SMITH
Life Science 11

Virology

Name:_____

Read the story below. Discuss with a partner after reading and write your thoughts about what is going on below the story.

In the early and mid-1700's many thousands of people were dying of a disease called smallpox. A pox is a blister-like skin sore. In the case of smallpox, these blisters are very small and itchy. Getting "the pox" meant almost certain death. **Variolation** was a technique used to try and reduce the occurrence of disease in those days. In this procedure, people were prepared through a fasting and feeding routine and then intentionally **inoculated** (treated a person) with pus from smallpox blisters to see if they survived. Some did, though they were scarred for life, many went blind because of the disease and so on, but they never suffered with smallpox again.

One survivor in England was Edward Jenner who became countryside doctor. Jenner observed that people who dealt first-hand with dairy cattle, such as the milkmaids, would get a similar kind of blister-like sore, yet they recovered, and never seemed to get sick with smallpox. He **hypothesized** (proposed an explanation) that cowpox, which the milkmaids got provided some protection from smallpox. Armed with this notion and an idea for an experiment, Jenner selected a potential patient – a young boy who had recovered from cowpox. Jenner intentionally infected the lad with smallpox and waited for a reaction. The boy never got sick!

Jenner had determined a relatively simple and harmless technique to prevent smallpox infection, and therefore the spread of the disease. Millions of lives were saved worldwide. Instead of inoculating with smallpox, which still caused great suffering and many deaths, he inoculated patients with cowpox from which patients survived generally with no ill effects.

His technique became widely accepted and was used for many different diseases where the **pathogens** (disease-causing organisms) were unknown or microscopic. Doctors were beginning to be able to prevent the spread of some diseases, even without knowing what caused them. The technique Jenner devised is still used today.

Discussion questions:

What do you think Jenner named the procedure/technique?

V accination

Would it be better to have cowpox or smallpox? Why?

cowpox b/c immune system can more easily control and destroy virus that causes cowpox than the one that causes smallpox. Immune system gets "used" to cowpox and can therefore fight smallpox better.

Variolation is now considered to be unethical. Why?

purposefully infect people w/ disease which is fatal

Many deaths

some that didn't die were scarred for life or went blind

Intro to Viruses

Smallpox is a virus. Viruses cause all pox diseases, including the Chickenpox.

The first virus to be discovered was the tobacco mosaic virus. (TMV).

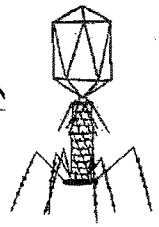
- Its discovery came from an exhaustive set of experiments to attempt to find out what was causing the blotchy appearance on tobacco leaves in some parts of Europe.
- WHY Tobacco though? long been noted as a very profitable crop; leaves w TMV not profitable.
- Many scientists contributed to finding more evidence about TMV and what exactly it was.
- An American biologist with an electron microscope was able to discover tiny, rod-shaped structures in the infected plants. These "things" were much smaller than bacteria and it was determined that they were the viruses.
- Knowledge about these pathogens grew rapidly as the causes of many other "mystery diseases" were being identified like influenza, mumps, rabies, and pox.

What is a Virus?

- A virus is a strand of viral hereditary information (mostly DNA or RNA) enclosed in a protein coat.
- A virus attaches itself to a healthy cell and injects its hereditary information into the cell.
- The virus uses the cell to make its identical offspring, and then it bursts the cell open, releasing all of the replicated viruses – this is called an active cycle.
- But sometimes the virus is not immediately active, and is called dormant cycle.

Alive or Not?

The following criteria identifies whether something is alive or not. Using these criteria, are viruses considered living?

