTIVE FEATURES OF VIRUS

(i) They are very smallest non- cellular organisms inside the host.

(ii) They do not have a cellular structure

(iii) They only reproduce by invading living cells. Therefore they are all parasitic and most cause disease.

(iv) They have simple structure, consisting of a small piece of nucleic acid, either DNA or RNA, surrounded by a protein coat.

(v) Virus differ in size, from 6 – 40nm in length

(vi) viruses can change the life process in the host cell, include causing harm, affecting growth, sometime causing death of the cells.

(vii) viruses breed true to form. This behaviour is genetically controlled.

ARE VIRUSES LIVING?

- If , to be defined as living, a structure must posses genetic material (DNA or RNA), and be capable of reproducing itself, then the answer must be that viruses are living.
- If to be living demands a cellular structure then the answer is that they are not. It should be noted that viruses are not capable of reproducing outside the host cell.

To understand virus, then it better to understand their evolutionary origin, these particle/ piece of genetic material they have " escaped" from prokaryotic and eukaryotic cell and have the potential to replicate themselves when they get back into the cell environment

Problems associated with the classification of viruses

- Virus do not grow or replicate on their own. They replicate only when they enter cells and utilize the machinery of their host.
- Movement and sensitivity to stimuli are common characteristics which define life clearly, by considering cellular organization, growth, reproduction and heredity, viruses are non –

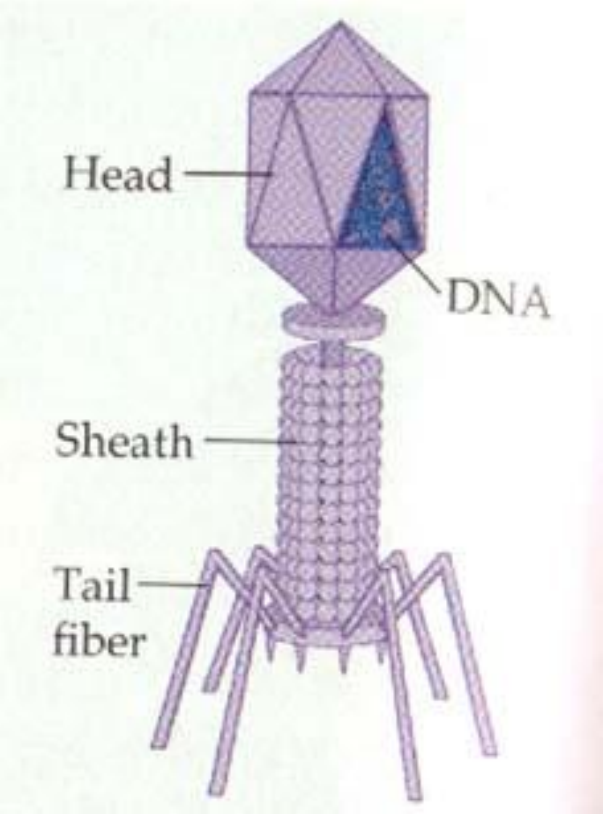
living because they lack all biochemical characteristics that can allow them to replicate on their own.

- Earlier theories that virus represent a group of half way between living and non – living have now abandoned. Viruses are not organisms and could not have existed independently of pre – existing organisms. Therefore are not included in any of the five kingdom to be discussed.

Classification of viruses

- The classification of viruses is based
- (i) The type of nucleic acid
- (ii) Their size and shape
- (iii) The presence or absence of an outer envelope.

