1.) The tree below includes 10 taxa which either have wings or are wingless.

a.) Based on parsimony, which is the ancestral character state and which is the derived character state for this clade?
b.) Mark on the tree where the ancestral character state and derived character state evolve.
c.) A group that only includes taxa with eyes would be a monophyletic, polyphyletic, or paraphyletic group?
d.) A group that only includes eyeless taxa would be a monophyletic, polyphyletic, or paraphyletic group?
e.) If new fossil evidence suggested that the ancestor of this group was wingless, how would this affect your answers to c and d ?
2.) The tree below includes 10 taxa which either have eyes or are eyeless.

a.) Based on parsimony, what is the ancestral character state. What is the derived character state?
b.) Eyes are very complex organs that are not easily evolved. Why might an evolutionary biologist be unwilling to accept the most parsimonious character state reconstruction, and instead prefer a less parsimonious hypothesis?
c.) Assume that eyeless taxa have lost eyes and that the eyes of taxon 1 and taxon 10 are homologous, mark on the tree where these two character states are likely to have evolved.
d.) Is a group that includes all the eyeless taxa a monophyletic, polyphyletic, or paraphyletic group?
e.) Is a group that includes the two taxa with eyes a monophyletic, polyphyletic, or paraphyletic group.
f.) Based on your character state reconstruction, are the eyeless character states of taxon 7 and taxon 4 homologous or homoplastic? What about the eyeless character states of taxon 2 and taxon 3 ?
g.) Character state reconstruction for this group depends on whether the eyes of taxon 1 and taxon 10 are homologous. Although it might seem unlikely that eyes evolved twice in this clade, it is not impossible. How might an evolutionary biologist determine whether or not the eyes of taxon 1 and taxon 10 are truly homologous? Do you think the similar function of these organs would influence the evolutionary biologists decision, why or why not?
3.) Given the character matrix below, determine the minimum number of steps for each tree. Which tree is most parsimonious?

| Character | $\mathbf{1}$ | $\mathbf{2}$ | $\mathbf{3}$ | $\mathbf{4}$ | $\mathbf{5}$ | $\mathbf{6}$ | $\mathbf{7}$ | $\mathbf{8}$ | $\mathbf{9}$ |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| taxon 1 | A | T | T | C | C | T | A | A | T |
| taxon 2 | A | T | T | C | C | A | T | A | T |
| taxon 3 | A | T | T | G | C | A | T | A | T |
| $\operatorname{taxon} 4$ | A | T | T | C | C | A | A | A | T |
| $\operatorname{taxon} 5$ | A | T | C | G | C | A | T | A | T |

a.)

b.)


