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- The SPO Virtual Classrooms offer many educational resources, including practice test questions, review questions, lecture PowerPoints, video tutorials, sample assignments and course syllabi. New materials are continually being developed, so check back frequently, or follow us on Facebook (Science Prof Online) or Twitter (ScienceProfSPO) for updates.
- Many SPO PowerPoints are available in a variety of formats, such as fully editable PowerPoint files (.ppt), as well as uneditable versions in smaller file sizes, such as PowerPoint Shows (.pps) and Portable Document Format (.pdf), for ease of printing. The font "Jokerman" is used frequently in titles. It has a microbiology feel to it. If you do not have this font, some titles may appear odd, oversized and off-center. Find free downloads of Jokerman by Googling "download jokerman font microsoft".
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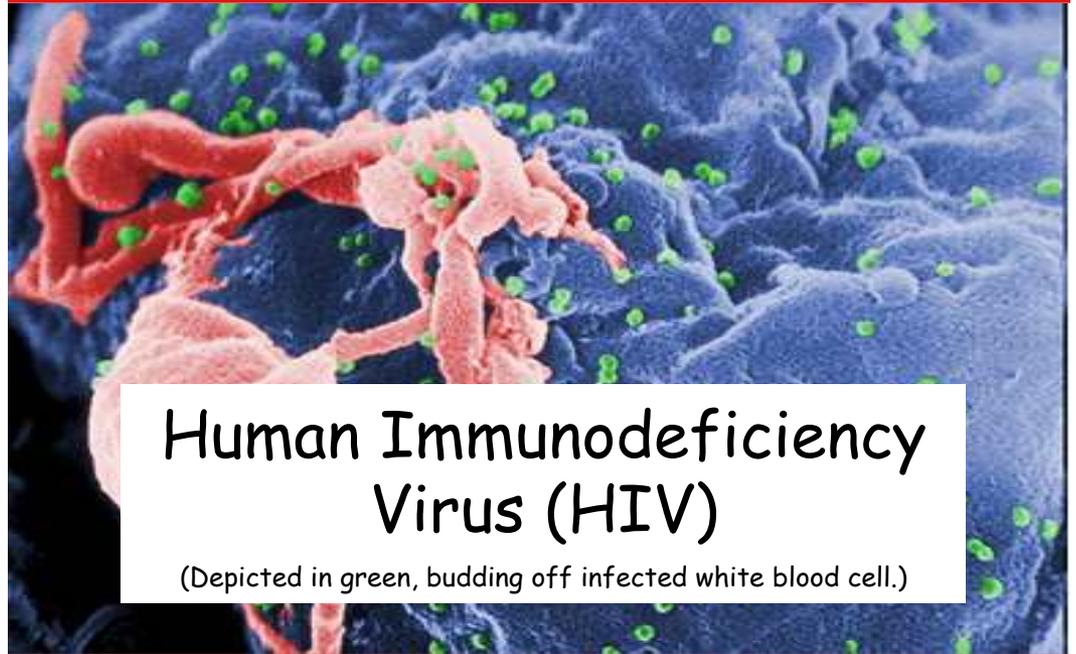
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Meet the  
Microbes:

# Viruses

HI  
my name is:

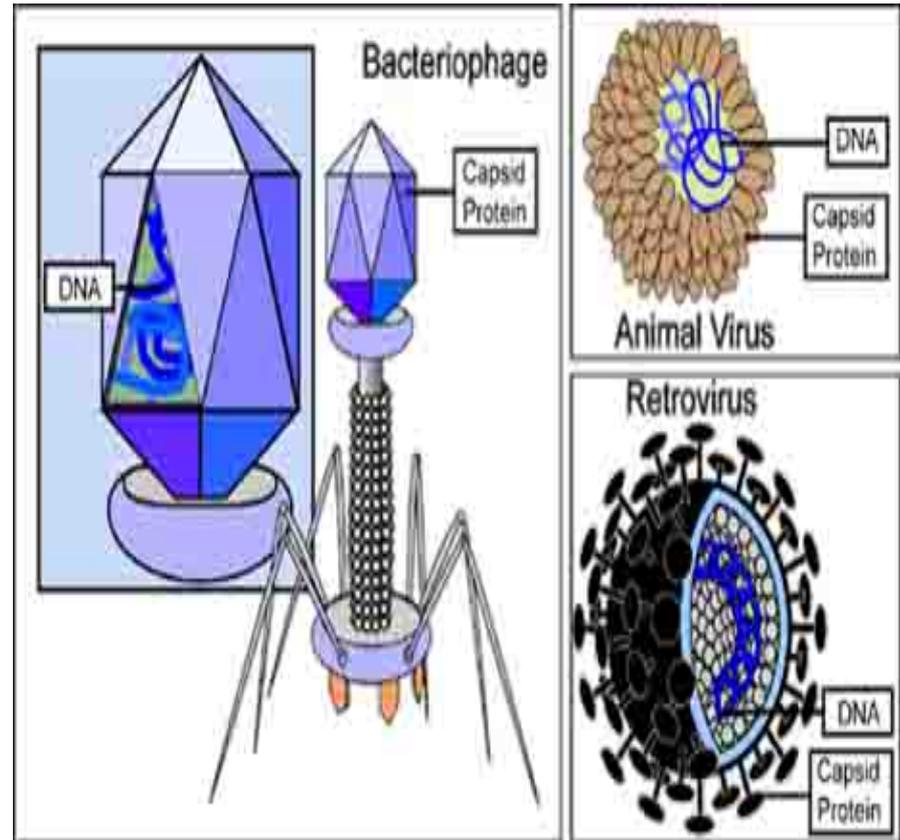


Human Immunodeficiency  
Virus (HIV)

(Depicted in green, budding off infected white blood cell.)

# How Are Viruses Classified?

- **genetic material**
  - DNA viruses contain [DNA](#) as their genetic material.
  - RNA viruses contain RNA as their genetic material.
- **shape**
  - Helical - capsomeres bonded, spiral shape
  - Polyhedral - flat sides
  - Spherical - round
  - Complex - many different shapes
- Presence or absence of a membranous **envelope** surrounding the capsid.
- Kinds of **cells** they attack
  - [Bacteriophage](#)
  - Animal Viruses
- **size** of [virus](#)
- **Q:** Which of these methods of classification to you think is most useful?