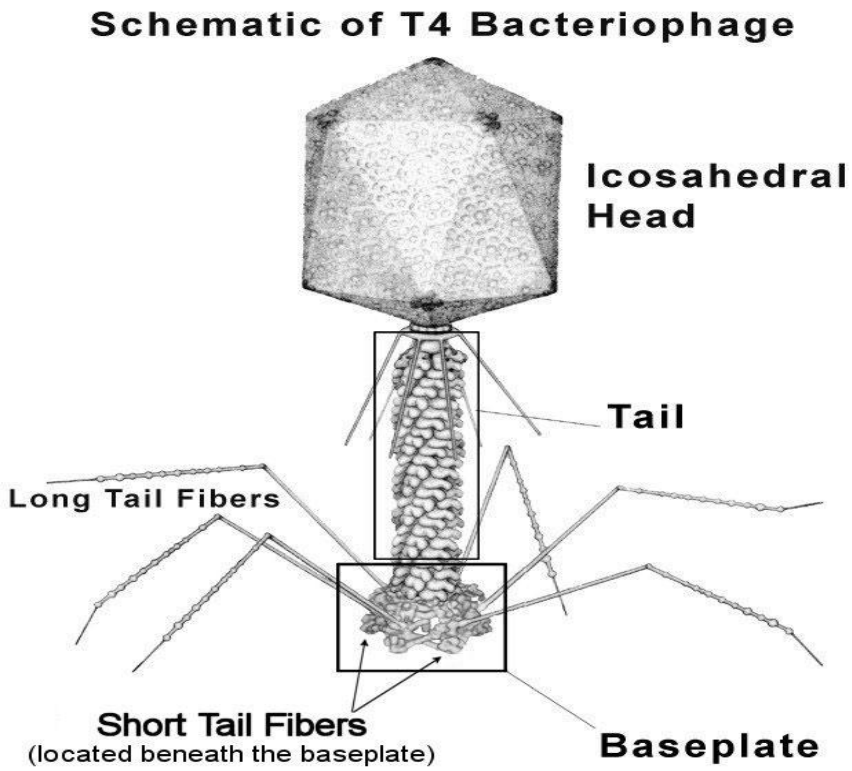
T4 Bacteriophage



The Structure Of a Virus

- Viruses are composed of a core of nucleic acid

- The Nucleic acid core is surrounded by a protein coat called a capsid
- The Nucleic core is either made up of DNA or RNA but never both



The main events of viral replication 2 cycles have been carefully studied.

1. LYTIC CYCLE

Viral replication occurs and the host cell undergoes lysis, breaking open of the cell to release viral particles. The following are six basic stages.

1.Attachment is a specific binding between viral capsid proteins and specific receptors on the host cellular surface. This specificity determines the host range of a virus.

2. Penetration follows attachment: Virions enter the host cell through receptor-mediated endocytosis or membrane fusion. This is often called viral entry

3. Uncoating is a process in which the viral capsid is removed: This may be by degradation by viral enzymes or host enzymes or by simple dissociation; the end-result is the releasing of the viral genomic nucleic acid

4. Replication/ Biosynthesis of viruses involves primarily multiplication of the genome. Replication involves synthesis of viral messenger RNA (mRNA) from "early" genes (with exceptions for positive sense RNA viruses

5. Assembly of the virus particles, some modification of the proteins often occurs. In viruses such as HIV, this modification (sometimes called maturation) occurs *after* the virus has been released from the host cell.

