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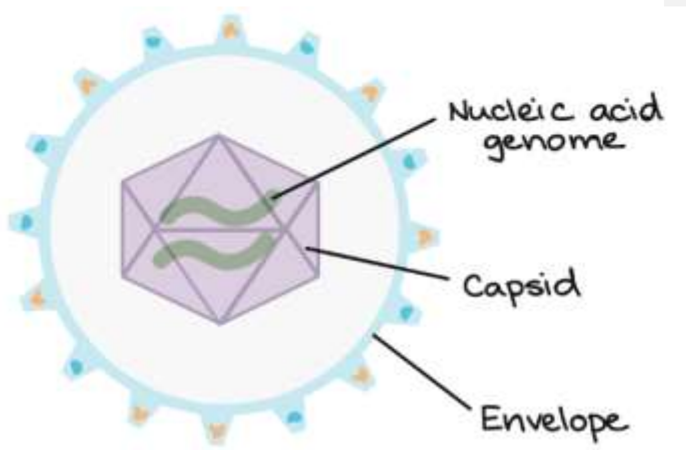
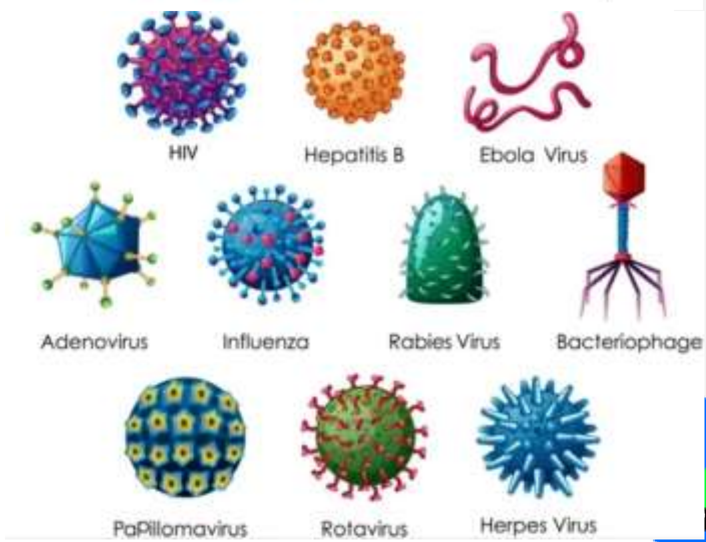
VIRUS

It's a small infectious particle that reproduces by **controlling** a host cell (target), and using its organelles to **make more viruses**, it's made up of a (**DNA** OR **RNA**) genome inside a protein shell called a **capsid**, some viruses have an external **membrane envelope**

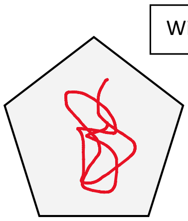


They are very diverse, they have different shapes, structures, genomes and targets

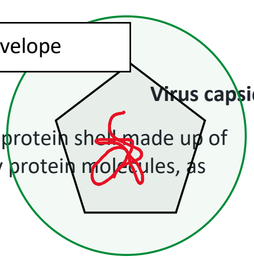
They are considered **unliving or undead** because they cannot reproduce by themselves, and they do not meet the requirements to be living