# Disease, Please: Influenza Pandemic

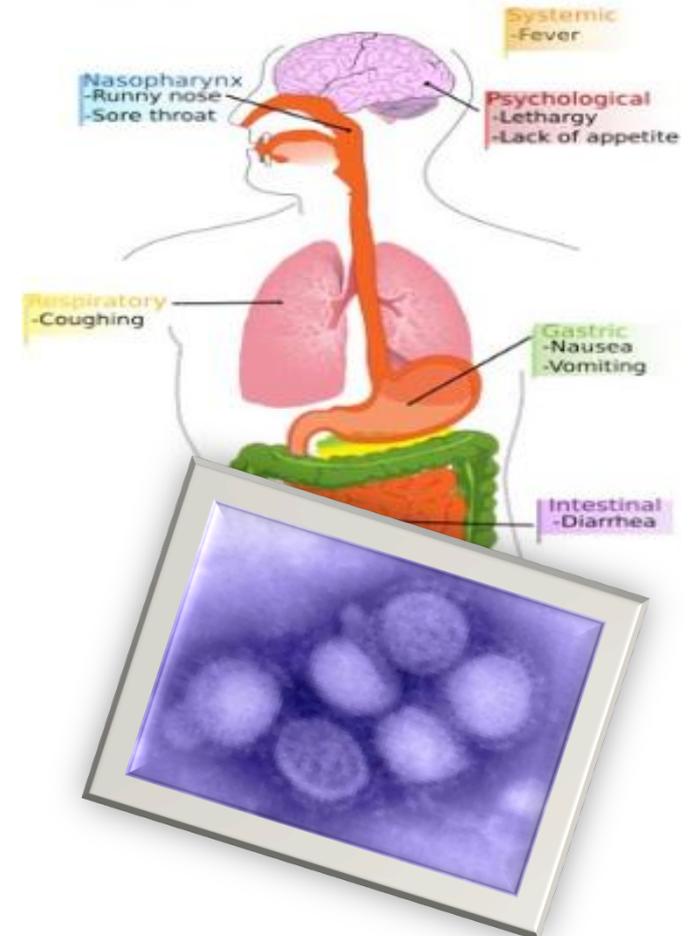
Caused by **enveloped ssRNA** animal viruses

- Epidemic of an influenza **virus** that spreads on a worldwide scale, infecting many people.
- In contrast to regular seasonal influenza epidemics, pandemics occur less frequently, with the 1918 **Spanish flu** the most serious pandemic in recent history.
- Pandemics can cause high levels of mortality. Spanish flu was responsible for deaths of 50 - 100 million people worldwide.
- ~ Three influenza pandemics in each century for the last 300 years.
  - Most recent ones:
    - **Asian Flu** in 1957
    - **Hong Kong Flu** in 1968
    - **Swine Flu** in 2009 - 2010
- Occur when a new strain of **influenza virus changes** in a way that allows it to be transmitted to humans from animals (especially pigs, chickens and ducks).
- These new strains are unaffected by immunity people may have to older human flu strains, so can spread rapidly.

Where does the influenza virus hide?

Lots of places, including ducks, chickens, pigs, whales, horses & seals.

## Symptoms of Swine Flu



**What is a  
zoonosis?**

## Disease Please:

# Ebola Virus Disease

(a.k.a. Ebola Hemorrhagic Fever)

Caused by **ssRNA** animal viruses, a filovirus

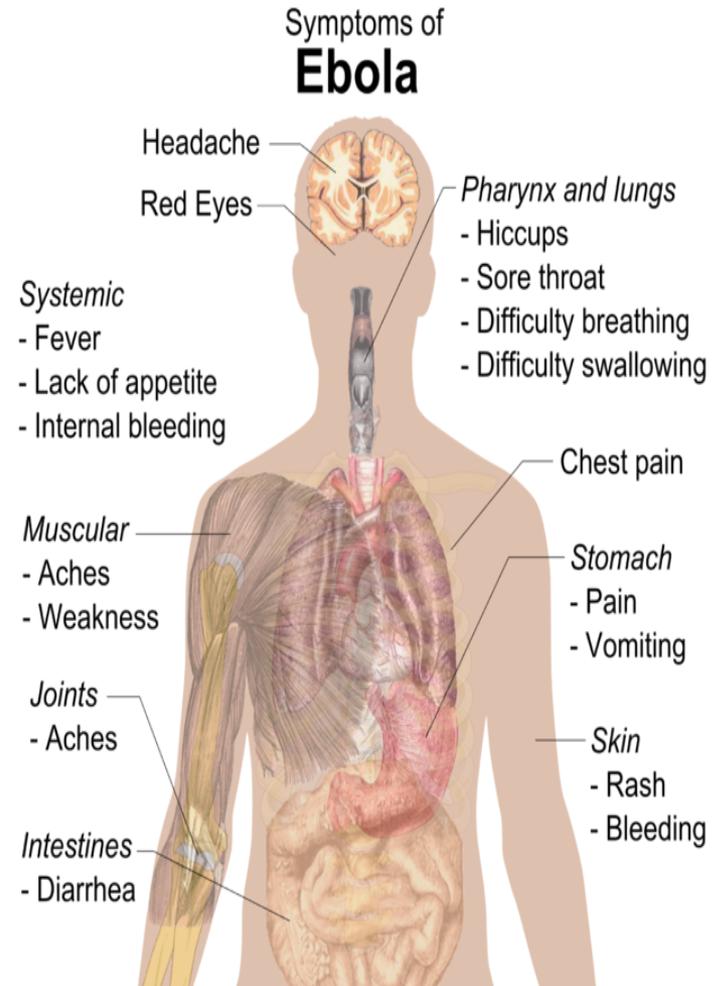
- Causes severe, often fatal hemorrhagic fever in humans and other mammals.
- Appeared in 1976 in 2 simultaneous African outbreaks.
- 2014 Ebola epidemic largest in history, more than 10,000 deaths.

## Transmission

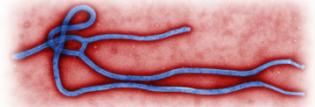
- From wild animals, spreads in human population.
- Direct contact with bodily fluids of infected people and animals, and contaminated surfaces.
- Health-care infected when precautions not strictly practiced.
- Traditional African burial ceremonies can play a role in transmission.
- People remain infectious as long as body fluids contain the virus. Recovered males can transmit through semen for up to 7 weeks after recovery.

## Where does the Ebola virus hide?

May be present in more animals than previously thought, including chimpanzees, gorillas, fruit bats, monkeys, antelopes, porcupines, rodents, dogs, pigs and humans.



# Ebola virus disease



Ebola, which first appeared in outbreaks in Sudan and DR Congo in 1976, is a severe and often fatal disease with no known specific treatment or vaccine. It has since killed more than 1,500 people in parts of Africa.

