Objectives for Unit Seven: Chapter 5.6, 32.1 – 32.2, 35 & 36 (36.1, Fig. 36.10, 36.3, Fig. 36.15):
Cell Signaling & Communication with applications to Hormones & Immunity

You should be able to:

1. Regarding cell communication, distinguish between a signal, receptor, signal transduction, signal amplification, and response. What is a hormone?
2. Identify various ways can communicate with one another (short distance, long distance).
3. Explain the value of a second messenger; give an example.
4. Explain how a signal transduction pathway can greatly increase the magnitude of the response.
5. Read diagrams of signal transduction pathways.
6. Explain how signals and receptors are similar to enzymes and substrates. What does the term LIGAND mean?
7. Explain why the active molecule at the end of a signal transduction path is often a protein kinase or a protein phosphatase. How are the opposite in effect?
8. Explain what a G-protein coupled receptor and pathway is.
9. Using epinephrine as an example, summarize the sequence of events leading to the conversion of glycogen to glucose under the influence of epinephrine.
10. Explain how epinephrine can cause different effects in different cell types.
11. Water soluble signals (like proteins) and lipid soluble signals (like steroids) do not cause their effect on cells in the exact same way. Distinguish between them. (Try practice sheets in your binder.)
12. Identify various types of short and long distance cell communication.
13. Explain how just a few signal molecules can lead to thousands of molecules being activated within a cell.
14. Identify an example and explain the purpose of second messengers.
15. Define apoptosis.
16. Using insulin and glucagon as examples, explain the negative feedback loop involved in the regulation of blood glucose levels.
17. Distinguish between Diabetes type I (juvenile) and type II (adult onset). Where is the problem in the cell communication pathway?
18. Using a diagram identify the interplay between the hormones of male and female human reproductive systems: testosterone, GnRH, FSH, LH, estrogen, progesterone, and HCG
19. Read and analyze diagrams illustrating hormone feedback loops.
20. In order for successful fertilization, a sperm must communicate with an egg. Explain how cell signaling and communication are involved in fertilization and leads to the fast and low block to polyspermy.
21. There are many different kinds of white blood cells involved in the immune system. Be able to match each kind (macrophages, natural killer cells, B-lymphocytes, cytotoxic T-cells, T-helper cells, mast cells) with it's main function.
22. Explain how the body's innate, first line defenses function to prevent invasion.
    - Skin
    - Lysozyme
    - Mucus & cilia
    - stomach acid
23. Explain how body's innate second line of defenses each fight against pathogens in general.
    - Complement
    - Macrophages
    - Inflammation
    - Fever
    - interferon
24. List the sequence of steps during inflammation.
25. Explain why lowering a moderate fever may not be beneficial to a speedy recovery in the long run.
26. Explain how the body's third line of defense (acquired or adaptive immunity) is different from the first and second lines.
27. Within the third line of defense distinguish between humoral and cell-mediated responses.
28. Explain the role B-lymphocytes and T-lymphocytes play in adaptive (learned) immunity.
29. Distinguish between antigen and antibody. How does the immune system distinguish between "self" and "non-self?" Explain how programmed cell death (apoptosis) play a role in the normal development and differentiation of the immune system.

30. Explain how clonal selection works to mount an immune response against a specific invader.
31. Human have about around 20,000 genes. How can they make as many as a million different kinds of receptors with so few genes?
32. Identify several examples in the functioning of the immune system where there is direct cell to cell communication. Explain the communication.
33. Explain how a primary immune response is different from a secondary immune response. Explain what role memory cells play in a secondary response. Draw a graph of antibody concentration during a primary and secondary immune response.
34. Identify which blood types (A, B, AB, O, Rh+, Rh-) can donate to and receive blood from. Explain why this is the case.
35. Given results of a blood typing test (pictures), identify the blood type.
36. Explain why an Rh- mother can have problems during pregnancy with an Rh+ baby. How are these problems avoided with modern medicine.
37. Using blood type data and population frequencies, calculate and evaluate the Chi-square statistic.
38. Explain how antibodies work to help rid the body of invaders.
39. Distinguish between MHC Class I & Class II. On what cells are they? For what are they used?
40. Explain the central role of Helper-t-cells in the third line of defense. How are interleukin 1 and interleukin 2 used?
41. Explain how Cytotoxic-T-cells identify and then destroy infected body cells.
42. Regarding allergies, explain the role or relationship of antibody, mast cells, histamines, antihistamines as medication, and anaphylactic shock.
43. Describe Edward Jenner's discovery of a vaccine for small pox.
44. Explain how vaccinations can project a person from disease.
45. Explain what an autoimmune disease is and identify several autoimmune diseases. What part of the body is attacked in each of the following?
    - Lupus
    - Rheumatoid arthritis
    - Diabetes Type 1
    - Multiple Sclerosis
46. Explain how disruption of a signal transduction pathway can contribute to autoimmune disease.
47. Explain how HIV reproduces enters and reproduces inside of a T-helper cell. Explain why researchers are having a difficult time developing a vaccine against HIV. (Only if we have discussed HIV).
48. What is the role of the CD4 molecule in the function of T-helper cells and in HIV infection?
49. LAB: Explain how the ELISA process works. How is the ELISA used in real-world applications?
50. Explain how disruptions in cell-signaling pathways can lead to cancer (*ras* gene, *p53* gene – See pg. 325-327)
51. Each chapter has some multiple choice questions and a few other additional questions at its end. Give these a try. You might see them again!

Some Examples of Calculation questions: These might be the actual questions.

52. Use the Chi-square statistic to compare he blood type percentages of a sample to the accepted percentages for a population.
53. Homeostasis, maintaining a steady-state internal environment, is a characteristic of all living organisms. Describe how homeostasis of blood-glucose levels is maintained in an organism of your choice.
54. Feedback mechanisms are used by organisms to maintain the steady-state physiological condition known as homeostasis. Explain how feedback mechanisms maintain homeostasis of blood glucose levels. (Same question as above, just worded a little differently)
55. What environmental conditions would favor sexual reproduction? Explain. What environmental conditions would favor asexual reproduction? Explain.
56. Explain how feedback mechanisms regulate the menstrual cycle in a nonpregnant human female.
57. Compare and contrast the origin and maturation of the male and female gametes in mammal.

A possible essays to write DURING THE TEST.

(#201)
(Long) Homeostatic maintenance of optimal blood glucose levels has been intensively studied in vertebrate organisms. *(I may have you write on only part of this question).*

(a) Pancreatic hormones regulate blood glucose levels. **Identify** TWO pancreatic hormones and **describe** the effect of each hormone on blood glucose levels.

(b) For ONE of the hormones you identified in (a), **identify** ONE target cell and **discuss** the mechanism by which the hormone can alter activity in that target cell. **Include** in your discussion a description of reception, cellular transduction, and response.

(c) **Compare** the cell-signaling mechanisms of steroid hormones and protein hormones.

(#244)
(Paragraph) An individual has lost the ability to activate B cells and mount a humoral immune response.
a. **Propose** ONE direct consequence of the loss of B-cell activity on the individual's humoral immune response to the initial exposure to a bacterial pathogen.
b. **Propose** ONE direct consequence of the loss of B-cell activity on the speed of the individual's humoral immune response to a second exposure to the bacterial pathogen.
c. **Describe** ONE characteristic of the individual's immune response to the bacterial pathogen that is not affected by the loss of B cells.

(#228)
(PARAGRAPH) The figure at right represents a generalized hormone-signaling pathway. Briefly **explain** the role of each numbered step in regulating target gene expression.