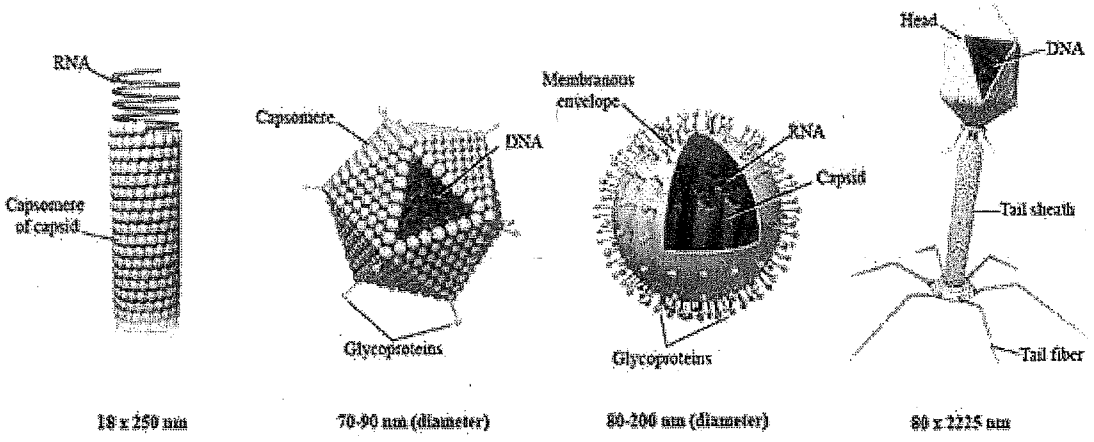
Characteristics of life:	Viruses are considered not living
Living things ... 1. Made of cells 2. Take in nutrients 3. Use energy 4. Produce waste 5. Respond to stimuli 6. Grow 7. reproduce	• They seem alive • They can kill and cause harm to the cell they infect • However... they can sort of "reproduce" and make copies of themselves 