Without envelope



with envelope



Virus capsid

It's a protein shell made up of many protein molecules, as

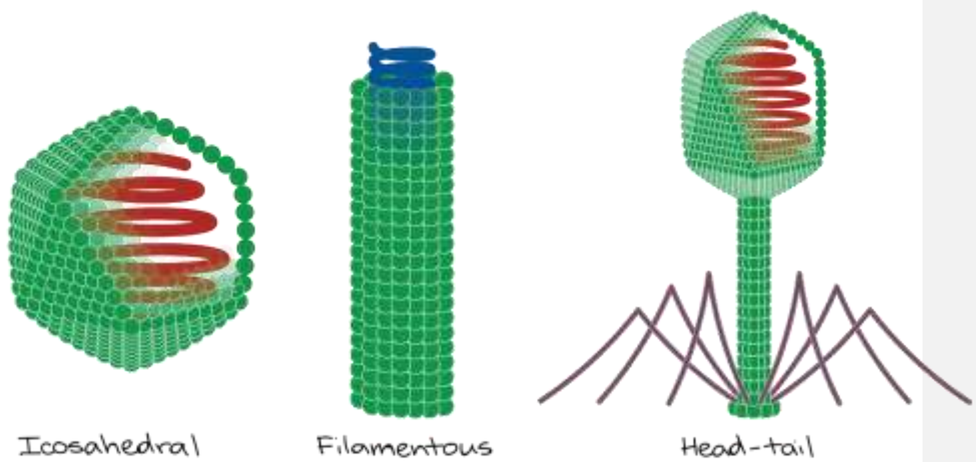
protein molecules join together to create **capsomers** which are the building blocks for capsids

Capsid proteins are encoded by the virus genome

Commented [SD1]: Meaning that the virus has the **instructions** how to make them, and when it infects a host cell, it uses its ribosomes to make those proteins

Capsids come in many forms, but they often take one of the following shapes (or a variation of these shapes):

1. **Icosahedral** – Icosahedral capsids have twenty faces and are named after the twenty-sided shape called an icosahedron.
2. **Filamentous** – Filamentous capsids are named after their linear, thin, thread-like appearance. They may also be called rod-shaped or helical.
3. **Head-tail** –These capsids are kind of a hybrid between the filamentous and icosahedral shapes. They basically consist of an icosahedral head attached to a filamentous tail.

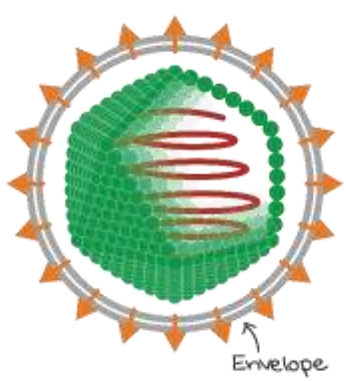


Viral envelope

It's an external lipid membrane that surrounds the entire capsid

Viruses do not have the instructions for their **envelopes**, instead they take a batch of the **host cell's membrane** and use it as their own

Envelopes contain proteins that are specified for the virus, which help viral particles bind to the host cell



Virus genomes

Is the complete sequence of DNA/RNA for a virus, it is its genetic material, made of nucleic acids

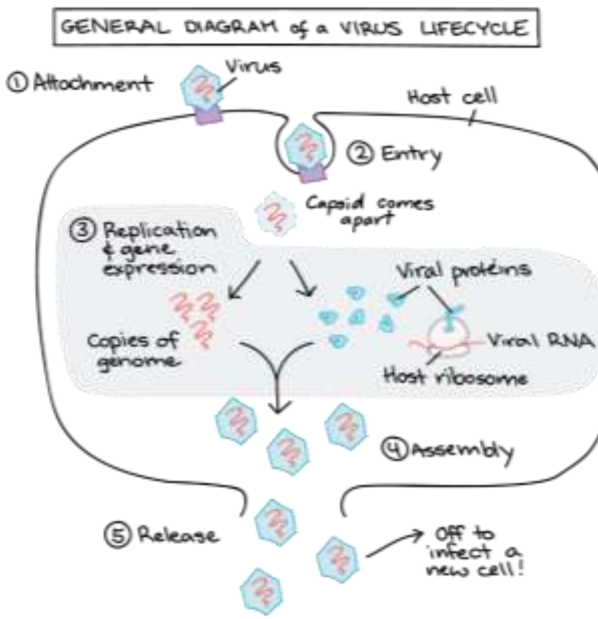
Viruses can have (double-stranded DNA, double-stranded RNA, single-stranded DNA, or single-stranded RNA).

