Assignment 12

1. Essay (3 points)
Write a short essay that answers the following questions:

   a) What is CODIS?
   
   b) What type of DNA is of interest in forensic science?
   
   c) What is a STR (as used by CODIS)?

2. True/false (3 points)
Indicate whether the following statements about DNA electrophoresis are true or false. Write true or false in each blank.

   _____ Polyacrylamide gels are used to separate DNA fragments.

   _____ The separation of DNA fragments is based on their size.

   _____ DNA standards are not used in most electrophoretic runs.

   _____ Each band on the gel contains millions of DNA fragments.

   _____ DNA fragments move down the gel because their net charge is negative.

   _____ The DNA fragments of highest molecular weight will be found at the bottom of the gel.

3. Essay (3 points)
Examine the DNA profile in the real DNA fingerprint (activity 2). Do you think that the defendant is innocent or guilty? Write a short essay that gives sufficient details to defend your answer.

4. Multiple-choice (1 point)
Which of the following is not a way in which capillary electrophoresis differs from gel electrophoresis?

   The results in the capillary system are presented as peaks on a graph.
   The capillary system requires a computer.
   The capillary system produces results faster than gel electrophoresis.
   Smaller amounts of DNA can be used in the capillary system.
   Only in the capillary system is the separation of DNA fragments based on size.
5. Multiple-choice (1 point)
Why are VNTRs important in the RFLP method of DNA fingerprinting?

They are DNA fragments that are naturally fluorescent.
They are repeated segments of DNA and the number of repeats varies among individuals.
They are long segments of DNA that are different in each individual.
They are the only DNA fragments that stick to the membrane when DNA is transferred from the original gel.
VNTRs are not important because they are not identified in the RFLP method.

6. Multiple-choice (1 point)
In the RFLP method, why is the DNA denatured after transfer to a membrane?

So that fragments will continue to separate from one another.
So that restriction enzymes can act.
So that the molecular weights of the fragments can be identified.
So that DNA probes can bind to the fragments.
All of these statements are correct.

7. Multiple-choice (1 point)
In the RFLP method, how do the bands on the final X-ray film differ from those in the original gel?

There are more bands on the X-ray film.
There are fewer bands on the X-ray film.
The bands on the X-ray film are closer together.
The bands on the X-ray film are lighter in color.
There is no difference: bands on the X-ray film and the gel are identical.

8. Essay (3 points)
Joe and Sam were adopted as infants into different families. They have just met and noticed how much they look alike. They are also the same age and suspect that they are twins who were separated at birth. They wish to know the truth, so have their DNA analyzed. Study this DNA fingerprint (RFLP method) and write a short essay that answers the following questions:

a) In the last column of the DNA fingerprint, what does “frequency of occurrence” mean?

b) What is the probability that Joe and Sam are not twins (i.e., that the DNA in the fingerprints could have come from unrelated men)? Show your calculations.

c) If there are 270,000,000 Americans, how many of them would be expected to have this DNA fingerprint? Show your calculations.
9. True/false (2 points)
Indicate whether each of the following is a reason why the PCR method of DNA fingerprinting is now the method of choice in forensic science (as compared to the RFLP method). Write true or false in each blank.

_____ The PCR method is faster.

_____ The PCR method requires less DNA.

_____ The PCR method does not require DNA segments to be separated when comparing samples from different individuals.

_____ The PCR method uses STR regions to determine differences in the DNA from different individuals.

10. Essay (2 points)
Write a short essay about Jeffreys' work that answers the following questions:

a) What factor(s) indicated that the boy in question was the son of the mother who had immigrated to England?

b) What factor(s) indicated that the boy in question had the same father as the mother’s other children?

The next four questions are based on simulations of DNA fingerprints. You have multiple chances to pick the correct answer, but be sure that you understand the rationale for your answer. Try several different versions of each question to assure that you understand how to solve the problem. (There will be similar questions on your next exam, with only one chance to pick the correct answer.)

11. Image upload (2 points)
Determining paternity: Examine the 5 lanes within the gel. Note that lane 1 is the DNA fingerprint of a mother, lanes 4 and 5 are her children, lanes 2 and 3 are potential fathers. Choose the correct father for each child or indicate that neither is the father (absent father).

Capture an image of one of the DNA fingerprints in simulation 1 for which you have determined the correct answer. The pop-up window that says your answer is correct should be in the image. Submit your image of the gel and “correct” box to web assign.

12. Essay (2 points)
Explain, in detail, how you analyzed the above DNA fingerprint (question 11) to obtain the correct answer.
13. Image upload (2 points)
Determining relatedness among 5 individuals: Examine the 5 DNA fingerprints in this gel. Four of the individuals are related to one another, but one is not. Pick the unrelated individual. HINT: 2 of the lanes represent parents and 2 lanes their children.

Capture an image of one of the DNA fingerprints in simulation 2 for which you have determined the correct answer. The pop-up window that says your answer is correct should be in the image. Submit your image of the gel and “correct box” to web assign.

14. Essay (2 points)
Explain, in detail, how you analyzed the above DNA fingerprint (question 13) to obtain the correct answer.