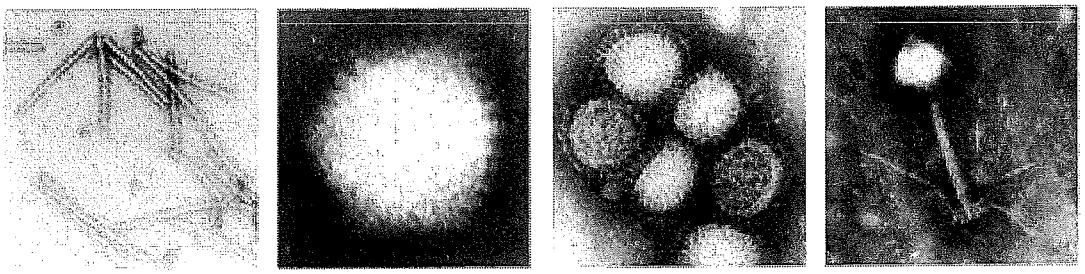
SMITH
Life Science 11

Virology

Name:_____

Structure of Viruses



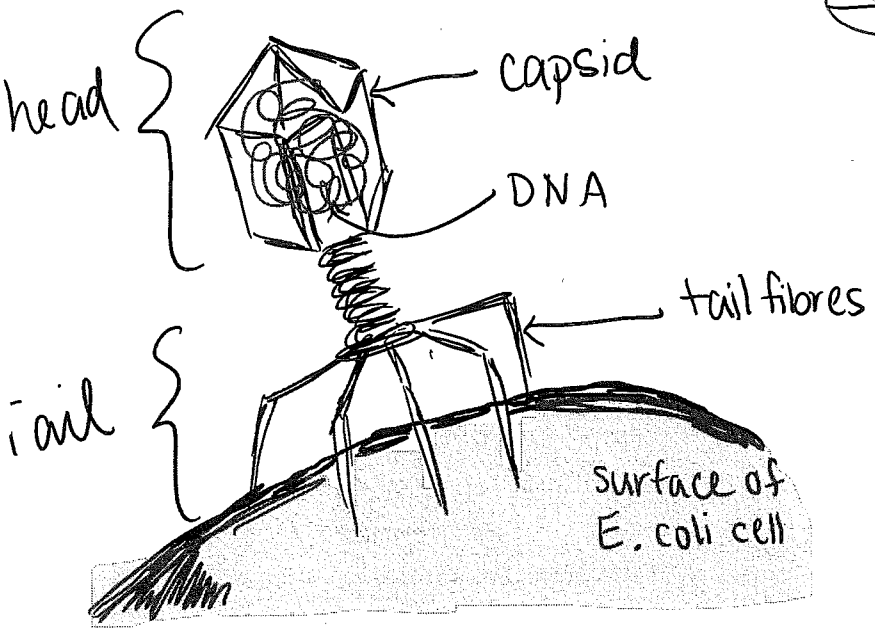


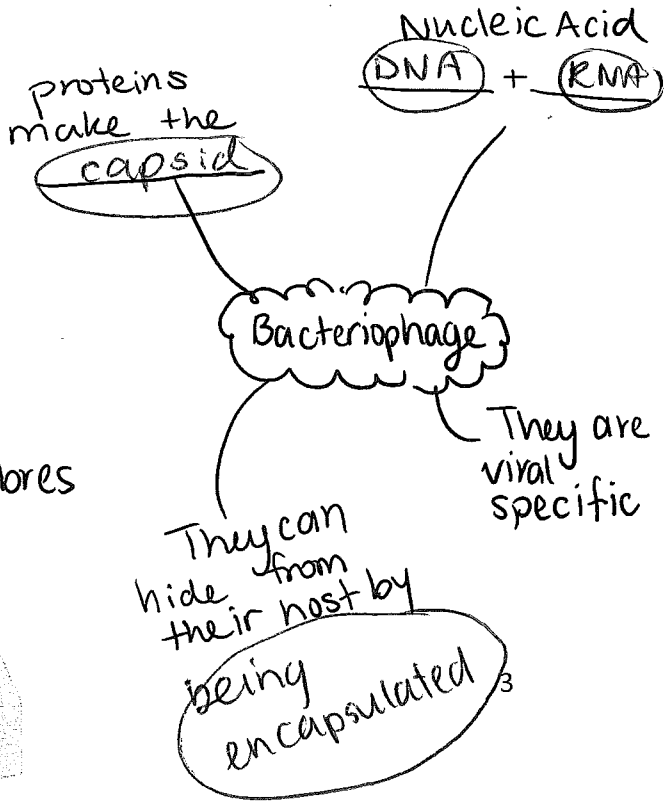
(a) Tobacco mosaic virus (b) Adenovirus (c) Influenza virus (d) Bacteriophage T4

Helical polyhedral spherical complex

- There are 4 general shapes of viruses. The more complex viruses tend to invade simpler cells, where the simpler viruses tend to invade more complex cells.
- A complex virus, bacteriophage, meaning killer of bacteria. Several of these viruses can land on a single bacterial cell at once.

