INS Biology Homework Week 4 **NAME:________________________________**
Due Wednesday, October 17

Your responses should be relatively brief, providing only the necessary information to answer the question.

1. Construct a version of the Hardy-Weinberg equations that could be applied to a gene with three alleles.

$$\mathbf{p^2 + q^2 + r^2 + 2pq + 2pr + 2qr = 1}$$

This equation basically states that alleles p, q, and r total up all of the alleles in the population for that gene.

2. Imagine an allele that is present at a frequency of 0.5 in a large population and in a small population. Compare and contrast the effects of genetic drift on this allele in the two populations.

<u>**Although the allele is present at the same frequency in both populations, genetic drift will be more pronounced in the small population.**</u> **In the small population, the time to fixation or loss of the allele will be shorter than that of the larger population; in both cases it is the result of sampling error.**

3. For a species of mongoose (a weasel like mammal), tail coloration is controlled by a single gene with two alleles, a recessive "ring stripe" allele and a dominant "black tip" allele. You examine a population of 200 individuals and find the frequency of the "ring stripe" allele to be 0.3. If the population is in Hardy-Weinberg equilibrium, how many individuals with each genotype would you expect?

Step A: find the frequency of the recessive (c) and dominant (C) alleles.

Let frequency C = p, and frequency c = q; recall p + q = 1; <u>q = 0.3</u>; <u>p = 1- 0.3 = 0.7</u>

Step B: determine the expected frequencies of p and q using the Hardy-Weinberg equation.

$\mathbf{p^2 + 2pq + q^2 = 1; (0.7)^2 + [(0.3*0.7) + (0.7*0.3)] + (0.3)^2 = 0.49 + [0.21 + 0.21] + 0.09}$

= 0.49 + 0.42 + 0.09 = 1 (note these numbers represent the frequencies of the genotypes!)

Step C: Solve for the expected allele frequencies so that you can compare observed and expected, which allows you to determine if the alleles are in HW equilibrium.

$\mathbf{p = p^2 + ½(2pq)}$ **and** $\mathbf{q = q^2 + ½(2pq)}$**; p = 0.49 + ½(0.42) = 0.7 and q = 0.09 ½(0.42) = 0.3**

The observed and expected frequencies for these alleles are the same, so the population is in HW equilibrium.

Step D: Determine the expected value of each genotype. There are 200 individuals in a population and 49% of them are CC, 42% are Cc, and 9% are cc. Therefore, there are 98 homozygous dominants, 84 heterzygotes, and 18 homozygous recessives in the population.

4. While studying a population of fruit flies, you notice a new mutation that causes a fly to grow a second set of wings. You are interested in investigating the effects of this mutation on fitness. Propose a hypothesis and null hypothesis, and design an experiment to test the hypotheses. Assume you have enough flies to perform your experiments. **NOTE: You were only graded on attempting this question. In the future you will be graded based on the following criteria:**

Level of Achievement	General Presentation	Reasoning, Argumentation
Exemplary (3 pts)	*The writer has designed appropriate experiments and those experiments are clear and logical. The experimental design is capable of falsifying or confirming the hypothesis. *The concept of variables is discussed and it is clear what variables are being controlled and which are being manipulated. If appropriate, positive and negative controls are included. *The author has included a clear, concise, falsifiable, and testable hypothesis.	*The writer demonstrates that they fully understand the process of experimental design. *The writer demonstrates that they understand how to set up and control an experiment. *The writer demonstrates their ability to generate a good scientific hypothesis.
Adequate (2 pts)	One of the above elements is lacking.	One of the above elements is lacking.
Needs improvement (1 pts)	More than one of the above elements is lacking.	More than one of the above elements is lacking.
No Experiments (0 pts)	The writer did not state hypotheses or design experiments.	This was the focus of the entire assignment.

Across

2. **MUTATION**—Changes in the genetic material; creation of new alleles
4. **INBREEDING**—Producing offspring with a close relative
6. **DISRUPTIVESELECTION**—Favors the extreme values over the mean but does not alter that value
11. **STABILIZINGSELECTION**—Weeds out the extreme values of a trait but does not alter the mean value
12. **SEXUALSELECTION**—Results in having male-male competition
13. **ANALOGOUSTRAITS**—Streamlined bodies in fish, whales, and seals are an example of this
14. **ALLELEFREQUENCY**—The proportion of the gene that an allele exists in a population
16. **EVOLUTION**—Lamarck and Darwin's contribution to Biology
17. **CONVERGENTEVOLUTION**—Process by which streamlined bodies in fish, whales, and seals evolved into similar forms
18. **GENETICDRIFT**—Affects small populations strongest
20. **INBREEDINGDEPRESSION**—Loss of heterozygosity as a result of extensive reproduction by close relatives with each other
21. **FUNDAMENTALASYMMETRYOFSEX**—Difference between male and female investment in reproduction
22. **FIXATION**—When only one copy of a gene exists as a result of genetic drift

Down

1. **FOUNDEREFFECT**—Sampling error caused by a certain type of movement of individuals from one population to another
3. **ARTIFICIALSELECTION**—Results in present day domestic plants and animals
5. **SEXUALDIMORPHISM**—Male and female peacocks are examples of this
7. **HOMOLOGOUS TRAITS**—Fur in mammals is an example of this
8. **GENETICBOTTLENECK**—Usually follows a population bottleneck
9. **NATURALSELECTION**—Darwin's original idea in evolutionary theory
10. **DIRECTIONALSELECTION**—Leads to the mean value of a trait getting bigger or smaller
15. **LOSS**—When only one copy of a gene exists as a result of genetic drift, what happened to the other copies
19. **MIGRATION**—Movement of individuals from one population to another