AP Biology **Population Genetics Simulation Lab** Name_____

Purpose: To investigate how allele frequencies change in populations.

Introduction

Population genetics is the study of genetic variation within populations, and involves the examination and modeling of changes in the frequencies of genes and alleles in populations over space and time. The focus is the population or the species - not the individual. Population genetics overlaps to a large degree with a field within evolutionary biology called *microevolution*, which is the study of changes in gene frequencies in populations.

One idea that people have regarding genes in populations is that recessive alleles will become less and less common over time. Let's see if that's true.

CASE 1: Modeling a population's genetic structure over several generations.

Here's the method: Each person in the class will take two allele cards, one "A,", one "a." In addition, each person will take a few extra cards of each type so that s/he can easily change genotypes as the simulation progresses.

For the purpose of this simulation, actual sex doesn't matter: you can "mate" with anyone. Here's how: Randomly choose someone. Shuffle your two allele cards. Randomly put one on the table. Your partner will do the same. These two alleles constitute the genotype of your first offspring. Then, take back your alleles to reconstitute your original genotype. Both you and your partner should shuffle your cards again to produce a second offspring.

One of you should assume the genotype of the first offspring, and record it under "My Genotype" for Generation 1. The second partner assumes the genotype of the second offspring. Now, using that new genotype, randomly find a new partner to mate with. If, for example, your new genotype is "AA," then you'll shuffle two "A" cards, putting one down for each offspring.

Repeat this until you're at Generation 5, recording your new genotype each time, and changing the cards you shuffle as needed. Return to your seat after the fifth generation.

Prediction: ***I predict that after several generations the frequency of A will*** _____

because _____

	My	Number of Individuals: _____				Number of Alleles:____			frequency	
Generation	Genotype	AA	Aa	aa	Total	# of "A"	# of "a"	Total	A	a
0	Aa	X		X					.5	.5
1										
2										
3										
4										
5										

1) Interpretation: ***What happened?*** _____

_____

_____

2) Shuffling cards represent what event during meiosis? _____

3) Shuffling cards represents what Mendelian principle? _____

CASE II: Selection against "a"

Not all alleles are created equal. Some confer different levels of fitness on their possessors. In this simulation, the genotype "aa" is completely lethal. To simulate this, follow the same procedure as in Case I, except that if your offspring is "aa," take back your cards and continue to create offspring until one survives. As above, change your cards as needed to get your new genotype.

Prediction: ***I predict that after several generations the frequency of A will*** _____

because _____

	My	Number of Individuals				Number of Alleles			Frequency	
Generation	Genotype	AA	Aa	aa	Total	# of "A"	# of "a"	Total	A	a
0	Aa	X		X					.5	.5
1				X						
2				X						
3				X						
4				X						
5				X						

1) Interpretation: ***In this case what occurred was*** _____.

2) ***I think this happened because*** _____

_____

One question I have is: _____

CASE III: Heterozygote Advantage

In this simulation, we'll try to simulate a more complex situation, such as the one that exists with sickle cell anemia. If you get "aa" the offspring dies, and you have to produce new offspring (as in Case 2). However, this time, if your offspring's genotype is "AA," flip a coin. If heads, the individual dies (of malaria) and you have to create another offspring. "AA" is only maintained in the population if your coin toss results in "tails"

Prediction: ***I predict that after several generations the frequency of A will*** _____ ***because*** _____

_____

	My	Number of Individuals				Number of Alleles			Frequency	
Generation	Genotype	AA	Aa	aa	Total	# of "A"	# of "a"	Total	A	a
0	Aa	X		X					.5	.5
1				X						
2				X						
3				X						
4				X						
5				X						

1) Interpretation: ***In this case what occurred was*** _____.

2) I think this happened because _____

_____

3) List two reasons why recessive alleles, even when harmful, get maintained in a population?

_____

_____

Conclusion: In the lines below, compare and contrast the three simulations in this model. As you do, address the following issues:

1. The most important idea in this lab was…
2. Microevolution is …
3. Some other ideas from biology that were addressed were…
4. In my opinion, the model that we used to simulate microevolution was (effective/ineffective) because ….
5. One thing I'd like to know more about now is…

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