

Viruses

- Understand the structure of bacteriophages & human immunodeficiency virus (HIV)
- Appreciate that viruses replicate in host cells (thereby destroying them)

- Viruses are very small (between 10nm and 300nm (0.3μm)) and can only be seen using an electron microscope

<http://www.cellsalive.com/howbig.htm>

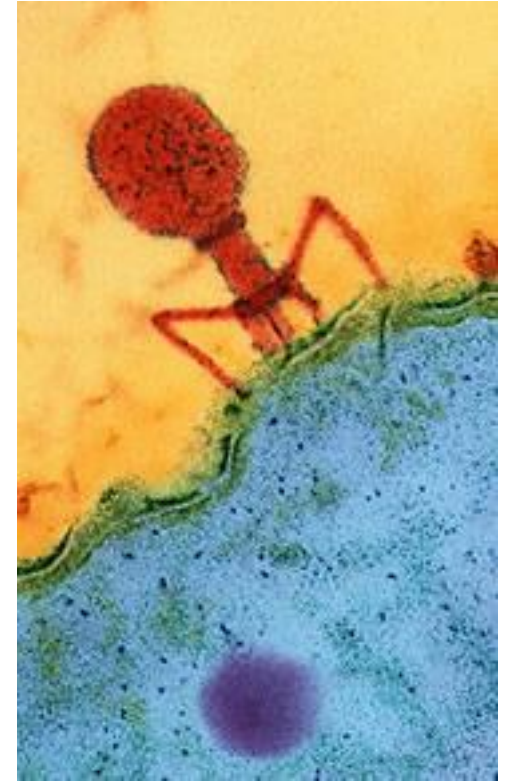
- Viruses have no cytoplasm and are not true cells (are not alive). They need to invade a living host cell and take over its metabolic processes (cellular reactions) in order to reproduce, so are regarded as "inert" until they do so.

- They cause disease by damaging the host cell and/or by producing toxins as they invade cells and reproduce

- All viruses consist of:
 1. A core of **nucleic acid** (DNA or RNA)
 2. A **protein coat** (capsid) (*not a cell membrane*)
- We will look at 2 types of

