SNS COLLEGE OF TECHNOLOGY
(An Autonomous Institution)
COIMBATORE-35
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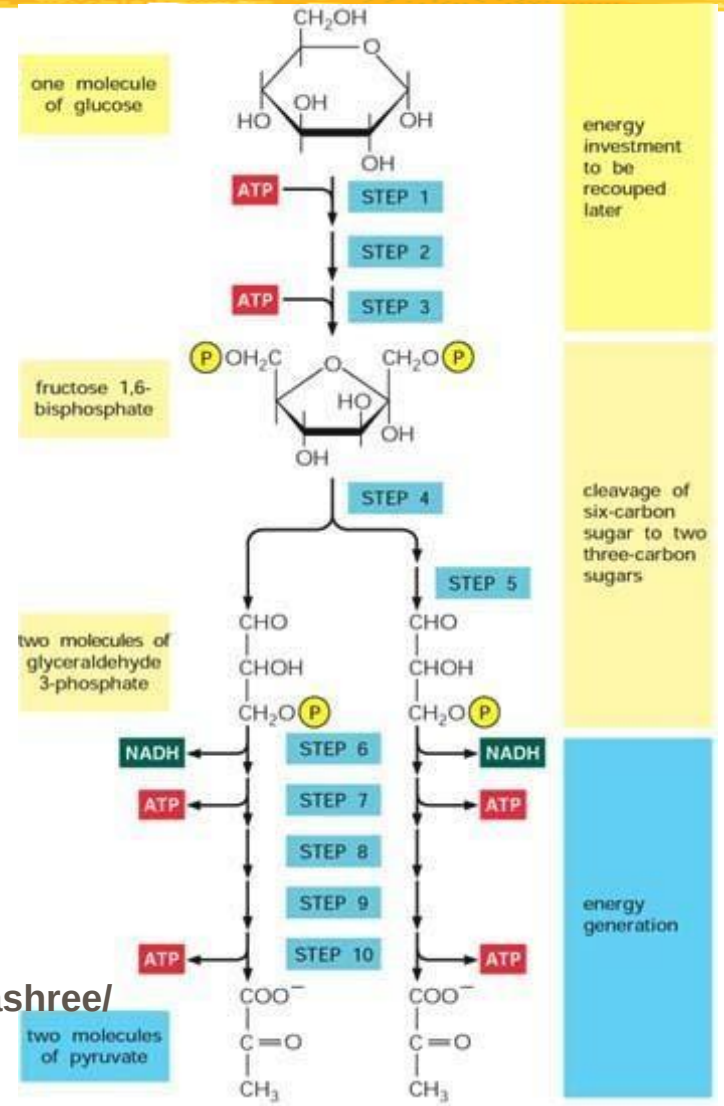
19GET277 / Biology For Engineers
IV YEAR / VII SEMESTER
UNIT-II: BIODIVERSITY

ECONOMIC IMPORTANCE AND CONTROL OF MICROBES

Using Microbes for a Variety of Everyday Applications

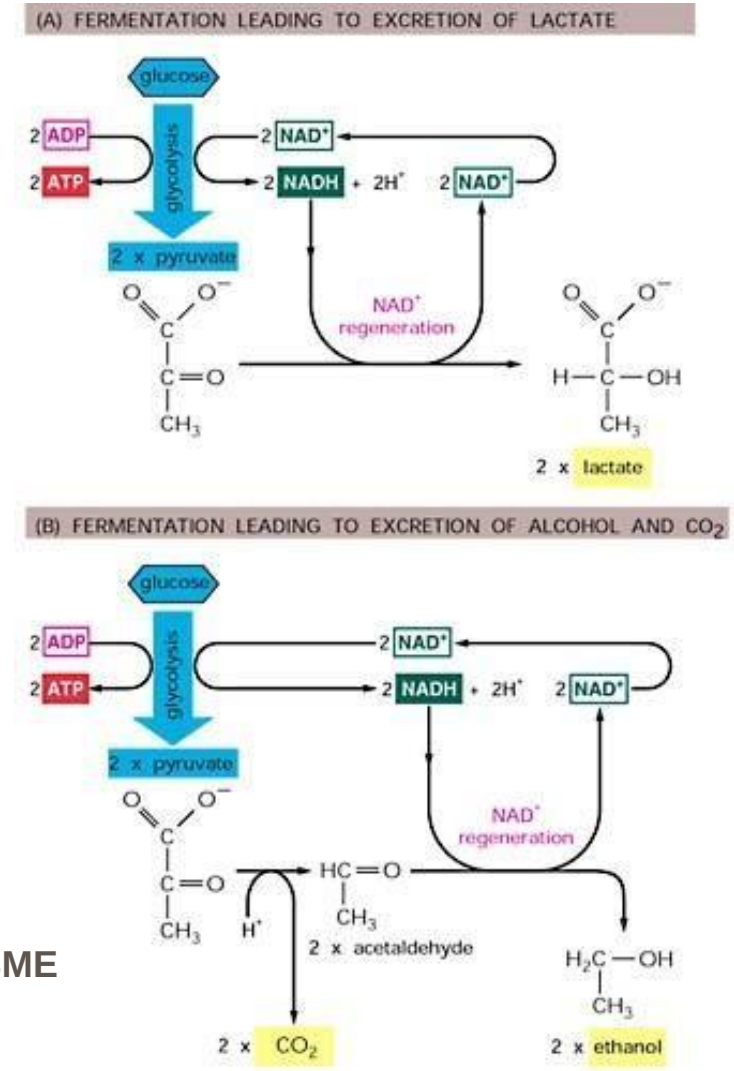
- Food Products
  - Energy production in bacteria
    - Aerobic or anaerobic



