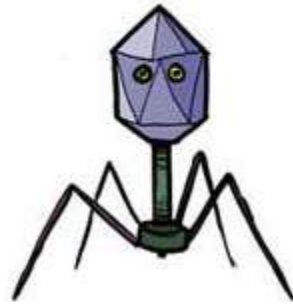


*Microbial Models: The  
Genetics of Viruses and  
Bacteria*



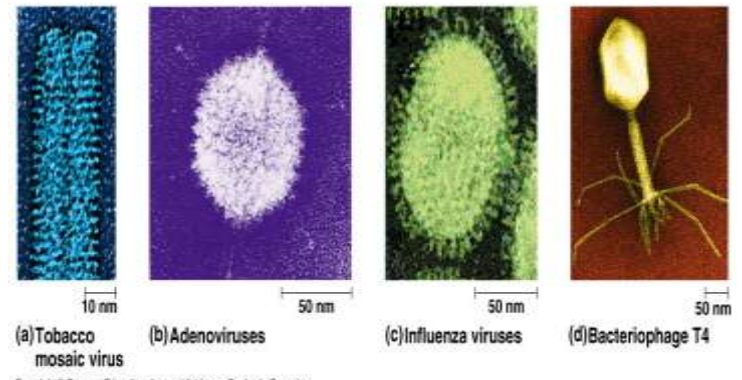
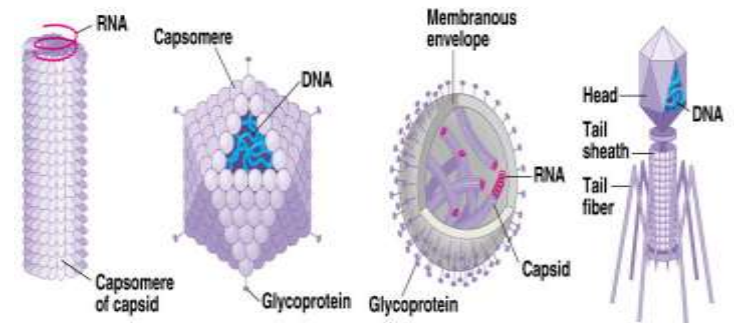
**Virus**



