**CONCEPT 4 – REGULATION**

1. Feedback
    a. _____ feedback mechanisms maintain dynamic _____ for a particular condition (variable) by regulating physiological processes, returning the changing condition back to its target set point.
    b. Positive feedback mechanisms _____ responses and processes in biological organisms. The condition initiating the response is moved farther away from the initial set-point. Amplification occurs when the stimulus is further activated which, in turn, initiates an additional response that produces system change.

2. Cell-to-cell communication
    a. Cells receive or send _____ or _____ signals from other cells, organisms or the environment.
    b. In _____ organisms it is response to its environment.
    c. In _____ organisms, signal transduction pathways coordinate the activities within individual cells. Ex. _____ stimulation of glycogen breakdown in mammals
    d. Cells communicate by _____ contact. Ex Immune cells interact by cell-cell contact, antigen- presenting cells (APCs), helper T-cells and killer T cells or _____ between plant cells that allow material to be transported from cell to cell.
    e. Cells communicate over _____ by using local regulators that target cells in the vicinity of the emitting cell. Ex. _____, plant immune response
    f. Signals released by one cell type can travel long distances to target cells of another cell type. Ex. _____
    g. A receptor protein recognizes signal molecules, causing the receptor protein's _____, which initiates transduction of the signal. Ex. G-protein linked receptors, ligand-gated _____, tyrosine kinase receptors.
    h. Signal transduction is the process by _____. Signaling cascades relay signals from receptors to cell targets, often _____ the incoming signals, with the result of appropriate responses by the cell.
    i. _____ inside of cells are often essential to the function of the cascade. Ex. _____
    j. Many signal transduction pathways include: Protein modifications or phosphorylation cascades in which a series of protein kinases _____ to the next protein in the cascade sequence.

3. Gene Regulation
    a. Prokaryotes
        (1) Inducers (turn genes _____) and repressors (turn genes _____) are small molecules that interact with regulatory proteins and/or regulatory sequences.
        (2) Regulatory proteins inhibit gene expression by binding to DNA and _____ (negative control).
        (3) Regulatory proteins stimulate gene expression by binding to DNA and _____ (positive control) or binding to repressors to inactivate repressor function.

b. Eukaryotes
   (1) _____ bind to DNA sequences and other regulatory proteins
   (2) Some of these transcription factors are activators (_____ expression), while others are repressors (_____ expression).
   (3) The combination of transcription factors binding to the regulatory regions at any one time determines how much, if any, of the gene product will be produced.

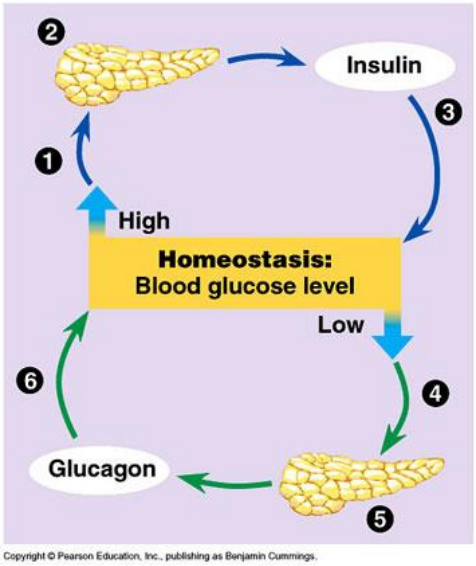
4. Immunity
   a. Plants, invertebrates and vertebrates have multiple, _____ immune responses, ex: _____ engulf and digest pathogens with the help of lysosomes
   b. Mammals use _____ immune responses triggered by natural or artificial agents that disrupt dynamic homeostasis.
      (1) The mammalian immune system includes two types of specific responses: _____ and _____.
      (2) In the cell-mediated response, _____ cells, a type of lymphocytic white blood cell, target intracellular pathogens when _____ are displayed on the outside of the cells.
      (3) In the humoral response, _____, a type of lymphocytic white blood cell, produce _____ against specific antigens.
      (4) Antigens are recognized by antibodies to the antigen.
      (5) Antibodies are _____ produced by B cells, and each antibody is specific to a particular antigen.
      (6) A second exposure to an antigen results in a _____ immune response.

5. Viruses
   a. Replication
      (1) Viruses _____ or RNA into host cell
      (2) Viruses have highly efficient replicative capabilities that allow for _____ evolution
      (3) Viruses replicate via the _____ cycle, allowing one virus to produce many progeny simultaneously
      (4) Virus replication allows for _____ to occur through usual host pathways.
      (5) RNA viruses lack replication _____ mechanisms, and thus have _____ rates of mutation.
      (6) Related viruses can combine/recombine information if they infect the same host cell.
      (7) Some viruses are able to integrate into the host DNA and establish a latent (_____) infection
      (8) _____ is a well-studied system where the rapid evolution of a virus within the host contributes to the pathogenicity of viral infection.
      (9) Genetic information in _____ is a special case and has an alternate flow of information: from RNA to DNA, made possible by _____, 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.

