

Answers to problem set 4.

1.) the genotype of the top left corner is $A_1A_1B_2B_2$, the bottom left corner is $A_2A_2B_2B_2$, the top right corner is $A_1A_1B_1B_1$, and the bottom right corner is $A_2A_2B_1B_1$.

The population can speciate from the top left corner and the bottom right corner. The population won't be able to speciate from the other two corners because selection will prevent the populations from moving from these corners, because to do so would entail a loss of mean fitness.

2.) Most would consider this only one species because all though the southern populations are reproductively isolated there is gene flow all the way around the ring. Each population can mate with its neighboring population (except the two southern populations).

The argument that there are two species in Southern California is simply that the two southern populations are reproductively isolated.

Because there is gene flow throughout the ring, none of the *Ensatina* populations are evolutionarily independent. Therefore we wouldn't consider the southern populations to be reproductively isolated.

In order for this group to be considered evolutionarily independent the northern populations would have to go extinct. This way the ring would be broken and there would no longer be gene flow between the two southern populations.

3.) a. there isn't just one correct answer for this question. But, in order to be correct the original population must become geographically isolated which would allow the evolution of prezygotic and postzygotic isolation.

b. again, no one correct answer. But all correct answers must invoke some kind of disruptive selection and assortative mating.

c. speciation would likely evolve more quickly if crossbills could not fly. Remember they fly thousands of kilometers a year. If crossbills couldn't fly there would likely be no chance of gene flow between populations, which would be conducive to allopatric speciation. Because they can fly, there is always a chance of gene flow between populations during the early stages of the speciation process. This would attenuate the speciation process.

d.) If the conifer forest occurred in a broad, contiguous expanse speciation would likely evolve more slowly. This condition suggests that the home ranges of the two populations would overlap. This would increase the chances of gene flow and slow speciation. If this was the case we might have to invoke sympatric speciation instead of allopatric speciation.

4.) a. Allopatric speciation

b. Allopatric speciation

in both a and b the populations evolve reproductive isolation while in separate geographical regions.

c. Sympatric speciation- evolution of reproductive isolation while living in the same geographic region.

The *Plestiodon* skink example represented allopatric speciation. The small skink species lives at higher altitudes in the mountains while the larger skink species lives in the very dry lowlands.

The cichlid fish of Lake Apoyo represents a case of sympatric speciation.

5.) a. mechanical isolation

b. the *Plestiodon* skinks

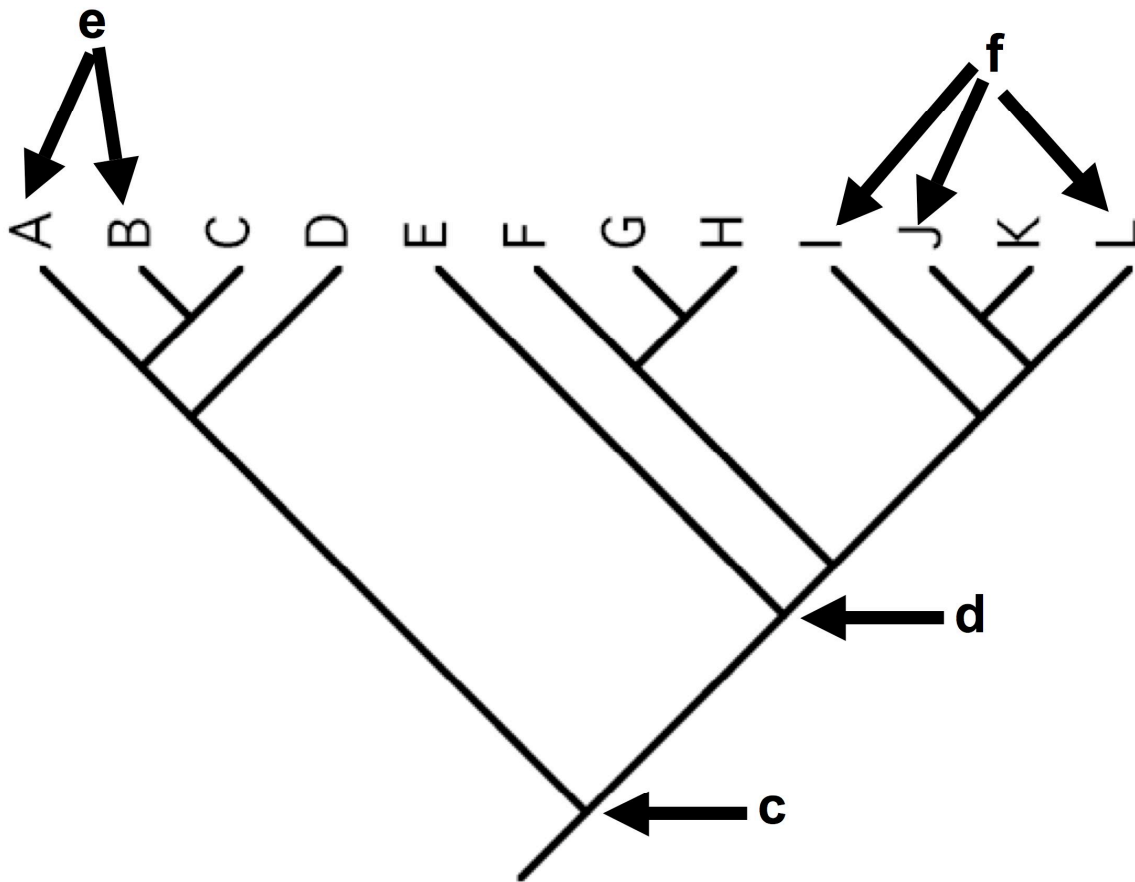
c. This question is pretty tricky. Even though these two species are sympatric, I don't see any evidence of sympatric speciation. The fact that the males will attempt copulation with females of either species makes it hard to imagine how this would have evolved in sympatry. Remember, in order for populations to speciate in sympatry there must be assortative mating. Because males will attempt copulations with females of either species, there doesn't appear that was assortative mating. So, if not sympatric, it is most likely a case of allopatric speciation.

