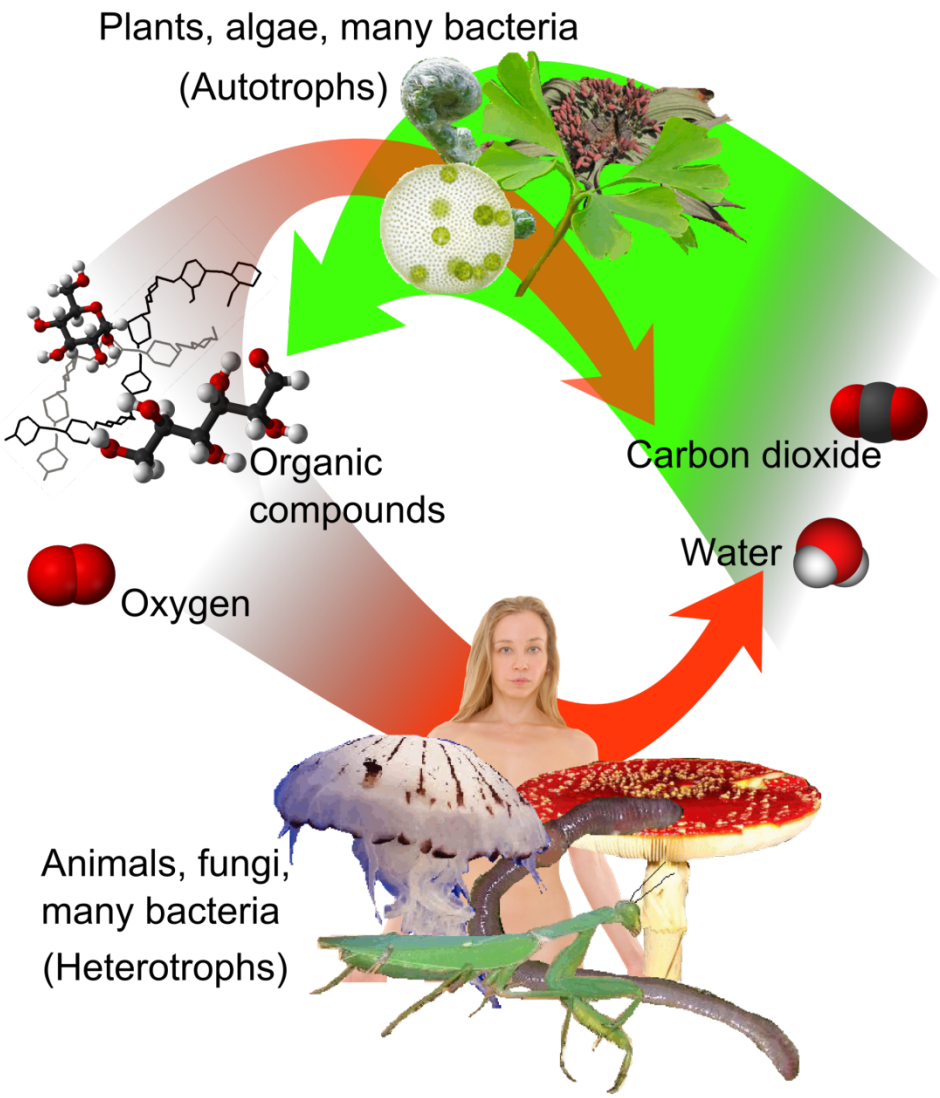
PART 2: A TOUR OF CELLS

HOW CELLS PERFORM WORK

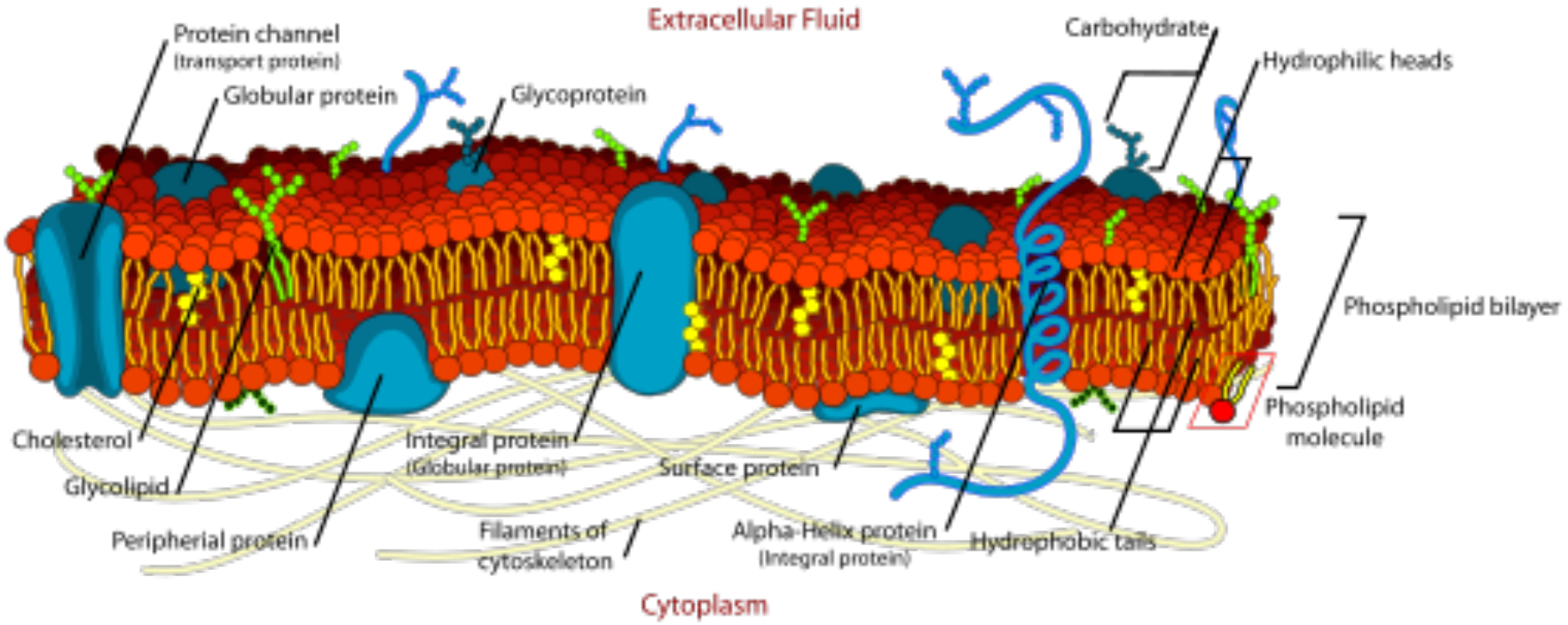
CELLULAR RESPIRATION



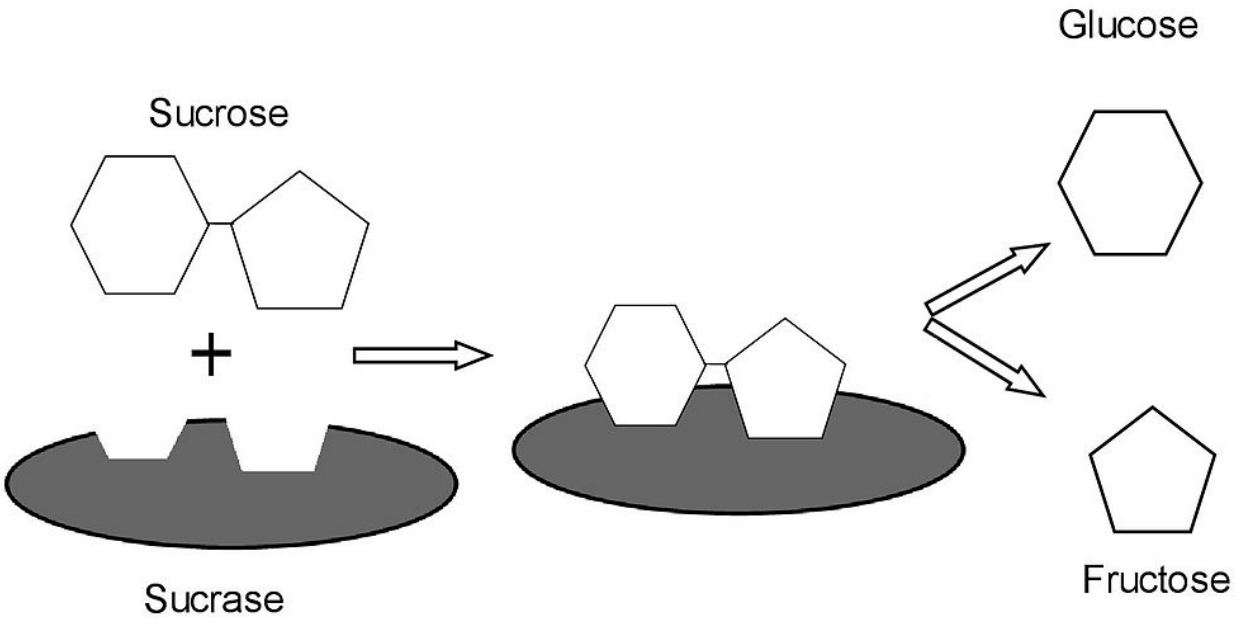
MEMBRANE FUNCTION

- Working cells must control the flow of materials to and from the environment.
- Membrane proteins perform many functions.
- **Transport proteins**
  - Are located in membranes
  - Regulate the passage of materials into and out of the cell

MEMBRANE PROTEINS



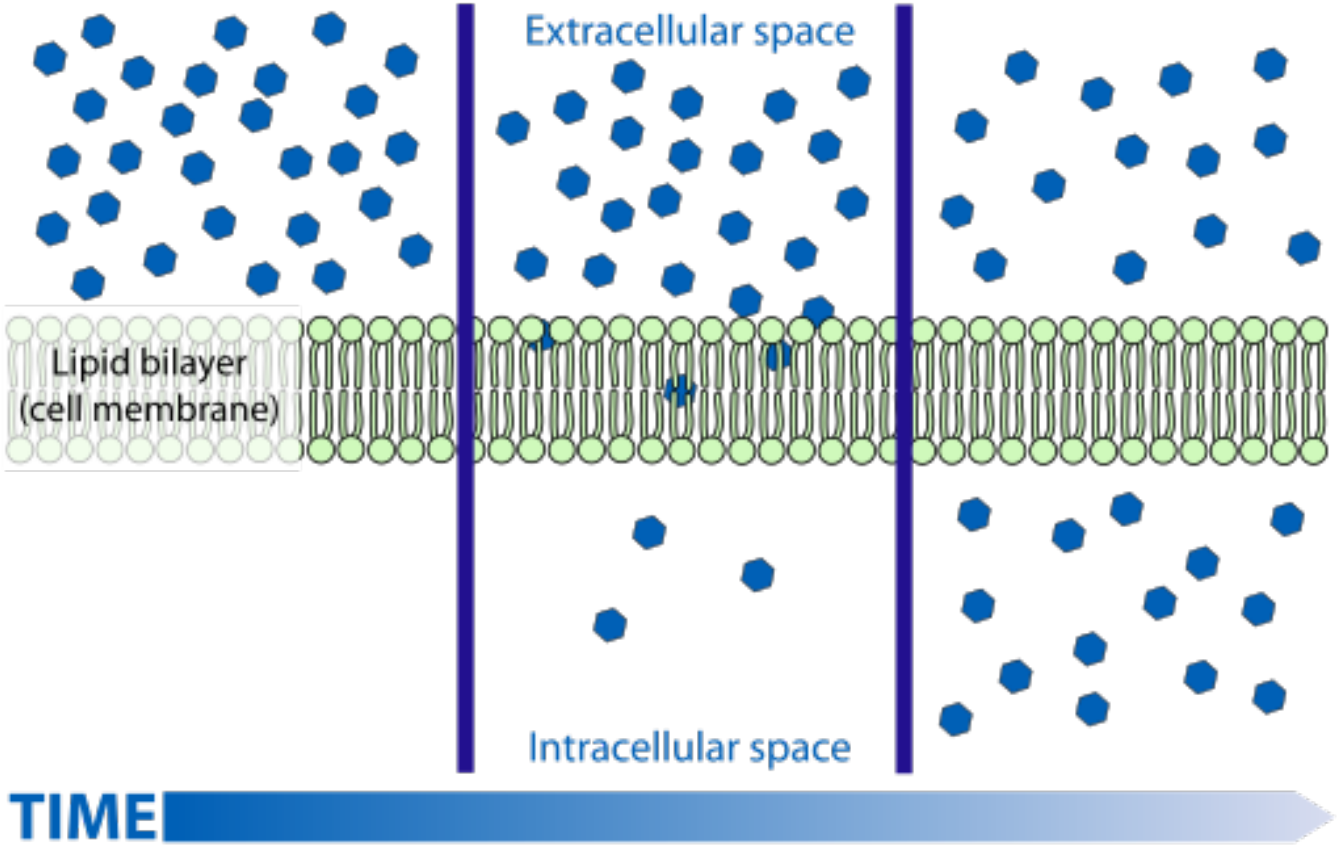
FRUCTOSE & GLUCOSE



