Bi 1X, Spring 2011

Final Projects

Presentations:

In the final presentations, each person in the group will have 5 minutes (i.e. each group will have 15-20 minutes depends on the number of people in your group) to give a visual and verbal presentation (PowerPoint or keynote will be fine) in which you link one or several of the great ideas of biology to a scientific topic that interests you. For example, if you are a Chemical Engineering major interested in energy, you could make a presentation on efforts to develop biofuels. If you are a Geology major, perhaps you will write on how fossils and molecular approaches allow us to comment on the history of life on Earth, etc. Or perhaps, you are just interested in all of the hype surrounding swine flu. The bottom line is that you will be judged on your logic, creativity, the quality of your evidence, the quality of your presentation and your ability to tie your discussion to the material you have learned this term.

16s Portfolio:

Over the past weeks we have used experiments to explore the big project of the course: collecting 16S sequences of the bacteria in the pond to answer an important question: who is in the pond?

The goal of your portfolio is to construct a narrative that captures the logic, the methods and the results of the work we have done this term and how this has gotten us these sequences. We want you to cover the entire 16S project in the portfolio, step by step, with pictures and summaries of your methods, and have you make a clear description what you have done in this course. This includes, but is not limited to, the collection of your samples, processing, PCR, purifications, gel electrophoresis, TOPO transformation, sequencing and analysis. If you find yourself mixed up by the different things we did in class, try first reviewing your lab notebook, which should have dates and more information on what you did. Additionally, copies of the protocols handed out in class are available on the website.

Concretely, we are expecting you to turn in a written portfolio of 8-10 pages in length that uses your results from the term to capture the logic and methods we have used. This means that you need to use your microscopy images, graphs, pictures, etc... as tools to build up your overall story. You will be graded on the quality of your narrative and the evidence you use to illustrate it. This report should include an introduction and conclusion, as well as the final sequence analysis report from the final week of class. All figures need detailed captions and you will likely need sections and subsections as well as text that provide a guide to the reader of the overall flow of the project.

Example Outline of Portfolio Setup:

1. Introduction:
   One or two paragraphs that answer the following questions:
   i. What is16s ribosomal RNA and what is its evolutionary significance? How does it help you answer the question of "who is in the pond?"
   ii. How did you use modern biological tools to attack the problem? Briefly summarize the procedure and timeline of the experiment.
2. Main Body:
   You can divide your main body into the following sections:
   1) Microscopy on pond water sample
   2) Process pond water sample to isolate DNA from the soil
   3) PCR and Gel electrophoresis
   4) PCR purification
   5) TOPO transformation
   6) Sequencing

   For each of the above section, be sure to discuss the following questions:
   - What is the molecular biological tool you used? How did it help you accomplish the objective for current section you worked on? Describe your procedure in detail. Remember to use full sentences and walk the reader through each step. Do not write a list. In this case, your lab notebook is a reference for you to look up exactly what you did in the procedure.
   - Discuss your results including sources of errors. Use data table and figures when it is applicable to support your discussion. Make sure to include title, axes labels, legend, scale bar, and caption such that you could independently understand it without having to refer to the text.
   - If there is no numerical or graphical result for a particular section, make sure to describe your observation in full sentences. Again, your lab notebook is a good reference for you here.
   - For sequencing analysis, pick the *best* sequencing result you have out of the five colonies to report in your portfolio. Be sure to answer the following questions in your discussion. These are the same questions in "Part IV: Phylogenetic Analysis" of the sequencing tutorial. Use full sentences in paragraphs to discuss your analysis.

     i. Draw your NJ tree using two topologies: rectangular and radiation. What is the difference between these two topologies? (submit only the rectangular tree)

ii. Why is the Jukes-Cantor model more accurate than simply using the p-distance to calculate evolutionary distances? What does the Jukes-Cantor model attempt to correct for?
iii. Do the bootstrap values support your classification?
iv. The tree that you submitted is an unrooted tree. What kind of organism would you need to root this tree? What would you gain by rooting the tree?
v. Use MEGA to find the percent identity between your sequence and its nearest neighbors.
vi. Who is the nearest 16S sequence to your pond sequence? What is the percent identity to that sequence? Is the nearest neighbor the same species, genus or phylum as your 16S? Can you use the nearest neighbor to classify your organism reliably?
vii. What is the precise taxonomic classification of your nearest neighbors?
viii. Read up on the microbe you identified (e.g. by looking up the references in the NCBI record, searching Google scholar for the microbe's name, searching WikiSpecies, etc.). Given this organism's physiology (respiration method, energy and carbon sources, typical osmolarity/pH/temperature ranges) is it plausible you found it in a fresh water pond or could it be a contaminating sequence in your PCR? Explain your answer.

3. Conclusion:
   One paragraph to summarize what you learned in the project and what are the great ideas of biology you have explored throughout the project.

4. References