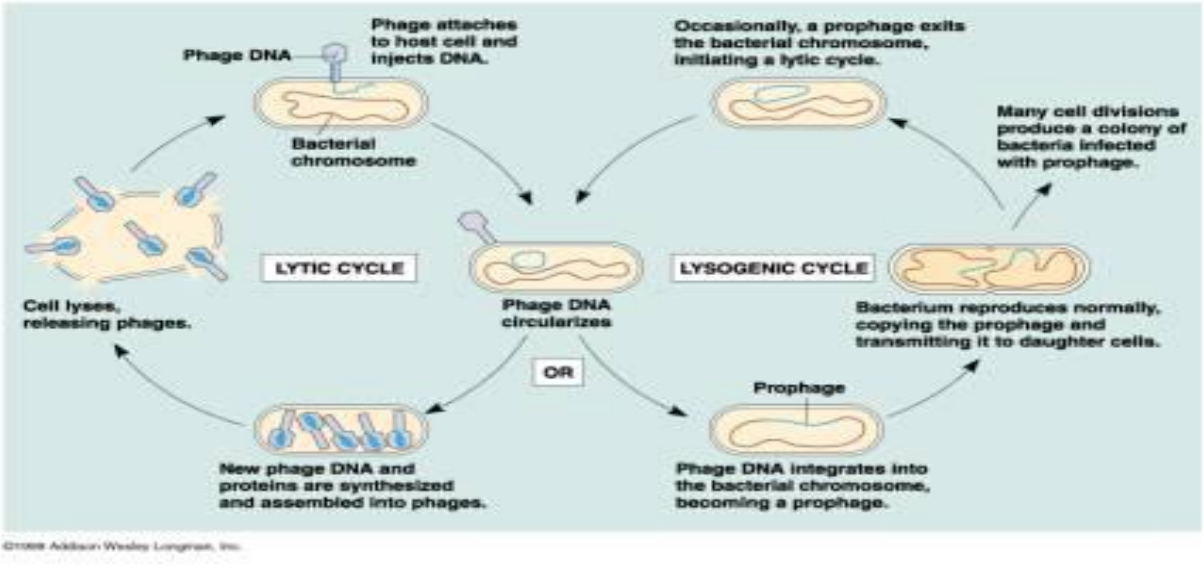
6. *released* from the host cell by lysis, a process that kills the cell by bursting its membrane and cell wall if present: This is a feature of many bacterial and some animal viruses. Some viruses undergo a lysogenic cycle where the viral genome is incorporated by genetic recombination into a specific place in the host's chromosome.

2.LYSOGENIC CYCLE

The phage becomes a prophage that is integrated into the host genome. At later time, the phage may re- enter the lytic cycle and replicate itself.

This type follows the first and second stage normal (attachment and penetration) then viral DNA become integrated into bacterial DNA with destruction of the host DNA. The viral DNA is called prophage. The prophage is replicated with the host DNA and all subsequent cell, called lysogenic cells, carry a copy of the prophage. Prophage may enter the lytic stage of Biosynthesis, Maturation and finally release.

Cycle of Lytic and Lysogenic



Advantages and disadvantages of viruses

Advantages of viruses

1. Scientific study

Viruses are important to the study of molecular and cell biology as they provide simple systems that can be used to manipulate and investigate the functions of cells. The study and use of viruses have provided valuable information about aspects of cell biology. For example, viruses have been useful in the study of genetics and helped our understanding of the basic mechanisms of molecular genetics, such as DNA replication, transcription, RNA processing, translation, protein transport, and immunology.

2. Vectors

Geneticists often use viruses as vectors to introduce genes into cells that they are studying. This is useful for making the cell produce a foreign substance, or to study the effect of introducing a new gene into the genome.

- 3. Genetic diversity
- Viruses are an important natural means of transferring genes between different species, which increases genetic diversity and drives evolution .It is thought that viruses played a central role in the early evolution.
- 4. Biological warfare

The ability of viruses to cause devastating epidemics in human societies has led to the concern that viruses could be weaponised for biological warfare.

5. Vaccines

Vaccination is a cheap and effective way of preventing infections by viruses. Vaccines were used to prevent viral infections long before the discovery of the actual viruses. Their use has resulted in a dramatic decline in morbidity (illness) and mortality (death) associated with viral infections such as polio, measles, mumps and rubella.[176] Smallpox infections have been eradicated.[177] Vaccines are available to prevent over thirteen viral infections of humans and more are used to prevent viral infections of animals

virotherapy uses viruses as vectors to treat various diseases, as they can specifically target cells and DNA. It shows promising use in the treatment of cancer and in gene therapy. Eastern European scientists have used phage therapy as an alternative to antibiotics for some time, and interest in this approach is increasing, because of the high level of antibiotic resistance now found in some pathogenic bacteria

Disadvantages of viruses

Causes diseases to human

Viruses are an established cause of cancer in humans and other species. Viral cancers occur only in a minority of infected persons (or animals). Cancer viruses come from a range of virus families, including both RNA and DNA viruses

Flu pandemic, AIDS, Ebola virus disease and Corona

If outbreaks spread worldwide they are called pandemics.

