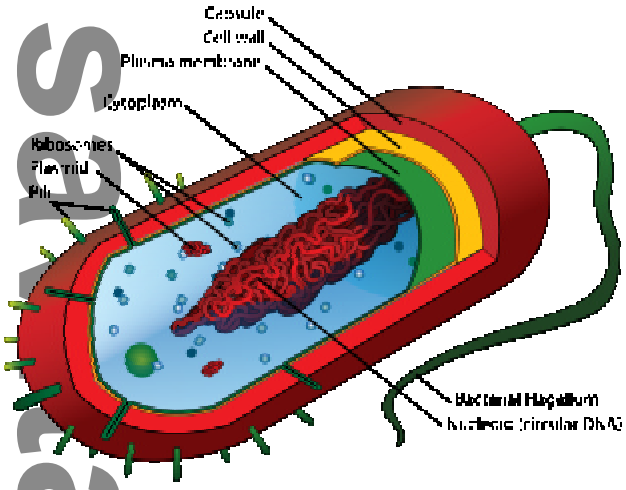
Antibacterials and Antivirals

Structure of a Bacterium:



Capsule: protective layer made up of proteins, sugars and lipids

Cell wall: provides the bacteria with its shape and structure

Cell membrane: permeable membrane allows for transfer of nutrients and chemicals into and out of the cell

Cytoplasm: liquid serves to protect cell parts and more cell materials throughout cell, made of glycogen, lipids and nutrients

Ribosomes: synthesize proteins

DNA: **single chromosome**, controls the functions of the cell

Flagella: tail like appendage used for movement

Pilus: small hair whose purpose is to attach themselves to surfaces and can be used for reproduction

Diseases: caused by bacteria e.g. anthrax, cholera, plague, strep throat, staph infections, tuberculosis

Penicillin: discovered by **Alexander Fleming** (1929), **Florey and Chain** discovered method to mass produce penicillin

General Structure of Penicillin:

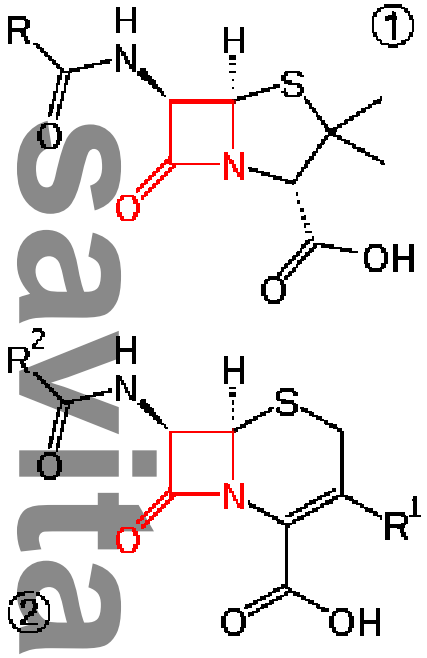


Diagram 1 is general structure of Beta Lactam, Red part is amide linkage in **Beta Lactam**

Penicillin's structure allows them to **interfere** with the formation of the cell wall when **bacteria reproduce** i.e penicillin prevents the x- linkage of small peptide chains → the main polymer in the bacterial cell walls

Penicillin does **not** affect bacteria which **already exists**: they affect the **synthesis** of **new bacteria**- Penicillins affect the synthesis of new bacteria **because** the new bacteria grows without the ability to maintain cell rigidity- therefore the x-linkage of peptide chains in cell walls is prevented, therefore the bacteria are susceptible to osmotic lysis (cytolysis)

Due to ring- strain, Beta Lactam is rendered more reactive to hydrolysis.

The beta lactam **binds** to the enzyme that **synthesizes** the cell wall in bacteria- thus blocking its action. Thus, the bacteria **ruptures** and breaks and therefore cannot reproduce.

Bacterial immunity to Penicillin:

Mutated bacteria, which are immune to antibiotics, are more likely to survive when excessive antibiotics are used. Bacteria develop enzymes known as "**penicillinases**" that destroy or render penicillin ineffective. Hence new antibiotics are developed by changing the R- group side chain. (See diagram)

Beta lactam is composed of 2 amino acids: valine and cyteine

Narrow Range and Broad Range Antibiotics:

Narrow range antibiotics target **specific** kinds of bacteria. They are usually more potent.

Broad range antibiotics are effective against a wide range of bacteria.

Diagnosis: A sample of body fluids will determine the type of bacterial infection.

Overuse of Penicillin:

Leads to greater immunity of bacteria to penicillin, since the strongest and most resistant strains will survive. Hence, greater doses are needed to be effective, thus there is inherent danger of super bacteria developing. Use of penicillin in animal feedstock contributes to the resistance problem. Penicillin kills both harmful and beneficial bacteria.

