Agriscience Final Exam by C. Kohn, Waterford WI

Group Names:   
   
Hour Date: Score: + = exceeded expectations. ✓= expectations were met but not exceeded. - = redo assignment

Directions: you may work in **groups of 2-3** to complete this exam. You may also choose to work alone. If you work in groups, you must alternate after every question (if you are with a partner, do every other question; if you are in a group of three, do every third question). Those not writing should be creating the answer that is written.

If a group does not split the work evenly and have every member contribute to every answer, they may be split up midway through the exam. Make sure *all* members are actively involved *all* of the time.

**Background: you are a team of scientists interested in creating a new breed of maple trees that glow at night. Your hope is to eliminate the need for streetlights (and the energy they use) by providing the same amount of light from these trees. As an extra bonus, you also hope to create glowing maple syrup. You intend to do this using the protein *luciferin*, which enables the production of light in fireflies. When *luciferin* reacts with ATP, it can then react with oxygen to produce a burst of light.**

1. Given *luciferin* is a protein, how do fireflies produce it? Answer this by explaining how any organism makes a protein. Be sure to include the explanations of the following: *1) DNA, 2) gene, 3) transcription, 4) translation, 5) mRNA, 6) tRNA, 7) ribosome, 8) protein folding, 9) protein shape, 10) protein function*.   
     
   Underline each of these ten terms when you use them below so that they can be found more easily.
2. How would you get this gene into a maple tree? Be sure to include the explanations of the following: *1) genome, 2) restriction enzyme, 3) sticky ends, 4) DNA ligase.*  
     
   Underline each of these three terms when you use them below so that they can be found more easily.
3. How did scientists figure out *which* gene was the *luciferin* gene? Be sure to include the explanations of the following: *1) Sanger method, 2) Gene knockouts.*Underline each of these two terms when you use them below so that they can be found more easily.
4. You find that usually your transgenic glowing trees are heterozygous, meaning that one chromosome exhibits the glowing trait while another does not. If the luciferin gene is incompletely dominant, how would the phenotype of a heterozygous tree differ from that of a homozygous dominant tree?   
     
      
     
   Explain why this would be the case:
5. Would the sap of this tree glow? Explain:   
     
      
     
      
     
      
   *Note: if ATP is necessary for the luciferin protein to glow, would the sap alone enable this to occur?*
6. How would your tree farms create a breed of trees whose offspring are guaranteed to glow? Explain by explaining how breeds of plants and animals were created through domestication:
7. Your team is also debating the creation of glowing pets that would double as nightlights to comfort young children who are afraid of the dark. How would the creation of glowing animals differ from the creation of glowing plants? Answer by explaining how glowing animals are created (e.g. through DNA Microinjection).
8. In your quest to create these organisms, you must prove to your corporate investors that you have actually created a transgenic glowing plants & animals. Your advisory team suggests you use the following tests: *Sanger method, PCR, electrophoresis, Southern blotting, ELISA*. In the space below, explain *how* each test would contribute to proving that you were successful:   
     
   Sanger Method:   
     
      
     
      
     
   PCR:   
     
      
     
      
     
   Electrophoresis (w/ restriction enzymes):   
     
      
     
      
     
   Southern Blotting:

ELISA:

1. Your group hypothesizes that the luciferin gene could be used to determine if individuals have genes that predispose them to getting a genetic disease (including cancer). How could this gene, gene knock-in technology, and stem cells be used to better understand how genetic diseases like cancer occur?