Viral genomes come in different shapes, sizes, and variaties depending on the complexity of the virus

Viral genomes have the same genetic code as normal living cells, because if they didn't, they would have no way to reprogram the host cell

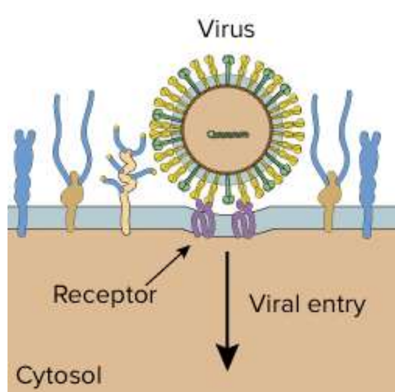
THE VIRAL LIFE CYCLE

it's a set of steps in which a viruses recognizes and enters a **host cell**, and then reprograms that host cell to create more viruses, and then release them into more cells to infect

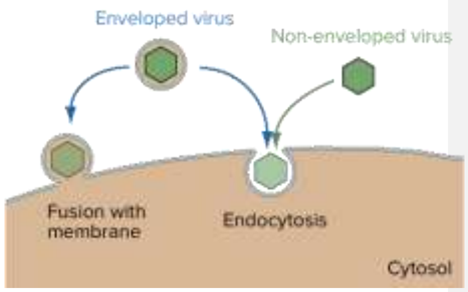


it contains a few steps

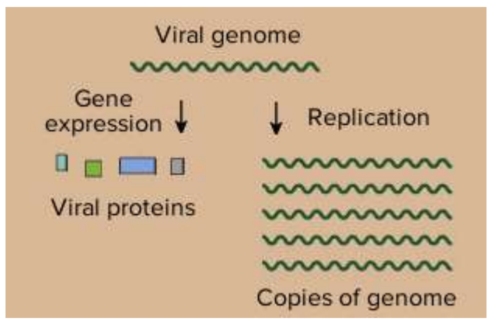
- **Attachment.**
  The virus recognizes and binds to a host cell via a receptor molecule on the cell surface, where a specific protein "**stick like**" on the capsid of the virus binds to a specific receptor on the membrane of the host cell, viruses attack specific cells depending on the type of receptor they have, if they do not have the required receptor, the virus can't infect the cell



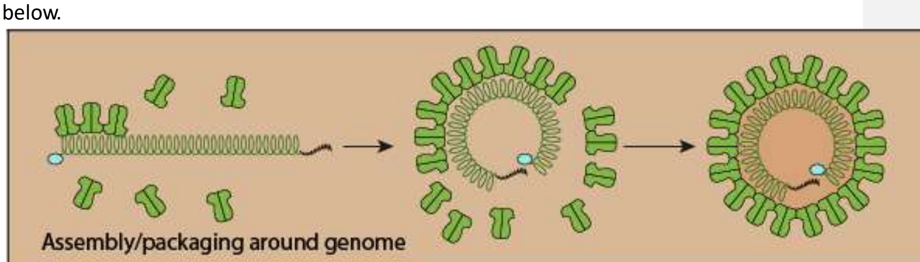
- **Entry.**
  The virus or its genetic material enters the cell, this can be done in 3 ways
  - **Fusion with the membrane** -> the most common way in viruses with envelopes, as the envelope merges with the membrane, letting the capsid enter
  - **Endocytosis** -> is when the virus tricks the cell to enter as a big molecule, this exists in most Non-enveloped viruses, and a few enveloped viruses
  - **Injection** -> exists in head-tail viruses, where the genetic material is injected in like a syringe



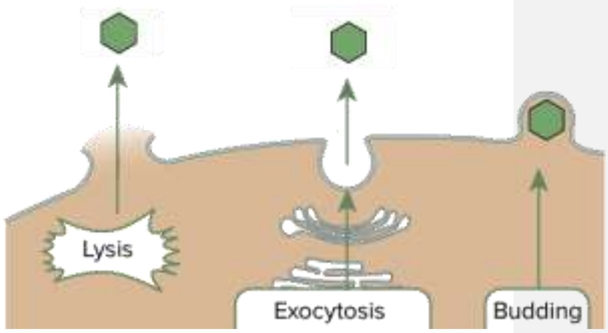
- **Genome replication and gene expression.**
  after the genetic material enters the host cell, it goes to the genome of the cell and inserts itself in it using a protein/enzyme called **integrase**, then the host cell will make copies of the viral genome and use its nucleotides and ribosomes to make proteins using the viral genetic material.
  - In RNA viruses, the RNA can't be copied by the cell, in this case, the virus must encode its own enzymes to copy the RNA
  - The virus must encode the capsid proteins
  - An enveloped virus must encode the envelope proteins
  - A virus also encodes proteins that help with manipulating the host genome, to do things like blocking defenses, or driving the host to actually benefit the virus