## SOURCE

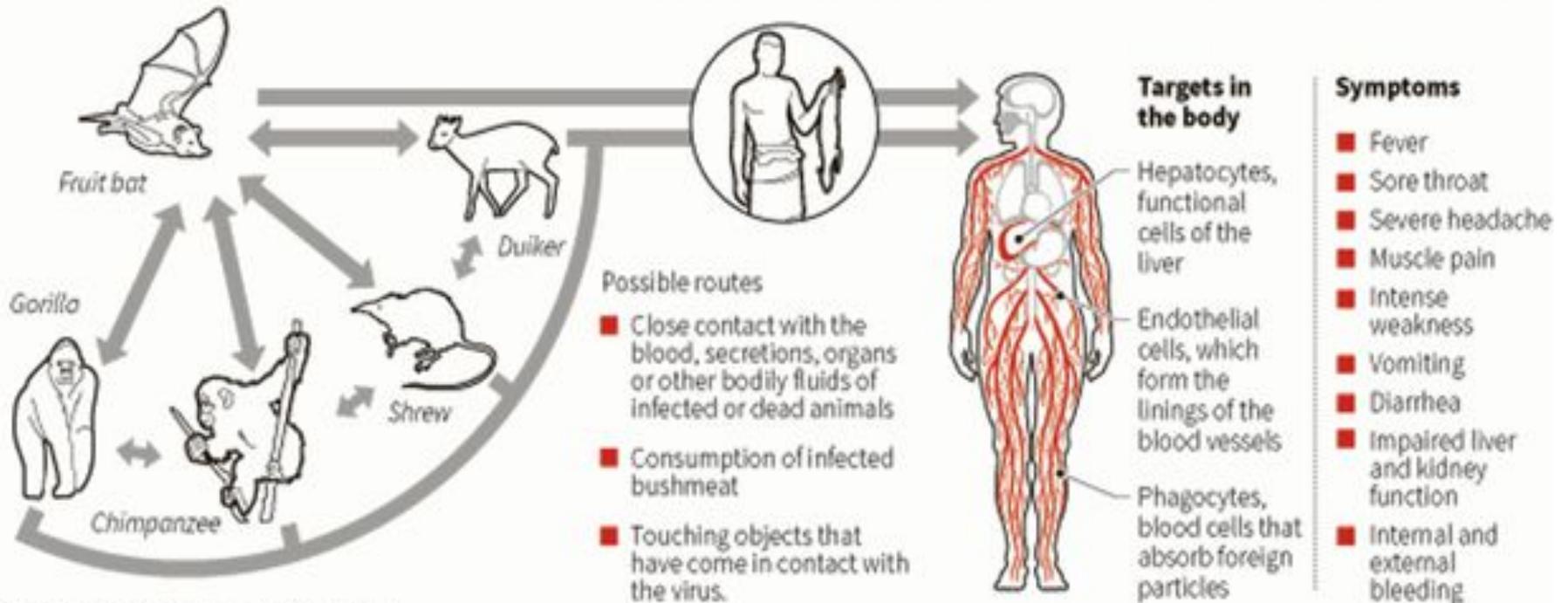
In Africa, particular species of fruit bats are considered possible natural hosts for Ebola virus.

## TRANSMISSION

Infected bats are thought to transmit the disease to humans, or indirectly through other animals which are hunted for their meat.

## DAMAGE

Incubation period is from two to 21 days. Death from the disease is often caused by multiple organ failure and tissue death.



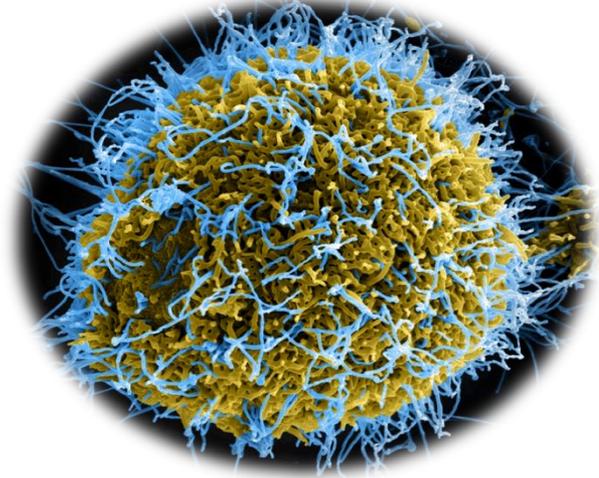
Note: List of animals is not exhaustive.

Sources: Centers for Disease Control and Prevention; World Health Organisation

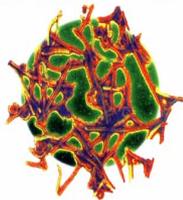
© CDC Images: 10/10/2014

© CDC Images: 10/10/2014

# Disease Please: Ebola



## THE HOT ZONE



A TERRIFYING TRUE STORY  
RICHARD PRESTON

## WEST AFRICA Ebola Outbreak



**1st Ebola outbreak  
in West Africa**

4 countries:

- Guinea
- Sierra Leone
- Liberia
- Nigeria



**Likely host = bats**

Ebola is fatal in

**55-60%**  
of cases reported  
in this outbreak.



U.S. Department of  
Health and Human Services  
Centers for Disease  
Control and Prevention

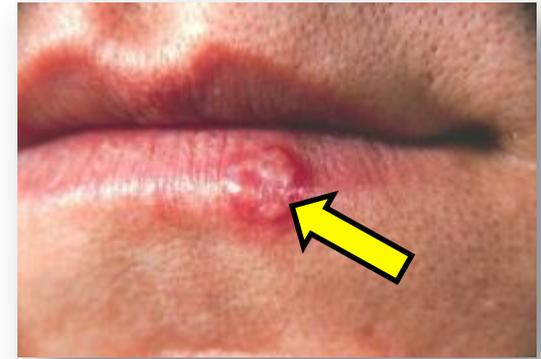
Images: Vero cell budding Ebola viruses,  
[Public Health Image Library #17768](#),  
[Ebola outbreak poster](#), CDC; [BLS-4 hazmat suit](#), Wiki

From the [Virtual Microbiology Classroom](#) on [ScienceProfOnline.com](#)

# Disease, Please: Herpes

Caused by **enveloped dsDNA** animal viruses

- Name derived from the Greek word herpein ("to creep"), referring to the latent, recurring infections typical of this group.
- Eight known herpes viruses infect humans (Human herpes viruses 1 - 8).
- Often cause blistery lesions in the skin and mucous membranes.
- Herpesviruses can exist in **latent** and **actively replicating** forms.
- Antiviral treatments treat active infection but do not cure latent viral disease.
- The following are herpesviruses:
  - **Herpes simplex virus 1:** associated with mouth chancre sores (HHV-1 aka HSV-1).
  - **Herpes simplex virus 2:** causes genital lesions (HHV-2 aka HSV-1).
  - **Varicella zoster:** causes chicken pox & shingles (HHV-3 aka VZV).
  - **Epstein-Barr virus:** causes infectious mononucleosis & is associated with Burkitt's lymphoma (HHV-4 aka EBV).
  - **Cytomegalovirus:** can be silent or cause brain damage in newborns & blindness in AIDS patients (HHV-5 aka CMV).
  - **Roseola:** childhood infectious rash & can cause mono-like symptoms in adults (HHV-6 and HHV-7).
  - **Kaposi's sarcoma:** an AIDS-associated disease caused by one of seven known human cancer viruses (oncoviruses) (HHV-8 and KSHV).



