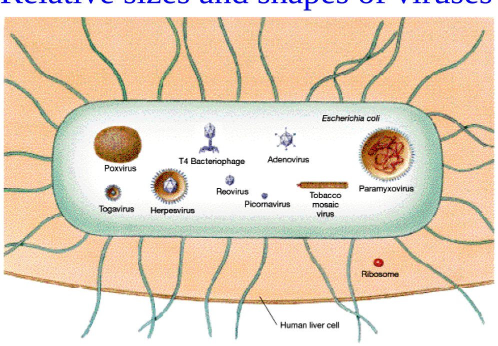
Chapter 13

Genetics of viruses and Prokaryotes

13.1 Common Sizes of Microorganisms

MICROORGANISM	TYPE	TYPICAL SIZE RANGE (μm^3)
Protists	Eukaryote	5,000–50,000
Photosynthetic bacteria	Prokaryote	5–50
Spirochetes	Prokaryote	0.1–2.0
Mycoplasmas	Prokaryote	0.01–0.1
Poxviruses	Virus	0.01
Influenza virus	Virus	0.0005
Poliovirus	Virus	0.00001

Relative sizes and shapes of viruses



Many shapes - Spherical to icoshedral

Bacteriophages (ready to eat)

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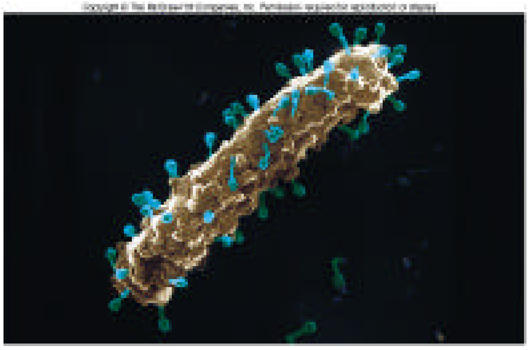


Viruses

- Nucleic acid
  - DNA or RNA
- Proteins
  - Capsid
- Sometimes lipids
  - Envelope
- Shapes
  - Long helix
    - Tobacco mosaic virus
  - Near spherical shape
    - Isosahedron (20 sided)
      - Poliovirus
    - HIV

TABLE 14.1 Classif

Picornaviridae

Flaviviridae

Rhabdoviridae

locality in Uganda)

TABLE 14.1 Classification of RNA Viruses Infecting Vertebrates

Reoviridae (respiratory enteric orphan virus)		Naked virion	Linear ds RNA divided into 10, 11, or 12 segments	Diarrhea in animals
Birnaviridae (*bi*, two)		Naked virion; icosahedral	2 segments of linear ds RNA	No human pathogens; diseases in chickens and fish
Retroviridae (*retro*, backwards)		Icosahedral; lipid-containing envelope	2 identical molecules ss RNA	HIV

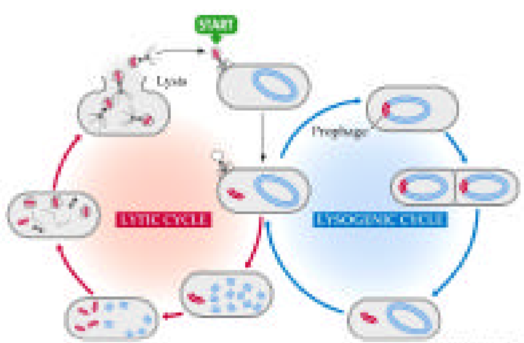
TABLE 14.2 Classification of DNA Viruses Infecting Vertebrates

Family	Drawing of Virion	Virion Structure	Genome Structure*	Characteristics and Representative Pathogenic Members
Hepadnaviridae (*hepa*, liver; *dna*, deoxyribonucleic acid)		Lipid-containing envelope	1 molecule, mainly ds DNA but with a single-stranded gap	Hepatitis B virus
Parvoviridae (*parvus*, small)		Naked	1 molecule, ss DNA	Outbreaks of gastroenteritis following eating of shellfish
Papovaviridae (papilloma, polyoma, vacuolating agent)		Naked	1 molecule, circular ds DNA	Human papillomaviruses associated with genital and oral carcinomas
Adenoviridae (*adenos*, gland)		Naked	1 molecule, ds DNA	Some cause tumors in animals
Herpesviridae (*herpes*, creeping)		Enveloped with surface projections	1 molecule, ds DNA	Herpes simplex virus; cytomegalovirus
Poxviridae (*poc*, pustule)		Enveloped; large brick-shaped	ds DNA; covalently closed ends	Smallpox virus; vaccinia virus
Iridoviridae (*irid*, rainbow)		Enveloped	1 molecule, ds DNA	No known human pathogens; only animal pathogens

