AP Biology **Name** _____
Chapter 20 Guided Reading: DNA Tools and Biotechnology
10ed

1. Define the two terms below:
    a. DNA technology

    b. Biotechnology

2. What is done in *nucleic acid hybridization?*

3. What is *genetic engineering*?

4. What is accomplished in *DNA sequencing?*

5. The following chart shows the materials that are added to the reaction tube to sequence a piece of DNA. Give the purpose of each.

Molecules Added to the Reaction Tube	Purpose
Template strand	
Primer	
DNA polymerase	
Deoxyribonucleotides	
Dideoxyribonucleotides	

6. Why does a dideoxyribonucleotide terminate a growing DNA strand?

7. Why are four nucleotides in DNA each labelled with a different color of fluorescent tag?

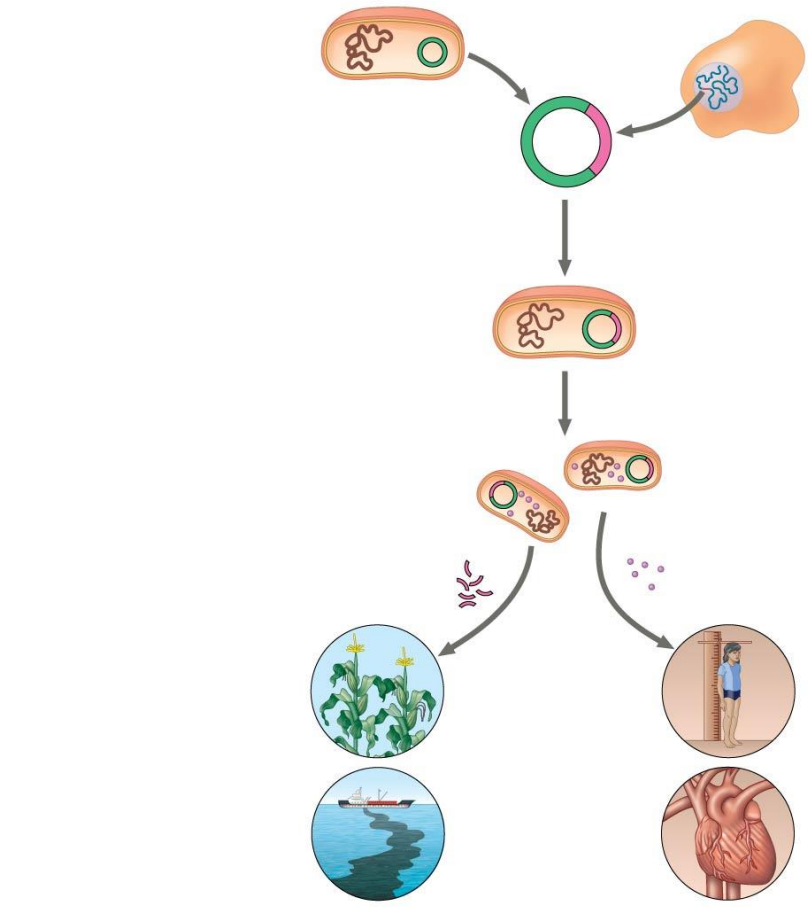
8. Figure 20.4 explains Next-Generation Sequencing. This procedure is an example of "high-throughput" DNA technology, and is currently the method of choice for studies where massive numbers of DNA samples are being sequenced. An interesting task is presented in the INTERPRET THE DATE question. Place the first 25 nucleotides in the space below.

9. What is *DNA cloning?*

10. Plasmids are important for biotechnology. Give a full and complete definition of *plasmid.*

11. What is a *cloning vector*? Why are bacterial plasmids widely used as cloning vectors?

12. Use the Figure 20.5 in your text, label and explain for four steps in this preview of *gene cloning*.



13. What is a *restriction enzyme?*

14. Draw and explain each step of Figure 20.6.

15. Explain the following key points about making a recombinant plasmid:
    a. What is an example of a *gene of interest* that might be engineered into a plasmid?

    b. What is a *restriction site?*

    c. What are *sticky ends?*

    d. Why are both the gene of interest and the plasmid cut with the same restriction enzyme?

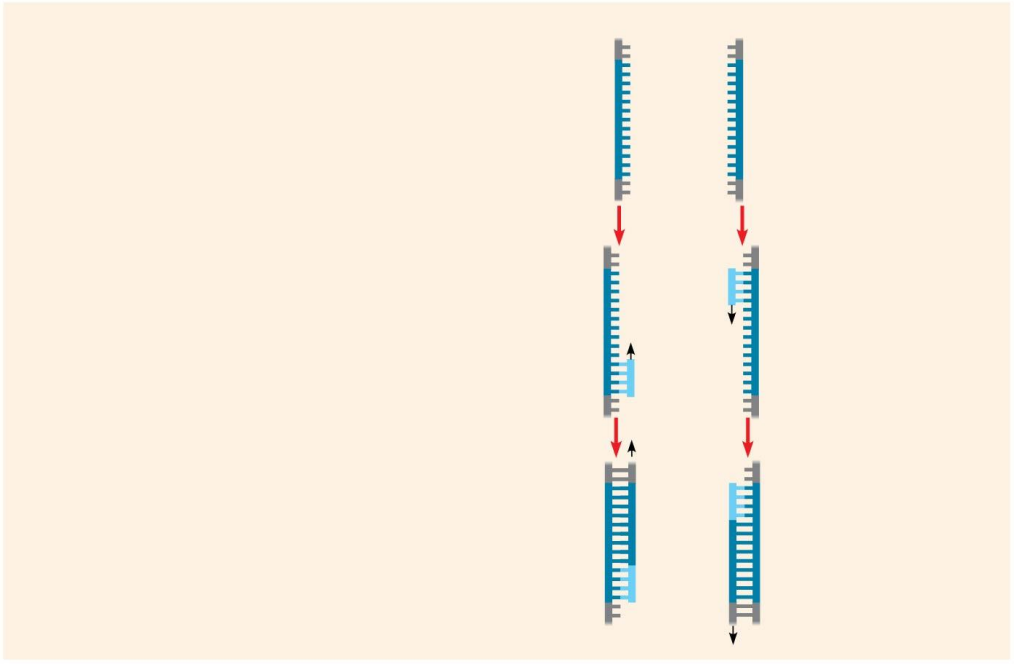
    e. What is the role of *DNA ligase* in this process?

