1. Describe the benefit of inserting a functional gene into a body.

2. What is 1 unwanted side effect that can come from inserting genes? __________________________

3. a. During what process do insects turn on and off genes? _______________
    b. Which hormone is used during this process? _______________
    c. What structure is present for the ecdysone levels to drop to zero?
       _______________

4. What are cell-specific promoters? ________________________________________________________________________________
                                                                                           ________________________________________________________________________________

5. Which disease has the “switch” approach been studied on the most? __________________________

6. Describe some problems that patients face when “rebooting” the immune system?

7. a. What are cytokines? __________________________________________________________________________________________________
    b. What is the most powerful cytokines? ____________________________________________________________________________________

8. a. One problem with the IL-12 is that they can cause a cytokine storm. Describe some of the issues that arise with this “storm”. __________________________________________________________________________________________________
    b. How does Laurence Cooper of University of Texas want to use these cytokine storms with cancer?
       __________________________________________________________________________________________________

9. The gene-plus-switch was injected in 12 metastatic breast cancer patients. Describe what happened to the patients’ tumors.

(Continue on back)
10. a. Richard Mulligan has been working with different kinds of switch using RNA molecules called ____________________.

b. What is the function of these molecules? ________________________________________________

c. These molecules also have to be able to do what? ________________________________________
_____________________________________________________________________________________

11. How does Mulligan plan to use mRNA and the “self-cleaving” ribozyme to essentially cause the building of a protein to come to a halt?

12. a. Ronald Break and his colleagues used an aptamer to help protect mRNA but also to stop protein synthesis. What is an aptamer? ____________________________
_____________________________________________________________________________________

b. What does the aptamer do in the presence of a drug? _________________________________
_____________________________________________________________________________________

c. What happens when the drug is no longer taken? _________________________________________
_____________________________________________________________________________________

13. a. What are CAR T cells? _____________________________________________________________

b. What would happen if IL-12 and IL-15 genes were added to a CAR T cell? _________________________________
_____________________________________________________________________________________

c. What does this reduce the occurrence of? ______________________________________________

14. TRUE or FALSE (circle one). In the future, doctors may be able to give patients a pill that switches on or off a transfer gene.