Gene Expression and Microbial Models

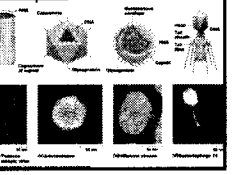


I. Viruses

A. Studying Viruses
1. Wendell Stanley was the first to isolated a virus in 1935.
2. Most viruses have capsids shaped like an icosahedron(polyhedron with 20 triangular faces.
3. Diseases caused by viruses are; warts, herpes, chicken pox, smallpox, the common cold, influenza(flu), rabies, AIDS, shingles, hepatitis

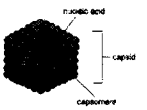


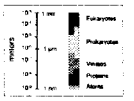
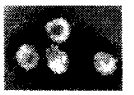
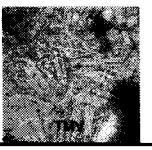




I. Viruses

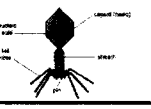
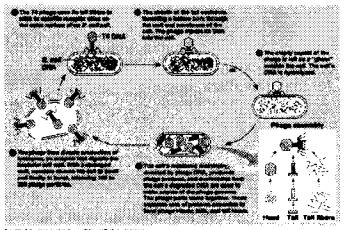
B. Not considered living things
1. Only composed of protein (capsid) and nucleic acid core (DNA or RNA)
2. No nucleus, cytoplasm, organelles, or cell membranes
3. Require a host cell to reproduce (Obligate intracellular parasite)
4. Do not carry out cellular respiration.
5. Can be crystallized.



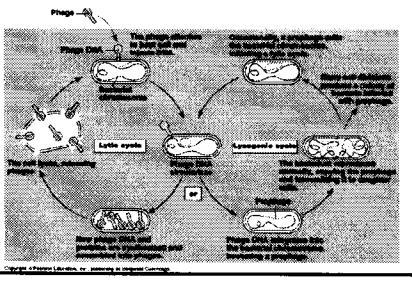

I. Viruses

C. Reproduction
1. From studies of bacteriophages (Viruses that infect bacteria)
2. Lytic Cycle
   a) Reproduction by virulent (disease-causing) viruses.
   b) The virus infects the cell causing it to lyse (break open).

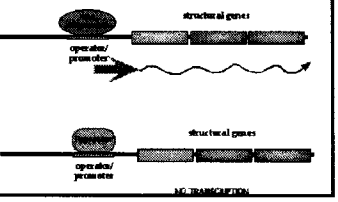
I. Viruses

3. Lysogenic Cycle
   a) Reproduction by temperate viruses.
   b) Don't immediately cause disease



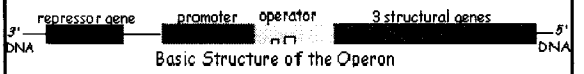
II. Gene Expression in Prokaryotes

A. Operon Model
1. Francis Jacob and Jacques Monod (1961)
2. Model explains regulation of gene expression in prokaryotes
3. Received a Nobel prize for this.
4. Bacteria produce just enzymes needed at the moment.

II. Gene Expression in Prokaryotes

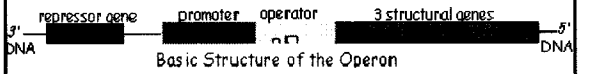
5. Operons
   a) Genes that function as a single unit
   b) Regulator gene codes for a repressor protein molecule.
   c) Promotor- sequence of DNA where RNA polymerase attaches



Basic Structure of the Operon

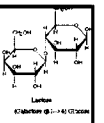
II. Gene Expression in Prokaryotes

d) Operator
   1) Sequence of DNA where repressor can bind
   2) Prevents RNA polymerase from attaching to the promotor.
e) Structural genes
   1) Code enzymes of a metabolic pathway
   2) Transcribed as a unit.

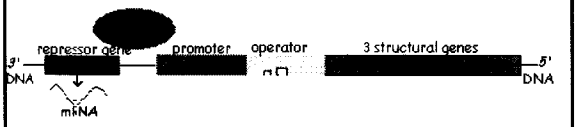


Basic Structure of the Operon

II. Gene Expression in Prokaryotes



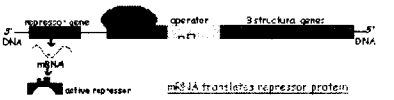
B. Looking at the lac Operon (inducible)
   1. E. coli produces three enzymes to metabolize lactose.
      a) Gene one codes for galactosidase (breaks lactose to glucose and galactose).
      b) Gene two codes for a permease (facilitates entry of lactose into the cell).
      c) Gene three codes for transacetylase (accessory in lactose metabolism).