- **Assembly.**
  New viral particles are assembled from the genome copies and viral proteins.
  - During assembly, newly synthesized capsid proteins come together to form capsomers, which interact with other capsomers to form the full-sized capsid.
  - Some viruses, like head-tail viruses, first assemble an "empty" capsid and then stuff the viral genome inside. Other viruses build the capsid around the viral genome, as shown below.



- **Release.**
  the new viruses can exit the host cell in some ways like
  - **Lysis ->** the viruses exit the cell by making it **burst**
  - **Exocytosis ->** the viruses exist the cells through its own export pathways
    transport proteins”
  - **Budding ->** where they make a shell out of the membrane of the cell, and take it with them as they go



The viruses might kill the cell as in **lysis,** or let it survive and make more viruses using **exocytosis or budding**

RECEPTORS

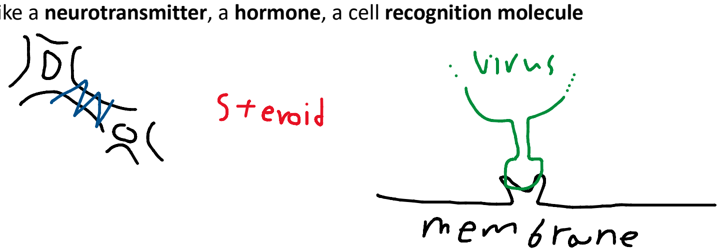
A **membrane receptor** is an **integral protein** that communicates with the outside environment

We are going to take multiple models of it

(LIGAND-GATED ION CHANNELS “النوع الوحيده الي عليكوا”)

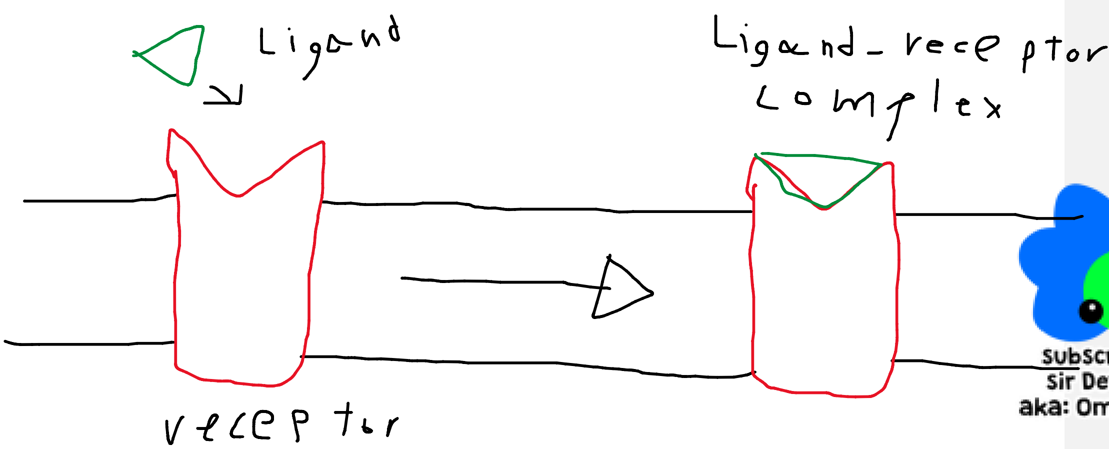
In our body, there are a lot of signaling molecules called **Ligands** or **extra-cellular signaling molecules**, it can be something like a **neurotransmitter**, a **hormone**, a cell **recognition molecule**