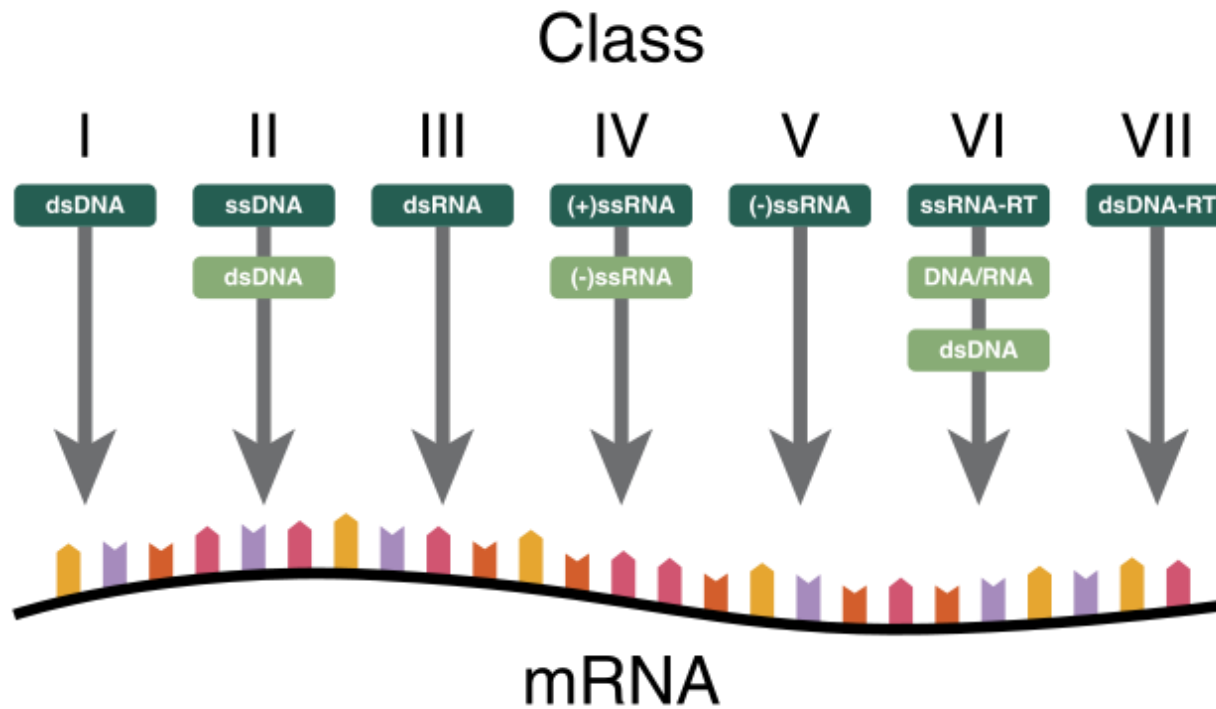
**Retrovirus**

# Viral structure

- ▶ Virus: “*poison*” (Latin); infectious particles consisting of a nucleic acid in a protein coat
- ▶ Capsid; (viral envelopes); DNA or RNA
- ▶ Bacteriophages (phages)



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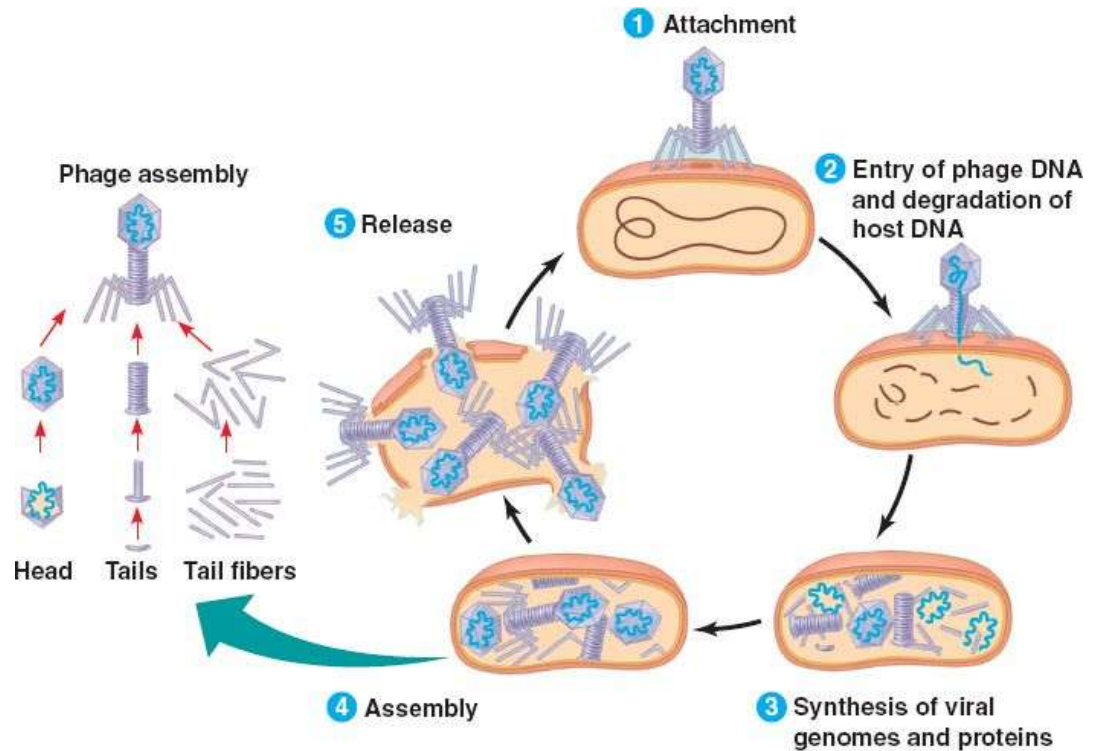
- "VirusBaltimoreClassification" by Thomas Splettstoesser (www.scistyle.com) - Own work. Licensed under CC BY-SA 3.0 via Wikimedia Commons - <http://commons.wikimedia.org/wiki/File:VirusBaltimoreClassification.svg#mediaviewer/File:VirusBaltimoreClassification.svg>