Antibacterial Phages:

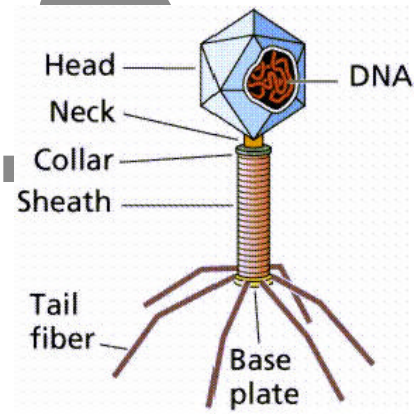
These can replace antibacterial drugs such as penicillin, these use viruses that will infect bacterial cells causing them to lyse, hence releasing more destructive phages.

Virus

Virus Characteristics:

- A virus is an **infectious agent** found in virtually all life forms
- A virus consists of genetic material and have a central core of either DNA or RNA
- A virus contains **no nucleus** or **cytoplasm** (unlike bacteria)
- A virus cannot reproduce outside a living cell. The virus uses the cell mechanism to replicate itself

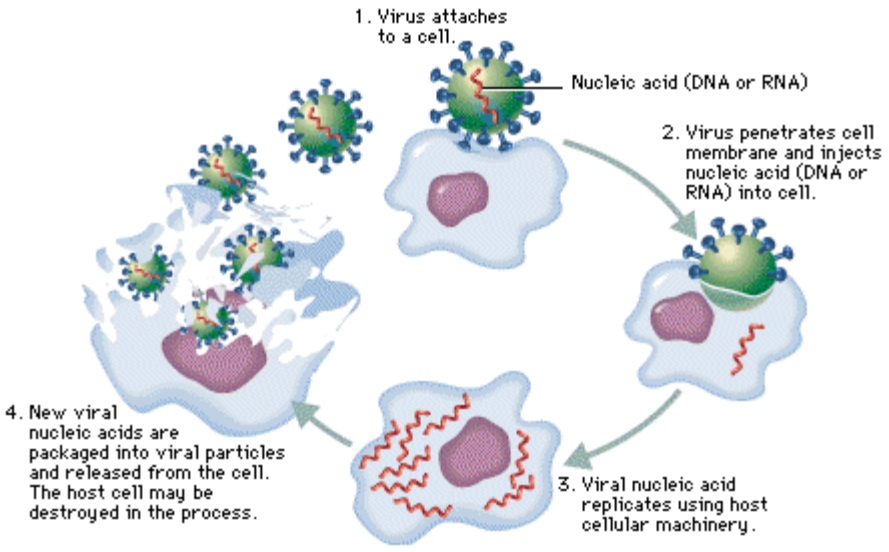
Virus Structure:



There are many types of viruses with varying shape and structure. All viruses have a central core of either DNA or RNA surrounded by a coat of regularly packed protein units.

Virus Replication:

1. Virus attaches to a cell
2. Virus penetrates cell membrane
3. Virus injects DNA/RNA into cell
4. Viral nucleic acid replicates itself using the host cellular machinery
5. The **new** viral nucleic acids are packaged into viral particles and released from the cell. The host cell may be destroyed in the process.



AIDS: Acquired Immune Deficiency

Is caused by a retrovirus that contains RNA rather than DNA. This virus invades particular cells that are within the immune system, making the body unable to fight of infections.

HIV: Human Immunodeficiency Virus

Causes **AIDS**, IT ATTACKS t- 4 Lymphocytes, a vital part of the human immune system. Thus, the ability of the body to resist viral, bacterial, fungal and other infections is greatly weakened.

Antiviral Drugs:

Common viral infections such as the influenza, mumps, or chicken pox are usually overcome by the body's immune systems.

Vaccines are used to build up immunity before a viral infection occurs.

Medications for viral diseases are used to: 1. Relive pain 2. Reduce fever, and 3. To counteract secondary infections

Rapid replication of viruses makes it difficult to develop effective antiviral drugs. The virus population is often very high even before the first symptoms appear.

Only a few effective antiviral drugs have been developed.

Antiviral drugs work by:

1. Altering the cell's genetic material so that the virus cannot use it to multiply, i.e. acyclovir- this is an antiviral drug used to treat Herpes Simplex
2. Preventing the new virus formed from leaving the cell: amantadine

However, viruses mutate frequently, thus leaving the antiviral drug ineffective.

Antiviral Drug: AZT

AZT was the first antiviral drug used to effectively treat HIV- AIDS

AZT combines with the enzyme that the HIV virus uses to build DNA from RNA and clogs up its active site. It acts as a reverse transcriptase inhibitor.

Since only retro- viruses, such as HIV, use this enzyme, AZT does not affect normal cells. (Unfortunately it causes anemia.)