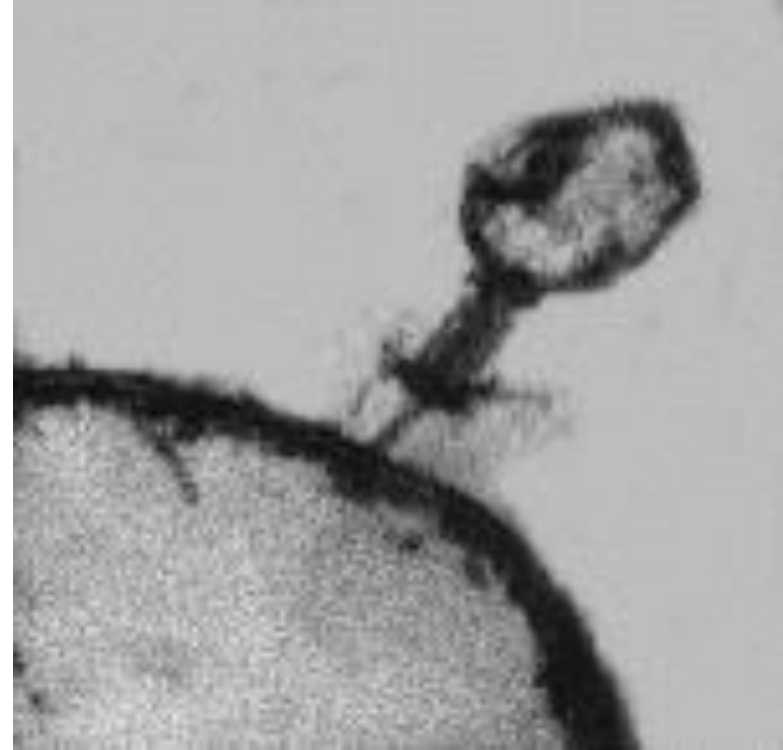
VIRUS

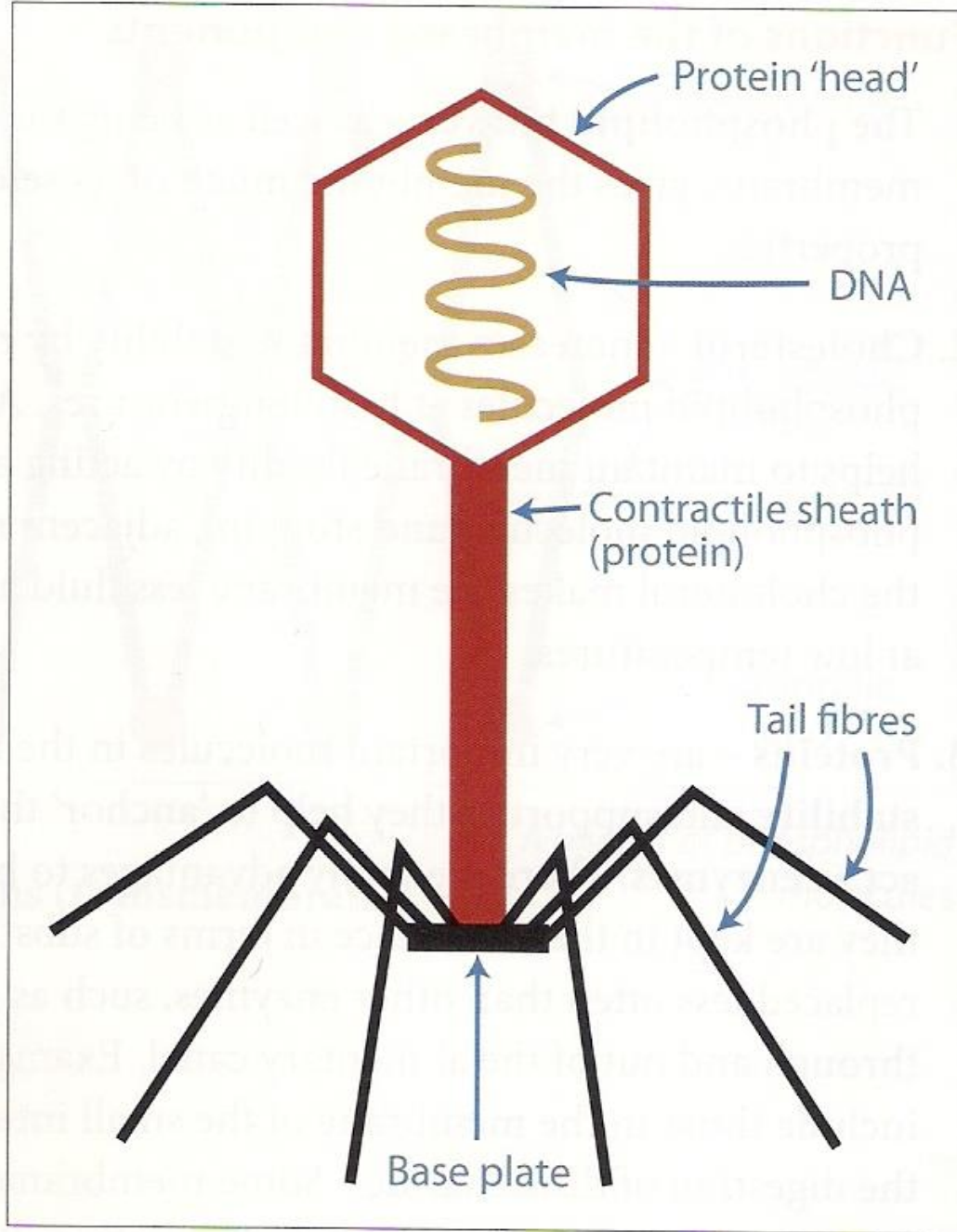
Bacteriophages



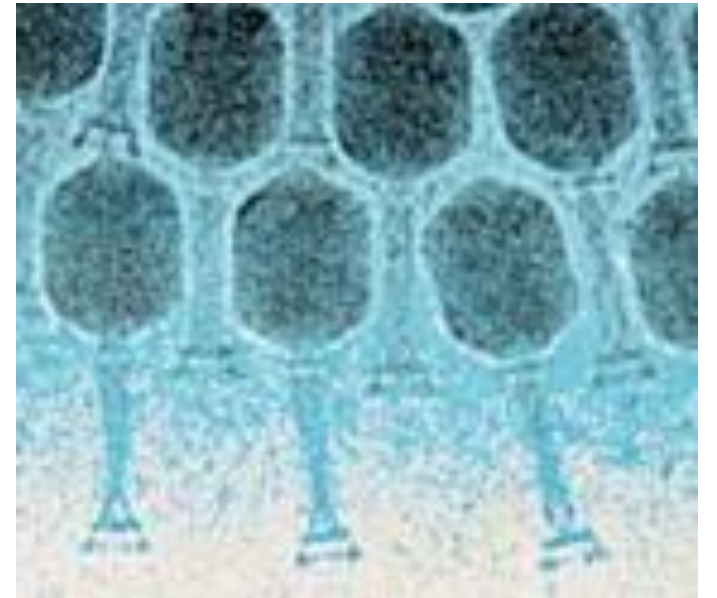
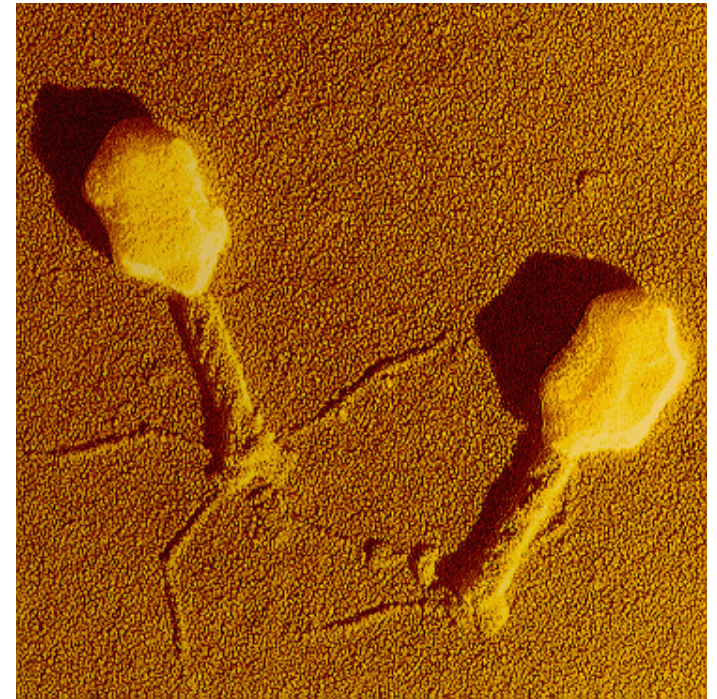
- A **bacteriophage** (phage) is a virus that is parasitic of bacterial cells (picture shows a bacteriophage attacking *E. coli*)
- It uses the bacterium to **replicate** itself, thereby destroying the bacterium

