Gene Regulaon

a. Prokaryotes
   (1) Inducers (turn genes on) and repressors (turn genes off) are small molecules that interact with regulatory proteins and/or regulatory sequences.
   (2) Regulatory proteins inhibit gene expression by binding to DNA and blocking transcripon (negave control).
   (3) Regulatory proteins smulate gene expression by binding to DNA and smulang transcripon (posive control) or binding to repressors to inacvate repressor funcon.

b. Eukaryotes
   (1) Transcripon factors bind to DNA sequences and other regulatory proteins
   (2) Some of these transcripon factors are acvators (increase expression), while others are repressors (decrease expression).
   (3) The combinaon of transcripon factors binding to the regulatory regions at any one me determines how much, if any, of the gene product will be produced.

Immunity

a. Plants, invertebrates and vertebrates have mulple, nonspecific immune responses, ex: phagocytes engulf and digest pathogens with the help of lysosomes

b. Mammals use specific immune responses triggered by natural or arficial agents that disrupt dynamic homeostasis.
   (1) The mammalian immune system includes two types of specific responses: cell mediated and humoral.
   (2) In the cell-mediated response, cytotoxic T cells, a type of lymphocyc white blood cell, target intracellular pathogens when angens are displayed on the outside of the cells.
   (3) In the humoral response, B cells, a type of lymphocyc white blood cell, produce anbodies against specific angens.
   (4) Angens are recognized by anbodies to the angen.
   (5) Anbodies are proteins produced by B cells, and each anbody is specific to a parcular angen.
   (6) A second exposure to an angen results in a more rapid and enhanced immune response.

Viruses

a. Replicaon
   (1) Viruses inject DNA or RNA into host cell
   (2) Viruses have highly efficient replicave capabilies that allow for rapid evoluon
   (3) Viruses replicate via the lyc cycle, allowing one virus to produce many progeny simultaneously
   (4) Virus replicaon allows for mutaons to occur through usual host pathways.
   (5) RNA viruses lack replicaon error-checking mechanisms, and thus have higher rates of mutaon.

(6)Related viruses can combine/recombine informaon if they infect the same host cell.
(7)Some viruses are able to integrate into the host DNA and establish a latent (lysogenic) infecon
(8)HIV is a well-studied system where the rapid evoluon of a virus within the host contributes to the pathogenicity of viral infecon.
(9)Genec informaon in retroviruses is a special case and has an alternate flow of informaon: from RNA to DNA, made possible by reverse transcriptase, an enzyme that copies the viral RNA genome into DNA. This DNA integrates into the host genome and becomes transcribed and translated for the assembly of new viral progeny.