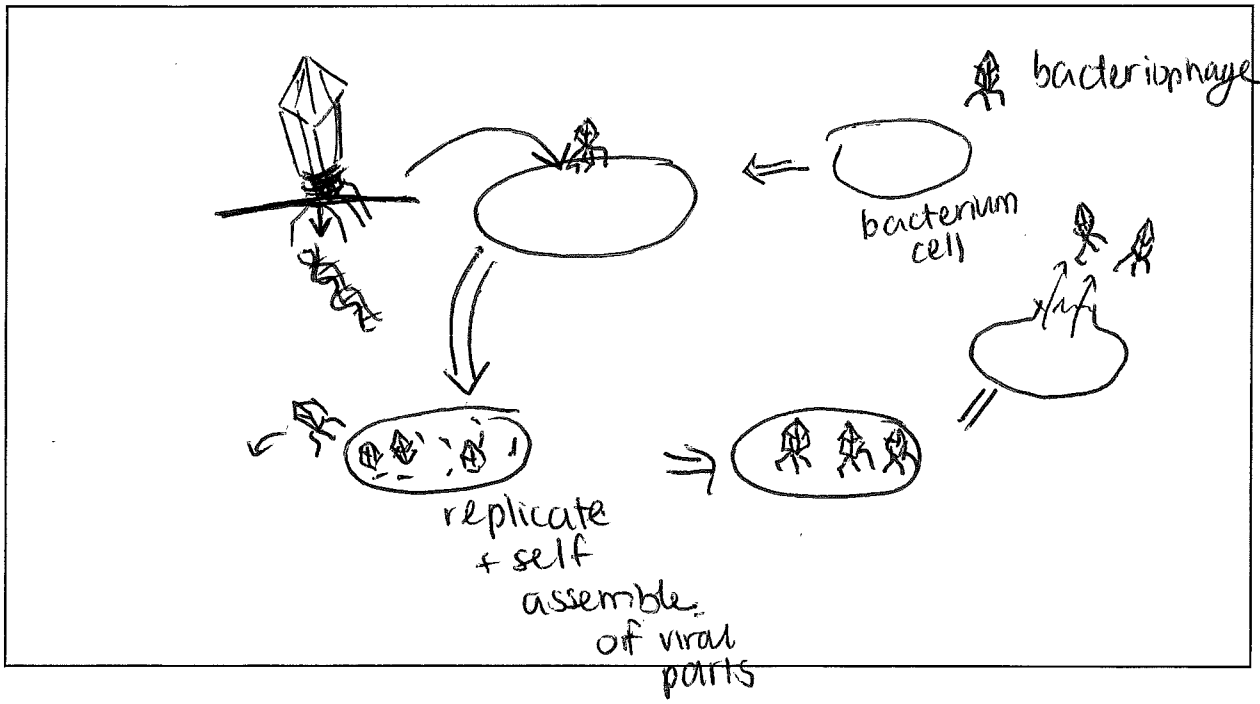
Bacteriophage T4 – or just call it T4

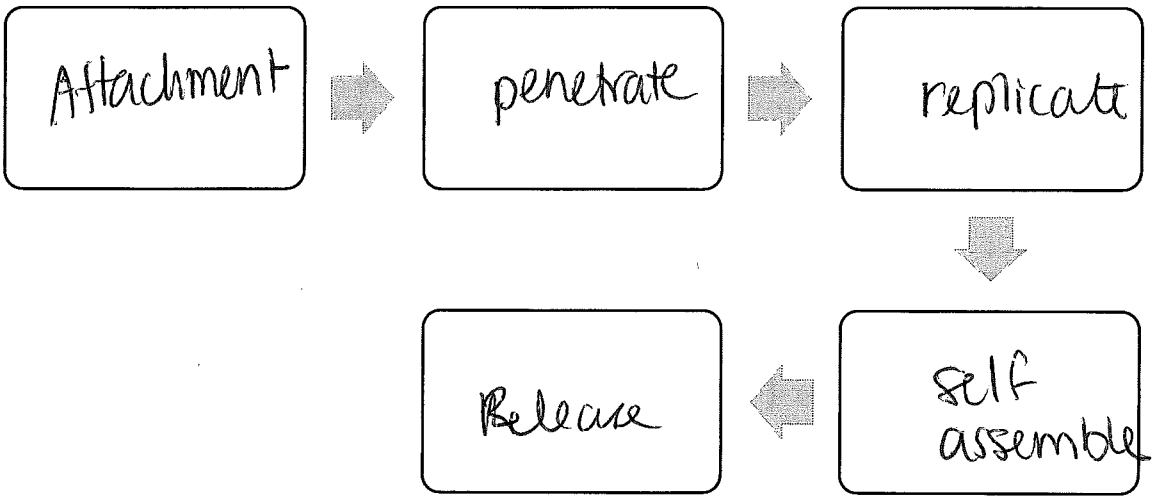




Viral Infection

Draw the **lytic cycle** with me and make notes along the way.



