

## 7.012 Section Problem

You are a microbial biologist and you isolate seven different strains (A - G) of chemosynthetic bacteria. To put the seven strains on a phylogenetic tree you perform two different experiments.

1st Experiment: you test whether different bacterial strains have similar metabolic processes or can carry out similar functions. The results lead you to group the seven strains as follows:

group 1: A, C, F  
 group 2: B, E  
 group 3: D, G

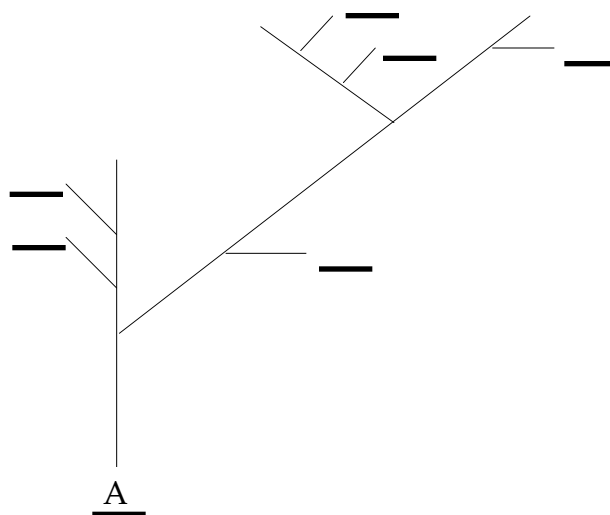
a) What are the limitations of using only functional or structural information in establishing evolutionary relationships?

2nd Experiment: You isolate DNA from each strain and sequence the 16S rRNA. A comparison of the DNA sequence is shown below. Matches (identity) to sequence A are indicated by -. (Assume that there is no back mutation.)

```

A : ATGGCTCGTTTAGTCCGATCCCGATATTGCTAATCGCGGGCTCAT
B : -----C-----T-----T-----
C : -----G---C-----
D : -----A-C---C---T-----T---A---A
E : T---A---C---C---T-----T-G---A---A
F : -----G---C-----T-----C-
G : -C-----A-C---C---G---T-----T---T---A---A
    
```

b) Beginning with A in the position shown, fill in the blanks with the appropriate strains.



c) On this alignment (this is identical to the one above), circle a stretch of nucleotides that you predict may serve an important function in 16S rRNA? Explain your answer.

```

A : ATGGCTCGTTTAGTCCGATCCCGATATTGCTAATCGCGGGCTCAT
B : -----C-----T-----T-----
C : -----G---C-----
D : -----A-C---C---T-----T---A---A
E : T---A---C---C---T-----T-G---A---A
F : -----G---C-----T-----C-
G : -C-----A-C---C--G--T-----T--T--A---A
  
```

d) You perform a small-scale microbial evolution experiment by mixing equal numbers of cells from bacterial strains B, D, E, G, and C. You grow these cells by continuously replacing the medium with fresh medium. You find that the population consists of the following **fixed** percentage of bacterial cells.

B: 20%  
 D: 20%  
 E: 20%  
 G: 20%  
 C: 20%

i) Experiment 1 (performed twice, each time beginning with the above population): chlorine is added to kill 99.99% of the bacteria, the chlorine is washed out and the remaining cells are supplied with fresh medium (no chlorine) and allowed to grow. You find the populations are now composed of the following percentages of bacterial cells:

<u>trial 1</u>		<u>trial 2</u>	
B:	5%	B:	40%
D:	35%	D:	3%
E:	30%	E:	10%
G:	10%	G:	37%
C:	20%	C:	10%

What evolutionary mechanism (agent of change) is responsible for the observed changes in the bacterial population? Explain how this occurred.

ii) You perform a similar experiment but instead of adding chlorine to kill the bacterial cells you expose them to high doses of UV radiation. You find the populations are now composed of the following percentages of bacterial cells:

<u>trial 1</u>		<u>trial 2</u>	
B:	5%	B:	4.5%
D:	42.5%	D:	41%
E:	5%	E:	5%
G:	42.5%	G:	43%
C:	5%	C:	6.5%

What evolutionary mechanism (agent of change) is responsible for the observed changes in the bacterial population? Explain how this occurred.