Using Microbes for a Variety of Everyday Applications

- Food Products
  - Fermentation

    (anaerobic respiration)
  - Lactic acid fermentation
    - Used to make cheese, yogurt, etc.
  - Ethanol fermentation
    - Used to make beer and wine

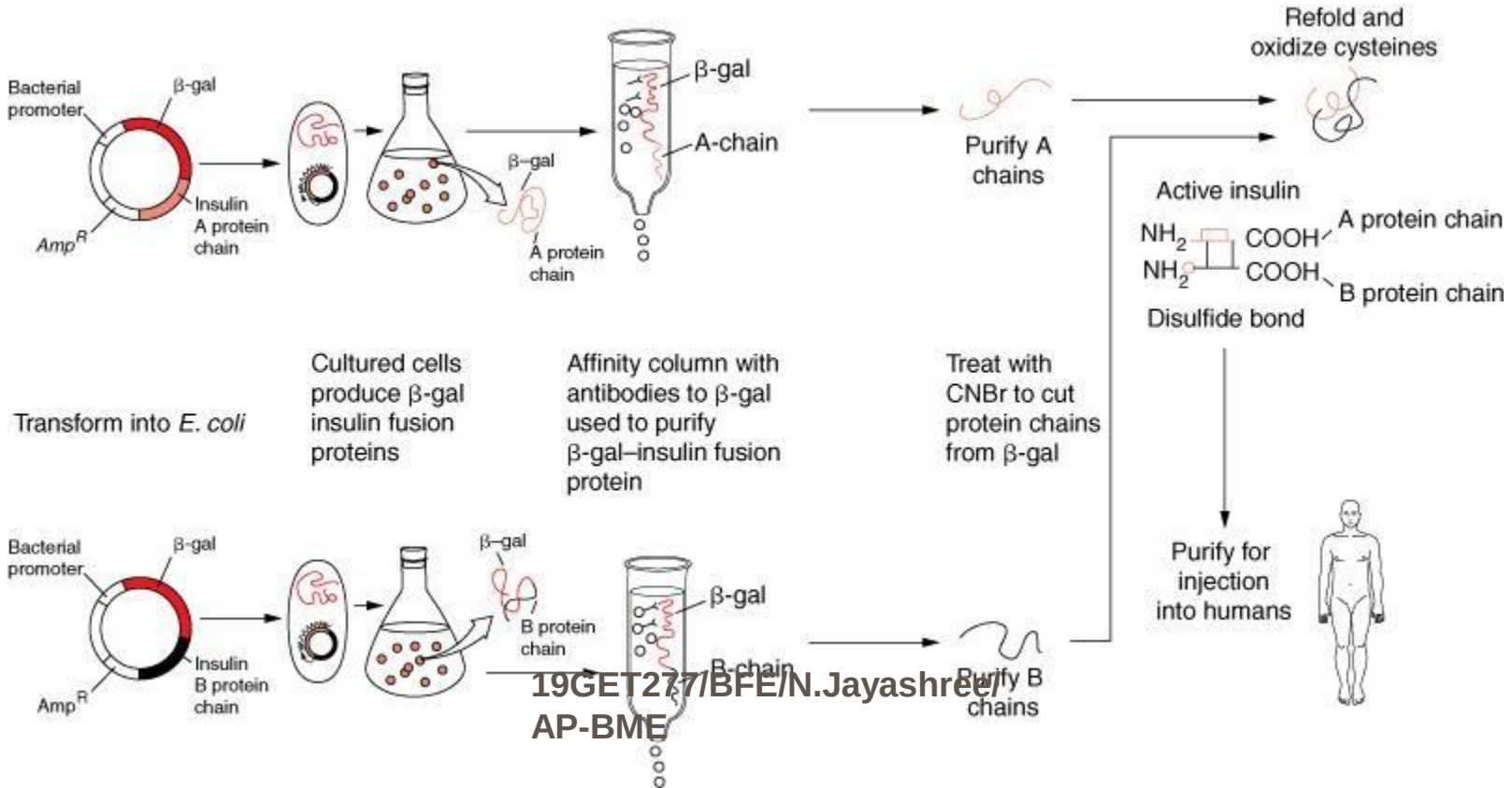


Using Microbes for a Variety of Everyday Applications

- Field Applications of Recombinant Microorganisms
  - Ice-minus bacteria (remove ice protein producing genes from P. syringae)
  - P. fluorescens containing the gene that codes for the bacterial toxin from Bacillus thuringiensis (kills insects) Bt toxin!