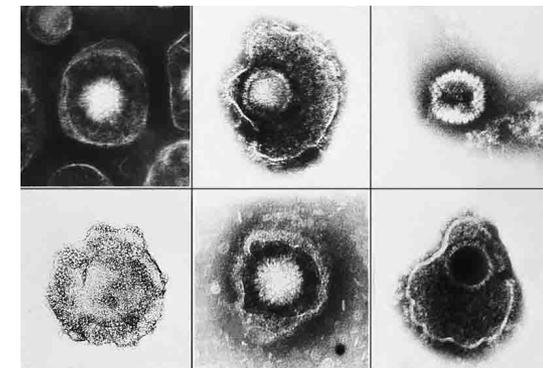
*"When I get a cold sore, I put Carmex on it, because Carmex is supposed to alleviate cold sores.*

*I don't know if it does help, but it will make them more shiny and noticeable.*

*It's like cold-sore-highlighter.*

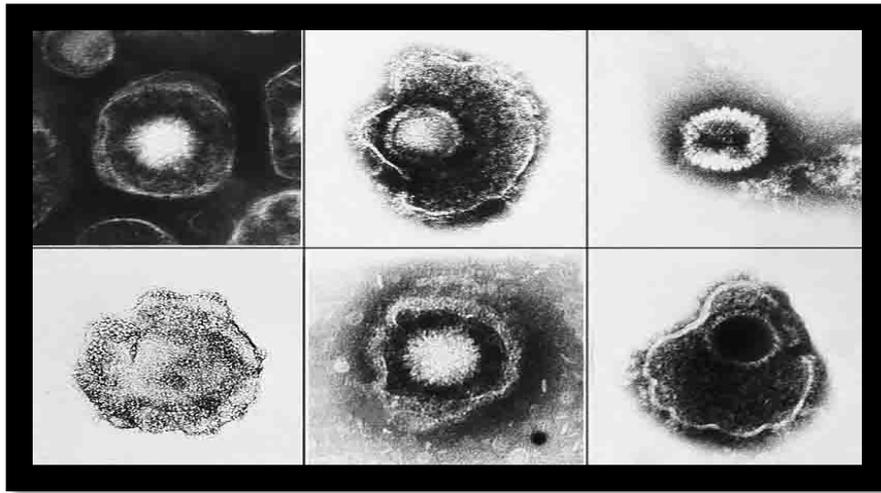
*Maybe they could come up an arrow that heals cold sores."*

– Mitch Hedberg



Review your understanding  
of viruses by viewing:

Animated lesson and quiz on  
Replication of  
Herpes Simplex Virus



Where do  
herpesviruses  
hide?

There are more  
than 130  
herpesviruses  
some are from  
mammals, birds,  
fish, reptiles,  
amphibians, and  
mollusks.

# Meet the Microbe: Human Immunodeficiency Virus

**Enveloped ssRNA** retrovirus

Can lead to acquired immunodeficiency syndrome (AIDS).

Virus infects human immune system cells.

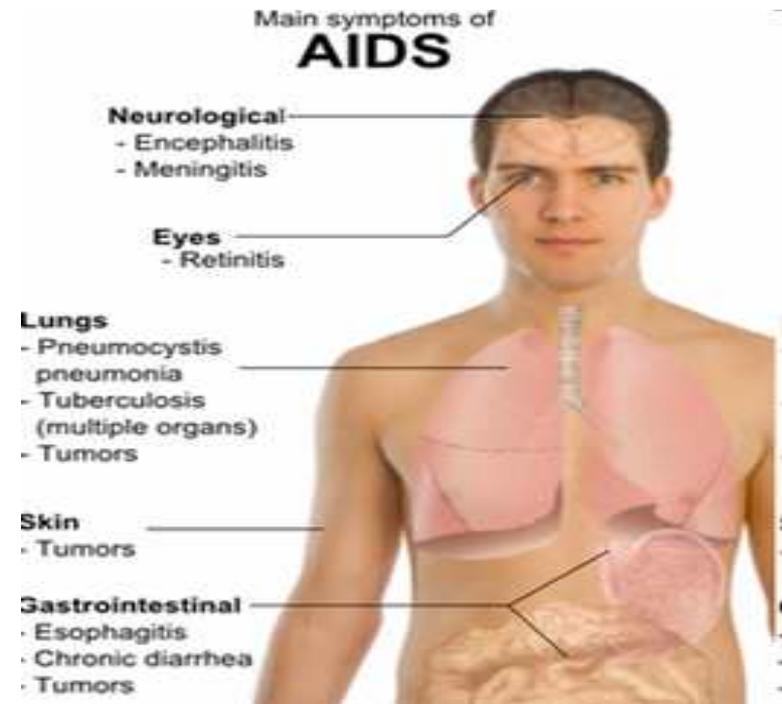
**Origin:** Sub-Saharan Africa during early 20<sup>th</sup> century.

## Symptoms / Course:

- Long and variable incubation time.
- Collection of infections and tumors resulting from damage to host immune system.
- Although treatments exist to slow the virus progression, there is no known cure.

**Transmission:** Direct contact with a bodily fluid containing HIV (blood, semen, vaginal fluid, shared needles and breast milk).

**Incidence:** Since start of epidemic > 60 million people infected, and > 30 million have died from AIDS.



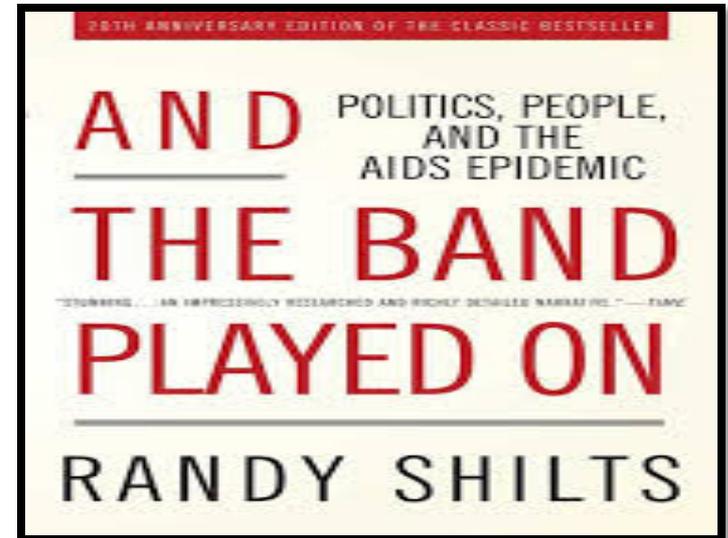
# History of HIV & AIDS

Named in 1982, first cases of AIDS were in gay men and injection drug users with no known cause of impaired immunity.