6.) a. epistasis- an interaction between loci that effects fitness. In other words, the fitness effects of the alleles at one loci depends on what alleles are present at a different loci.

b. epistasis is irrelevant to the 1 locus model, but is very relevant to the 2 locus model. Remember that in the two locus model the population becomes separated into two. In one population a mutation occurs at a locus and goes to fixation. The same thing happens in the other population but at a different locus. When the populations come back together and hybridize the offspring have low fitness because of the epistatic interaction between the two mutant alleles at the different loci.

7.) Assortative mating allows the population to split into two and move up separate peaks on the adaptive landscape. If there wasn't assortative mating, the population could not separate and it would end up on a single adaptive peak.

- 8.) a. J
 b. the clade that includes F,G,H, I, J, K, L



- g. various answers: make sure to circle everything in the group including common ancestor
 h. various answers: make sure to include the common ancestor in your circle.
 i. various answers: of course for this group you will not include the common ancestor in your circle.

9.) B, E, F are the same as A

10.) a. it does support the verdict. The woman's HIV sequence is most closely related to the convicted rapist.

b. if the woman's HIV sequence was more similar to one of the other samples, it would suggest that the man wasn't the rapist.

c. Remember that HIV evolves rapidly. It is likely that the man had two distinct populations of HIV. The woman contracted both from the man. But when they sequenced the man, by chance they only found the one sequence. So when they made the tree, one of

the woman's HIV sequences was more closely related to the convicts sequence than to her second sequence. Don't worry, you'll never see anything this hard on the exam.

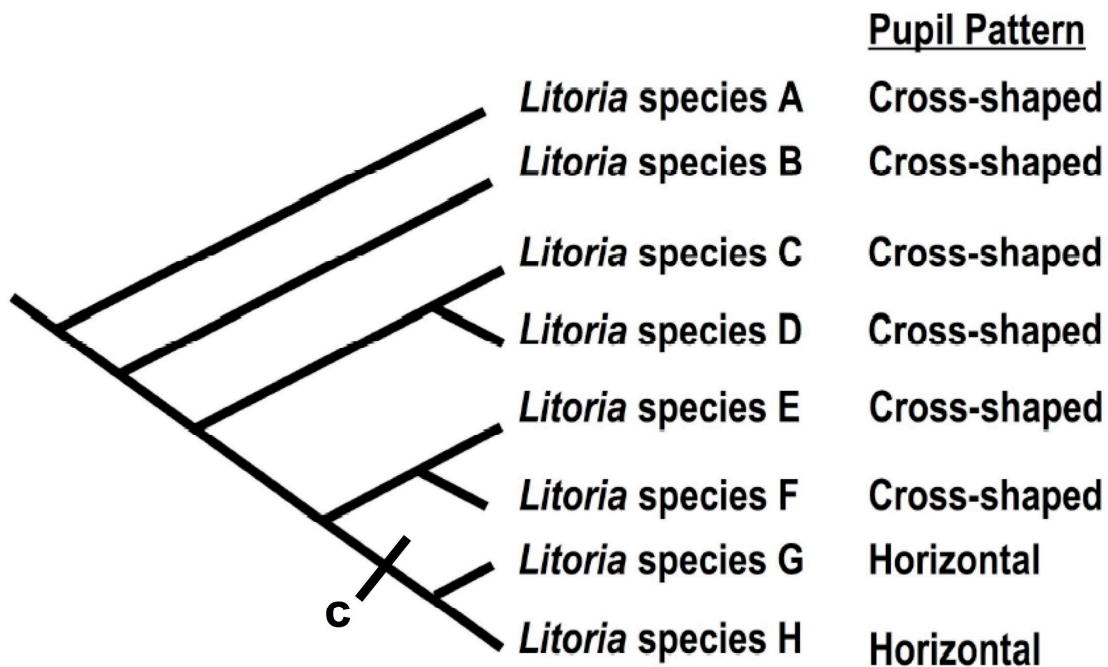
11.) a. It is more likely that the mystery species had been introduced from another region. It doesn't appear to be very closely related to either of the Lake Constance species, which it would be very closely related if it was a hybrid.

b. I would suggest that it originated in Japan. It's nested within an all Japan clade, which supports this hypothesis.

c. this question should read "mystery species" not "mystery tree". Anyway, if it was a hybrid it should sister group to one of the Lake Constance species or possible nested between them, depending on which genes are sequenced. But, the main point is that it should appear more closely related to one of these species than to the Japanese species.

12.) a. horizontal pupil pattern

b.



c. They represent a paraphyletic group. You would only have to break off the Horizontal clade and you would be left with the Cross-shaped clade. I would include the ancestor of the group, but not all the descendants, therefore it is paraphyletic.