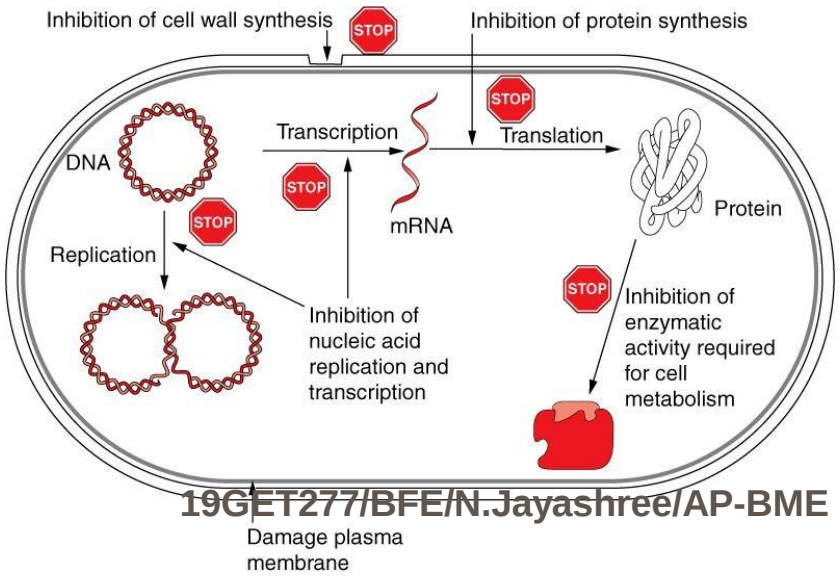
Using Microbes for a Variety of Everyday Applications

- Therapeutic proteins
  - Recombinant insulin in bacteria



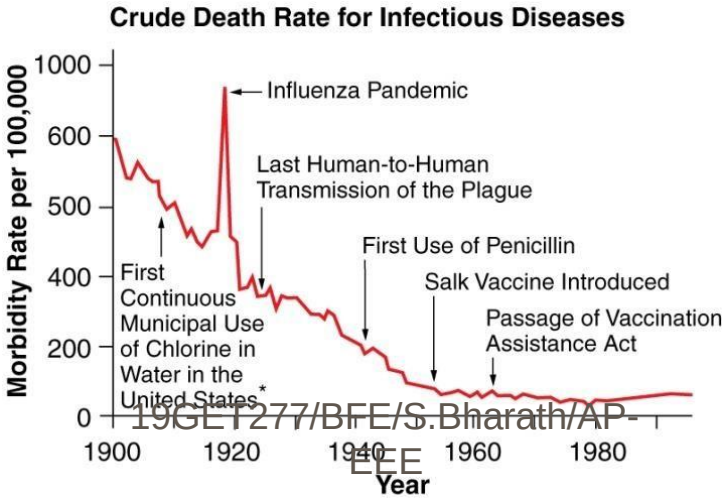
Using Microbes for a Variety of Everyday Applications

- Using Microbes Against Other Microbes
  - Antibiotics
  - Act in a few key ways
    - Prevent replication
    - Kill directly
    - Damage cell wall or prevent its synthesis



Vaccines

- First was a vaccine against smallpox (cowpox provides immunity)
  - DPT-diphtheria, pertussis, and tetanus
  - MMR –measles, mumps, and rubella
  - OPV- oral polio vaccine (Sabin)

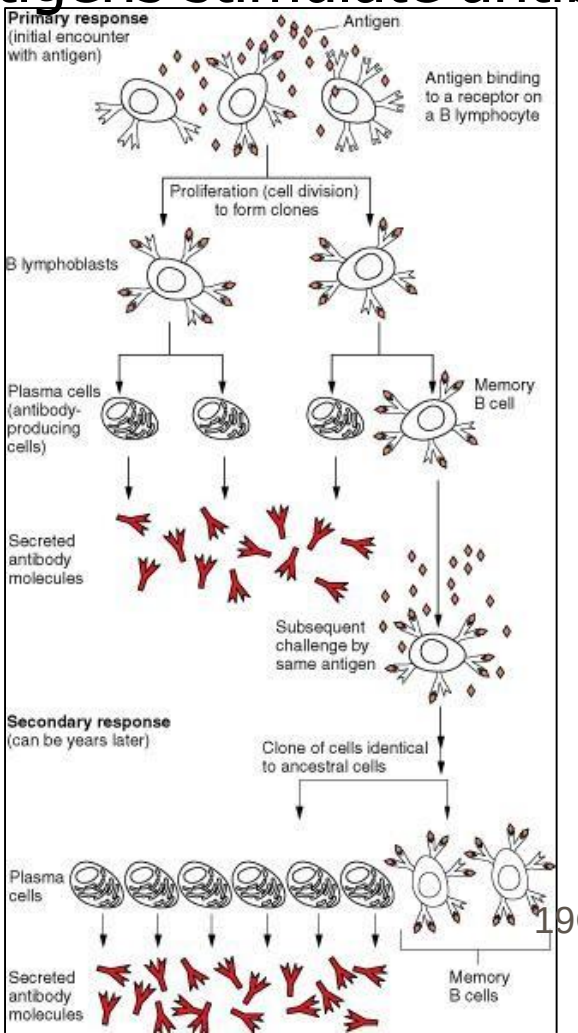


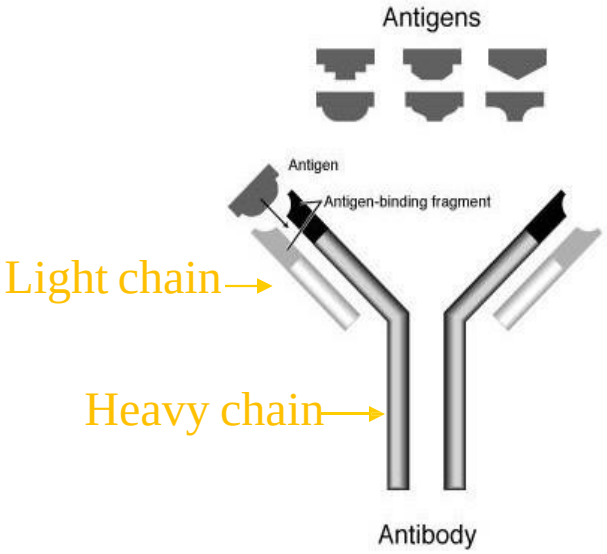
Vaccines

- A Primer on Antibodies
  - Antigen- foreign substances that stimulate an immune response
  - Types of leukocytes or white blood cells
    - B-lymphocytes: antibody-mediated immunity
    - T-lymphocytes: cellular immunity
    - Macrophages: “cell eating” (phagocytosis)