Some AIDS associated opportunistic illnesses:

- *Pneumocystis carinii* pneumonia (PCP) - fungal
- Coccidioidomycosis - fungal
- Cryptosporidiosis, intestinal - protozoan
- Herpesviruses
  - \* Cytomegalovirus disease (CMV)
  - \* Herpes simplex (HSV-1, HSV-2)
  - \* Kaposi's sarcoma tumors (HV8)
  - \* Varicella zoster (VZV)
- Histoplasmosis - fungal
- Mycobacterium avium complex - bacterial
- Tuberculosis - bacterial
- *Salmonella* septicemia - bacterial
- Toxoplasmosis of brain - protozoan

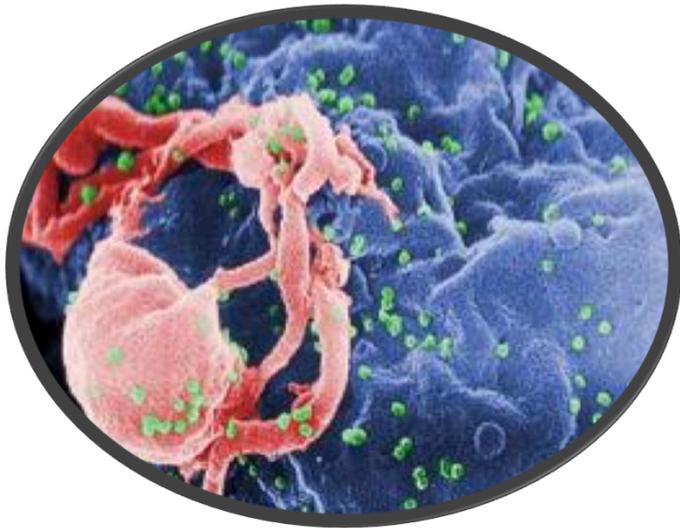
To learn about beginning of the AIDS pandemic read the bestselling book "*And the Band Played On*".



Everything comes from somewhere...

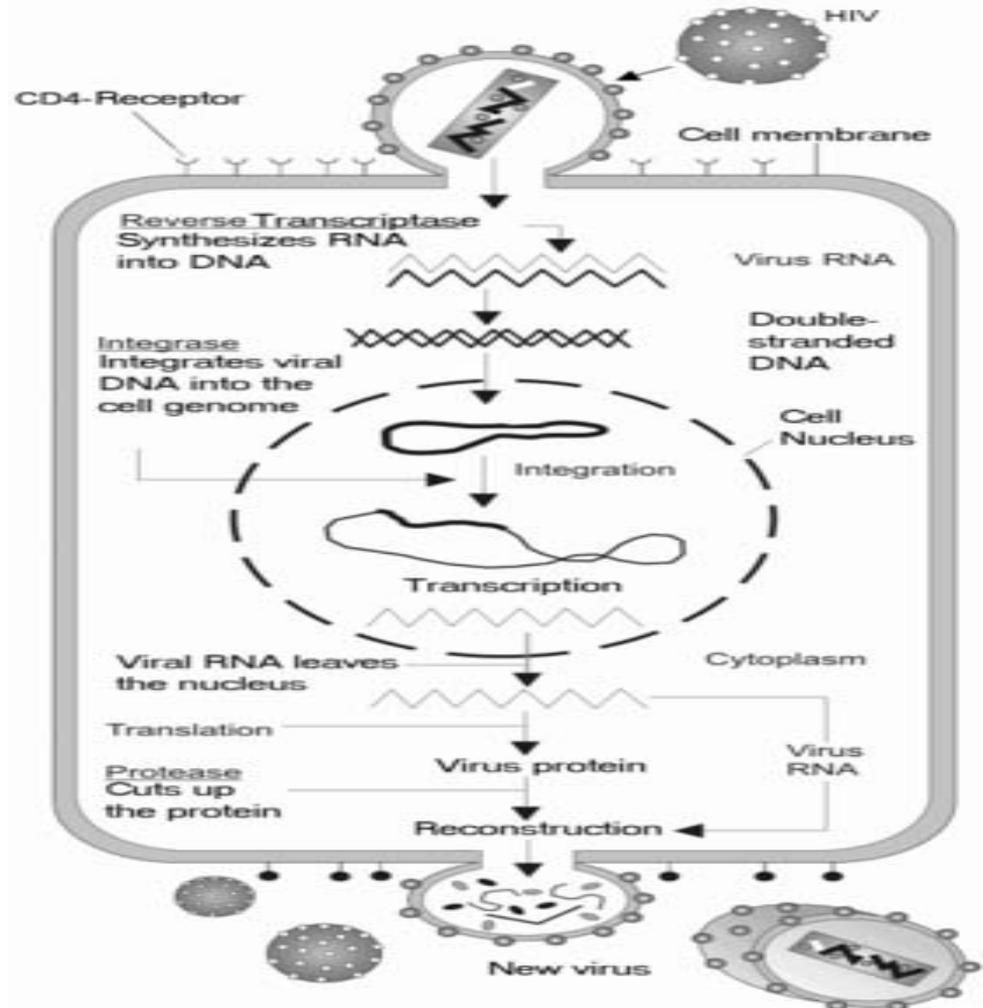
***Where did HIV come from?***

Listen to the  
RADIOLAB podcast  
**"Patient 0"** to find out.



## Where does the HIV virus hide?

Primates have a similar disease SIV, that ultimately gave rise to the HIV epidemic.



**REVIEW!**

HIV Replication  
animation and quiz from  
McGraw-Hill.

# Disease, Please: Common Cold

Caused by **nonenveloped ssRNA** animal viruses

Most colds caused by Rhinoviruses (genus) and Coronavirus (a group within a genus). But more than 200 different viral types can cause colds. That is why vaccination not practical.

**AKA:** Nasopharyngitis, acute viral rhinopharyngitis, acute coryza (say coe-rize-ah).

## TRANSMISSION:

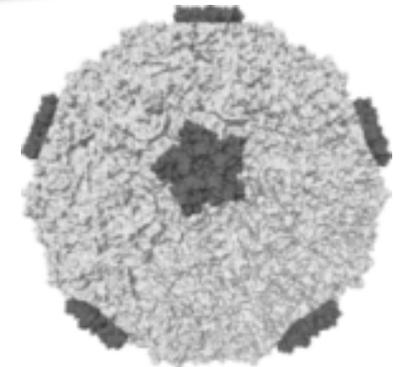
1. Spreads from infected persons through air-borne droplets, direct contact with nasal secretions or **fomites**.
2. Infects cells of the nasal and adenoid mucous membrane.
3. Trick infected cells into making more cold viruses, which are then transmitted as you sneeze or touch things with hands contaminated with nasal secretions.
4. When your body catches on, inflammation occurs as body tries to rid itself of virus. It's at this point that you get fever and other cold symptoms.