Most researchers believe that HIV originated in sub-Saharan Africa during the 20th century;it is now a pandemic, with an estimated 38.6 million people now living with the disease worldwide

- Plant pathology
- There are many types of plant virus, but often they cause only a loss of yield, and it is not economically viable to try to control them. Plant viruses are often spread from plant to plant by organisms, known as *vectors*. These are normally insects, but some fungi, nematode worms, and single-celled organisms have been shown to be vectors. When control of plant virus infections is considered economical, for perennial fruits, for example, efforts are concentrated on killing the vectors and removing alternate hosts such as weeds.Plant viruses are harmless to humans and other animals because they can reproduce only in living plant cells

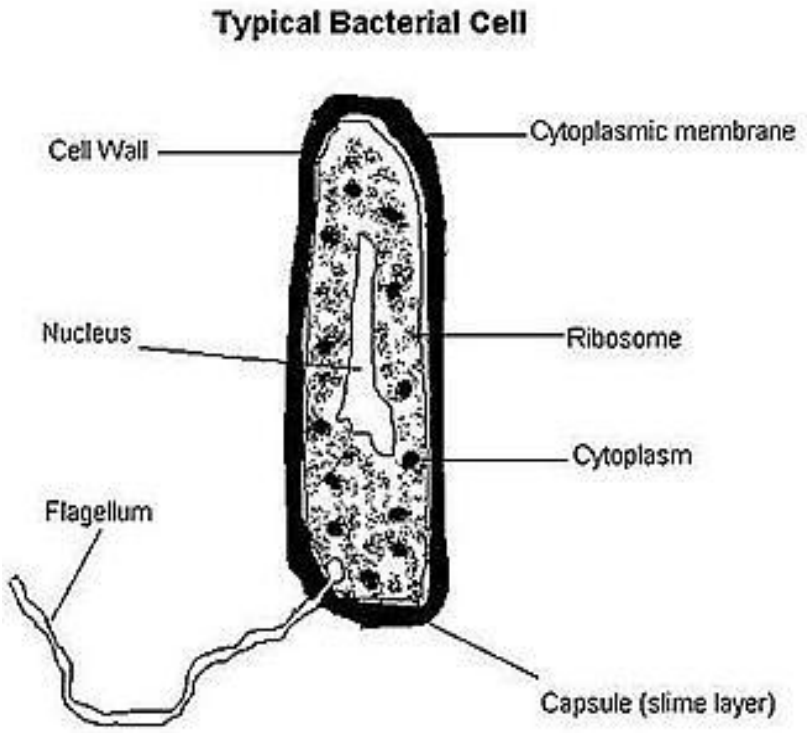
KINGDOM MONERA

- Mainly include simple organism, these organisms play important roles in nature. The kingdom includes two main groups of organisms, blue- green algae and bacteria. These organisms are grouped together because they are prokaryotes. i. e. they have no true nucleus or nuclear membrane (distinctive features of the kingdom)
- The nucleus of bacterial is dispersed in the whole cytoplasm and hence is not seen.
- They consist of single cells.

Division Eubacteria

- Except for very few, virtually all eubacteria have cell walls containing peptidoglycan.
- Their cell walls are composed of either cellulose or chitin.
- They contain a single type of RNA polymerase which is rather simple.
- Bacteria are generally distinguished from each other by their shape/ form.