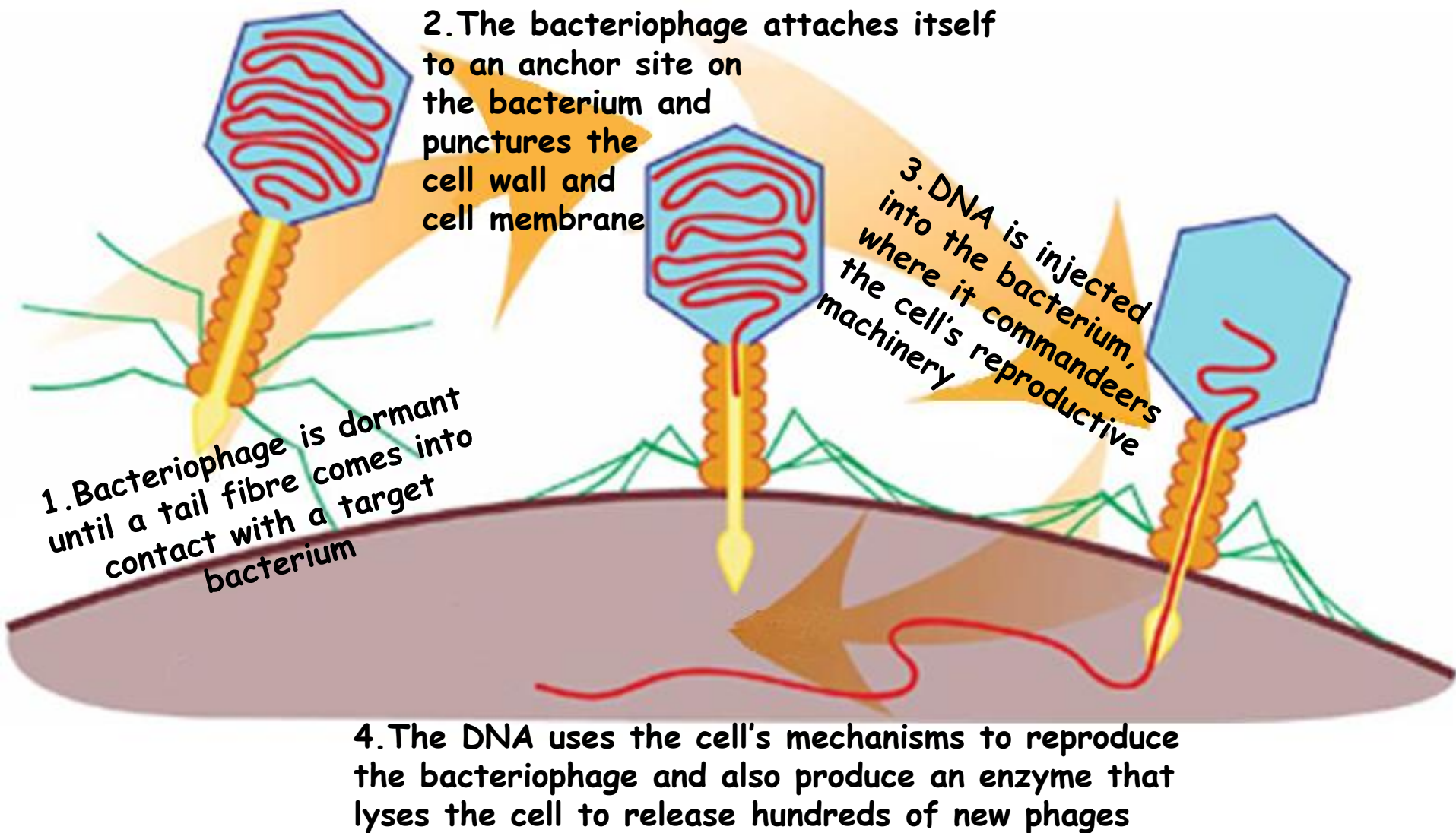
- Phages contain **DNA** bounded by a protein coat
- They **have no** cell membrane, **organelles**, chromosomes or cytoplasm (so they cannot carry out reactions on their own)
- They must **invade** a living **bacterial cell** in order to reproduce
- The viral DNA codes for the production of **new viral proteins** (to make the protein coat)
- The **phage DNA replicates** many times and the new copies are packaged into the protein coats
- The host **bacterial cell eventually ruptures** to release the new phages (viruses)





A bacteriophage





<http://www.bbc.co.uk/news/science-environment-15242386>

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Ocean trawl reveals 'megavirus'