PASSIVE TRANSPORT: DIFFUSION ACROSS MEMBRANES

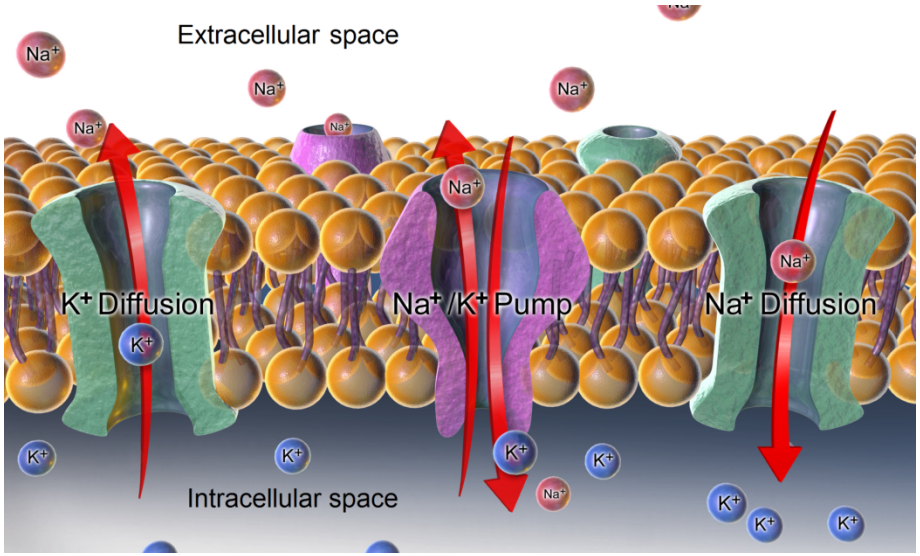
- Molecules contain heat energy that causes them to vibrate and wander randomly.
- Diffusion is the tendency for molecules of any substance to spread out into the available space.
- Passive transport is the diffusion of a substance across a membrane without the input of energy.
- Diffusion is an example of passive transport.
- Substances diffuse down their concentration gradient, a region in which the substance's density changes