Commented [SD2]: This name is because they are outside the cell, or **external**



Ligands interact with the **membrane receptors** and trigger changes inside the cell

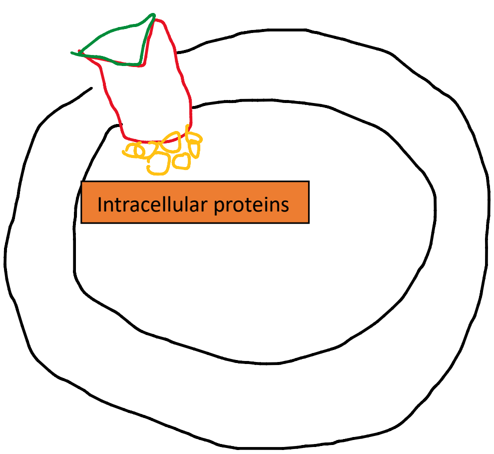
NOTE -> Ligands can only interact with specific receptors depending on their composition structure, in our example, the ligand is triangle shaped, so it can only bind to triangle shaped receptors



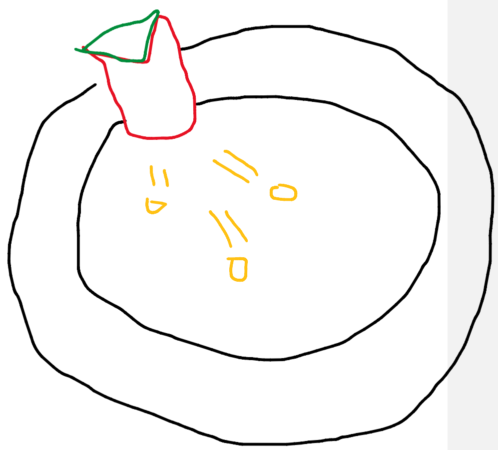
the process above is called **Signal Transduction**

it's where a ligand binds to a membrane receptor, and then the receptor calls an **intracellular response**, this will lead to a calling the function of the signal

Commented [SD3]: It's when the membrane receptor calls **proteins** inside the cell (intracellular proteins) to activate them to do their thing



Intracellular response begins



Proteins begin making the cell call a function

(G protein-coupled receptor "مش عليكوا")

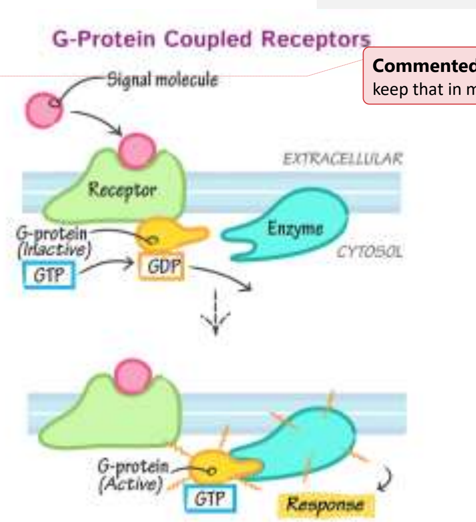
it exists of multiple parts

- **Receptor**
- **GTP (guanosine triphosphate)**
- **Enzyme**

Commented [SD4]: It and GDP are called G-proteins, just keep that in mind

How it works

- A signal molecule binds to the receptor
- The receptor turns the inactive GTP into a GDP (guanosine diphosphate) by removing a phosphate group, this gives the G-protein energy to move to the enzyme
- When the GDP interacts with the enzyme, it activates it generating a response that will lead to the calling the function of the signal, the GDP will get turned back into GTP and go back to the receptor



(enzyme linked receptor "مش عليكوا")

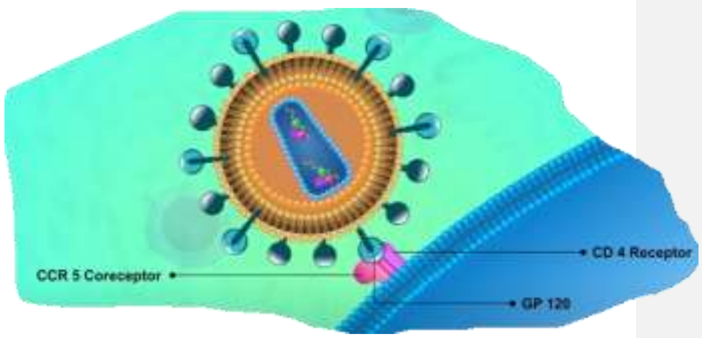
It uses enzymes to call funtions in the cell, we don't need to learn more about it.