By Jonathan Amos
Science correspondent, BBC News

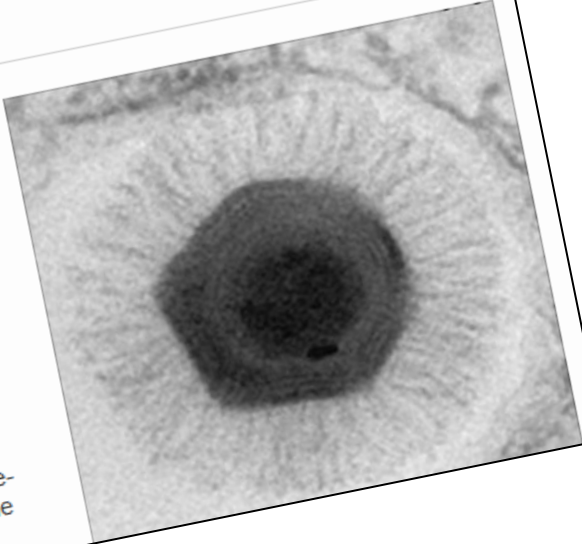


The largest virus yet discovered has been isolated from ocean water pulled up off the coast of Chile.

Called *Megavirus chilensis*, it is 10 to 20 times wider than the average virus.

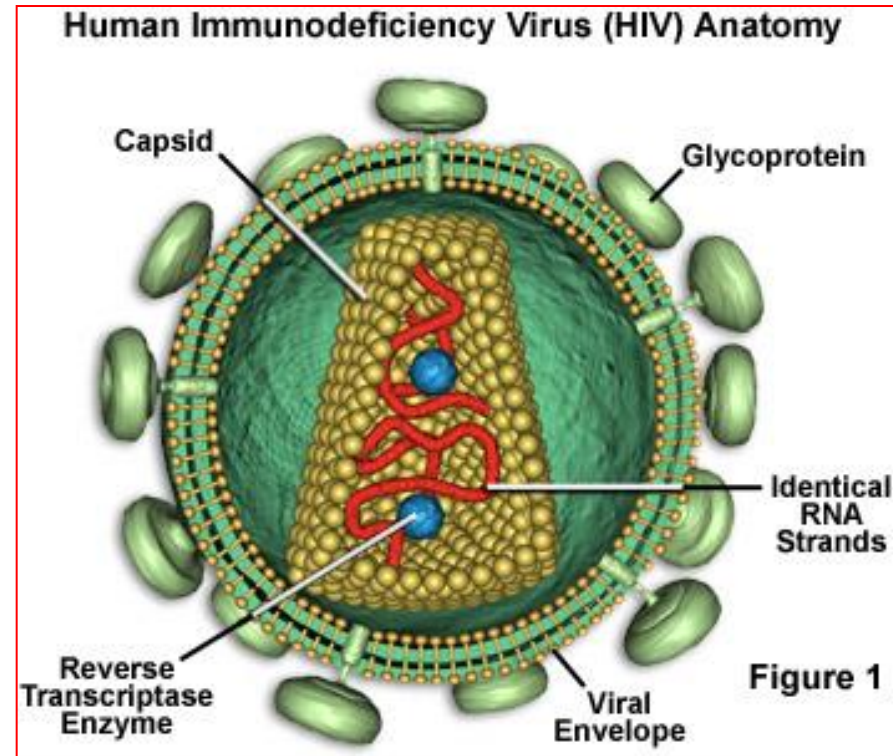
It just beats the previous record holder, Mimivirus, which was found in a water cooling tower in the UK in 1992.

Scientists tell the journal PNAS that Megavirus probably infects amoebas, single-celled organisms that are floating free in the sea.