DIFFUSION AND EQUILIBRIUM

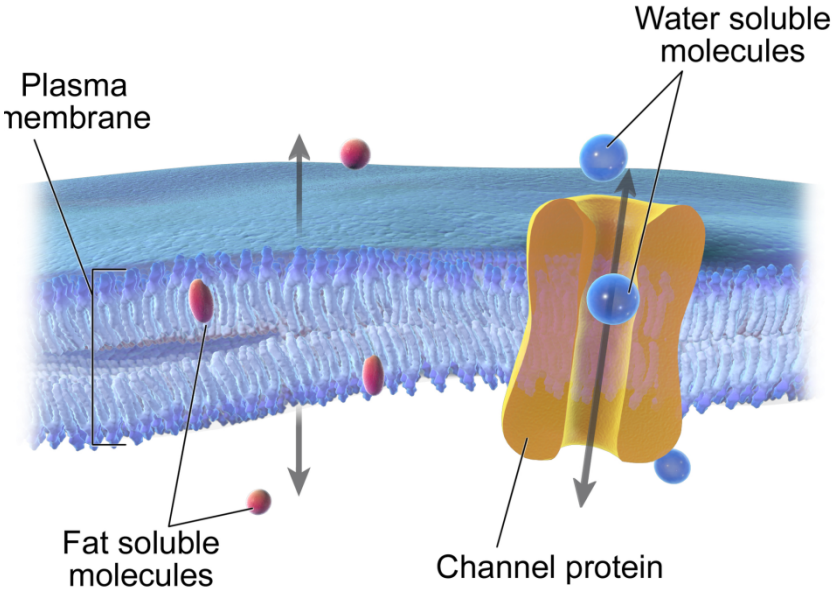


MEMBRANE TRANSPORT

ACTIVE TRANSPORT (REQUIRES ENERGY)



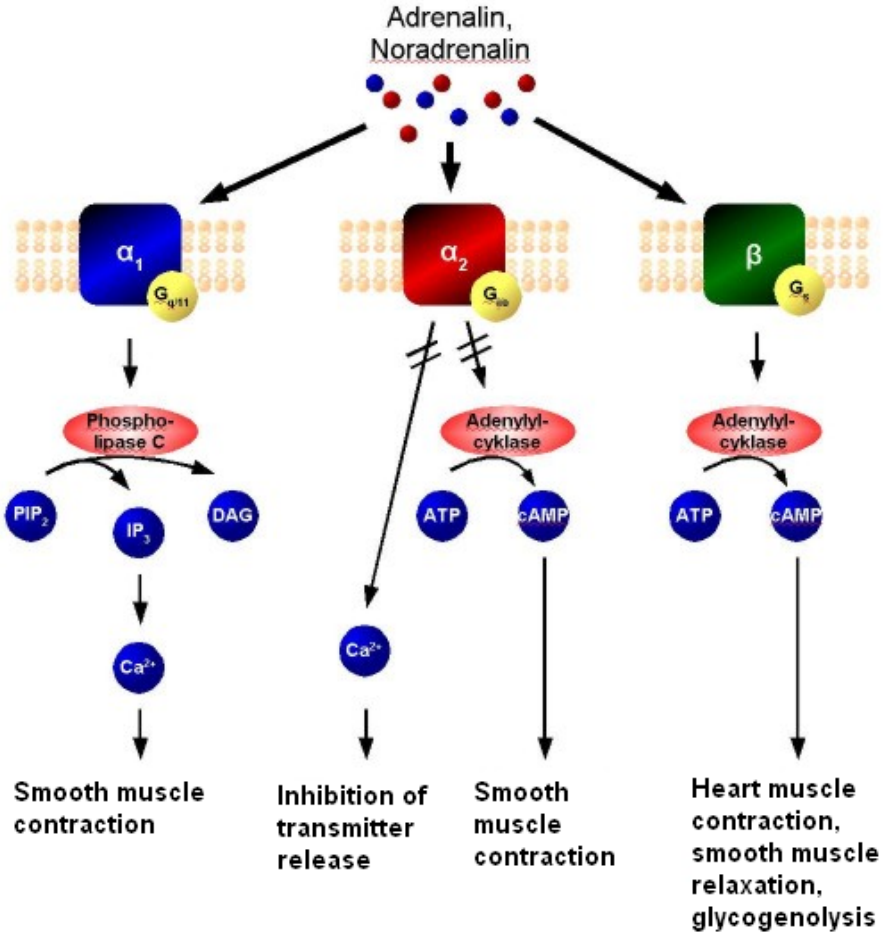
PASSIVE TRANSPORT (REQUIRES NO ENERGY)

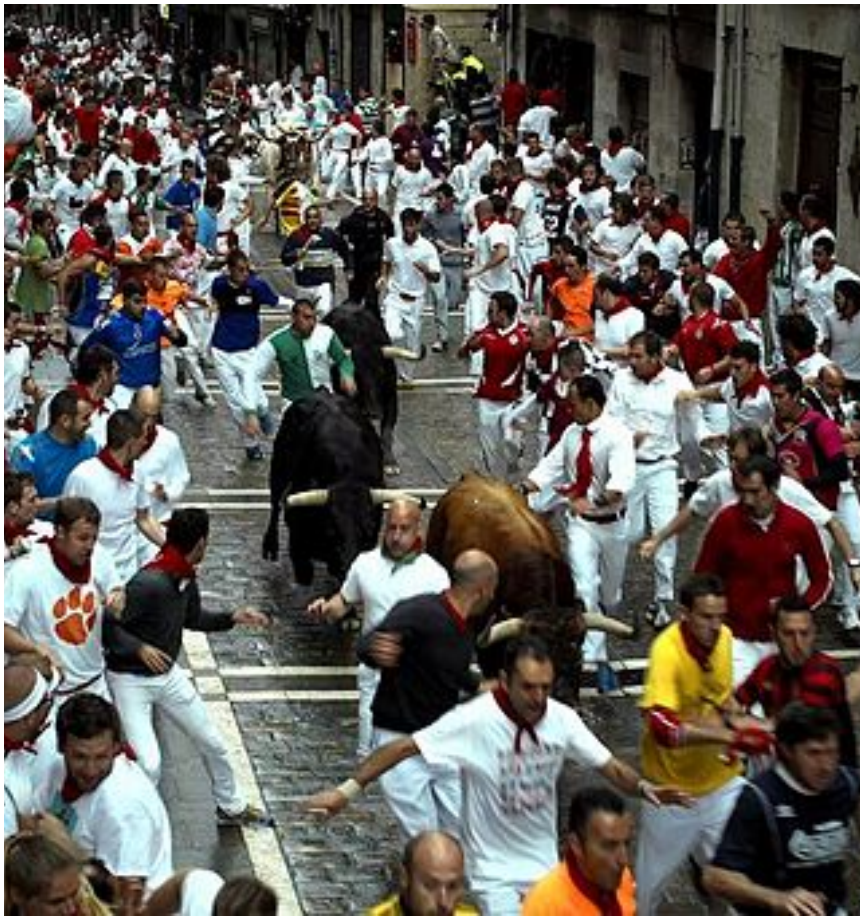


THE ROLE OF MEMBRANES IN CELL SIGNALING

- The plasma membrane helps convey signals between
  - Cells
  - Cells and their environment
- Receptors on a cell surface trigger signal transduction pathways that
  - Relay the signal
  - Convert it to chemical forms that can function within the cell

ADRENALINE


Adrenalin,
Noradrenalin
α1
Gq/11
α2
Gio
β
Gs
Phospho-
lipase C
PIP2
IP3
DAG
Ca2+
Adenylyl-
cyklase
ATP
cAMP
Adenylyl-
cyklase
ATP
cAMP
Ca2+
Smooth muscle
contraction
Inhibition of
transmitter
release
Smooth
muscle
contraction
Heart muscle
contraction,
smooth muscle
relaxation,
glycogenolysis