Vaccines

- Antigens stimulate antibody production in the immune system



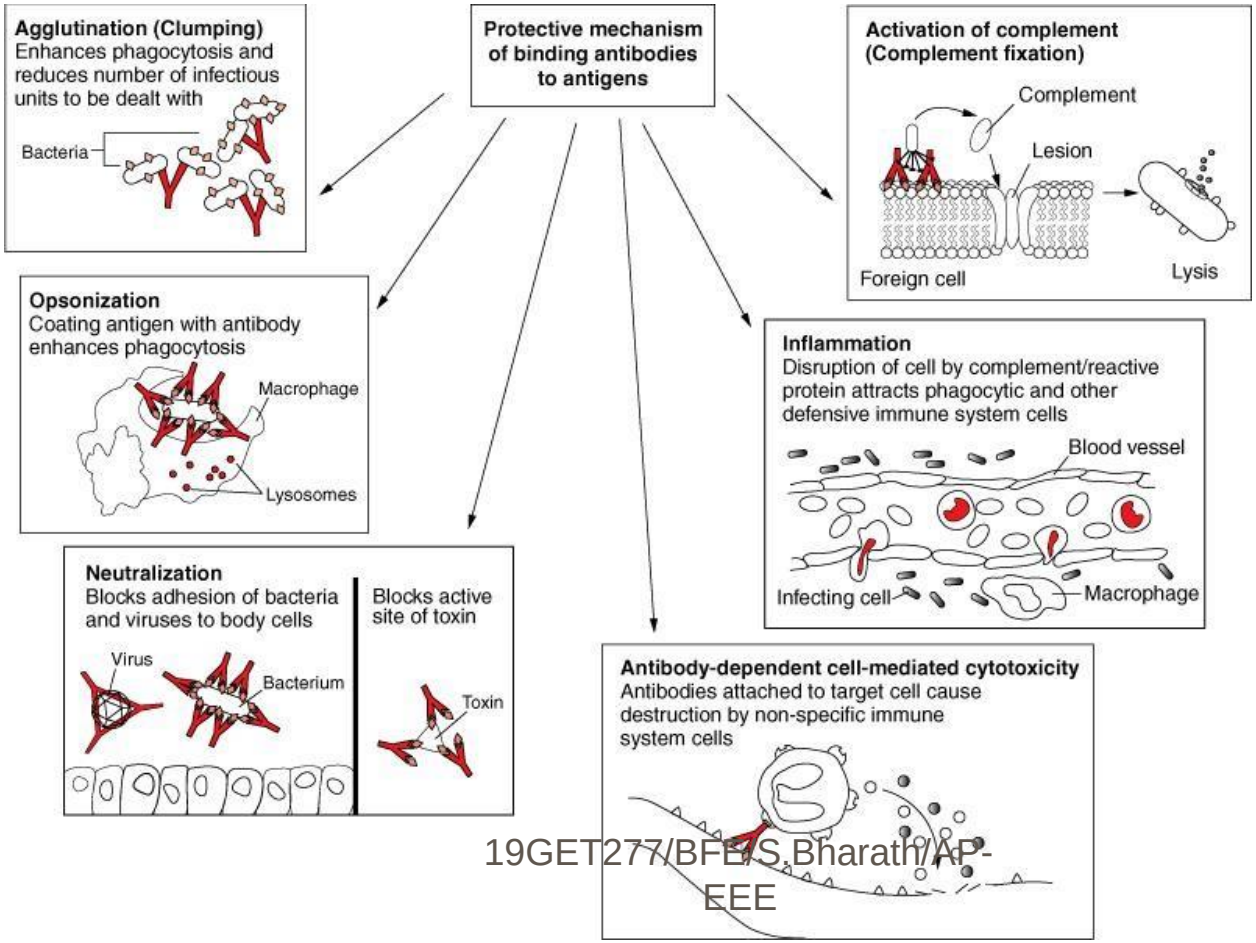


IgA – first line of defense

IgG and IgM – activates macrophages

Vaccines

- Mechanism of Antibody Action



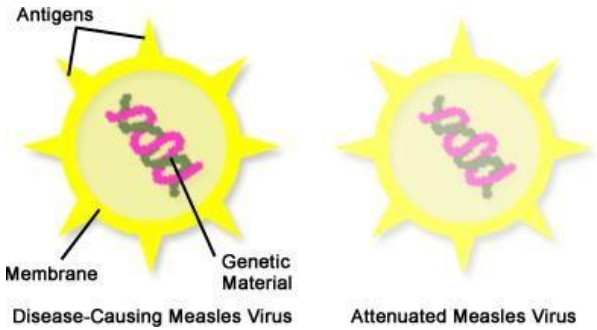
Vaccines

- How are vaccines made?
  - They can be part of a pathogen (e.g. a toxin) or whole organism that is dead or alive but attenuated (doesn't cause disease)
    - Subunit (toxin) or another part of the pathogen
    - Attenuated (doesn't cause disease)
    - Inactivated (killed)
- What about flu vaccines (why do we have to get a shot every year?)