Bacteria Cell



- Make up the larger of the two prokaryote kingdoms
- Generally are surrounded by a cell wall composed of complex carbohydrates

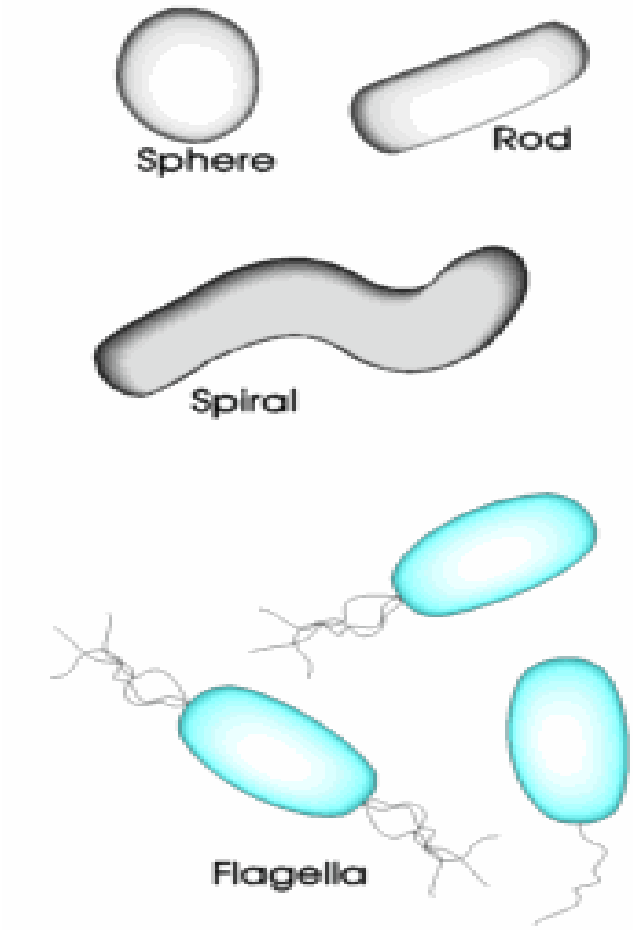
Division cyanobacteria

- Also known as cynophytes or blue – green algae are prokaryotic organisms, either unicellular or occurring in strands, filaments or colonies that occupy a variety of habitants (freshwater, sea water and moist places) where they may form an important part ot the soil community.
- They are called " blue – green" but actually may have many colours depending on which pigments or combination of pigment dominate.
- Reproduction of cynobacteriais (as with eubacteria) by binary fission (in unicellular forms) . Have no sexual reproduction**.**
- Photosynthetic bacterium
- Bluish-greenish color

- Contain membranes that carry out the process of photosynthesis
- Do not contain the same type of chloroplasts as plants do
- This bluish-greenish algae can be found nearly everywhere on earth.
- Can survive in extremely hot environments and even extremely cold environment

Bacterium Shapes

- Cocci~ Sphere shaped bacteria
- Bacillus~ Rod shaped bacteria
- Spirrillium ~ Spiral shaped bacteria
- Flagella~ Leg-like structures that help to propel the bacterium**.**



Classification of Bacteria

- A broad and general classification of bacteria is based on their;

(i) Shape (microscopic examination)

(ii) Ability to grow aerobically or anaerobically (Culture)

(iii) Gram – staining reaction (Staining test)

Gram – stain test

- This is based on a reaction of bacteria to stain of crystal violet or iodine solution. The test was developed in 1884 by Dr. Christian Gram from Denmark.
- In this test, bacteria are killed and stained with e.g. crystal violet, the stained cells then are treated with organic solvent (ethanol).
- Some bacteria are thus readily discoured (gram negative) while other retain the stain (gram positive)
- The different in reaction reflects a fundamental difference in the structure of cell wall between the two types of bacteria.
- This is an important taxon features that helps us to divide bacteria into these 2 groups

