Optional Final Assignment
BIOL 01104, Fall 2018
Instructor: Dr. Spielman
Due <u>on paper</u> on Monday 12/10/18 at beginning of class

<u>Question 1</u>
Consider the following experimental scenario and answer the questions about this experiment on the next page:

Roosters and hens were selected on the basis of similarity in age, weight, and overall health, and all were of the same breed. All chickens received the same feeding and care, apart from what is described in each treatment.

Twenty-four roosters and 120 hens were divided into four treatment groups (see below), each with six roosters and 30 hens. Within each treatment group, each rooster was housed with five hens, and roosters and hens were kept separate, so roosters only had access to their five hens and vice versa. Egg-laying was monitored for six egg-laying periods. After each egg-laying period, roosters were switched into a different hen house with a different set of five hens but kept in the same treatment group. Assume all roosters and hens were randomly selected, were all of the same breed, and received similar feeding and care (aside from differences in treatments).

Treatment A: Roosters in this group received a daily oral dose of a 20 ml drink containing 10% ethyl alcohol.

Treatment B: Roosters in this group received a daily oral dose of a 20 ml drink containing 5% ethyl alcohol.

Treatment C: Roosters in this group received a daily oral dose of a 20 ml drink containing 1% ethyl alcohol.

Treatment D: Roosters in this group received a daily oral dose of a 20 ml "virgin" drink containing no ethyl alcohol.

The following table of results were obtained:

Mean number of eggs laid

Treatment	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6
A	47	32	14	10	5	3
B	48	38	27	26	17	7
C	51	44	58	26	31	43
D	53	51	52	53	54	63

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1. Identify the alternate and null hypothesis hypotheses being tested by writing them here:

2. If the alternative hypothesis were TRUE, what do you predict the results would show? If the null hypothesis were true?

3. Explain whether this experiment includes each of the following. Then, conclude if the experiment has a valid scientific setup.

    a. Replication

    b. Control group

    c. Randomization

d. Is it valid?

4. What conclusions can you draw from the results? Do the authors reject their null hypotheses, or do they find evidence for the alternative hypothesis?

Question 2

King snakes, which are non-venomous, exist in a variety of color morphs in the eastern United States. Most morphs are a mottled brown color that blends in with many of the surfaces where the snakes sunbathe. Other morphs have bright bands of color that are similar to the color patterns of the venomous coral snake. Hawks are visual predators that hunt snakes, although they avoid venomous species like the coral snake.

A hypothetical mark-and-recapture experiment (similar to Kettlewell's moths) was performed on two populations of king snakes. One population is in an area where coral snakes are also present; the other population has no coral snakes in its area. In each population, the researchers marked and recaptured both mottled king snakes and brightly banded king snakes. Answer the following questions based on this information.

a. For each of the two populations, how do you expect selection to affect brightly banded snakes?

b. Given your answer above, what would you predict would be the results of the mark and recapture experiment for each population?

Finally, the results are in! In the population without coral snakes, the researchers recaptured 22% of the mottled snakes and 6% of the banded snakes. In the population with coral snakes, the researchers recaptured 19% of the mottled snakes and 14% of the banded snakes.

c. Calculate the selection coefficient (**s**) for each morph in <u>each</u> population. There will be FOUR total calculations. In which population does selection appear to be stronger?

d. You further study the population WITH coral snakes. You determine that, in total, this population contains 500 mottled snakes and 150 banded snakes. What is the average fitness of this population?

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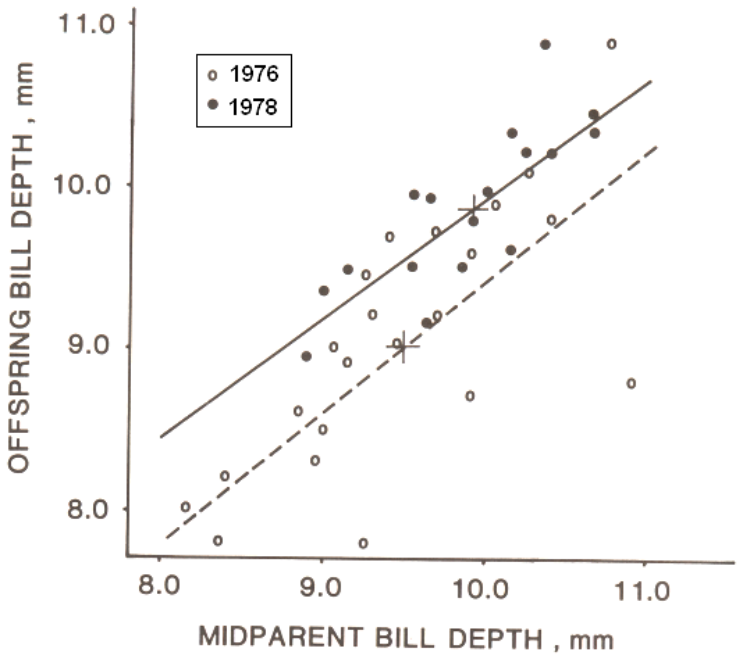
Question 3

The figure below (also seen in class!) shows the relationship between the beak depth of parents and their offspring of the medium ground finch (*Geospiza fortis*) in the Galapagos Islands. The open circles represent birds born in 1976 and the filled circles birds born in 1978. Crosses represent the average bill depth of parents and offspring in the two years. The Islands underwent a severe drought in 1977.



a. Does bill depth appear to be a heritable trait in these birds? Explain your answer precisely.

b. Did evolution occur in this population from 1976 - 1978? Explain your answer.