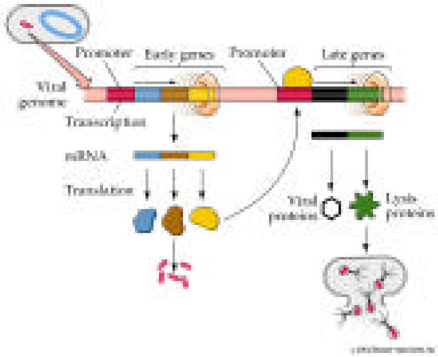
TABLE 14.3 Classification of Human Picornaviruses

Family	Genus	Species
Picornaviridae	*Enterovirus*	Polioviruses 1–3 Coxsackieviruses A1–A24 (no A23), B1–B6 Echoviruses 1–34 (no 10 or 28)Enteroviruses 68–71
	Rhinovirus	Rhinoviruses 1–100
	Hepatovirus	Hepatitis A virus

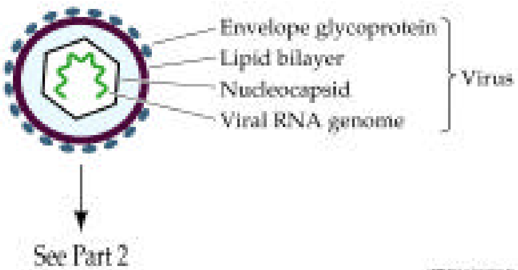
Life cycle of a bacteriophage



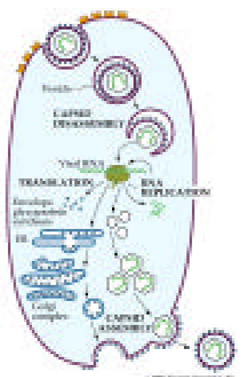
Viral replication



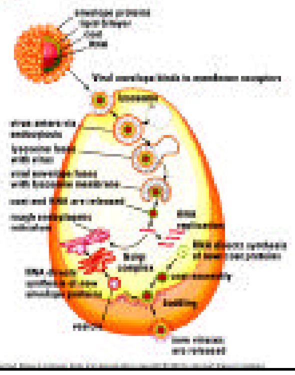
structure



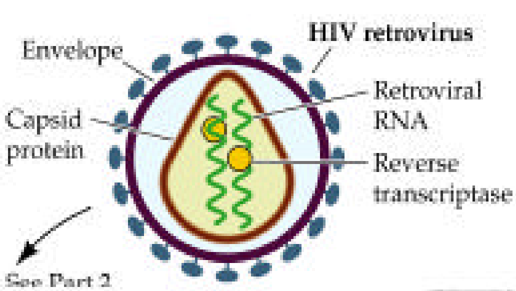
Influenza virus life cycle



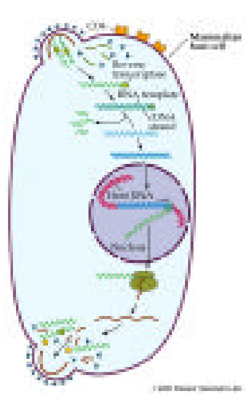
Influenza virus tricks a cell into taking up the virus