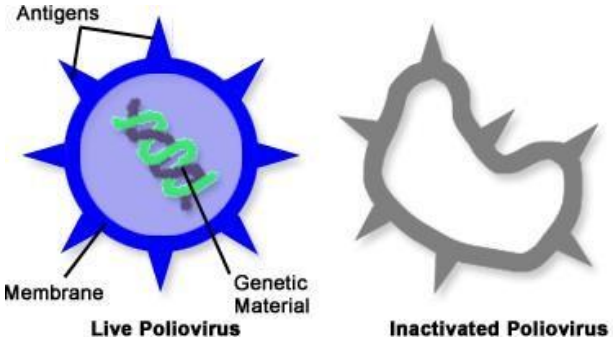
Recombinant Vaccines

- Vaccines – provide immunity to infectious microorganisms

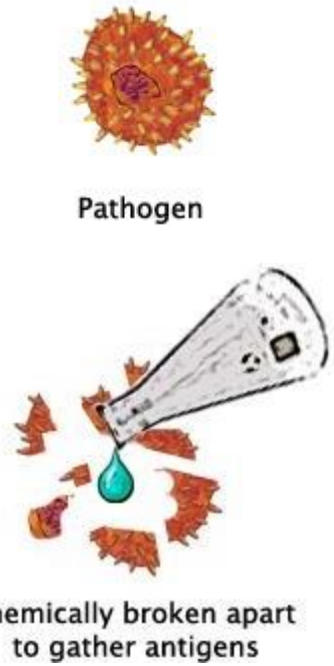
Attenuated Vaccine



Inactivated Vaccine

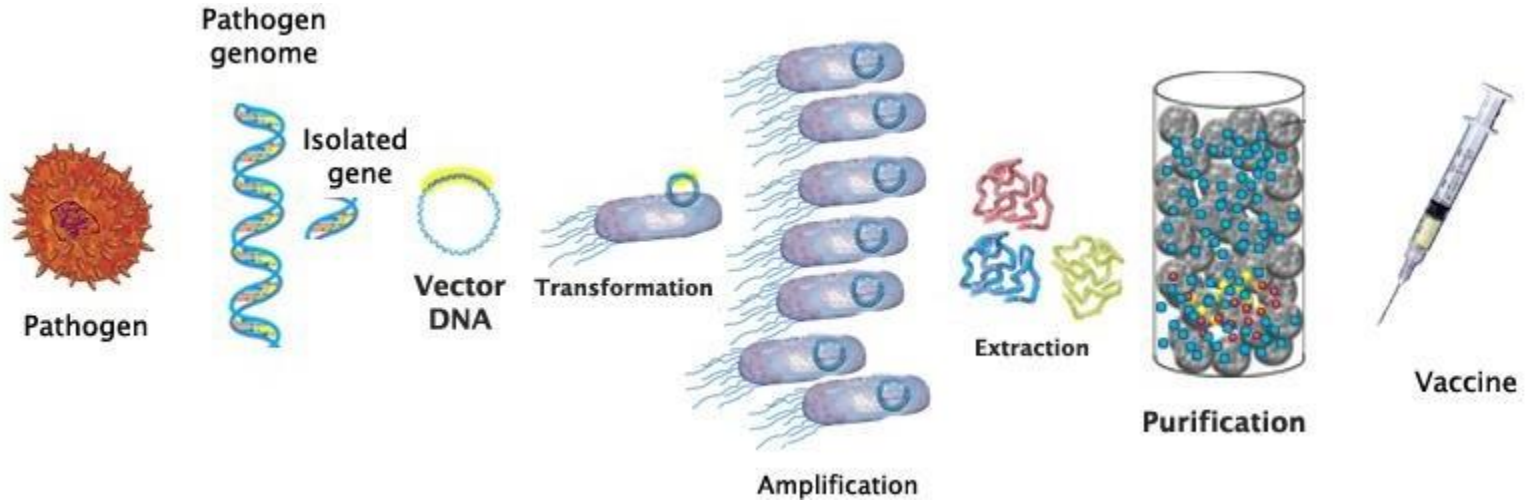


Subunit Vaccine



Recombinant Vaccines