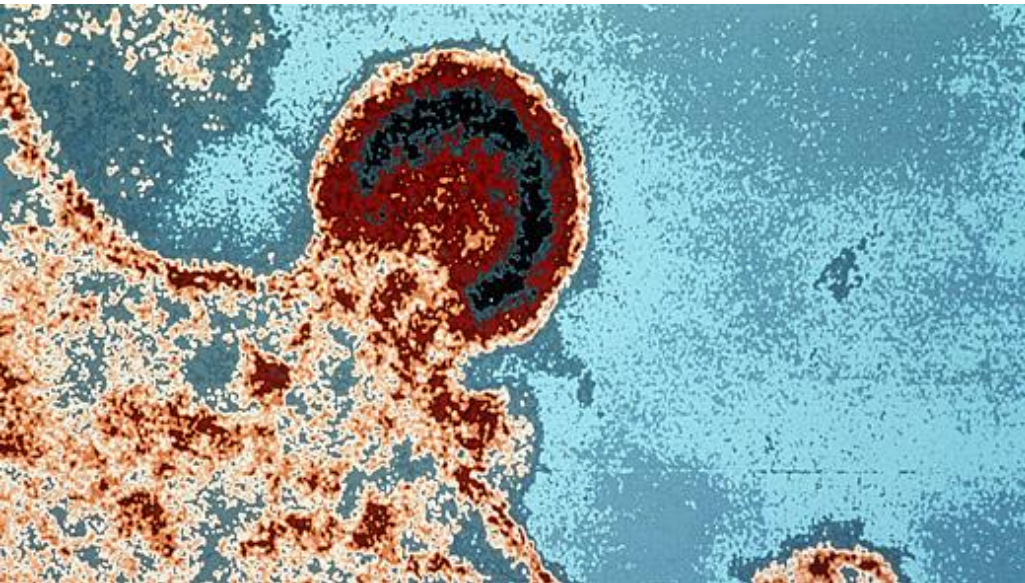
HIV - Human Immunodeficiency Virus

- HIV contains 2 **RNA molecules** bounded by a protein coat. They also have a **lipid bilayer** that contains **glycoprotein**. *Why would this be useful for the virus?* Allows the virus to remain largely undetected by the human immune system as it resembles a normal human cell membrane and can fuse easily with host cell membrane
- HIV invades a type of **lymphocyte** (white blood cell) called a **helper-T cell** which is normally involved in the immune response to a pathogen (a disease causing organism), and delivers the RNA and enzyme



- They are "**retroviruses**" as they contain the enzyme **reverse transcriptase** which catalyses the **synthesis of viral DNA from its RNA template**
- New viral protein and copies of RNA are then made
- T-helper cells are destroyed, weakening the immune system and eventually causing AIDS

HIV infecting a lymphocyte:

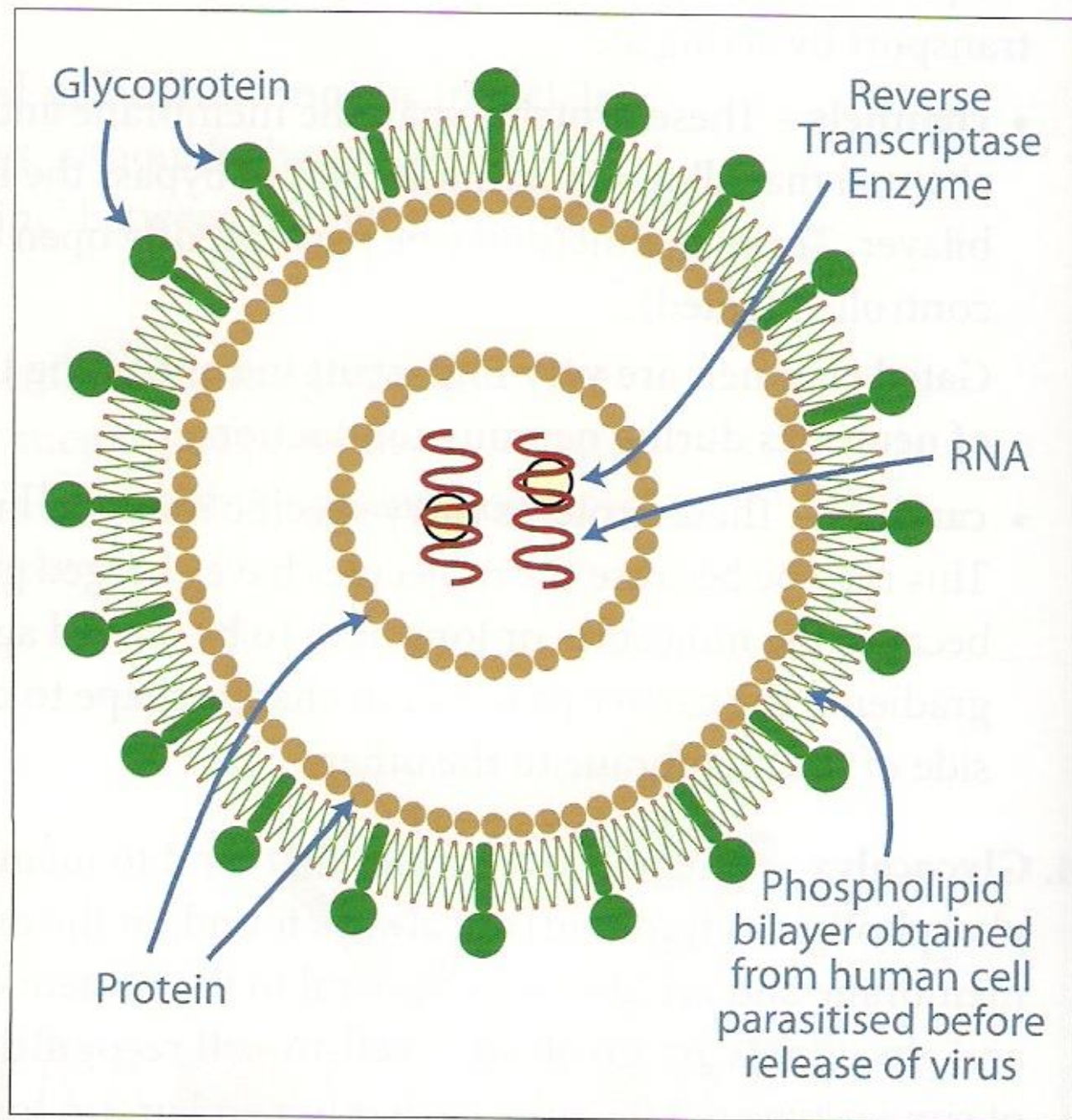


- **AIDS** (acquired immune deficiency syndrome) is the name given to the collection of diseases brought on by the weakening of the body's immune system

HIV life cycle:

http://www.galaxygoo.org/biochem/hiv/hiv_lifecycle.html

More detailed description: <http://www.rnceus.com/arvd/hiv7.swf>



The HIV virus

Complete the summary table describing
bacteriophages and HIV



Homework for tomorrow:
Complete defs and PPQs - NOT ESSAY

Factor	Bacteriophage	HIV
<i>What they infect</i>	Bacterial cells	Helper-T cells
<i>What they contain</i>	DNA	2 RNA strands and reverse transcriptase enzyme
<i>How they work</i>	At anchor site they puncture cell wall and membrane to inject nucleic acid	Virus membrane fuses with helper-T membrane and releases contents

Comparing viruses: bacteriophages and retroviruses:

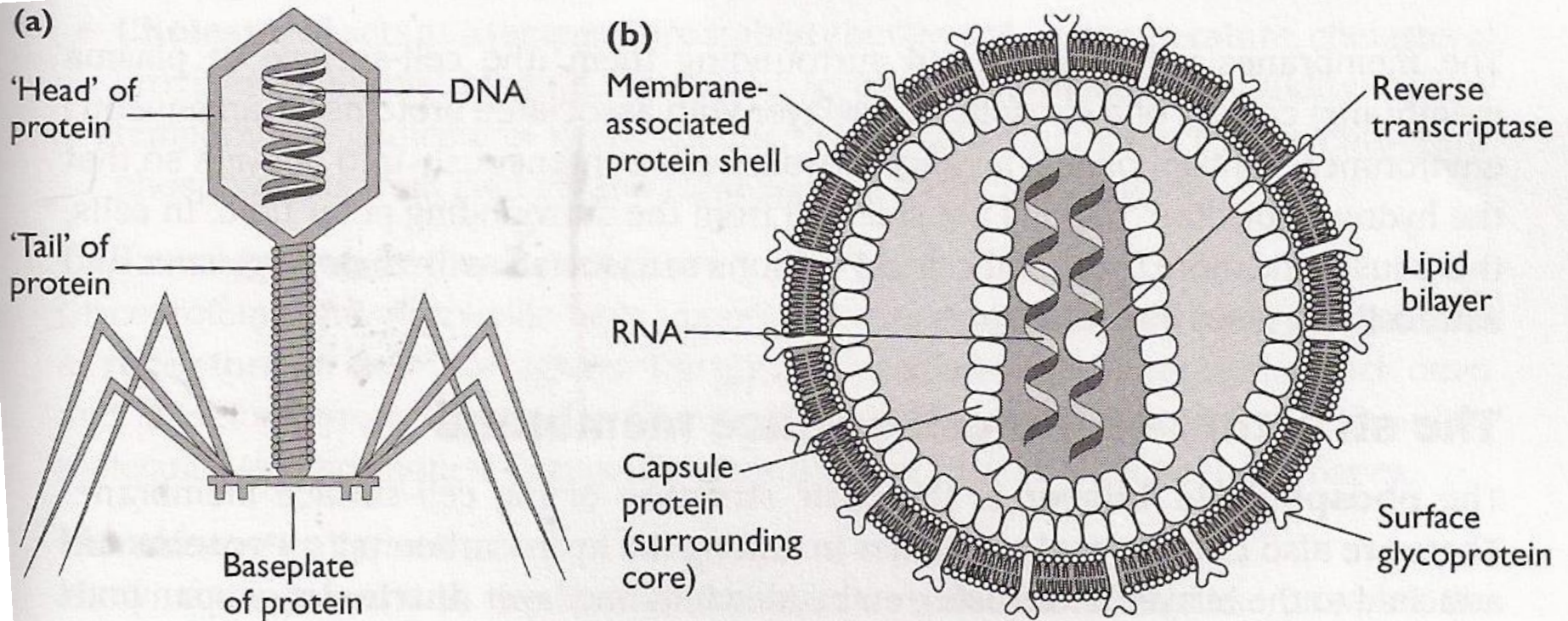


Figure 36 (a) A bacteriophage; (b) The human immunodeficiency virus

Definitions

Use your notes and Froggy to write definitions for the following key words:

- Bacteriophage / phage
- RNA
- Glycoprotein
- Retrovirus
- Receptor site
- Reverse transcriptase
- Lymphocyte
- Helper T-cell
- Lipid bi-layer



Definition answers:

- **Bacteriophage** / phage - This type of virus carries DNA and infects bacteria to replicate itself
- **RNA** - The nucleic acid which carries the genetic information in the HIV virus for the creation of viral copy DNA
- **Glycoprotein** - Carbohydrate and protein found on the surface of HIV and is involved in binding to the receptor site of the helper T-cell . Used in cell signalling and recognition - helps HIV evade detection by host immune system
- **Retrovirus** - A virus which uses the enzyme reverse transcriptase to synthesise viral DNA from RNA. This needs to occur so the viral DNA can be inserted into the host cell genome and then proteins created

- **Receptor site** - the area on the cell surface membrane that the virus binds to before injecting nucleic acid (phage) or fusing membranes (retro v)
- **Reverse transcriptase** - The enzyme carried by HIV to enable DNA to be synthesised from its RNA
- **Lymphocyte** - A type of white blood cell involved in the immune response to a pathogen
- **Helper T-cell** - The type of lymphocyte which the HIV virus infects and uses to replicate itself
- **Lipid bilayer** - Enables the HIV virus to remain undetected by the immune system by resembling host cells