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Question 4

Two islands lie some miles apart. A population of grasshoppers of the <u>same species</u> lives on each island. An examination of variation in genes of these two populations provided the following results:

	Frequency of the same allele	
Gene	**Island A**	**Island B**
1	0.65	0.63
2	0.22	0.21
3	0.58	0.58
4	0.66	0.67
5	1.00	1.00

Do these results suggest evidence *for* or *against* migration of grasshoppers between these islands? Explain.

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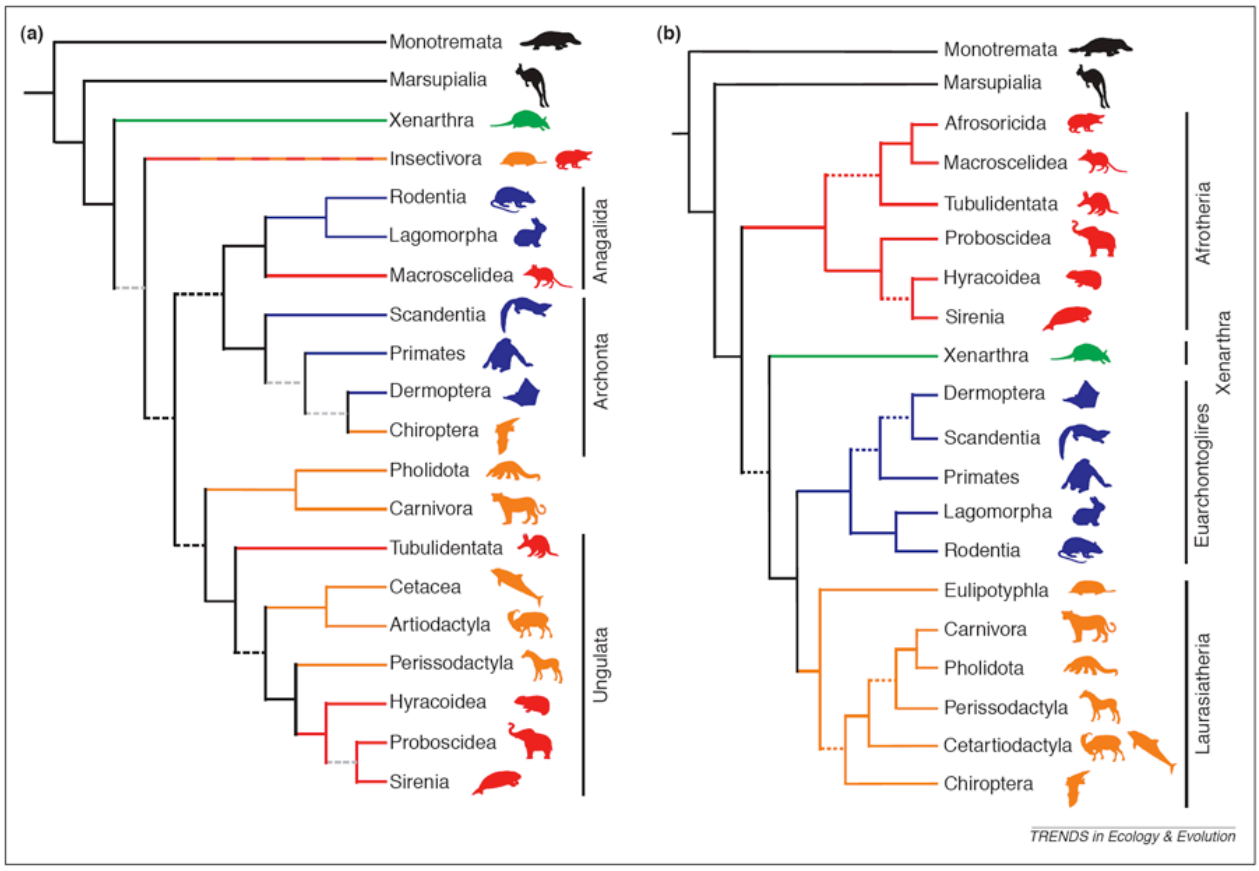
Question 5



a. The evolutionary group Paenungulata is defined as all of the descendants of the most recent common ancestor of Proboscidea, Sirenia, and Hyracoidea. Directly circle the <u>entire</u> <u>monophyletic group</u> corresponding to Paenungulata on each tree.

b. The two phylogenies shown above depict *competing hypotheses* for the evolutionary relationships among mammals. Draw two new trees, one based on (a) and one based on (b), which show ONLY the relationships among these six OTUs: Carnivora, Perissodactyla, Tubulidentata, Primates, Chiroptera, and Hyracoidea. *Draw on the next page in the space provided.*

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Draw phylogeny for (a):

Draw phylogeny for (b):