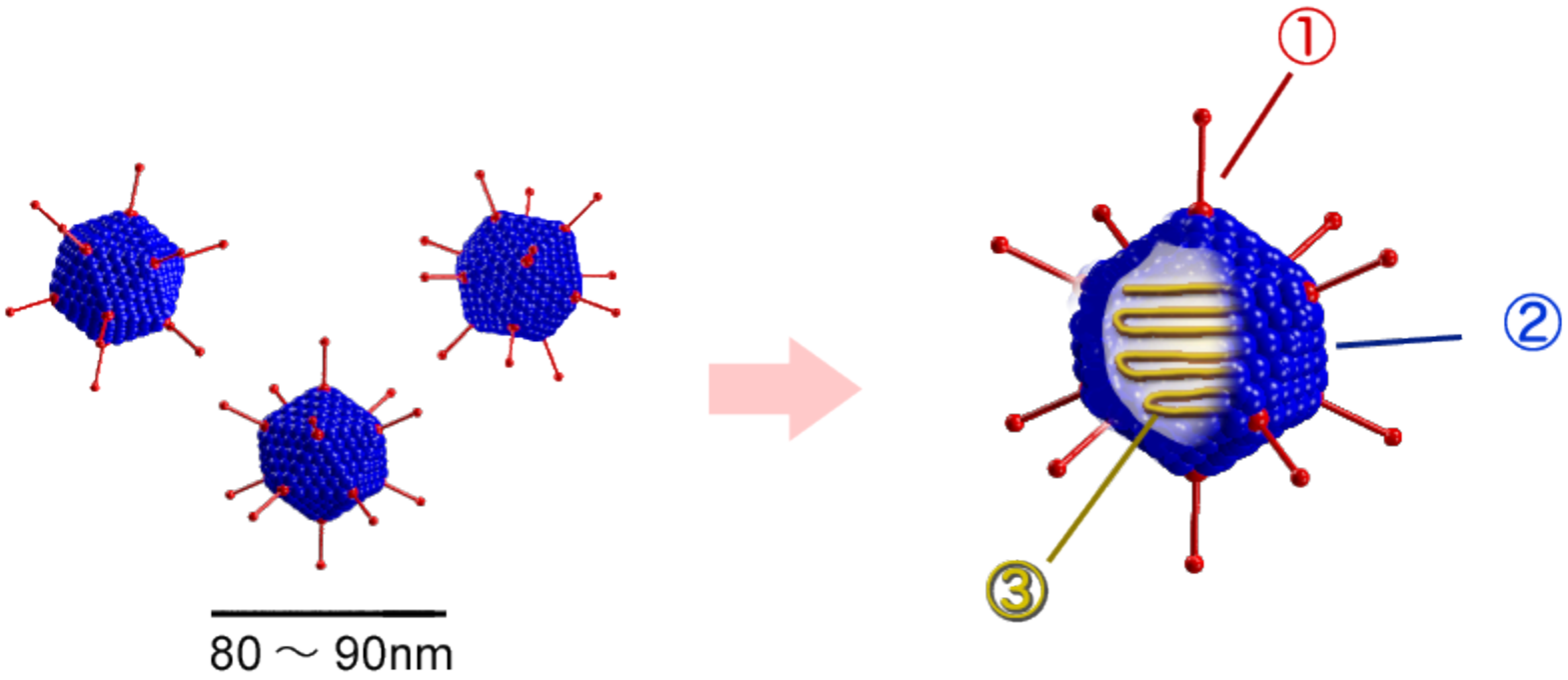


HOW VIRUSES MAKE PROTEIN

VIRUSES AND OTHER NON-CELLULAR AGENTS

- Viruses exhibit some, but not all, characteristics of living organisms. Viruses:
- Possess genetic material in the form of nucleic acids
- Are not cellular and cannot reproduce on their own.

ADENOVIRUS STRUCTURE



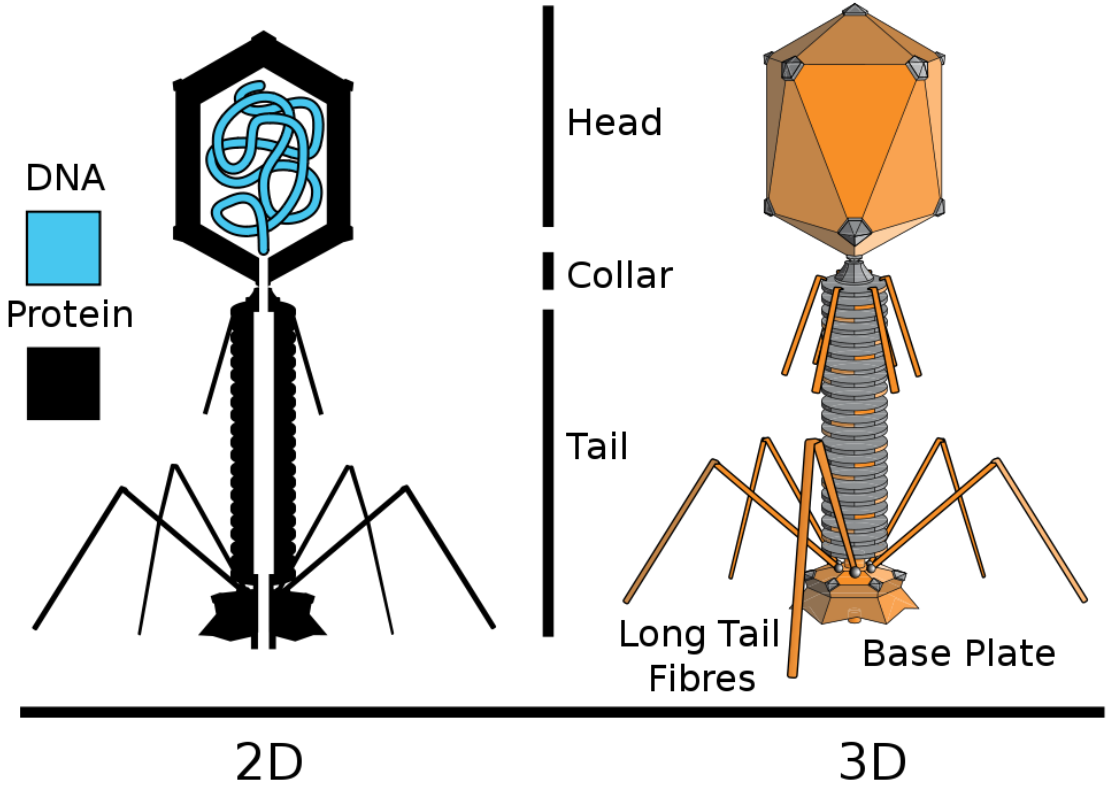
BACTERIOPHAGES

- **Bacteriophages**, or **phages**, are viruses that attack bacteria.
- Phages have two reproductive cycles.
  - (1) In **the lytic cycle**:
  - Many copies of the phage are made within the bacterial cell, and then

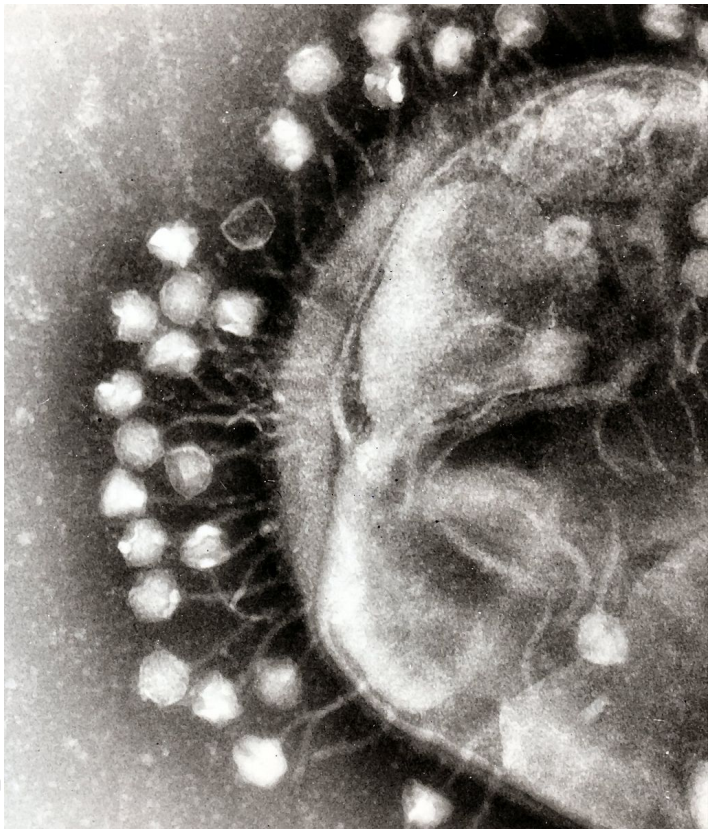
    The bacterium lyses (breaks open)
- (2) In the lysogenic cycle:
  - The phage DNA inserts into the bacterial chromosome and
  - The bacterium reproduces normally, copying the phage at each cell division

BACTERIOPHAGES CONT.