**SYMPTOMS:** Sore throat, runny nose, nasal congestion, sneezing and cough; muscle aches, fatigue, malaise, headaches, muscle weakness, and loss of appetite. (Fever and extreme exhaustion more commonly associated with influenza).

**COURSE:** Symptoms usually resolve after ~ 1 week, but can last up to two.

Can cold viruses hide?

They can't. Only infect humans, but like most diseases, were probably of animal origin (zoonoses).



# Disease, Please: Measles, Mumps & Rubella

Caused by **enveloped ssRNA** viruses

Common childhood infectious diseases before widespread vaccination.

If contract as an adult, illness is more severe.

All three are highly contagious, spread by air-borne droplets.

**MMR vaccine** is given 2x in childhood and once in adulthood.

**Measles:** Classic symptoms include 3 day fever, itchy rash, and the three C's: coughing, coryza (runny nose), and conjunctivitis (red eyes).

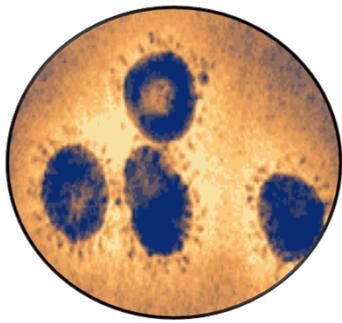
**Mumps:** Painful swelling of the salivary glands with fever. Testicular swelling and rash may also occur.

**Rubella** (German measles): Symptoms usually mild; similar to flu, plus a rash that starts on face and spreads to trunk and limbs. Can cause birth defects if mother contracts rubella during pregnancy.

Where do these virus hide?

No known animal reservoir.

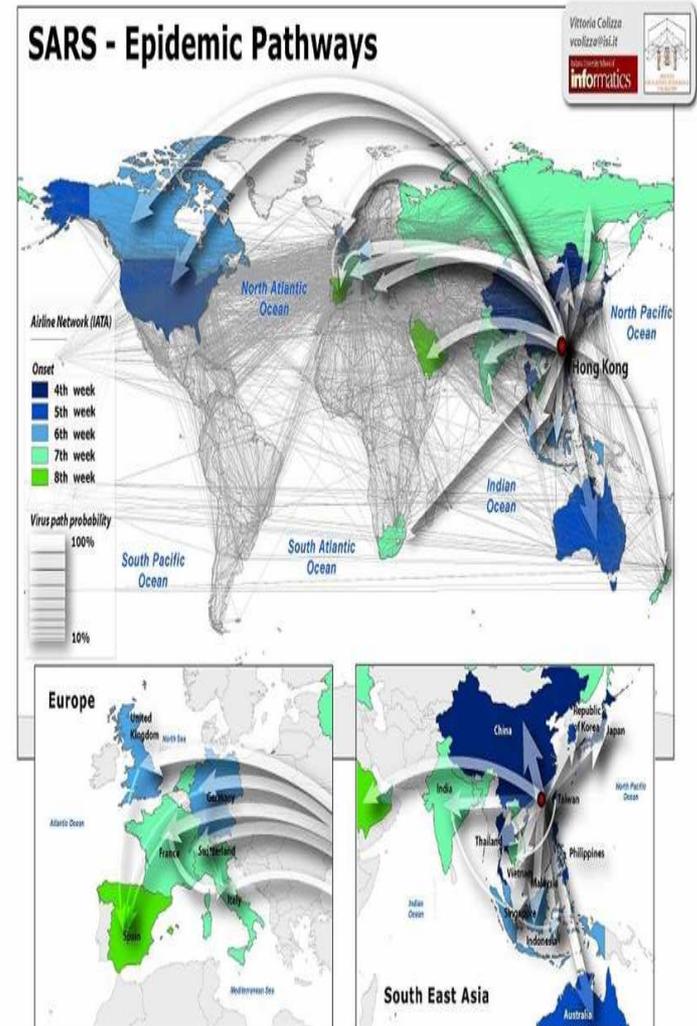




# Disease, Please: SARS

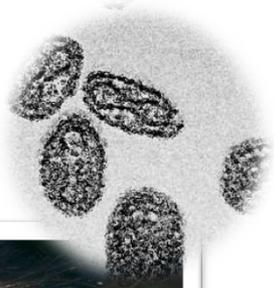
- Severe acute respiratory syndrome caused by the SARS coronavirus, an **enveloped ssRNA** virus.
- One near pandemic to date, with 8,096 known infected cases and 774 deaths (fatality rate of 9.6%).
- Within a matter of weeks in early 2003, SARS spread from a province of China to infect individuals in 37 countries.
- Majority of those who became sick were household contacts and **health care workers**.
- Scientists in the Netherlands demonstrated that the SARS virus fulfilled Koch's postulates, confirming it as the causative agent. In their experiments, macaques infected with the virus developed the same symptoms as human SARS victims.

Where does SARS hide?  
Bats.



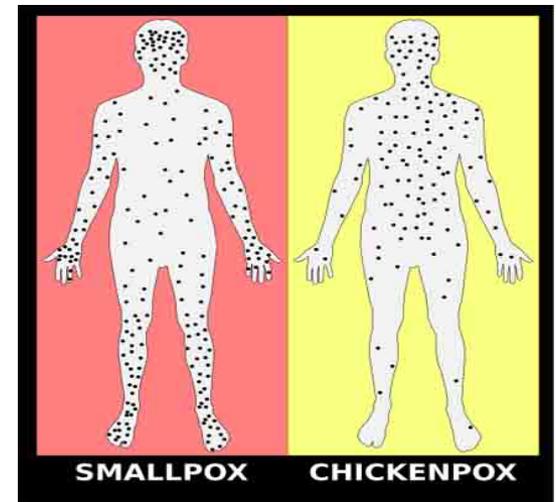
# Smallpox

Can smallpox viruses hide?  
They can't. Only infect humans.



Caused by **enveloped dsDNA** animal virus.

- Caused two airborne virus variants, *Variola major* and *Variola minor*.
- Deadly disease that, in survivors, can cause disfigurement and blindness.
- Approx 500 million deaths worldwide in the 20<sup>th</sup> century.
- Eradicated in 1979 though widespread vaccination.
- Now still possible weapon of bioterrorism.
- Watch this short National Geographic [video on Smallpox](#).