***Thinking Practice***

1. The figure to the right shows the feedback mechanism for regulating blood glucose.
    a. Is this a positive or negative feedback loop? Explain your answer.

    b. Individuals that suffer from Type I diabetes do not have functional insulin-producing cells. Describe how their blood will differ from that of a healthy individual after a glucose-rich meal.



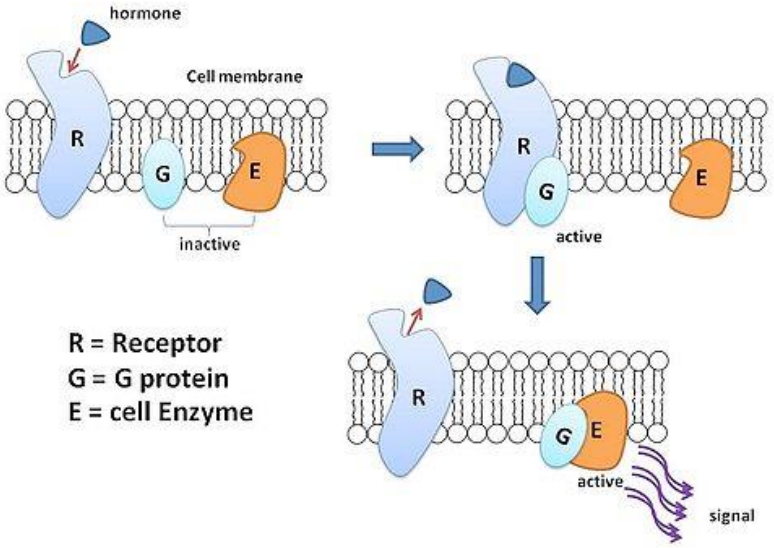


2. One student described an action potential in a neuron by saying "As more gates open the concentration of sodium inside the cell increases and this causes even more gates to open." Is this an example of a positive or negative feedback loop? Justify your reasoning.

3. Refer to the diagram at the right to respond to the following questions.
    a. Is the hormone hydrophobic or hydrophilic? How do you know?

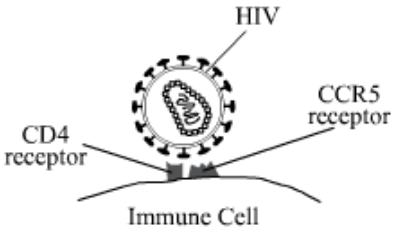
    b. Explain how the action of the hormone might be different if it could move through the cell membrane.

    c. Explain what is happening in this picture and make a prediction about what will be the end result in the cell to which this hormone has bound.



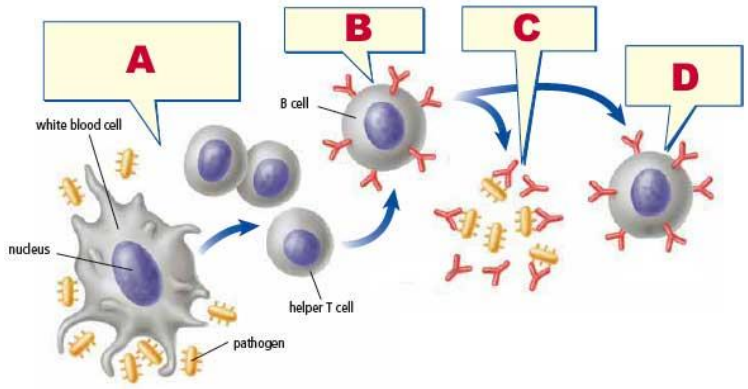

4. Lactose digestion in *E. coli* begins with its hydrolysis by the enzyme *b*-galactosidase. The gene encoding *b*-galactosidase, *lacZ*, is part of a coordinately regulated operon containing other genes required for lactose utilization. Use the legend below to draw the gene and its interaction with RNA polymerase, the repressor protein, and lactose when lactose is being digested.

Despite multiple exposures to HIV, human immunodeficiency virus, a small number of people do not develop AIDS and show no evidence of HIV-infected cells. By comparing these individuals' genes with that of HIV-positive individuals, researchers discovered that resistant individuals have an unusual form of a gene on the short arm of chromosome 3. This gene codes for an immune cell surface protein called CCR5. It is already known that in order to infect a cell, HIV must bind to the main immune cell surface marker CD4, which has many important functions in the immune system. Now we understand that in addition to CD4, the CCR5 receptor is a coreceptor for HIV infection.




5. Based on the information provided, propose a possible mechanism for a drug to resist HIV infection.

6. Refer to the images at the right to answer the following:
   a. Which immune response in shown: cell mediated or humoral? Explain how you know.




   b. What are the "Y" shaped molecules called? What is their role in the immune response?

   c. Describe how the "Y" shaped molecules relate to the graph displayed.