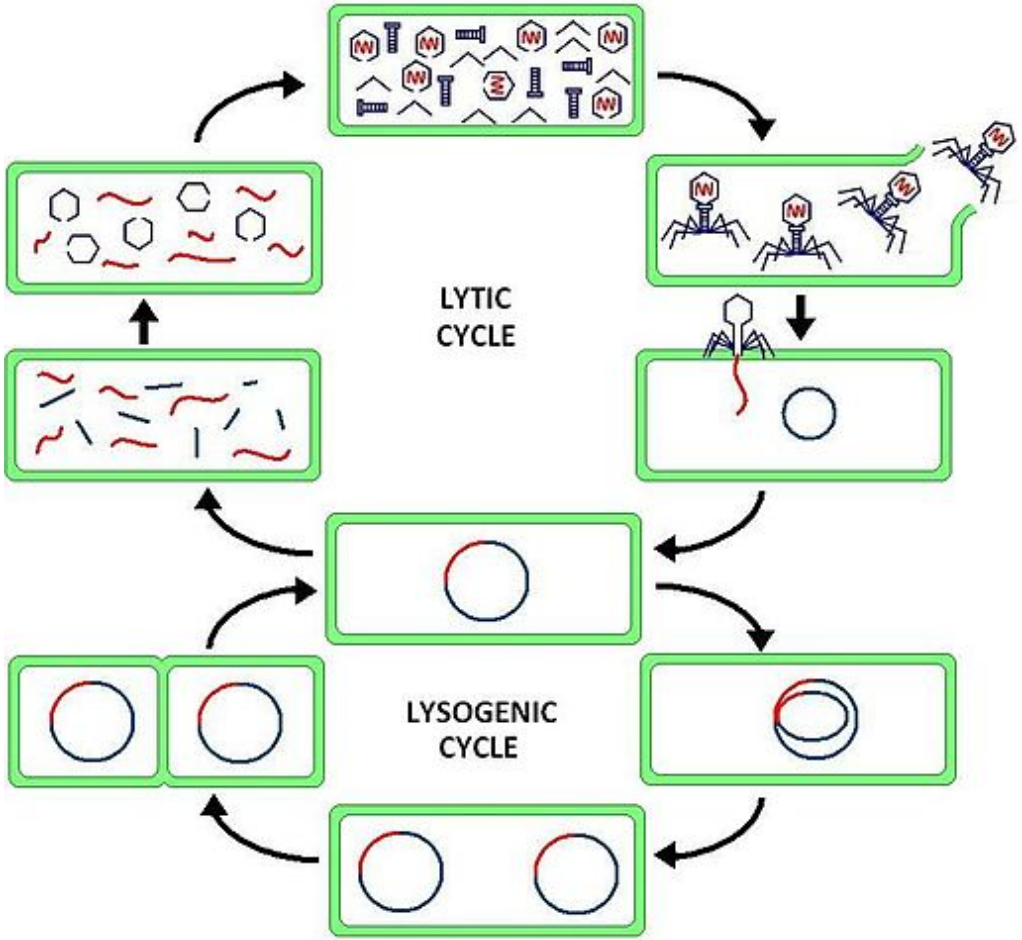
2D AND 3D REPRESENTATION (2NM TALL)