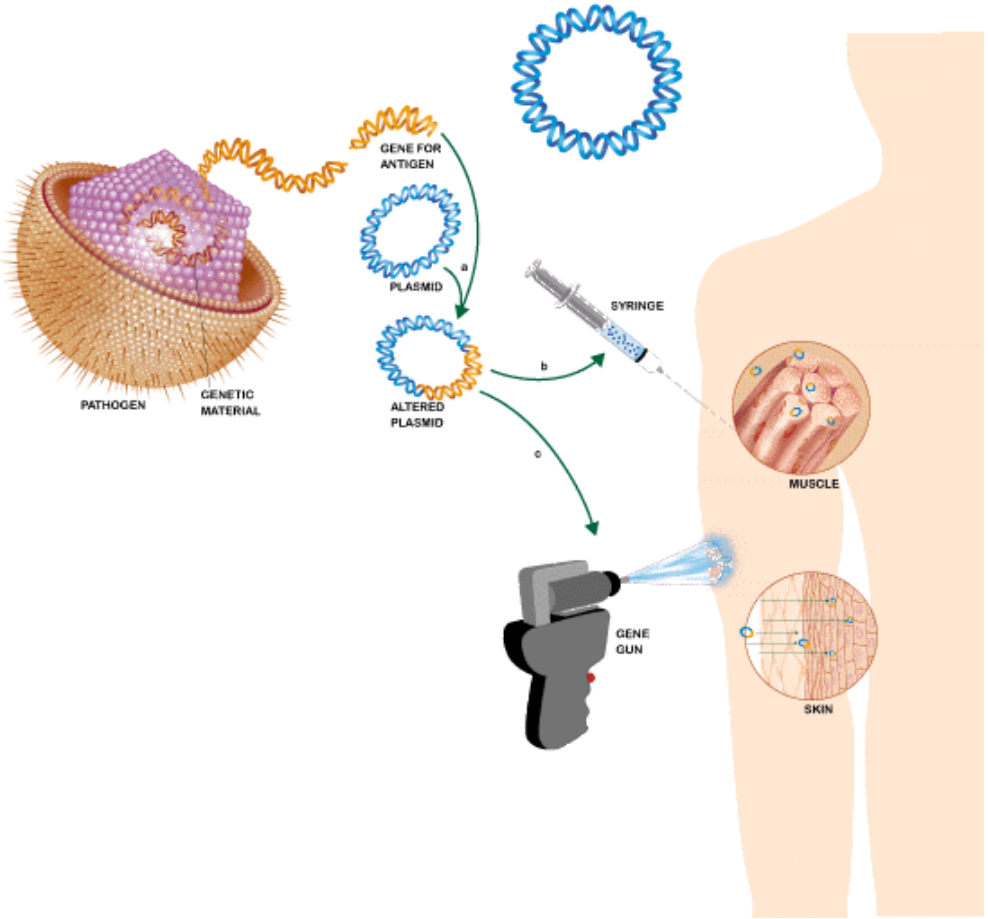
- Recombinant Vaccines
  - A vaccine produced from a cloned gene



Video: Constructing Vaccines

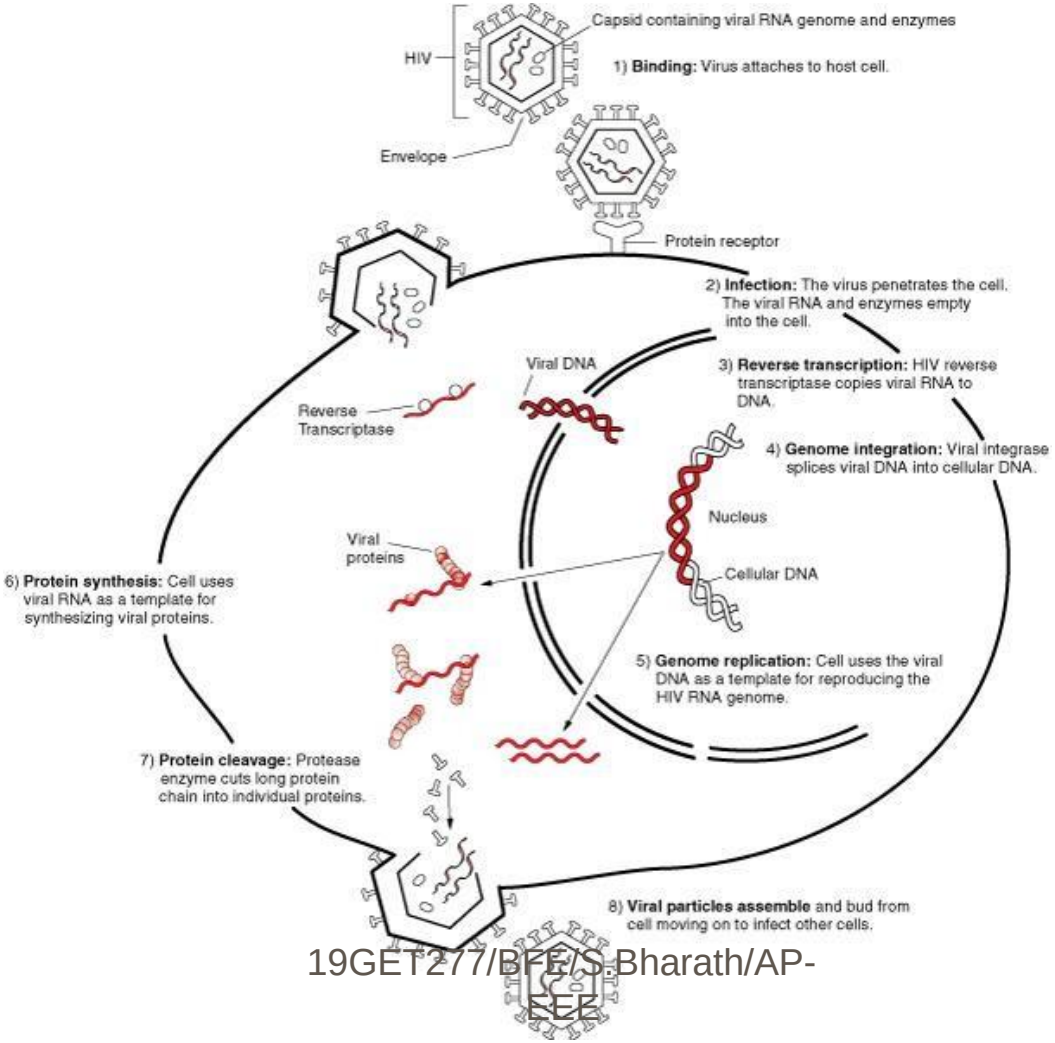
Recombinant Vaccines

- DNA vaccines
  - Direct injection of plasmid DNA containing genes encoding specific antigenic proteins