# Meet the Microbe:

## HPV (Human Papillomavirus)

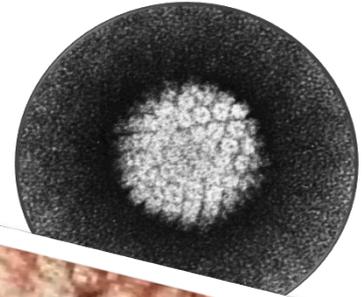
**Nonenveloped dsDNA** virus

- Highly contagious sexually transmitted infection caused by several sub-types of the human papillomavirus.
- Many types of HPV. Most harmless, but some cause genital warts, and a subset of those can cause cancer: of cervix, vulva and vagina in women; anus and penis in men. Can also cause cancers of head, neck and anus.
- Genital warts often occur in clusters and can be very tiny or can spread into large masses in the genital area.
- Two vaccines are available to prevent infection by some HPV types: Gardasil (Merck) and Cervarix (GlaxoSmithKline).
- Article HPV "[Vaccine Works for Boys: Study Shows First Clear Benefits](#)", Science News, Feb. 2011.

Where does HPV virus hide?

Numerous animal species.

Centers for  
Disease  
Control  
[HPV vaccine  
Q & A](#)



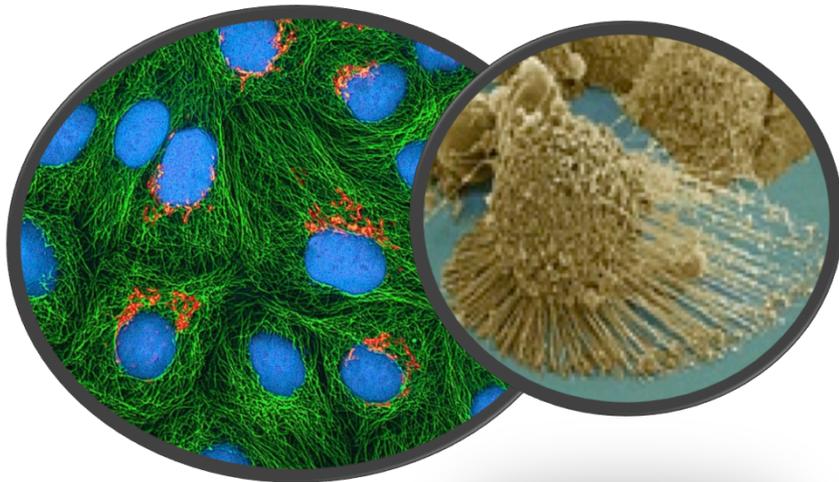
**WATCH THIS!**

Dr. David Agus  
explains the  
[risks of HPV and  
benefits of vaccination.](#)

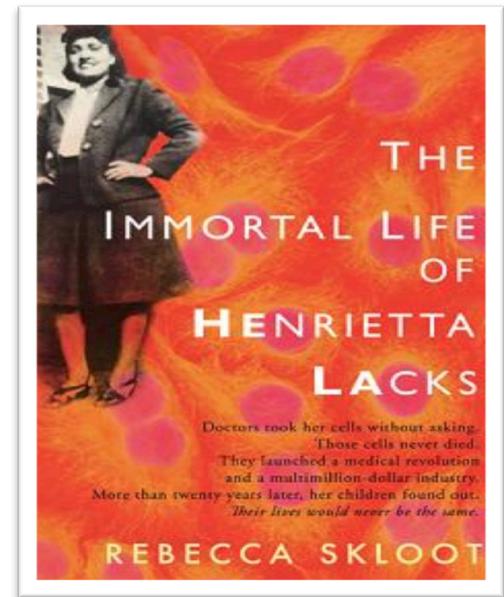
# Everyday Biology

Let's explore the amazing story of [Henrietta Lacks and her immortal cells](#).

**Q:** *What does the Henrietta Lacks story have to do with our lectures about cell biology and virology?*



[Watch a video of HeLa cells dividing in vitro.](#)

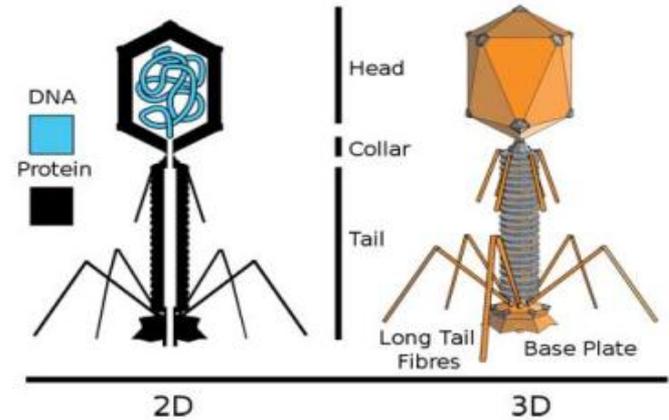
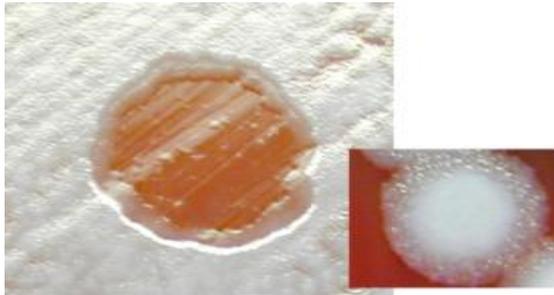


# Meet the Microbe: T4 Phage

## Nonenveloped dsDNA virus

(Not the true for all bacteriophages. Phages, as a group, can have ssRN dsRNA, ssDNA, dsDNA).

- A [bacteriophage](#) that infects *Escherichia coli* O157:H7, a cause of foodborne illness.
- The "O" in the name refers to the cell wall **antigen** number, whereas the "H" refers to the flagella antigen. **Q: What is an antigen?**
- **Phage Therapy:**
  - Phages in general have been investigated as medical therapy for disabling bacteria that cause human illness, since phages are much more specific than antibiotics.
  - "[Human Volunteers Receiving Escherichia coli Phage T4 Orally: a Safety Test of Phage Therapy](#)" by Anne Bruttin & Harald Brüssow, American Society for Microbiology, 2005.



**REVIEW!**

Steps in  
Replication of  
T4 Phage in  
*E. coli*

animation and quiz  
from McGraw-Hill.