ELECTRON MICROSCOPE

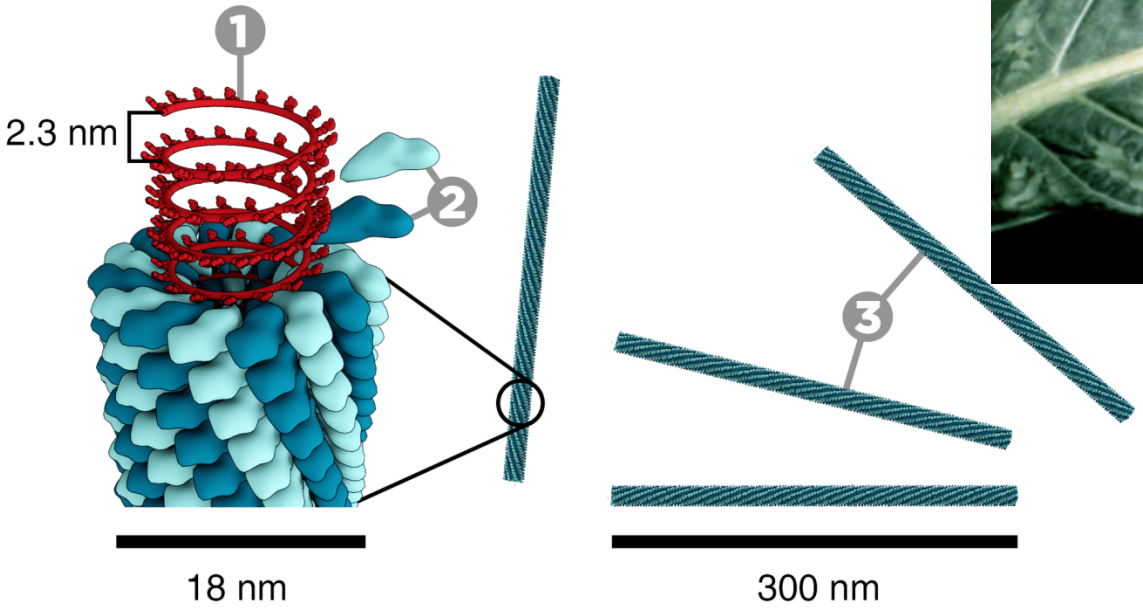


LYTIC CYCLE



TOBACCO MOSAIC VIRUS

STRUCTURE

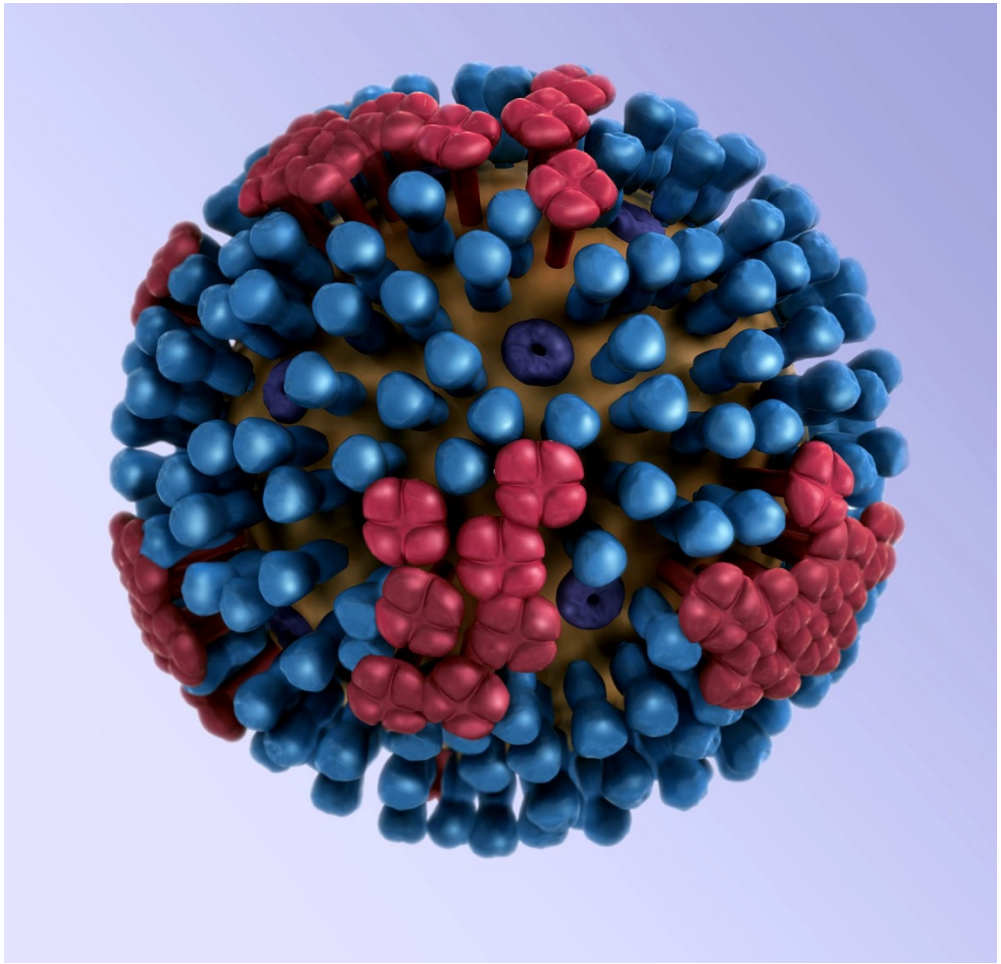


TOBACCO LEAF WITH TMV

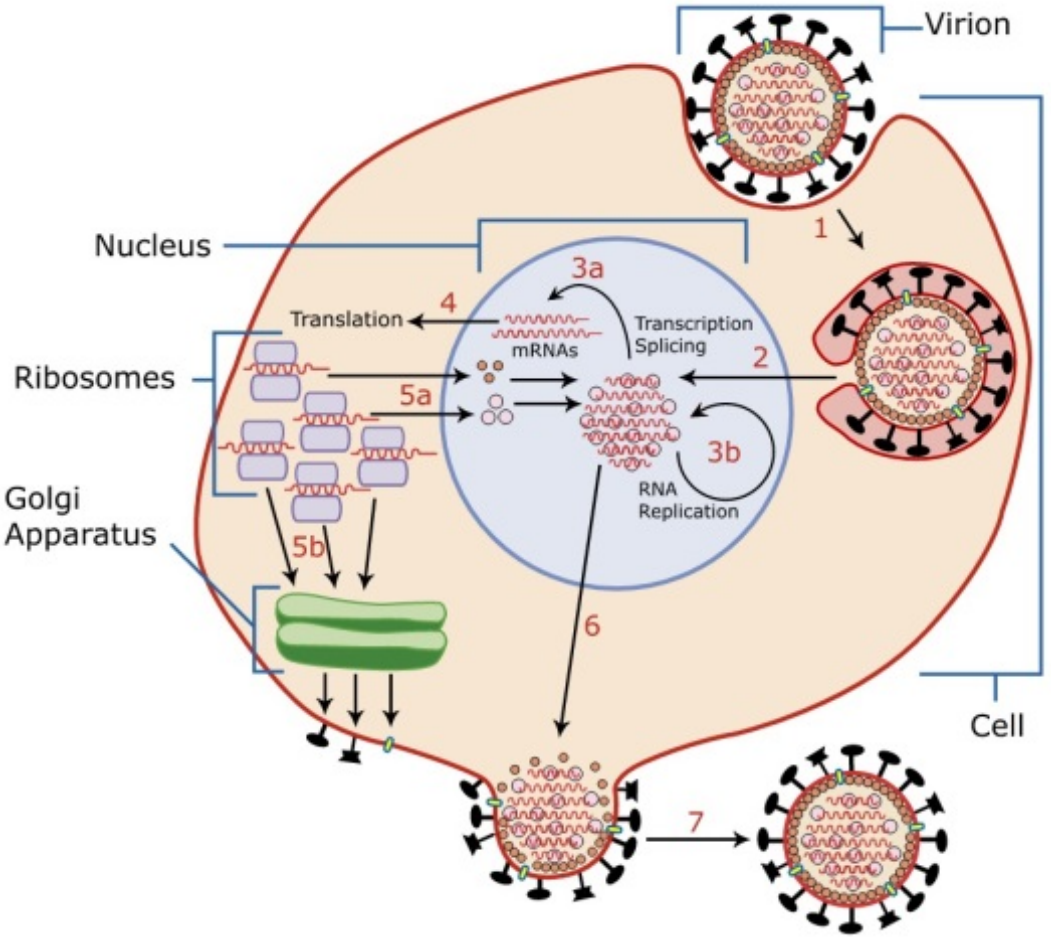
ANIMAL VIRUSES

- Viruses that infect animals are:
  - Common causes of disease
  - May have RNA or DNA genomes
- Some animal viruses steal a bit of host cell membrane as a protective envelope.
- The reproductive cycle of an enveloped RNA virus can be broken into seven steps.