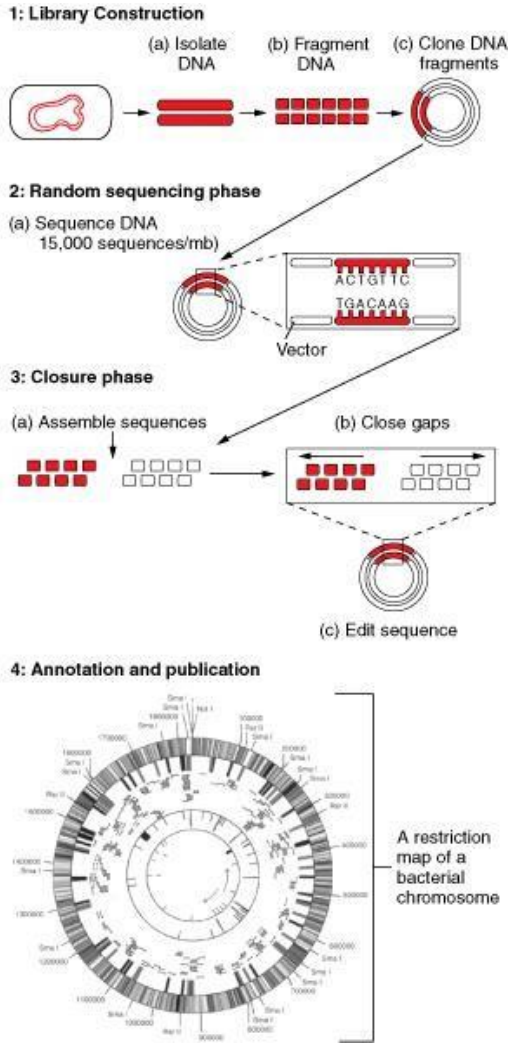
Bacterial and Viral Targets for Vaccines

- HIV



Microbial Genomes

- Microbial Genome Program (MGP) –the goal is to sequence the entire genomes of microorganisms that have potential applications in environmental biology, research, industry, and health
- Sequencing Strategies→



Microbial Genomes

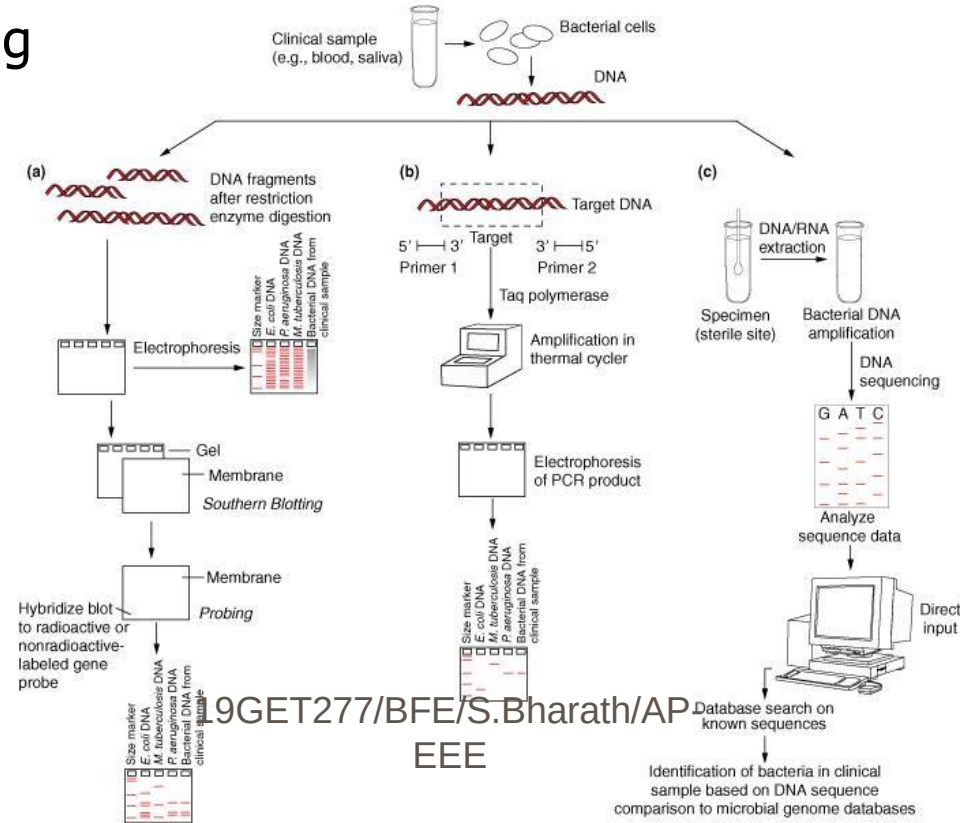
- Why study viral genomes?
  - Decipher genes and their products so that agents that block attachment, block replication can be made