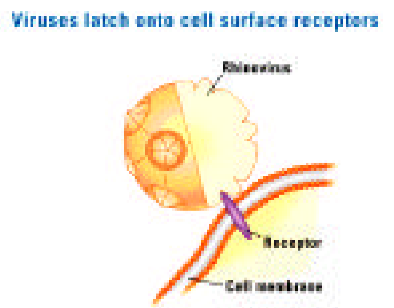
HIV

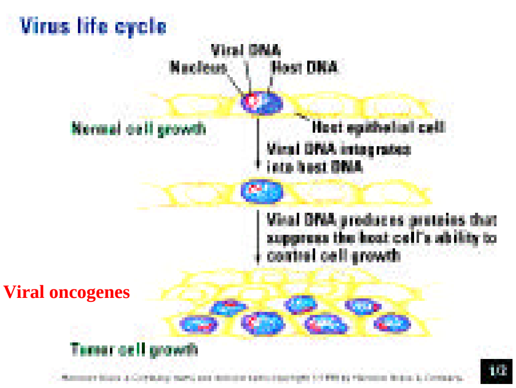


HIV life cycle

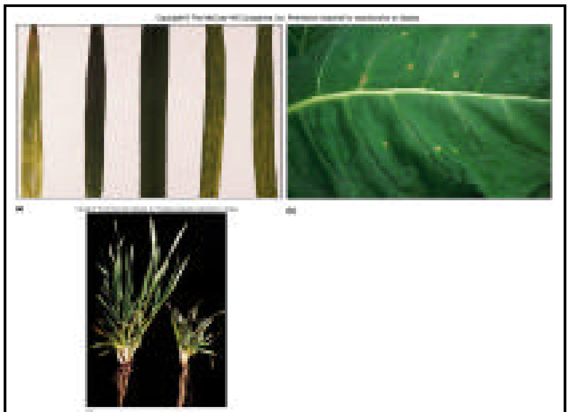


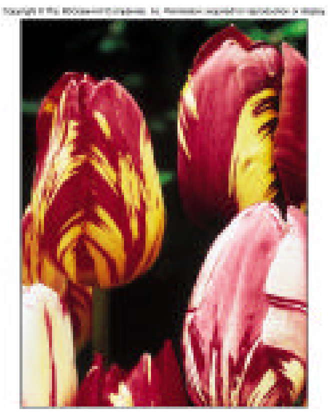
Cold virus



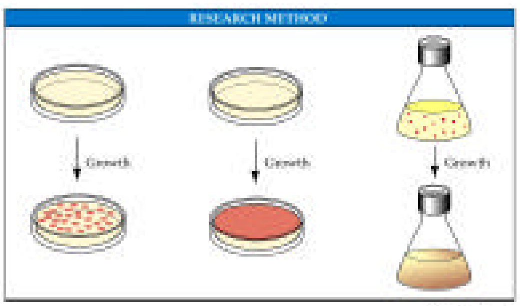


Viral oncogenes



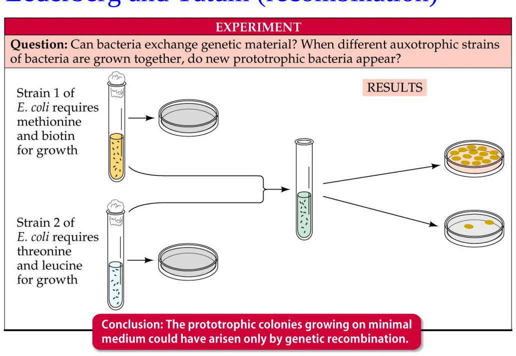


Bacteria Growth

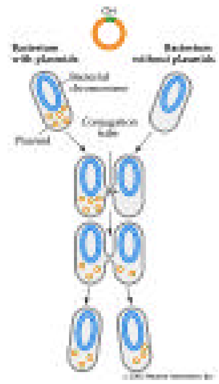


Escherichia reproduces every 20 minutes

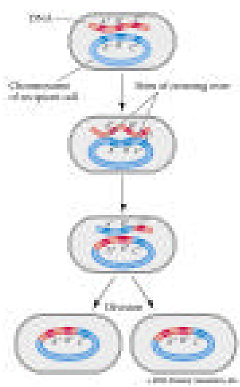
Lederberg and Tatum (recombination)



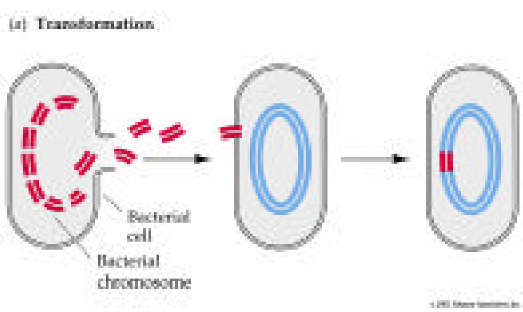
Conjugation - transfer between bacteria



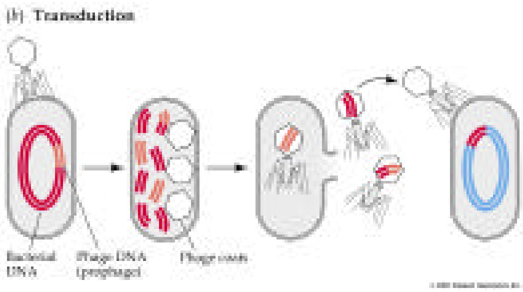
Incorporation of the new DNA or Recombination