16. Carefully study Figure 20.7 to learn about *gel electrophoresis.*

17. Why is the DNA sample to be separated by gel electrophoresis always loaded at the cathode or negative end of the power source?

18. Explain why shorter DNA molecules travel farther down the gel than larger molecules.

19. Name and explain the three initial steps that occur in cycle 1 of *polymerase chain reaction* (PCR).



20. What is the purpose of the primers?

21. Why was the discovery of *Taq polymerase* a breakthrough for this process?

22. How many molecules will be produced by four PCR cycles?

23. What are four important applications of PCR?

24. What is an *expression vector?*

25. Why can only *complementary DNA (cDNA)* be used in engineering a plasmid that will be inserted into a bacterial cell?

26. What advantages does use of yeast have over bacterial cells for an expression system?

27. What are two techniques besides use of cloning vectors that can be used to introduce recombinant DNA into eukaryotic cells?

28. We tell our students “DNA is DNA is DNA.” Cite an example from the *EVOLUTION* heading to explain what we mean.

29. Using Figure 20.11, label and explain the five steps in the production of cDNA.

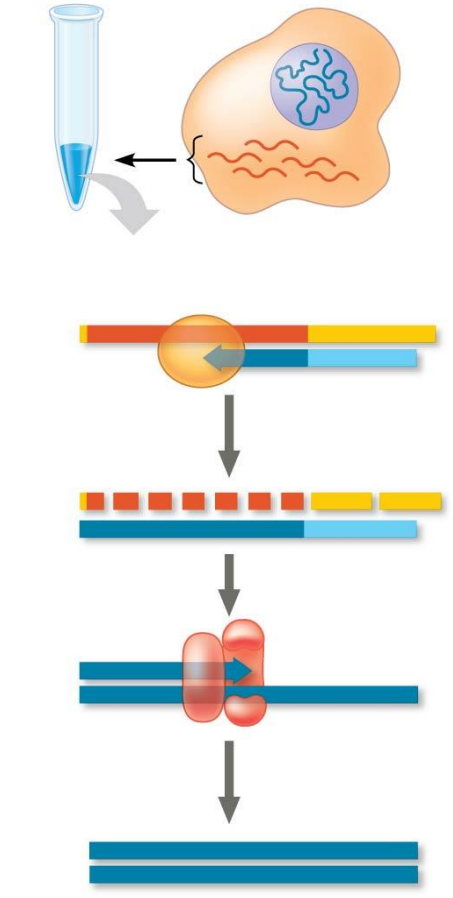
    1.

    2.

    3.

    4.

    5.



30. *DNA microarray assays* can be used to determine a pattern of gene expression, such as what genes are expressed in an embryo on day 2 of development compared to day 5. Scan this section to explain how microarrays are used in understanding patterns of gene expression in normal and cancerous tissue.

31. Read carefully on page 419, and make a list of steps that would be required to do a microarray assay.

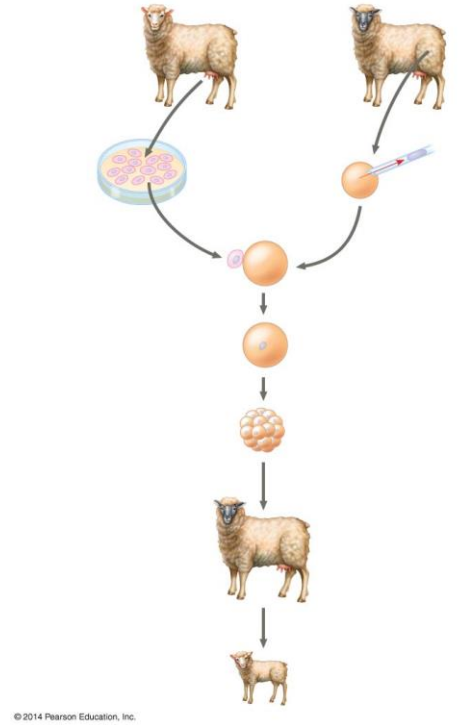
32. What are *SNPs?* How are they used to help screen for certain diseases? What are some examples of diseases for which there are genetic markers?

33. What are *stem cells?*

34. What is a *totipotent* cell?

35. How is *nuclear transplantation* performed in animals?

36. Label the six steps in reproductive cloning in mammals and briefly explain each step.



37. Describe three problems associated with animal cloning.

38. What is the major difference between *embryonic stem (ES) cells* and *adult stem cells?*

39. How might *induced pluripotent stem (iPS) cells* resolve the debate about using stem cells for medical treatments?

40. What are two potential uses for human iPS cells?

41. Explain the idea of *gene therapy,* and discuss the problems with their technique as demonstrated in the treatment of SCID.

42. Explain how *transgenic* “pharm” animals might be able to produce human proteins.

43. Describe how *short tandem repeats (STRs)* can produce a sensitive *genetic profile.*

44. How does the *Ti plasmid* make genetic engineering in plants a possibility?

45. What are *genetically modified (GM) organisms,* and why are they controversial?