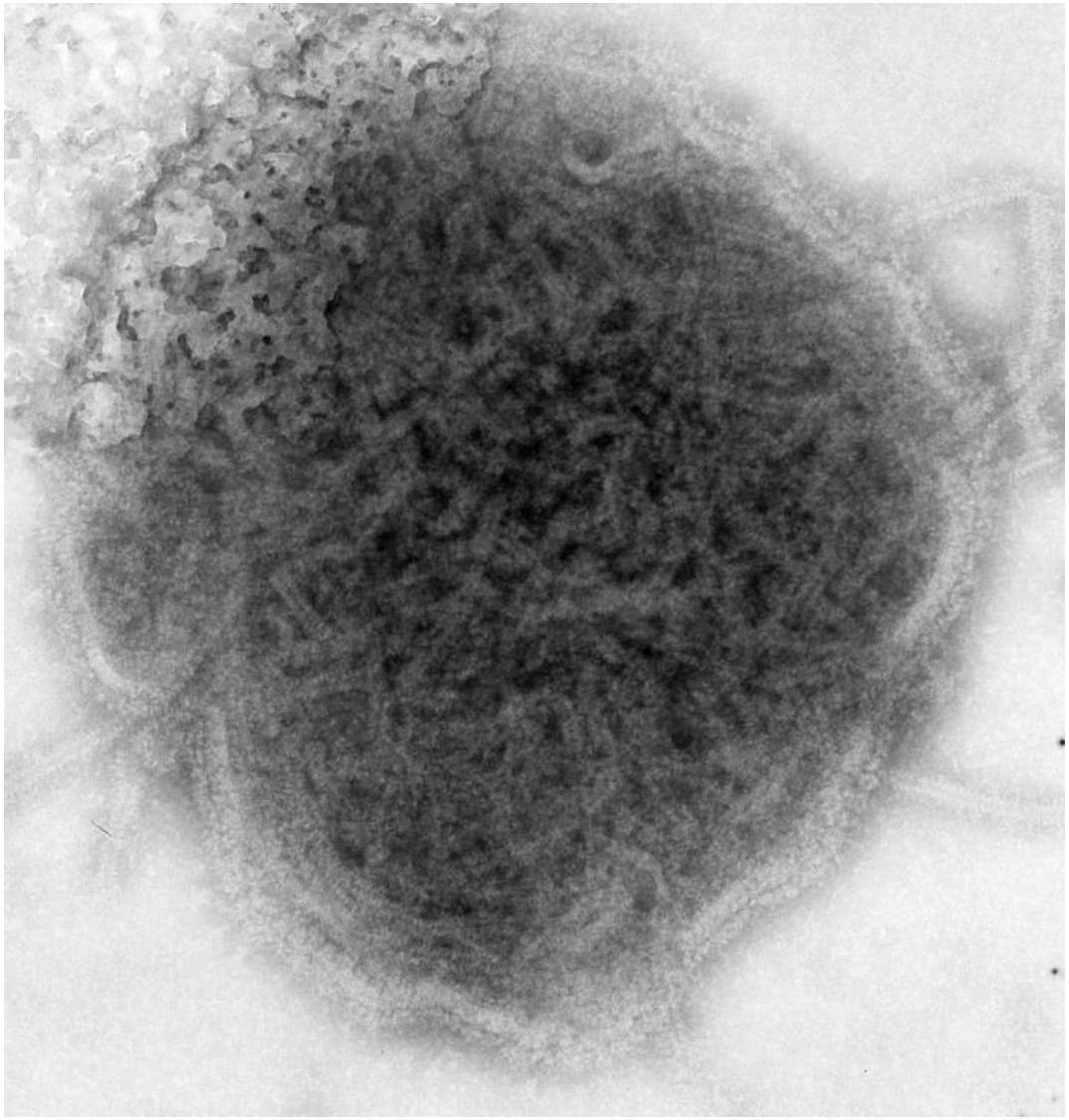
INFLUENZA VIRUS



REPRODUCTIVE CYCLE OF ENVELOPED VIRUS



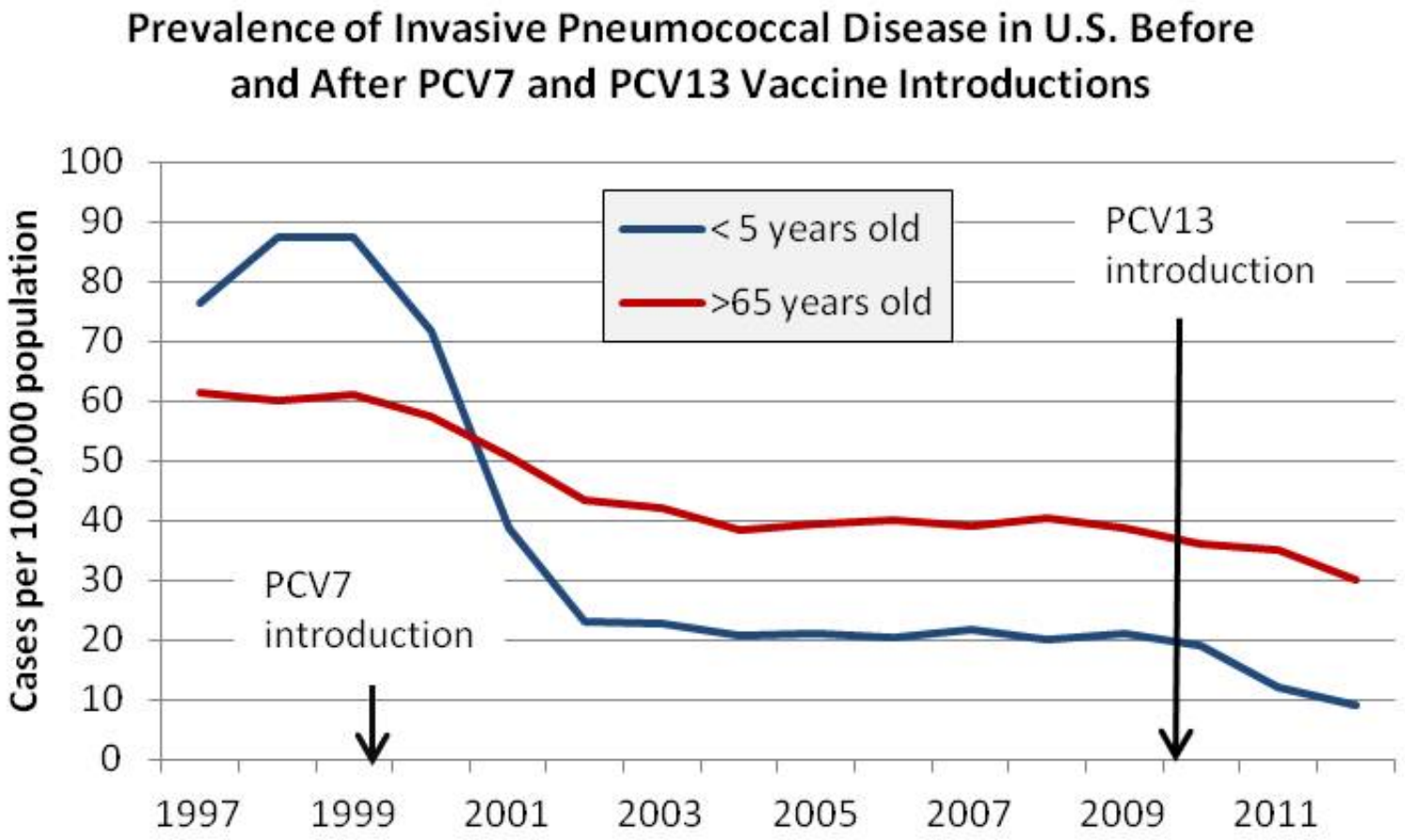
MUMPS VIRUS



THE PROCESS OF SCIENCE: VACCINATIONS AND THE ELDERLY

- Observation: Vaccination rates among the elderly rose from 15% in 1980 to 65% in 1996.
- Question: Do flu vaccines decrease the mortality rate among those elderly people who receive them?
- Hypothesis: Elderly people who were immunized would have fewer hospital stays and deaths during the winter after vaccination.
- Experiment: Tens of thousands of people over the age of 65 were followed during the ten flu seasons of the 1990s.
- Results: People who were vaccinated had a:
  - 27% less chance of being hospitalized during the next flu season and
  - 48% less chance of dying

