BIOLOGY 4DD3 Problem Set 2

1. Please find at least two errors in Figure 3.7 in the textbook (Li, W.-H. and D. Graur. 2000. *Fundamentals of Molecular Evolution*. Sinauer).

2. Please verify that the D values that are reported on page 94 in the textbook (Li, W.-H. and D. Graur. 2000. *Fundamentals of Molecular Evolution*. Sinauer) are correct (the values refer to alignments I, II, and III on pages 91-92 and equation 3.49 with the parameters defined on page 94).

3. Please explain how the value for each bar in Figure 4.3 was obtained (for the first and last two bars, please provide a calculation; for the other bars, you may provide a calculation but at least cite a source from the textbook and a description about how the value may be reproduced).

4. Compare very carefully the contents in paragraph 2 on page 110 and the first paragraph under the heading "*Variation among different gene regions*," on page 111, in the textbook (Li, W.-H. and D. Graur. 2000. *Fundamentals of Molecular Evolution*. Sinauer). Please comment on the logical relation between them.

5. (a) Please use Table 1.5 in the textbook (Li, W.-H. and D. Graur. 2000. *Fundamentals of Molecular Evolution*. Sinauer) to determine the fraction among ~~deleterious~~ mutations at third positions in codons that would be subject to negative selection.

(b) A study revealed that 42% among all mutations occurring at third positions in codons were neutral. Please comment on the implications that this observation has for synonymous substitutions at third positions.

6. Please summarise the information that is provided by (a) row and (b) column totals in Table 4.5, by specifying a null hypothesis (formulated on the basis of no bias in nucleotide mutation) and comparing the values that are presented in the table to those that would be expected according to the null hypothesis.

(c) Please use the information from parts a and b to predict the nucleotide composition that should prevail in noncoding regions that are subject to no functional constraints.

7. Please identify typographical errors in paragraph 2 on page 134 in the textbook (Li, W.-H. and D. Graur. 2000. *Fundamentals of Molecular Evolution*. Sinauer), by comparing the text to the information that is provided in Figure 4.13.