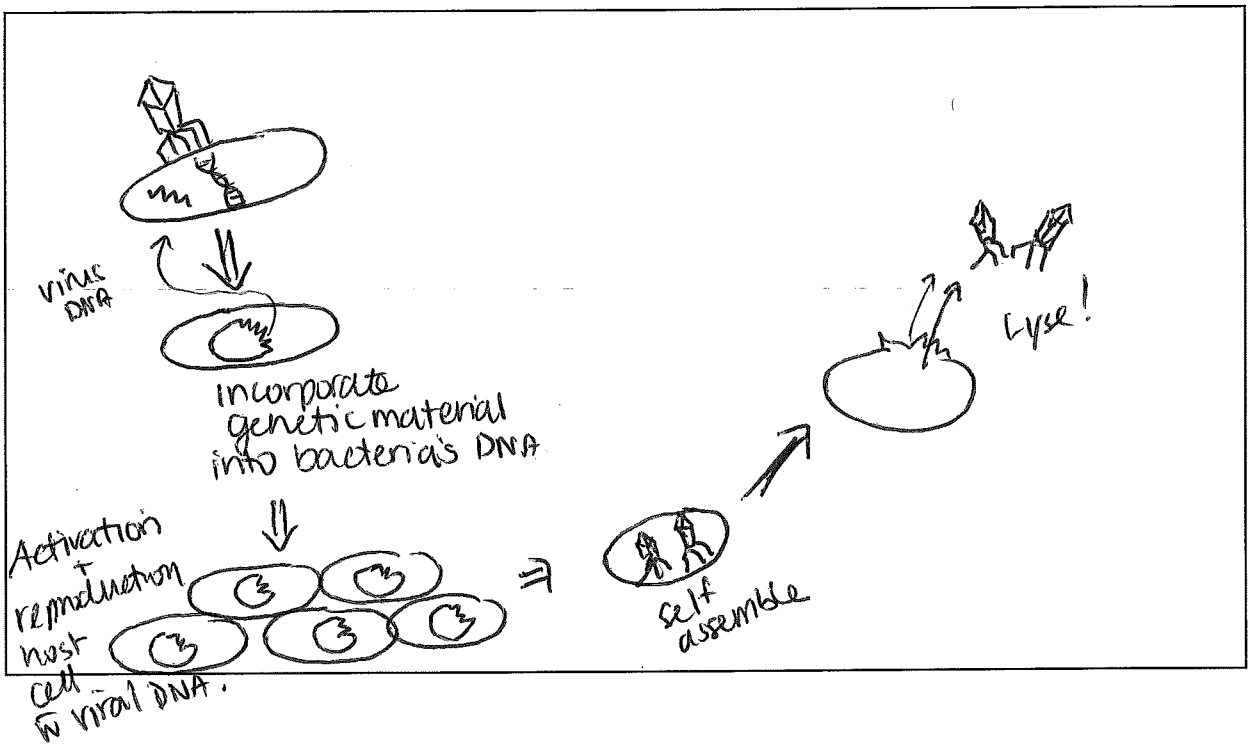


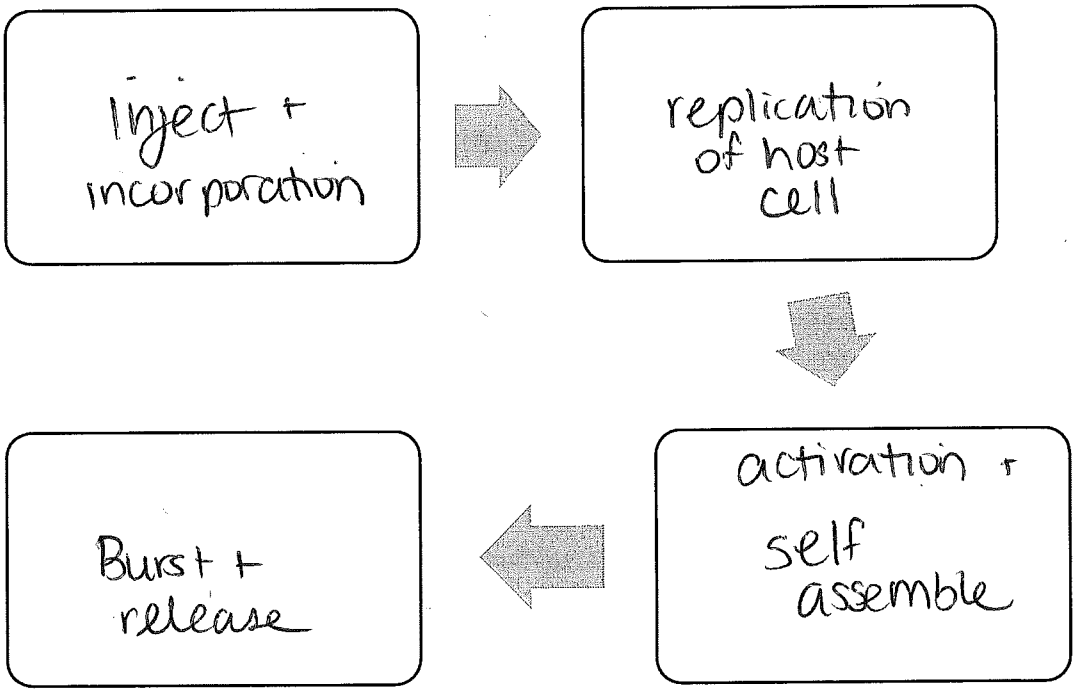
SMITH
Life Science 11

Virology

Name:_____

Draw the **lysogenic cycle** with me and make notes along the way.



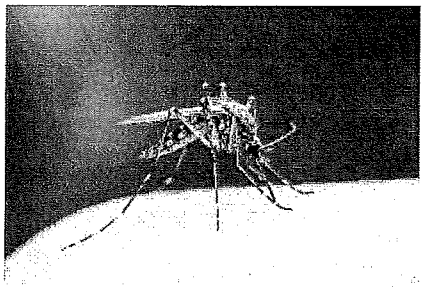


Effects of Viruses

There is no escaping viruses if they are present and can come into contact with cells by injecting viral nucleic acid, replicating and lysing of the cell, causing cell death.

Outbreaks of world epidemics such as HIV, West Nile, SARS, Ebola and more recently Zika keep them in the news and have promoted ongoing research.