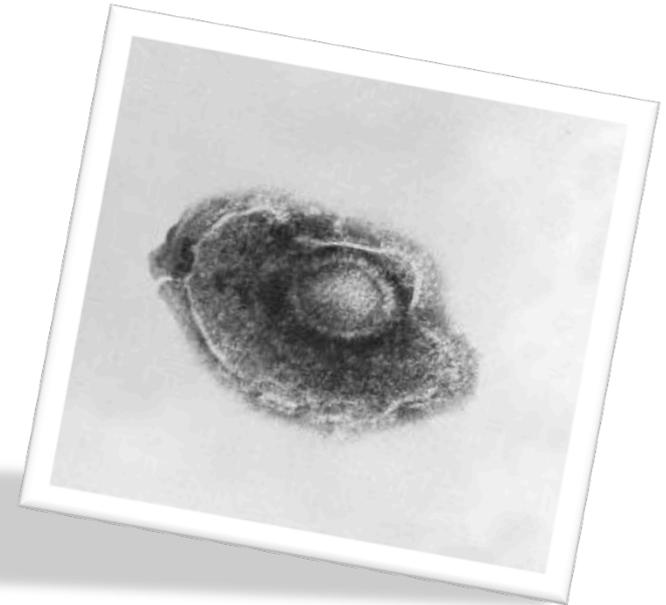
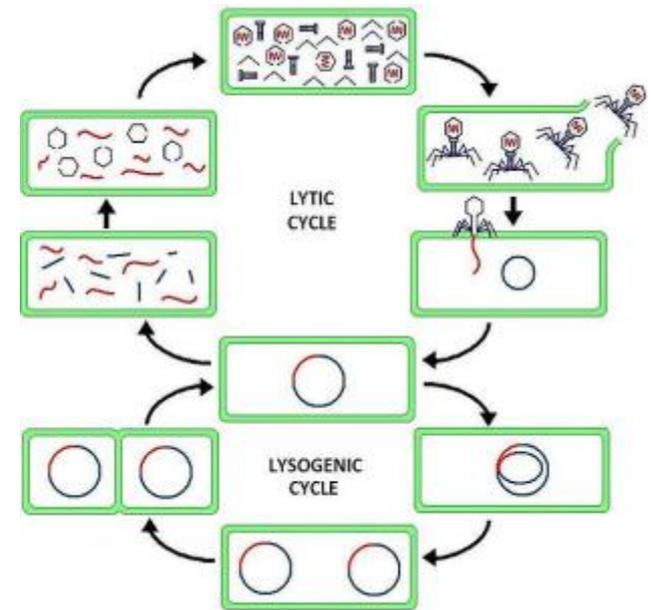
# Hidden Viruses

## Prophage

- When **bacteriophage** DNA becomes integrated into DNA of host bacteria.
- **Q:** What type of bacteriophage life cycle would a prophage be involved in?

## Latency

- When animal viruses remain dormant in host cells.
- May be prolonged for years with no viral activity, signs, or symptoms.
- Some latent **viruses** do not become incorporated into host chromosome.
- When viral DNA is incorporated into host DNA, condition is permanent; becomes permanent physical part of host's

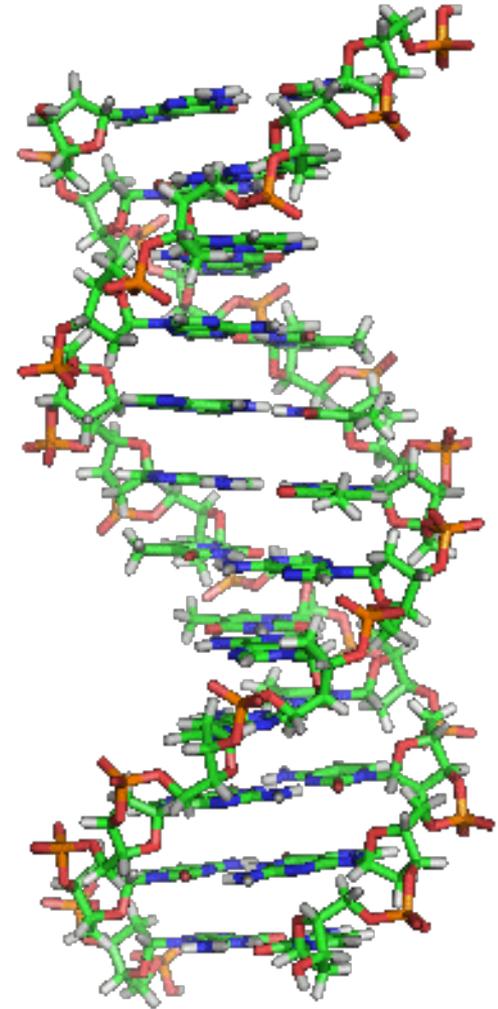


# Hidden Viruses

Genetic instructions of all **living things** are encoded in the nucleic acid DNA.

The genetic material of **viruses** is more varied: ssRNA, dsRNA, ssDNA or dsDNA.

**Q:** Only one type of genome allows a virus to become hidden. Which one?



# Modified "Live" Virus Vaccines vs "Killed" Viruses Vaccines

**Modified live virus vaccines** contain viruses that have been weakened (attenuated) in virulence, yet retain their antigenic properties to prompt an immune response.

MLV vaccines **must replicate after inoculation** to produce enough antigen to produce an immune response.

## ***Advantages:***

- One dose
- Quicker immune response
- Stronger, more durable response
- Fewer post-vaccine reactions

## ***Disadvantages :***

- Possible reversion to virulence
- Possible viral shedding
- Not recommended for pregnant animals
- Improper handling may inactivate

**Killed virus vaccines** contain viruses that have been treated by chemical or physical means to prevent them from replicating in the vaccinee.

## ***Advantages:***

- Safer
- No possibility for reversion
- Recommended for pregnant animals
- Stable in storage

## ***Disadvantages :***

- Multiple doses required
- Weaker immune response
- Shorter duration immune response
- Hypersensitivity reactions more common

# Confused?

Here are links to fun resources that further explain Microbiology:

- [Viruses: Meet the Microbes](#) Main Page on the Virtual Microbiology Classroom of [Science Prof Online](#).
- [HIV Replication](#) animation and quiz from McGraw-Hill.
- Play "[Sneeze](#)", an online game where the object is to infect as many people as possible with your coughs and sneezes.
- Play [Pandemic 2](#) a video game of strategy, where you try to become a successful pandemic microbe and infect the world. My 14-year old daughter and I recommend this one to you.
- "[Quarantine](#)" a scary movie about a new infectious disease.
- "[Comparison of Cold & Flu Symptoms](#)", article, by T. Port.
- "[Catch My Disease](#)" song by Ben Lee.

*(You must be in PPT slideshow view to click on links.)*

# Smart Links

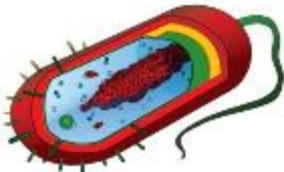


# Are microbes intimidating you?

*Do yourself a favor. Use the...*

## Virtual Microbiology Classroom (VMC) !

The VMC is full of resources to help you succeed,  
including:



- practice test questions
- review questions
- study guides and learning objectives

You can access the [Virtual Microbiology Classroom](#) (VMC) on the Science Prof Online website [www.ScienceProfOnline.com](http://www.ScienceProfOnline.com)

