• Viruses – “living organisms”?  
• Structure – usually consist of protein or lipid shell with attached protein “spikes”  
• “Spikes” called **Antigens**  
• Central protein core containing DNA or RNA nucleic acids; Living??  
• Some – bizarre head and tail structure
• Require a host cell to invade and use for reproduction of the virus
• Cell mutated/destroyed in the process
• Most viruses are specific as to the cell invaded
• Examples:
  • HIV invades specific White Blood Cell – destroys the cell and host’s immune system
  • HPV (Human papilloma virus) invades skin cells – mutates the cells to cause warts; can be genitals; cause cervical cancer
  • Rabies virus – brain
  • Common cold – respiratory tract
  • Influenza – digestive or respiratory tract
  • Hepatitis – Liver
  • Herpes – lips (cold sores); genitals
Viral Attack of Host Cell

- Virus enters by various modes of infection
- Virus locates host cell
Viral Host Cell Attack –
Step # 1

- Virus locates host cell
Step # 2

- Virus uses “spikes” to “burrow” into host cell membrane
- Viral core with nucleic acid is injected into the host cell
- Viral core uses enzymes to snip host cell DNA and insert itself, forever mutating the host cell DNA
Host Cell Fate – 2 Options

- Host cell forever mutated;
- **Option # 1**: Viral DNA copied during mitosis and passed to daughter cells
- Daughter cells may make mutant proteins
  - ex. warts
- Viral can lie dormant, sometimes for years
  - ex. HIV
Viral Host Cell Entry – Option # 2

• Virus can activate and use host cell to reproduce “baby viruses” – causes cell death
• Virus shoots only central core and nucleic acid material inside
• Protein shell remains outside and is harmless
• Virus uses cell nucleotide “spare parts” to build viral nucleic acids (genes)
• These use host cell ribosomes and amino acids to build protein shells – “baby viruses”
• Host cell explodes releasing viruses
• Cycle repeats
Recovery from a Virus

- Sometimes virus can be removed by immune system White Blood Cells
- Can engulf or produce proteins to disable the virus called **Antibodies**
- Antibodies bond with antigen spikes to prevent burrowing into host cell
- Example – recover from a cold, flu, chickenpox
- White blood cells “remember” how to make antibodies
- Irony of HIV?
Types of Viruses and Vaccines

- DNA Virus – has DNA nucleic core
- Stable virus; doesn’t mutate easily
- Examples: Polio, Chickenpox, Measles
- Easier to develop a vaccine
- Retro Virus – has RNA nucleic core
- Highly mutable
- What often mutates are Antigen “spikes”
- Examples: Influenza, HIV
- Harder to develop a vaccine
- Must “guess” what virus will “look” like
HIV Virus “Take-over” of White Blood Cell – Step # 1

Virus burrows in and injects its RNA core
Step # 2

- Viral RNA uses cellular “spare parts” to convert itself into viral DNA
- Uses an enzyme called: Reverse Transcriptase
Step # 3

- Cellular DNA is “snipped” with a restriction enzyme
- Viral DNA inserts into cellular DNA
Step # 4

- Viral DNA can remain dormant for years
- Or, can “activate” and use cellular “cell parts” to build viral RNA

Inside white Blood Cell
Step # 5

- Viral RNA uses cellular parts to bond amino acids to make its protein core, shell and antigens
- Uses protease enzymes to bond the amino acids
- Host cell ruptures
- Releasing "baby viruses"
How do Anti-HIV Drugs Work?

- “Triple cocktail”
- Can contain protease inhibitors
- How would these work?
- Can contain AZT – Azidothymidine
- “Fake” Thymine
- Acts a “stop sign” for conversion of viral RNA to viral DNA
- Means no insertion into cellular DNA
Role of AZT in HIV treatment

- Virus inserts its core, like normal
• Virus accidentally picks up an AZT nucleotide “spare part” instead of thymine
• Stops the conversion to viral DNA
Vaccine

- What’s in a vaccine?
- Often contain an “empty” shell or deactivated/nonharmful virus
- “Teach” WBC how to make antibodies
- “Real” virus enters and is quickly attacked and destroyed by WBC antibodies
Mutated Virus

- Will the same vaccine work?
- Retroviruses highly mutable
Recombinant DNA Technology (Genetic Engineering)

- Combining pieces of DNA from two different organisms to create some “new” and “improved” characteristic in an organism
- Example: Treatment for diabetes
- Used to get insulin from pig pancreases
- Insert the human gene that codes for insulin protein into bacteria (e. coli)
- Bacteria have circular chains of DNA called a **Plasmid**
- Bacteria become “insulin factories”
Gene Insertion into Bacteria

- Use a special virus called: **Bacteriophage**
- Virus that attacks bacteria
- Insert the human DNA gene coding for insulin protein into the phage virus
- Let the virus attack the e. coli bacteria
- Virus shoots in the human gene to insert into the bacterial plasmid
- Bacterial DNA is recombined with human DNA
- Called a **transgenic species**
- Bacteria can do protein synthesis and make insulin protein
- Bacteria stored in huge vats
- Insulin collected and bottled for human use
- Label will say of “recombinant origin”
More examples of Recombinant DNA Engineering

- Soybeans with genes inserted for immunity to Round Up herbicide
- Herbicides usually kill specific types of plants by interfering with cells’ ability to do protein synthesis to make cell walls and important enzymes
- Similar plants (ie. Dicots) are usually killed by the same herbicide
- Example: Grass/corn (Monocots) killed by a certain herbicide which probably wouldn’t kill a dicot (soybeans)
- Most weeds in farm fields are dicots; some grass (monocots)
- Corn with genes inserted for immunity to insects
- Monkeys with firefly “glow” genes
- Human genetic engineering example: Insert “healthy” genes into lung cells of cystic fibrosis patients