- Viruses can be passed between organisms in numerous ways.
- **Vectors** like mosquitos are common culprits.
- Other viruses are **airborne** and spread through cough and sneezes
- Still some are transmitted by transfer of ~~Bodily~~ fluids (direct contact with person or contaminated surface)



Viral Specificity – The key to any viral infection is that the proteins of the viral capsid and the surface proteins of the cell's membrane must match up before penetration is possible.

Cells and organisms have numerous ways that help prevent this from occurring.

- Plants and fungal cells have cell wall
- Animals often have hardened exteriors like shells, scales, feather and so on

Once the viral nucleic acid gets through the barrier, cell infection can occur repeatedly.

What about humans?

1. *First line of defense:* skin

The biggest organ in our body is our skin. We have mucus membranes, sphincter muscles, and more to prevent pathogen entry into the body and to the blood.

2. *Second line of defense:* WBC's

Viruses that move past here initiate our WBC's. They will do their best to ingest and destroy the pathogens that got through and became activated. WBC's travel around the body identifying pathogens by whether they have certain antigens on their surfaces.

3. *Third line of defense:* Lymphocytes

A new WBC gets initiated. It is called a lymphocyte. They recognize the pathogen and then release proteins to isolate and destroy it. For example, it can release antibodies. It can also release interleukins which can increase body temperature and further activate more WBC's. This line of defense has good memory to recognize the pathogens to ward them off in the future.

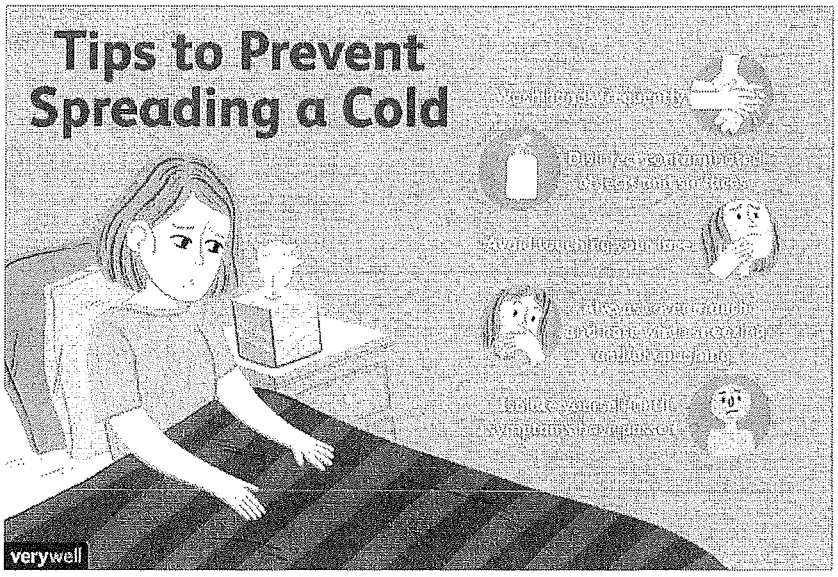
****** Scientists are starting to genetically engineer viruses that will infect diseased cells or disease-causing cells. Oncolytic cells are begin designed to attack and destroy cancerous cells.**

SMITH
Life Science 11

Virology

Name:_____

Reducing the Spread of Viral Disease



Treating is difficult

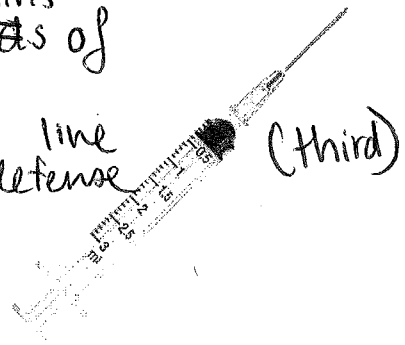
Viruses are metabolically inactive, but bacteria are not, and can be treated with **antibiotics**

Viruses do not do "much" – they are not considered living, so an antibiotic would not be able to treat what they are doing

Immunity

Vaccination techniques are being used to produce 2 kinds of immunity against pathogens.

Active Immunity: exists when weakened ~~strand~~strains of pathogen are injected into person. Recognition of particles activates tertiary line of defense (third)



Passive Immunity:

injection of antibodies giving person artificial capability of combating infection

Short lived - vaccines set immune up for rapid recognition and destruction of great # of infections

Herd Immunity:

- W/o vaccination
- vast majority get vaccinated
- so movement of pathogen hampered in population, so some may avoid infection.
- attractive solution for those w compromised immunity