VACCINE RESULTS ON POPULATION



VACCINES

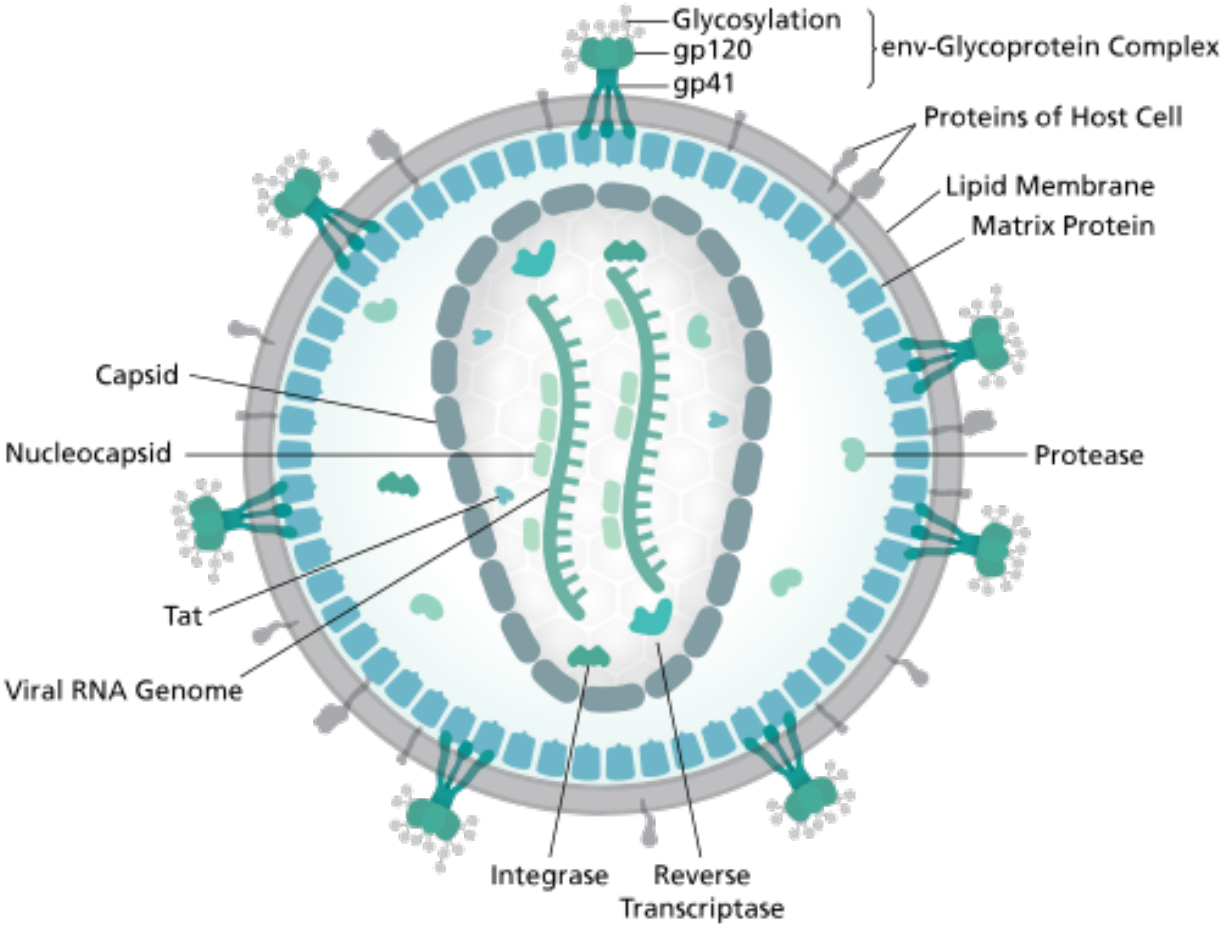

100 DOSES
℞ only
Smallpox Vaccine
Dried, Calf Lymph Type
Dryvax®
Dose: Approx. 2.5 µL
WYETH LABORATORIES
Marietta, PA 17547 U.S.A.
U.S. Govt. License No. 3
00346-02-2


HMC

HIV: THE AIDS VIRUS

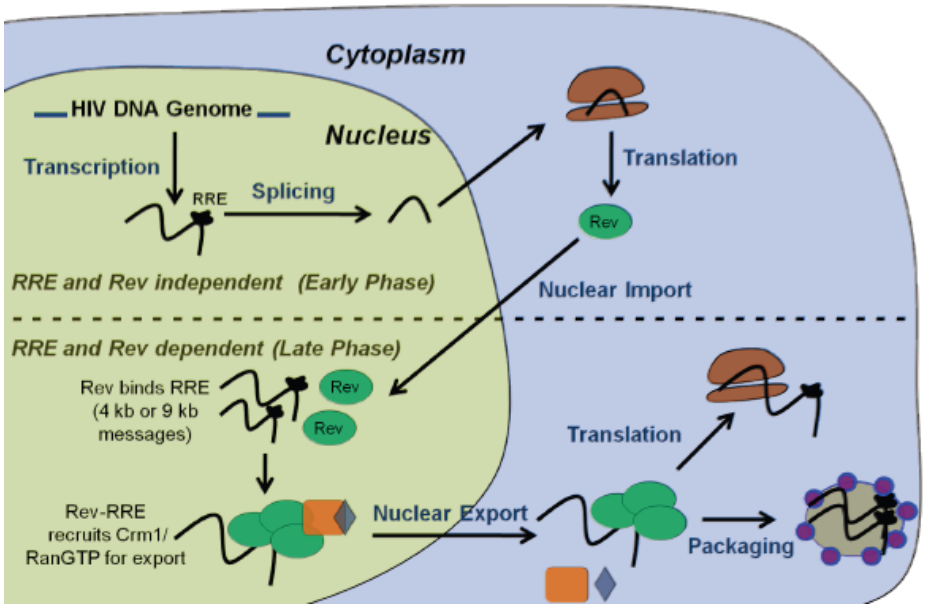
- HIV is a **retrovirus**, an RNA virus that reproduces by means of a DNA molecule.
- Retroviruses use the enzyme **reverse transcriptase** to synthesize DNA on an RNA template.
- HIV steals a bit of host cell membrane as a protective envelope.
- **AIDS** (acquired immune deficiency syndrome) is:
- Caused by **HIV** infection and
- Treated with drugs that interfere with the reproduction of the virus

HIV STRUCTURE

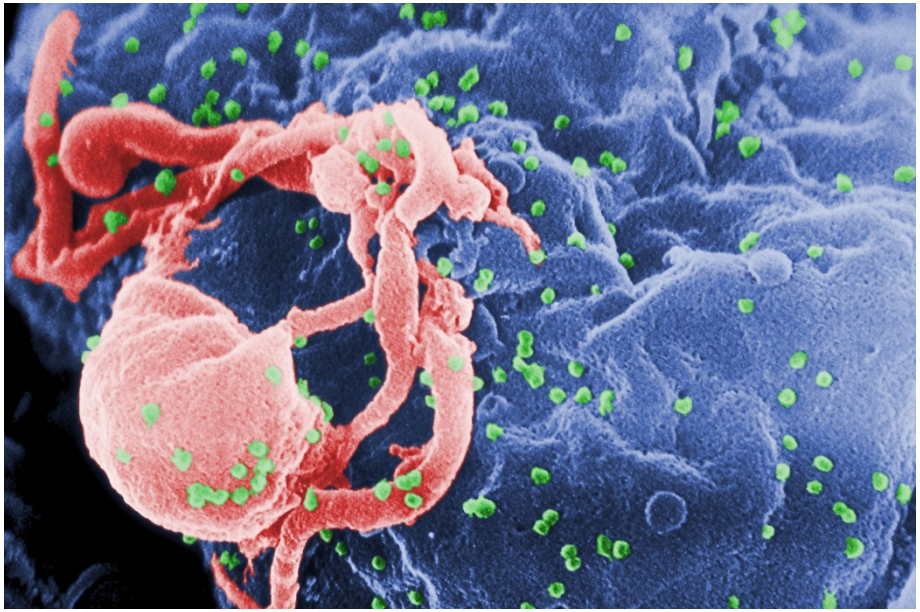


REV/RRE FUNCTION

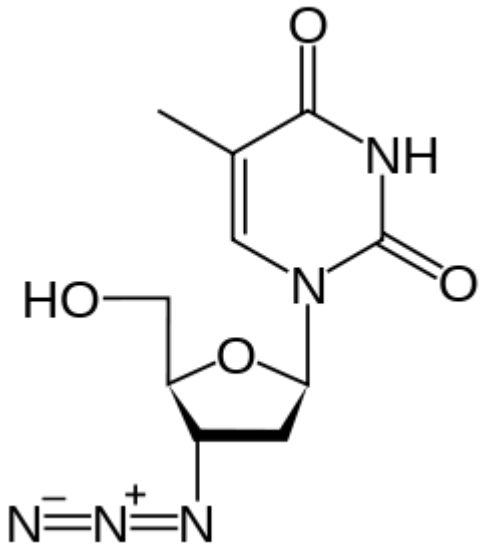
Rev/Rre Function



HIV (in green) infecting lymphocyte



AZT



Viroids and Prions

- Two classes of pathogens are smaller than viruses:
  - Viroids are small circular RNA molecules that do not encode proteins
  - **Prions** are misfolded proteins that somehow convert normal proteins to the misfolded prion version
- Prions are responsible for neurodegenerative diseases including:
  - Mad cow disease
  - Scrapie in sheep and goats
  - Chronic wasting disease in deer and elk
  - Creutzfeldt-Jakob disease in humans

Prions continued

- Prions are responsible for neurodegenerative diseases including:
  - Mad cow disease
  - Scrapie in sheep and goats
  - Chronic wasting disease in deer and elk
  - Creutzfeldt-Jakob disease in humans

AVIAN FLU

- Avian flu:
  - Infects birds
  - Infected 18 people in 1997
  - Since has spread to Europe and Africa infecting 300 people and killing 200 of them
  - If avian flu mutates to a form that can easily spread between people, the potential for a major human outbreak is significant.
- New viruses can arise by:
  - Mutation of existing viruses
  - Spread to new host species