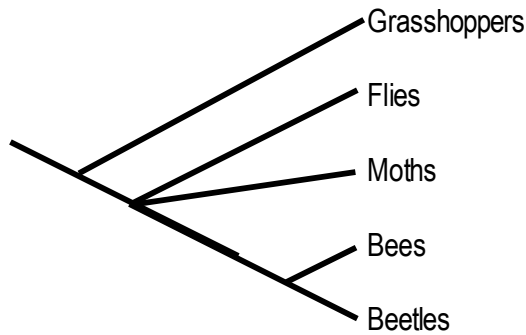
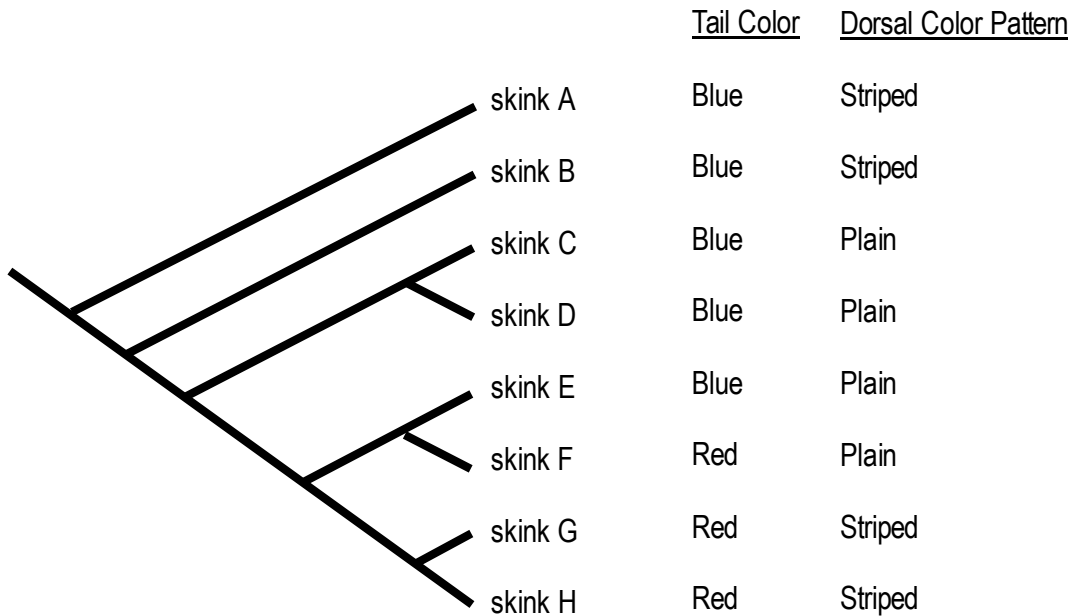


Problem Set 9

1. Refer to the insect tree used in our examples of character evolution today. There were two trichotomies in the insect tree.
 - a. What is the most common reason for a trichotomy (or larger polytomy) in a phylogeny? (2 pts)
 - b. What other trees are possible resolutions of the trichotomy in the tree below? (3 pts)



2. An assumption that is sometimes made in biology is that the more common state of a trait is the ancestral state. Give an example (of a tree and a trait evolving on the tree) and use it to show why this assumption is not justified (4 pts)
3. Based on the tree of skink taxa (A-G) indicate the evolutionary history of the two traits whose states are indicated and answer the following:
 - a. What is the ancestral state for tail color? (1 pt)
 - b. What is the derived state for dorsal color pattern? (1 pt)
 - c. Identify an instance of homoplasy. (2 pts)
 - d. Are the skink lineages that lack stripes paraphyletic or polyphyletic? Justify your answer. (2 pts)
 - e. What are the two equally parsimonious reconstructions for the evolutionary history of tail color? (4 pts)



4. For the following 6 taxa, draw a tree satisfying each condition below: (8 pts)

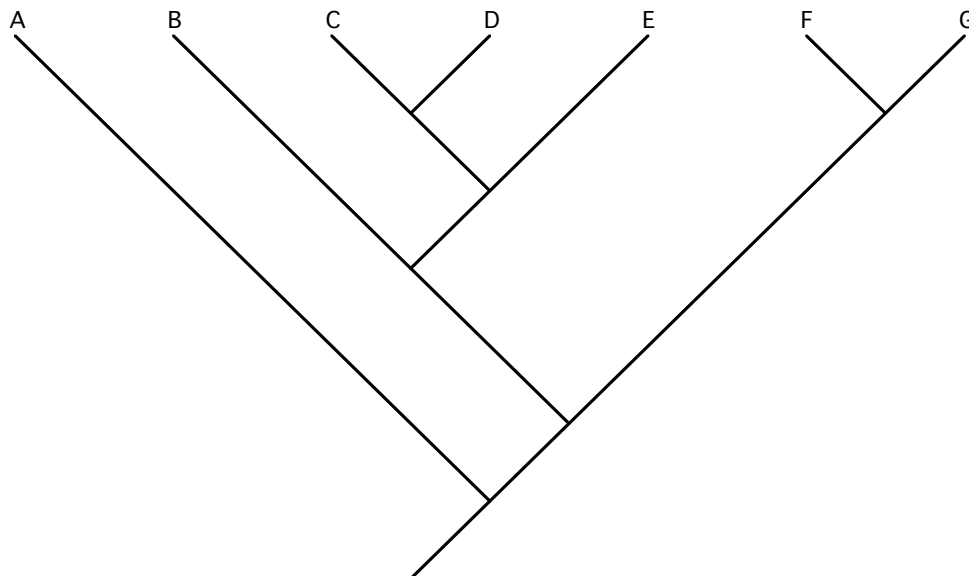
<u>Taxon</u>	<u>Character = number of limbs</u>
A	Four limbs
B	Four limbs
C	Four limbs
D	Four limbs
E	two limbs
F	two limbs