# Viral reproduction: Lytic Cycle

The lytic cycle:

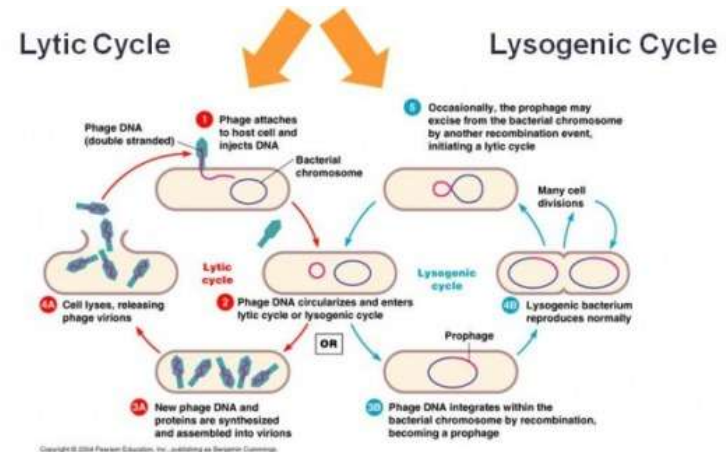
1. attachment
2. injection
3. synthesis
4. assembly
5. release

► Results in death of host cell



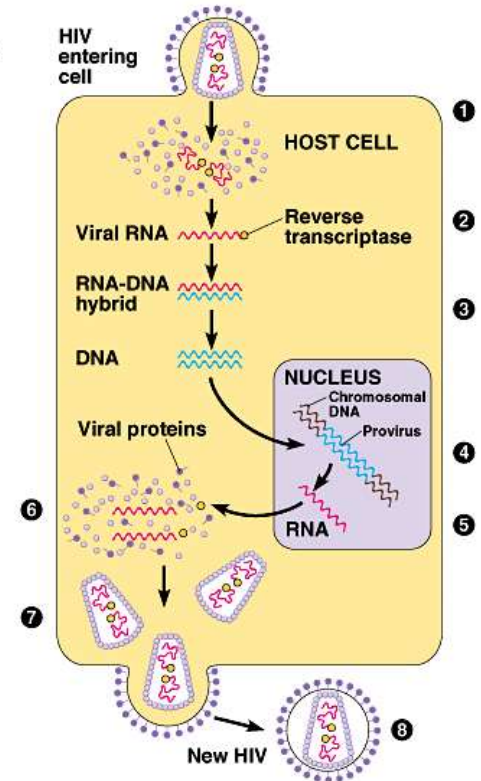
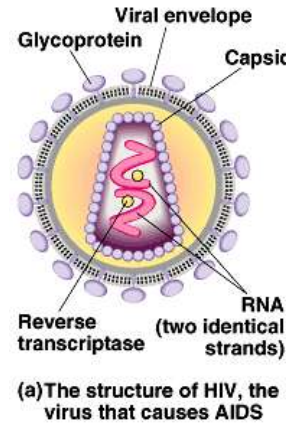
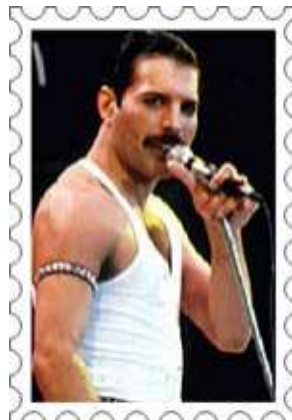
# Viral reproduction: Lysogenic Cycle

- Genome replicated w/o destroying the host cell
- Genetic material of virus becomes incorporated into the host cell DNA (prophage DNA)
- Temperate virus (phages capable of using the lytic and lysogenic cycles)
- May give rise to lytic cycle