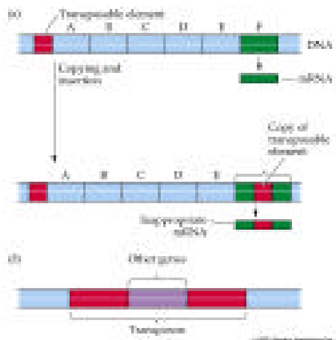
Tranformation - naked DNA transfer



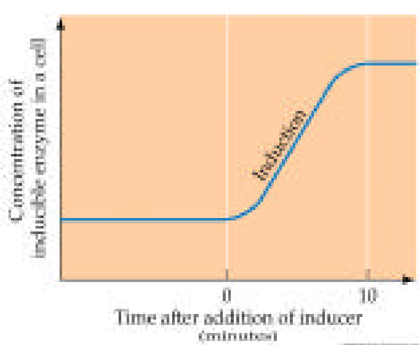
Transduction - virus mediated transfer



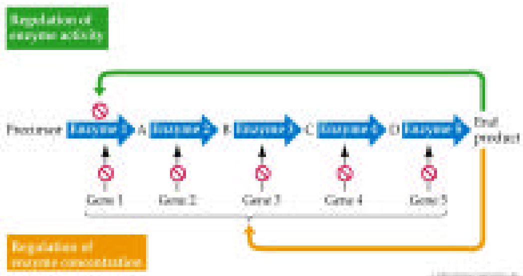
Transposon or jumping genes



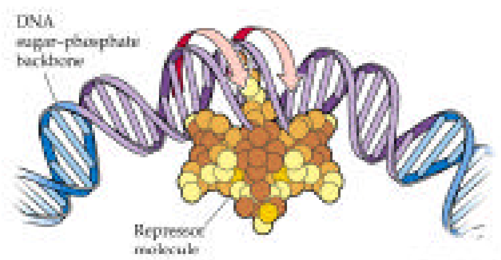
Regulating genes by induction



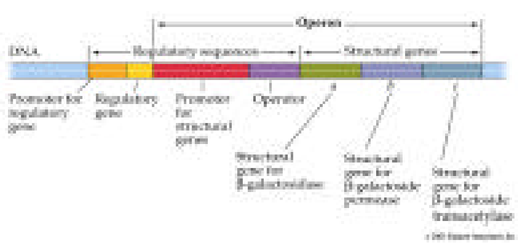
Regulation of genes



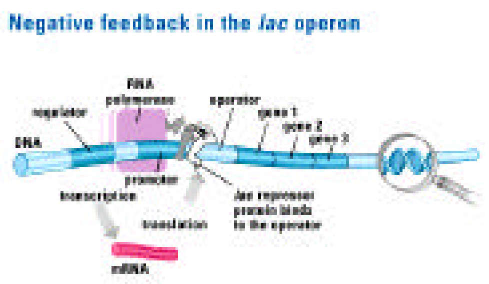
Repression of genes



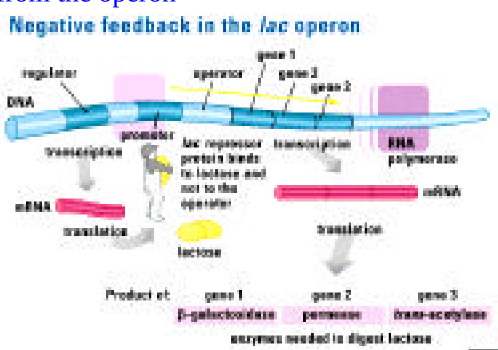
The lac operon in *E. coli*

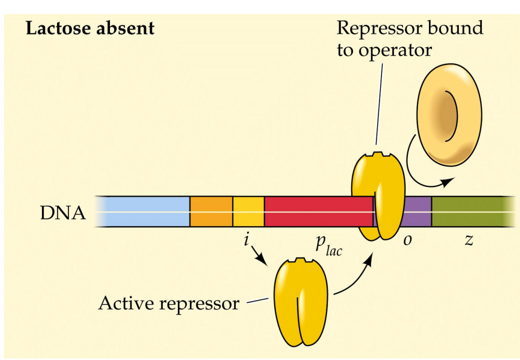


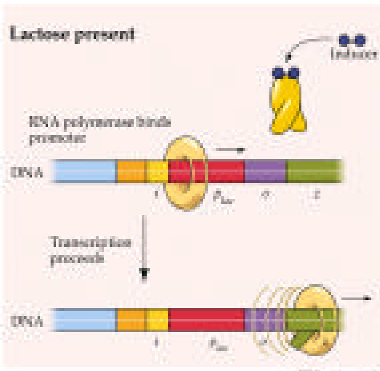
Repressor bind to the operator and prevents RNA polymerase from transcribing the genes



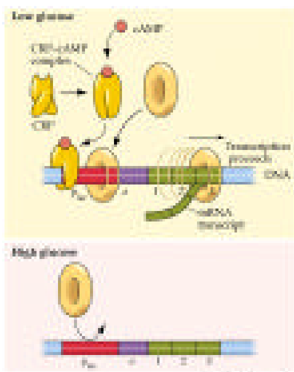
Lactose binds to the repressor and removes it from the operon







Positive control and Cap protein

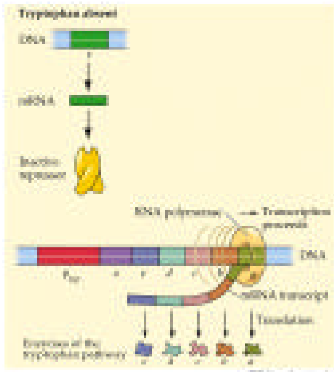