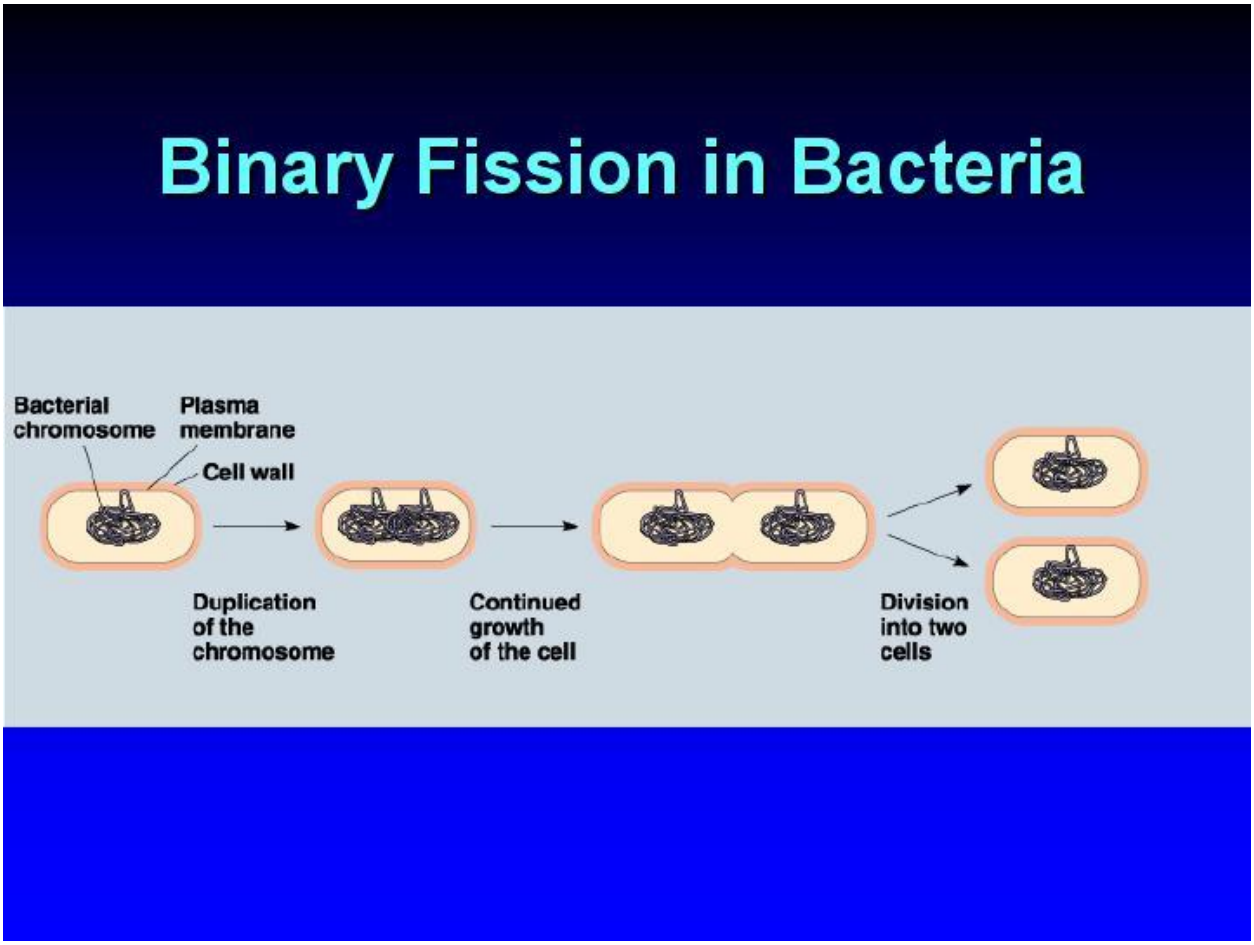
(i) Gram – positive bacteria; have a thick layer of peptidoglycan in their cell wall.
(ii) Gram – negative bacteria; have only a thin layer in their cell wall

Movement of bacteria

- Flagella ~ Tail like structure the whips around to propel the bacterium
- Cillia ~ Miniature flagella surround the cell that help to "swim"
- Non motile ~ Sticky cillia like structures that keep the bacterium from moving