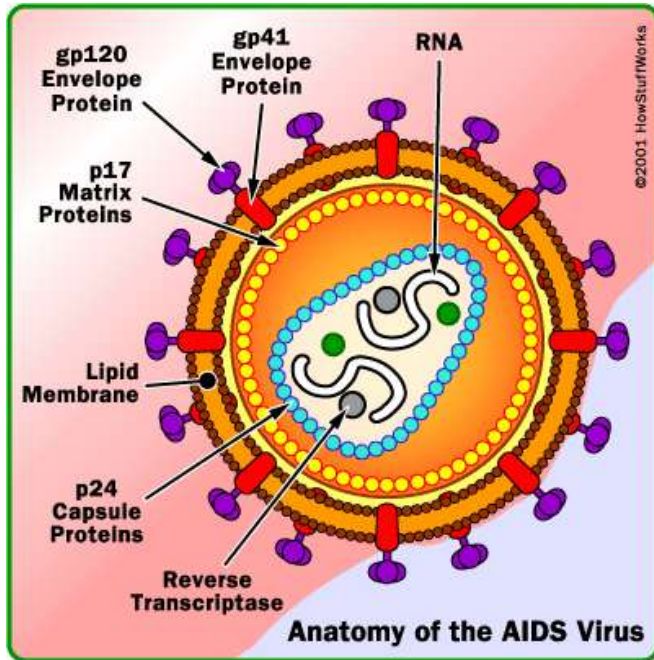
# RNA viruses

- Retroviruses: transcribe DNA from an RNA template (RNA--->DNA)
- Reverse transcriptase (catalyzing enzyme)
- High error rate, no proofreading
- Evolves quickly



# “THE VIRAL GENOME”

- Icosahedral (20 sided), enveloped virus of the lentivirus subfamily of ***retroviruses***.
- Retroviruses transcribe RNA to DNA.



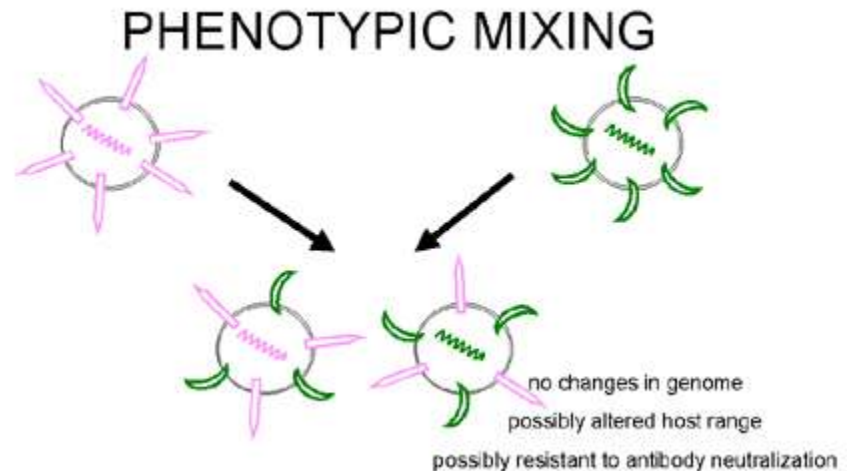
Two viral strands of RNA found in core surrounded by protein outer coat.

Outer envelope contains a lipid matrix within which specific viral glycoproteins are imbedded. These knob-like structures responsible for binding to target cell.

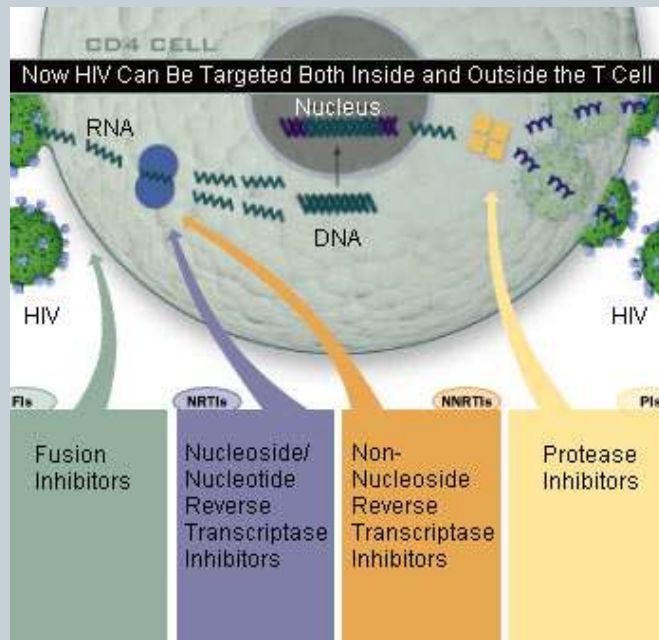


# Viral Phenotypic Acquisition

- The viral genome is copied into the host DNA and transmitted with the host genome
- When two viruses are present at the same time, they share information.
- Protein capsules can be swapped.
- This can increase virulence and increase the rate of evolution