- Condition 2: A tree showing that two limbs is the ancestral state for the clade formed by taxa A-F.
- Condition 3: A tree in which two limbs characterizes a monophyletic group.
- Condition 4: A tree showing that two limbs is a derived state that has unambiguously evolved two times independently.
- Condition 1: A tree in which you cannot tell whether four limbs or two limbs is the ancestral state for the clade formed by taxa A-F.

5. Use the tree below to reconstruct the following patterns of character evolution. (6 pts)

- Fill in the states of character 1 in the blanks below so that state 1 characterizes a paraphyletic group. (Note: assume that character 1 has two states; call one state '1' and the other state something else (e.g. '0'))
- Fill in the states of character 2 in the blanks below so that state 1 shows convergence. (Make sure that convergence is the only most parsimonious reconstruction.)
- Fill in the states of character 3 in taxa A-G so that state 1 shows a reversal. (Again, make sure that convergence is the only most parsimonious reconstruction).

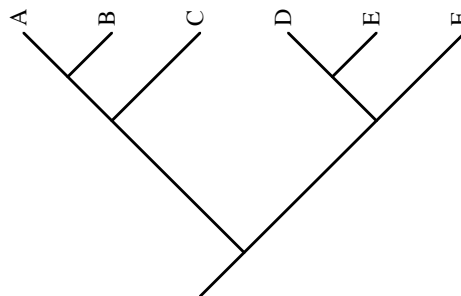
char. 1	___	___	___	___	___	___	___
char. 2	___	___	___	___	___	___	___
char. 3	___	___	___	___	___	___	___



6. Refer to the spider web evolution example from lecture to answer the following questions:
- Draw a tree in which each web type characterizes a monophyletic group. (You don't need to include all of the taxa; you only need to include enough of the taxa to make it clear that the phylogeny would support the conclusion that each web type characterizes a monophyletic group.) (2 pts)
 - Based on the tree in b, what could you have been able to conclude about the evolution of spider web types? Explain your answer. (3 pts)
7. A graduate student studying carnivorous plants hypothesizes that secretion of sticky substances on leaves is an intermediate step in the evolution of elaborate insect catching devices such as the snap-trap of Venus flytraps.
- Explain how you could test this hypothesis. (3 pts)
 - Draw a tree (showing the relevant traits in each of the included taxa) that unambiguously supports the hypothesis. (2 pts)
8. A hardworking graduate student at the University of Hawaii observed that less toxic species of pufferfish puff up a lot when faced with a predator and are covered with long spines, but that more toxic species puff up a bit and are covered with short spines. She hypothesized that spines and puffing work together as an anti-predator adaptation, and therefore coevolve. Use the information in the table below to answer the following questions:

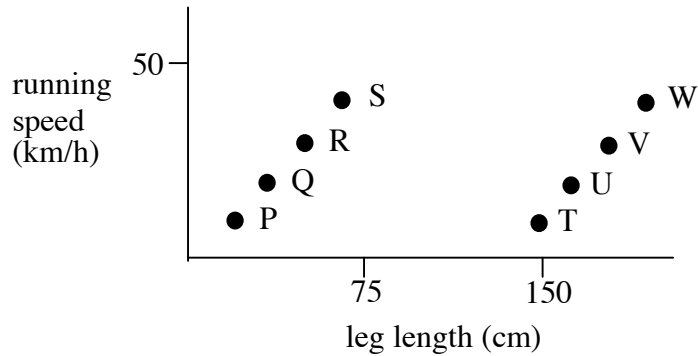
species	puffing ability	spine length
A	high	long
B	high	long
C	high	long
D	low	short
E	low	short
F	low	short

- Assume that the tree below shows the relationships among taxa A-F. Explain why this tree does **NOT** provide strong support for the graduate student's hypothesis. (2 pts)



- Draw a tree that would provide the strongest possible support for the conclusion that spine length and puffing ability co-evolve because the two traits work together to provide effective defense against predators. (3 pts)
- Explain why the tree you have drawn provides stronger support for this hypothesis than the tree in a. (3 pts)

9. You want to test the hypothesis that longer legs make it possible to run faster. First, you go to Africa, and while on safari, estimate leg length and running speed in a representative sample of the eight species (labeled P-W) of antelope that you see. These data are shown in the graph below.



- Explain why you can't reject your hypothesis, even though your graph does not show a clear correlation. (3 pts)
- Draw a tree showing relationships that would provide support for your hypothesis. (3 pts)
- Using the tree in b, graph the contrast in leg length vs. the contrast in running speed and explain why this graph provides a more appropriate test of your hypothesis that leg length and running speed coevolve than the graph shown above. (3 pts)