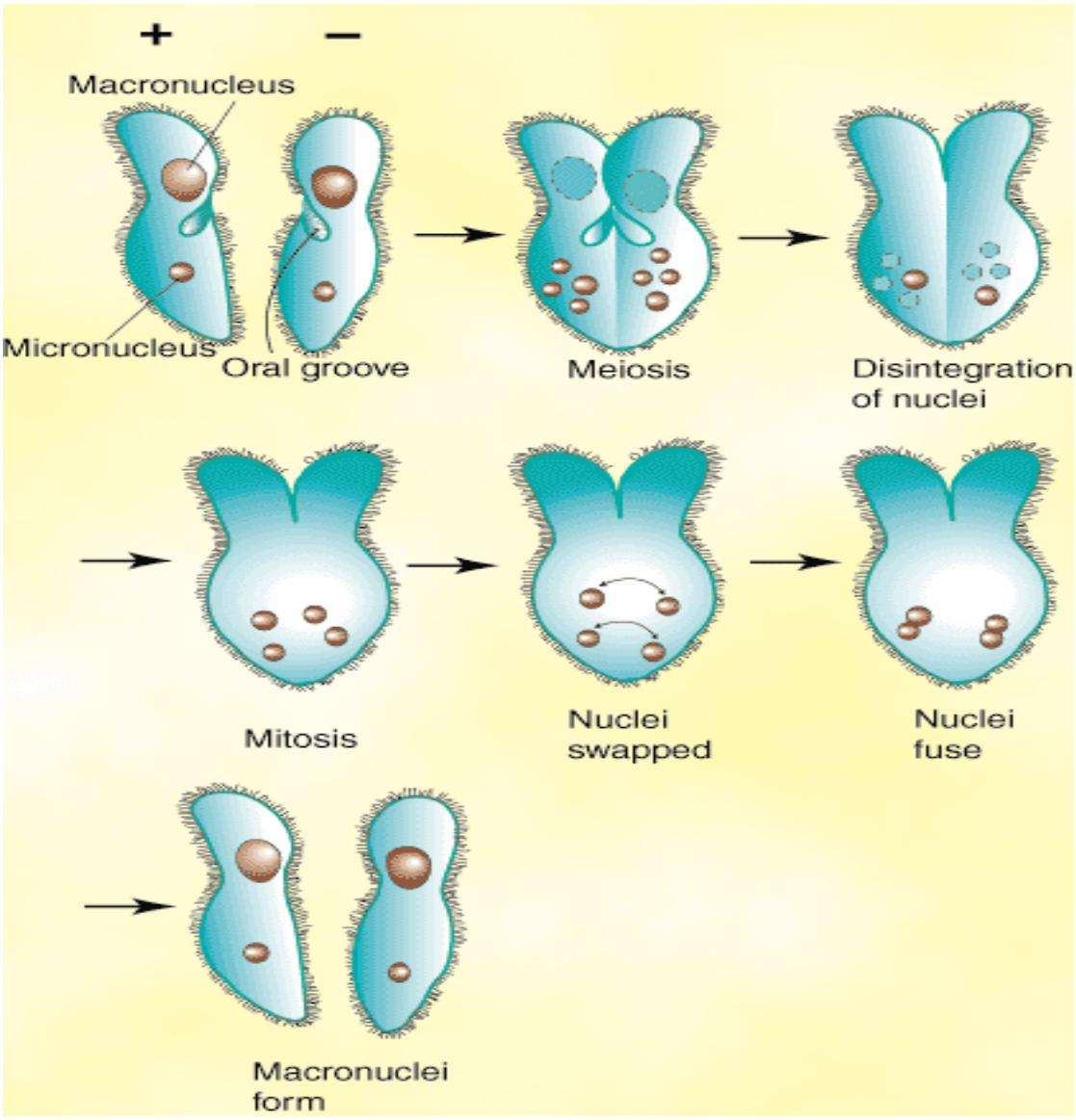
Bacteria Reproduction

- Binary Fission
- Conjugation
- Spore Formation



Conjugation

- A type of Bacteria Sex
- Two organism swap genetic information, that contains the information such as a resistance to penicillin



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