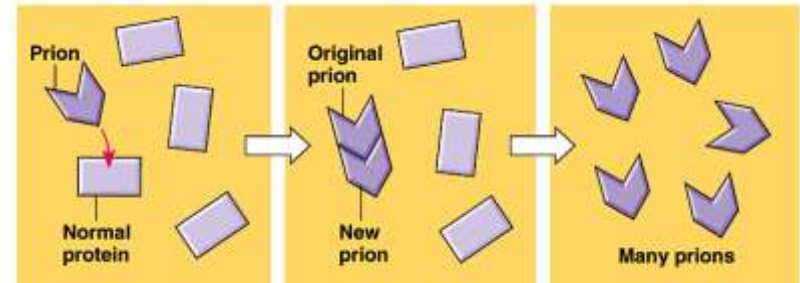
# Treatment Options



HAART =  
highly active  
anti-retroviral  
treatment

# Viroids and prions

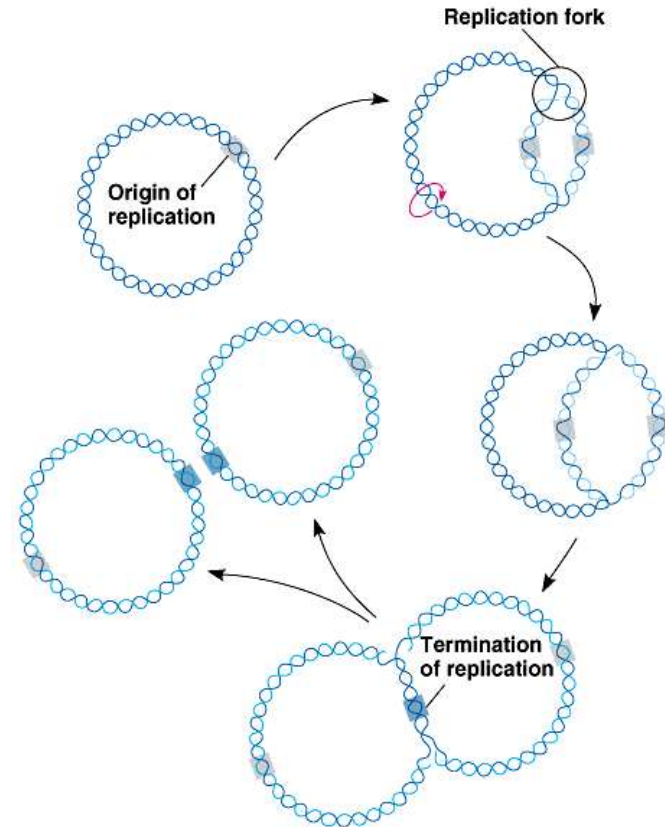
- ▶ Viroids: tiny, naked circular RNA that infect plants; do not code for proteins, but use cellular enzymes to reproduce; stunt plant growth
- ▶ Prions: “infectious proteins”; “mad cow disease”; trigger chain reaction conversions; a transmissible protein



