MCDB 1150_Fall 2014
Problem set 1 Due Sept 4

The first problem set has been posted on D2L. You can find a PDF of the questions in Content (it includes these instructions). You can find the actual problem set in the Quizzes tab.

Once you open a problem set, you can leave D2L and reenter the problem set as many times as you like, until you submit the answers. You must SAVE your answers (either individually or by hitting the "Save All" button) if you want them to still be there when you come back. If you enter your answers immediately before you submit them, you do not need to save them. However, we still recommend that you save them, since if you think you have selected an answer but have failed to do so you will get zero points for that question. If you forget to submit your answers prior to the deadline, they will not be automatically submitted for you.

If you accidentally submit the answers before you mean to do so, contact Megan (Megan.Greening@colorado.edu) to get the problem set reset for you. If you need the problem set reset and it is close to being due, include your answers in the email in case Megan cannot get it reset for you in time.

1. Over evolutionary time, many cave-dwelling organisms have lost their eyes, tapeworms have lost their digestive systems, and whales have lost their hind limbs. How can natural selection account for these losses?

Answer True or false:

Under particular circumstances that persisted for long periods, each of these structures presented greater costs than benefits.

a. True
b. False

2. Some animals, including scorpions and snakes, produce venom to immobilize or kill their prey. Venom can also serve as a defense against predators. The bark scorpion produces venom, but one of its predators--the grasshopper mouse--is immune to it. Therefore, grasshopper mice can eat bark scorpions without being injured by the venom.

Researchers hypothesize that reduced sensitivity to bark scorpion venom evolved in grasshopper mice populations through natural selection. The reduced sensitivity to the venom confers an advantage by enabling grasshopper mice to exploit an additional food source.

Researchers noticed that when venom was injected into the paws of mice, the mice licked their paws. The researchers performed an experiment to measure the effects of varying concentrations of bark scorpion venom on this licking behavior. Below is a table of data from the experiment.
What conclusions can you draw from this data set? Choose ALL that apply.

Venom concentration (μg/μl)	Paw licking (seconds)
0	5
0.05	25
0.10	63
0.15	111
0.20	178
0.25	213

Length of paw licking (seconds) as a function of venom concentration (μg/μl).

a. The length of time that mice lick their paws is positively correlated to the concentration of venom injected.
b. The length of time that mice lick their paws is negatively correlated to the concentration of venom injected.
c. The longest that the mice licked their paws occurred at a venom concentration of 0.25 ug/ul.
d. This data suggests that humans would lick their hands if injected with bark scorpion venom.

3. Given a population that contains genetic variation, what is the correct sequence of the following events under the influence of natural selection?

1. Well-adapted individuals leave more offspring than do poorly adapted individuals.
2. A change occurs in the environment.
3. Genetic frequencies within the population change.
4. Poorly adapted individuals have decreased survivorship.

a. 4, 2, 1, 3
b. 2, 4, 3, 1
c. 4, 1, 2, 3
d. 2, 4, 1, 3

4. Cotton-topped tamarins are small primates with tufts of long white hair on their heads. While studying these creatures, you notice that males with longer hair get more opportunities to mate and father more offspring. To begin to test the hypothesis that long hair is adaptive in these males, you should:

a. determine if males with shaved heads are still able to mate
b. look for evidence of hair in ancestors of tamarins
c. determine if other traits in these males are also adaptive
d. determine if hair length is heritable

5. A scientist is studying a population of beetles that typically have black wings. Their eggs hatch in early spring, the young insects grow through the late spring and summer, they lay eggs in the early fall, and they die in the early winter. Recently some beetles have been born with

white wings. Early in life, the black- and white-winged beetles seem to be very similar in number of mating events, eggs laid, and survival rates, but shortly after laying their eggs the white beetles die and there are only black-winged beetles during the late fall. Which of the following is true with regard to the beetles?

a. Black-winged beetles have a higher fitness that white-winged beetles.
b. The number of baby white-winged beetles will decrease in frequency over time.
c. White- and black-winged beetles have equal fitness.
d. White wings are an adaptation.
e. none of the above

6. Which of the following statements best describes evolution by natural selection of *Mycobacterium* tuberculosis growing in the lungs of a patient undergoing long term rifampin treatment? **Choose all that apply.**

a. The drug-resistance trait is an adaptation to rifampin.
b. The drug-susceptibility trait is an adaptation to rifampin.
c. The drug-resistant *Mycobacterium* tuberculosis have higher fitness than the drug-susceptible *Mycobacterium* tuberculosis during rifampin treatment of patients.
d. The drug-resistant *Mycobacterium* tuberculosis have lower fitness than the drug-susceptible *mycobacterium* tuberculosis in during rifampin treatment of patients.

7. Answer True or False:

It would be difficult to assess the relative fitness of drug-susceptible and drug-resistant *Mycobacterium tuberculosis* in an environment without antibiotics.

a. True
b. False

8. Within a few weeks of treatment with the drug 3TC, a patient's HIV population consists entirely of 3TC-resistant viruses. How can this result best be explained?

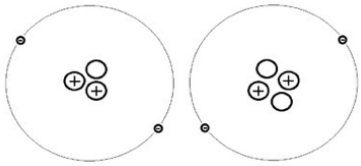
a. HIV can change its surface proteins and resist vaccines.
b. The patient must have become reinfected with a resistant virus.
c. A few drug-resistant viruses were present at the start of 3TC treatment, and after the drug treatment, their frequency increased.

d. The drug caused the HIV genes to mutate.
e. HIV began making drug-resistant versions of its enzymes in response to the drug.

9. Over the past several decades, natural selection has resulted in populations of *Staphylococcus aureus* (an infectious wound bacterium) evolving resistance to most antibiotics. What would you predict would happen to an antibiotic resistant *S. aureus* population if antibiotic use was terminated?

a. The growth rate of drug resistant *S. aureus* in the population will increase more than that of drug-sensitive *S. aureus*.
b. The cells in the population would lose the mutation that caused antibiotic resistance.
c. The frequency of resistant *S. aureus* will decrease in the population.
d. The mutation rate of drug resistant cells would revert back to the mutation rate of nonresistant cells in the population.

10. Models of two atoms are shown in the figure. **Choose all** of the true statements about these atoms.



a. These atoms both have the same net charge.
b. These atoms both have the same atomic mass.
c. These atoms represent different elements.
d. These atoms represent different isotopes of the same element.
e. These atoms both have an unfilled valence shell.
f. These atoms both have the same number of protons.
g. These atoms both have the same number of neutrons.
h. These atoms both have the same atomic number.
i. These atoms both are neutral.
j. These atoms both have the same number of electrons
k. These atoms both have a positive charge of +2.