Positive control

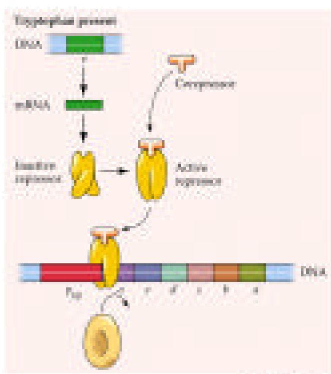
13.2 The Relationships Between Positive and Negative Control in the lac Operon

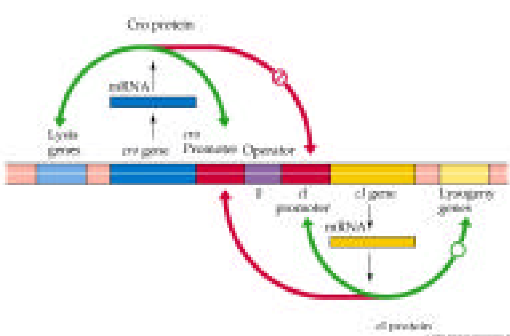
GLUCOSE	cAMP LEVELS	RNA POLYMERASE BINDING TO PROMOTER	LACTOSE	LAC REPRESSOR	TRANSCRIPTION OF LAC GENES?	LACTOSE USED BY CELLS?
Present	Low	Absent	Absent	Active and bound to operator	No	No
Present	Low	Absent	Present	Inactive and not bound to operator	No	No
Absent	High	Present	Present	Inactive and not bound to operator	Yes	Yes
Absent	High	Absent	Absent	Active and bound to operator	No	No

Tryptophan



Tryptophan





Haemophilus influenzae genome

Avery, Macleod, and McCarty's experiments

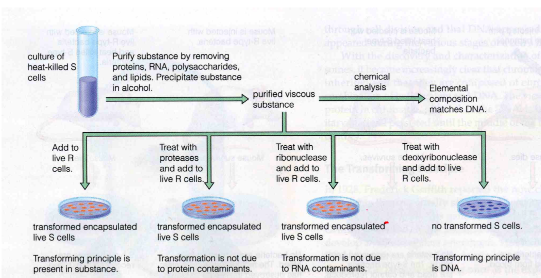


Figure 2.3 Avery, MacLeod, and McCarty's experiments demonstrating that Griffith's transforming principle is DNA.