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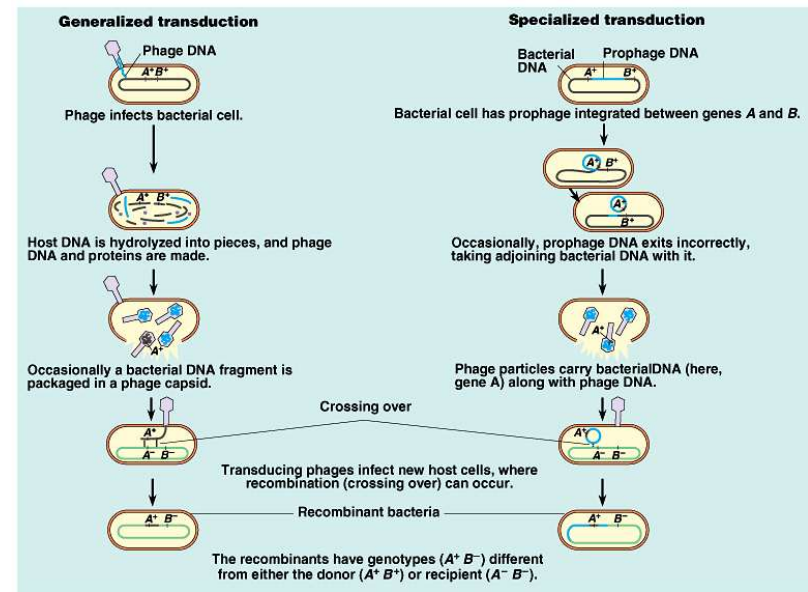
# Bacterial genetics

- Nucleoid: region in bacterium densely packed with DNA (no membrane)
- Plasmids: small circles of DNA
- Reproduction: binary fission (asexual)



# Bacterial DNA-transfer processes

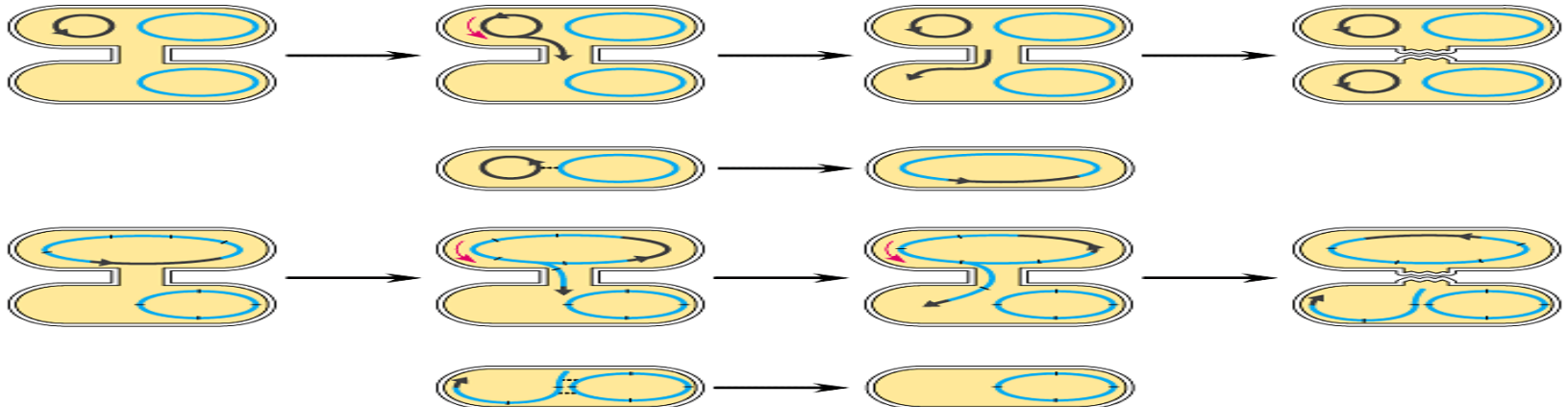
- Transformation: genotype alteration by the uptake of naked, foreign DNA from the environment (Griffith expt.)
- Transduction: phages that carry bacterial genes from 1 host cell to another
  - *generalized* ~ random transfer of host cell chromosome
  - *specialized* ~ incorporation of prophage DNA into host chromosome
- Conjugation: direct transfer of genetic material; cytoplasmic bridges; pil; sexual