Transcription of repressor gene

II. Gene Expression in Prokaryotes

2. The regulator gene codes for a lac operon repressor protein
3. Repressor binds to the operator and prevents transcription of the three genes.

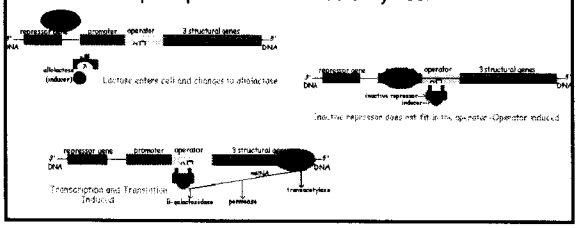


mRNA translates repressor protein

Inactive repressor falls in the operator and RNA polymerase is blocked

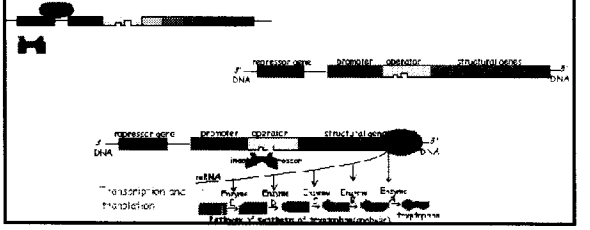
II. Gene Expression in Prokaryotes

4. Lactose binds to the repressor
5. Prevents repressor from binding to the operator.
6. RNA polymerase is able to bind to promoter
7. Transcription produces the three enzymes.



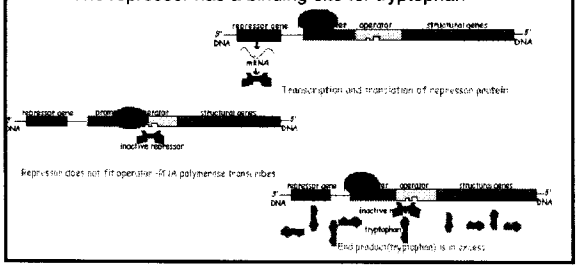
II. Gene Expression in Prokaryotes

C. Looking at the trp Operon (repressible)
   1. E. coli produces five enzymes to synthesize the amino acid tryptophan.
   2. If tryptophan is already present, these enzymes are not needed.



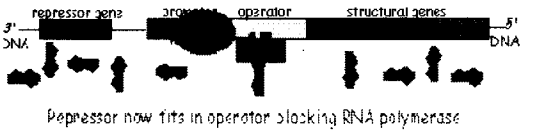
II. Gene Expression in Prokaryotes

3. Regulator gene codes for a repressor that is unable to attach to the operator
4. The repressor has a binding site for tryptophan



II. Gene Expression in Prokaryotes

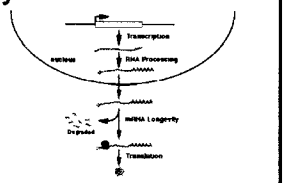
5. If tryptophan is present, it binds to the repressor.
6. Repressor now binds to the operator stopping tryptophan production
7. Repressible operons are involved in anabolic pathways that synthesize substances needed by cells.

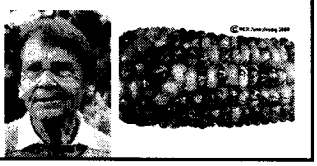


Repressor now fits in operator blocking RNA polymerase

III. Gene Expression in Eukaryotes

A. Lack a universal regulatory mechanism
B. Utilize Various Methods (4 levels)
   1. Transcriptional control
   2. Posttranscriptional control
   3. Translational control
   4. Posttranslational control
C. Transposons
   1. Barbara McClintock (nobel prize in 1983)
   2. Jumping genes





IV. Pathogenic Particles

A. Viroids
   1. Mainly plant pathogens
   2. Circular RNA loop
B. Prions
   1. proteinaceous infectious particle that lacks nucleic acid
   2. Mad Cow disease, Chronic Wasting disease