Table 5.4 EXAMPLES OF MEDICALLY IMPORTANT VIRAL GENOMES THAT HAVE BEEN SEQUENCED

Virus	Human Disease or Illness	Year Sequenced
Ebola virus	Ebola hemorrhagic fever	1993
Hepatitis A virus	Hepatitis A	1987
Hepatitis B virus	Hepatitis B	1984
Hepatitis C virus	Hepatitis C	1990
Herpes simplex virus, type I	Cold sores	1988
Human immunodeficiency virus (HIV-1)	Acquired immunodeficiency syndrome (AIDS)	1985
Human papillomavirus	Cervical cancer	1985
Human poliovirus	Poliomyelitis	1981
Human rhinovirus	Common cold	1984
Severe acute respiratory coronavirus (SARS-CoV)	Severe acute respiratory syndrome (SARS)	2003
Variola virus	Smallpox	1992

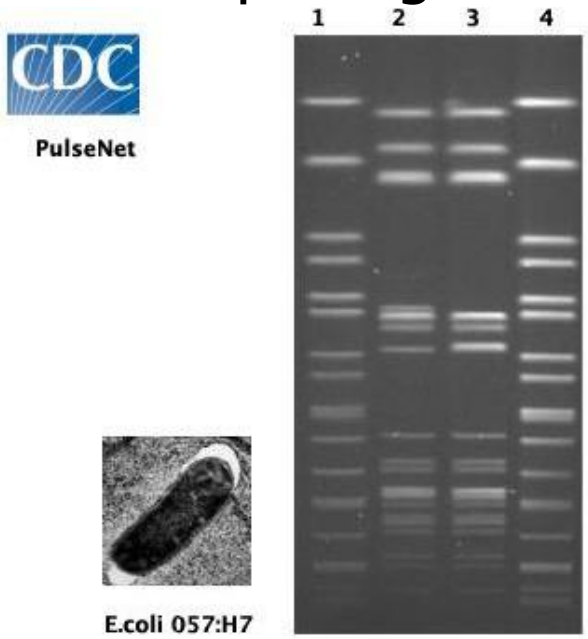
Microbial Diagnostics

- Using Molecular Techniques to Identify Bacteria
  - RFLP
  - PCR and Real time PCR
  - Sequencing



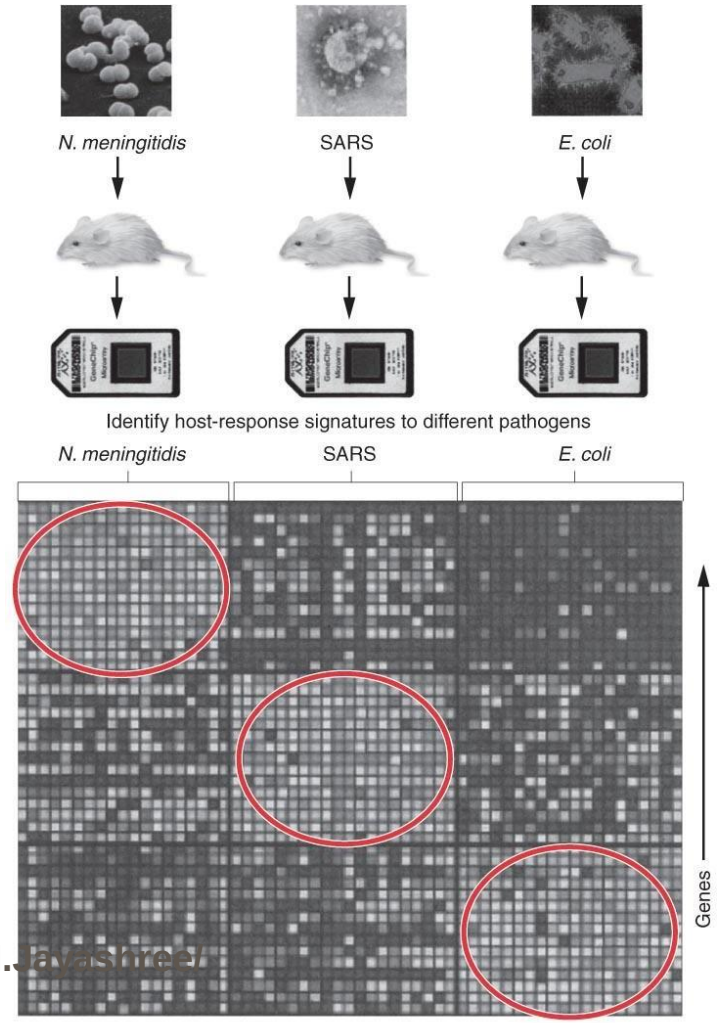
Molecular Diagnostics

- Application: Molecular Epidemiology
  - Pulse Net monitors disease outbreaks related to different strains of food-borne pathogens



Microbial Diagnostics

- Microarrays for tracking contagious disease
  - PulseNet used to identify outbreaks



Microbial Diagnostics

- Combating Bioterrorism
  - The use of biological materials as weapons to harm humans or animals and plants we depend on for food
  - Examples in History
    - Throwing plague infected dead bodies over the walls of their enemies

Microbial Diagnostics

- Using Biotech Against Bioweapons
  - Postal service x-raying packages
  - Antibody tests in the field
  - PCR tests in the field
  - Protein Microarrays for detecting bioweapon pathogens