HIV INTRODUCTION

It's a membrane-envelope virus that destroys the infected immune system, that is why it is called "**H**uman Immunodeficiency **V**irus"

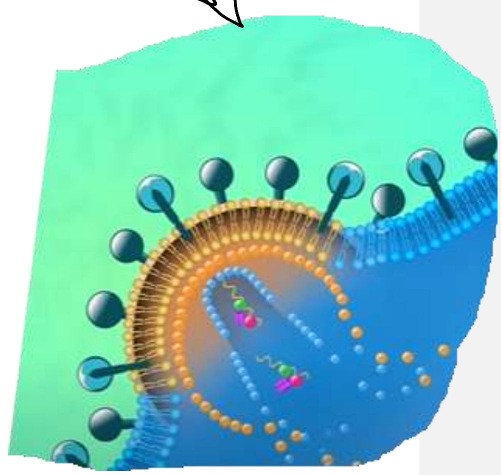
HIV LIFE CYCLE

HIV has a specific **glycoprotein** "proteins on the cell membrane used for signaling" called **GP120**, the glycoprotein binds with the **CD4** receptor of the cell, to complete the entering process, another receptor called **CCR5 Coreceptor** must exist with the CD4 receptor.



Then the virus will fuse with the membrane leading to the genetic material of the virus entering the cell succesfully

the virus embeds an enzyme called **Reverse transcriptase** that turns the RNA of the virus into DNA that can be inserted in the genome of the host cell



then the cell will begin creating the proteins necessary for creating new viruses like the **GP120 glycoproteins** and the **capsid proteins**, and then everything will be assembled back into a new copy of the virus

the virus exists the cell through **exocytosis**, which will lead to the cell surviving to make more viruses

[summarization of the virus in a video]

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OVERALL SUMMARY

HIV

- It's a virus that attacks the body's immune system, specifically the CD4 cells, often called T cells. Over time, HIV can destroy so many of these cells that the body can't fight off infections and disease.
- HIV stands for human immunodeficiency virus. It is the virus that can lead to acquired immunodeficiency syndrome, or AIDS, if not treated. Once you get HIV, you have it for life.

What It Does to Cells

- HIV attacks the body's immune system, specifically the CD4 cells (T cells), which help the immune system fight off infections. Untreated, HIV reduces the number of CD4 cells (T cells) in the body, making the person more likely to get other infections or infection-related cancers.

Symptoms

- The symptoms of HIV vary depending on the stage of infection. In the early stages, individuals may experience no symptoms or an influenza-like illness. As the infection progressively weakens the immune system, an individual can develop other signs and symptoms, such as swollen lymph nodes, weight loss, fever, diarrhea and cough.

Prevention and Treatment

- No effective cure currently exists for HIV. But with proper medical care, HIV can be controlled. Treatment for HIV is called antiretroviral therapy or ART. If taken properly every day, ART can dramatically prolong the lives of many people infected with HIV, keep them healthy, and greatly lower their chance of infecting others.

Cure Research

- Research is ongoing for a cure for HIV/AIDS. The current treatment involves antiretroviral therapy or ART which helps control the virus.

Statistics

- HIV/AIDS is a global pandemic affecting millions of people worldwide. The disease is most prevalent in Africa and Asia.

Life of Disease

- The disease progresses in stages from acute HIV infection to clinical latency and finally to AIDS. With treatment, people with HIV can live nearly as long as someone who does not have HIV.

How to lower your chances of getting it

- Don't have unprotected sexual intercourse
  - The usage of latex condoms
- Check the safety of the blood before transfusion