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# Bacterial Plasmids

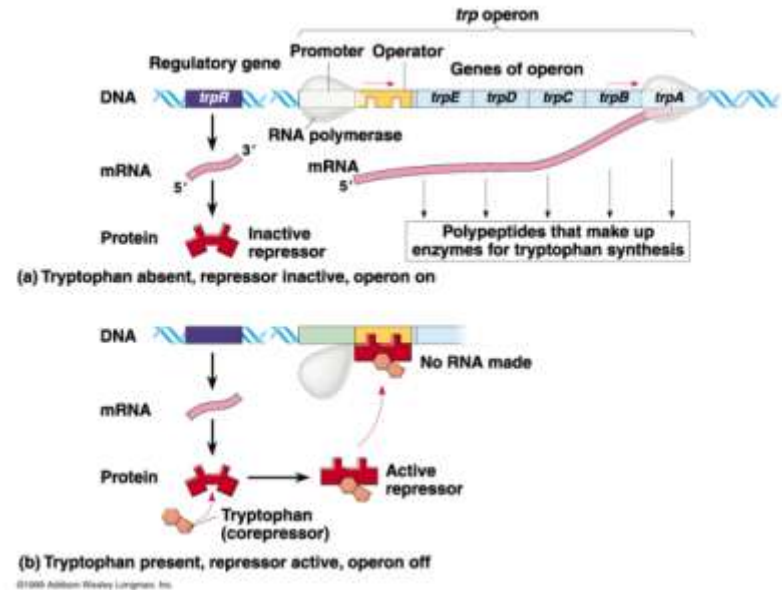
- Small, circular, self-replicating DNA separate from the bacterial chromosome
- F (fertility) Plasmid: codes for the production of sex pili (F+ or F-)
- R (resistance) Plasmid: codes for antibiotic drug resistance
- Transposons: transposable genetic element; piece of DNA that can move from location to another in a cell's genome (chromosome to plasmid, plasmid to plasmid, etc.); "jumping genes"



# Operons, I

Def: Unit of genetic function consisting of coordinately related clusters of genes with related functions (transcription unit)

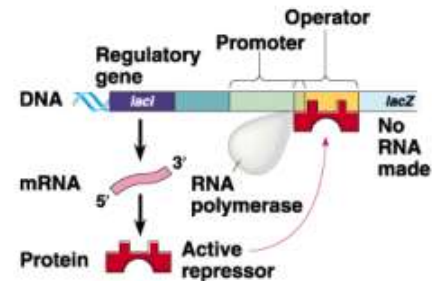
- ▶ Repressible (*trp* operon):
- ▶ tryptophan (a.a.) synthesis
- ▶ *promoter*: RNA polymerase binding site; begins transcription
- ▶ *operator*: controls access of RNA polymerase to genes (tryptophan not present)
- ▶ *repressor*: protein that binds to operator and prevents attachment of RNA polymerase ~ coded from a regulatory gene (tryptophan present ~ acts as a *corepressor*)
- ▶ transcription is repressed when tryptophan binds to a regulatory protein



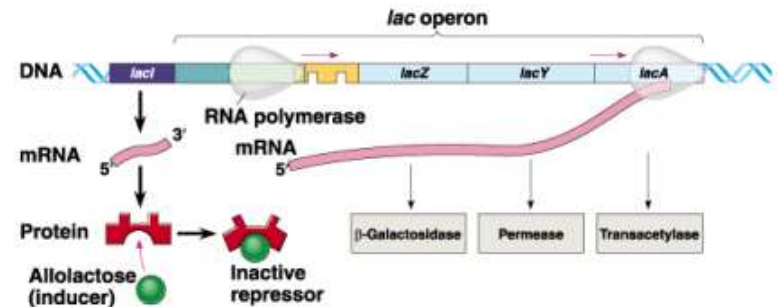
# Operons, II

Def: Unit of genetic function consisting of coordinately related clusters of genes with related functions (transcription unit)

- ▶ Inducible (*lac* operon):
- ▶ lactose metabolism
- ▶ lactose not present:
  - repressor active, operon off;
  - no transcription for lactose enzymes
- ▶ lactose present:
  - repressor inactive, operon on;
  - inducer* molecule inactivates protein repressor (allolactose)
- ▶ transcription is stimulated when *inducer* binds to a regulatory protein



(a) Lactose absent, repressor active, operon off



(b) Lactose present, repressor inactive, operon on

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