Biology 3201 Investigation 17.B Testing the Hardy-Weinberg Principle Gillam Holy Heart Name: __________________

The Hardy-Weinberg principle states that the allele frequencies in a population will not change from generation to generation, as long as five conditions are met. In this investigation, you will focus on the first two conditions:

- The population is large enough that chance events will not alter allele frequencies.
- Mates are chosen on a random basis.

Part 1 of this investigation involves simulating the effect of random mating on allele frequencies in a large population. Part 2 involves testing to find out if a model population is at genetic equilibrium.

<u>Question</u>

What processes affect the genetic equilibrium of a population?

<u>Part 1: Demonstrating Genetic Equilibrium</u>

Hypothesis (1 Mark)

Make a hypothesis about the effects of random mating on allele and genotype frequencies in a population over time.

____

____

____

Prediction

In a model simulation using 80 beads, the proportions of corresponding alleles in a population undergoing random mating are 48/80 for D, the dominant allele, and 32/80 for d, the recessive allele. Calculate the allele frequencies for d and D. Use the Hardy-Weinberg equation to predict the expected frequency of each genotype DD, Dd, and dd. Then predict the allele and genotype frequencies for future generations.

$p^2 + 2pq + q^2 = 1$ **$p + q = 1$**

p = **p^2 =**

q = **q^2 =**

2pq =

Will the future generations have the same frequency or will they change?

____

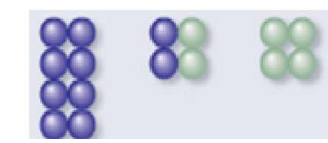
____

Materials

- 2 paper cups (or similar containers)
- 48 dark-coloured beads
- 32 light-coloured beads

Procedure

1. Label one paper cup "male gene pool" and the other paper cup "female gene pool." Put 24 dark-coloured (D) and 16 light-coloured (d) beads in each cup. The beads represent the alleles for a specific trait.
2. Gently shake the cups to mix the beads. To simulate random mating, without looking, select one bead (allele) from each cup. Place the pair of beads (the genotype of the offspring) on the table. Repeat this process, lining up the genotypes (DD, Dd, and dd) in separate columns until you have used all the beads.



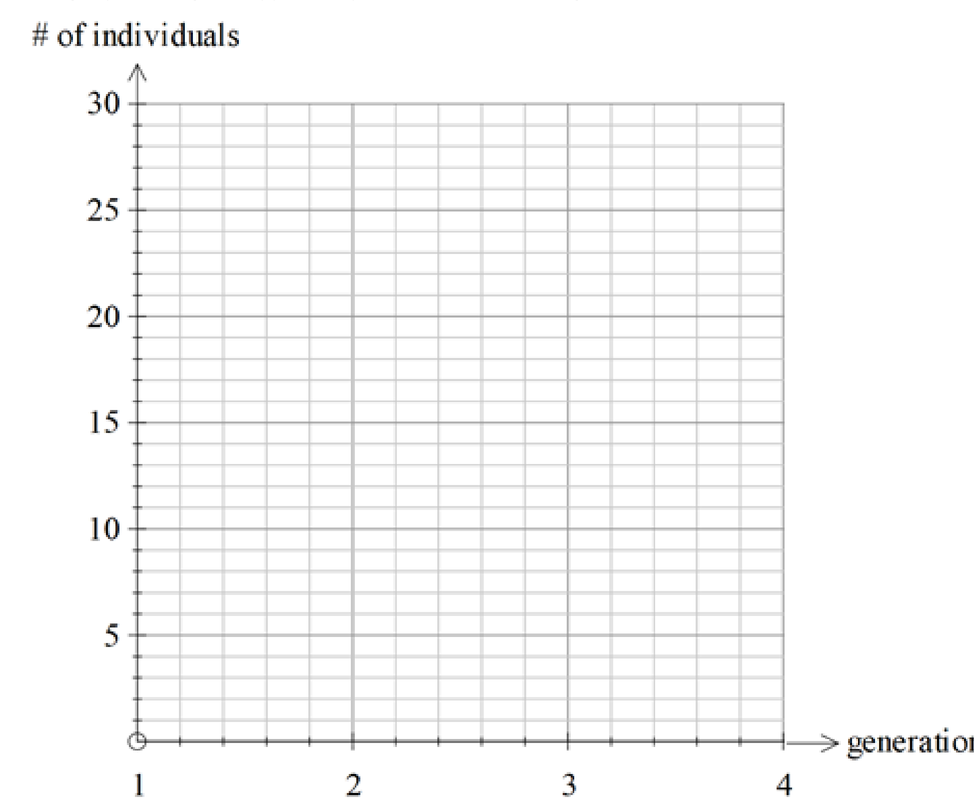
3. In your data table, record the number of offspring with each genotype for this generation.

4. To establish the gene pool for the next generation, assume that half the population in each column of beads is male and the other half is female. Place the beads representing the male genotypes in the male gene pool and the beads representing the female genotypes in the female gene pool. Remember that genotypes are made up of two alleles, so each male and female must contribute two beads to the gene pool. (You should end up with an equal number of alleles in each gene pool. If there is an odd number of genotypes in a column, assume that the last genotype belongs to a male. The next time this happens, assume that the last genotype belongs to a female. Switch from male to female every time there is an odd number of genotypes in a column.)

5. Repeat steps 3 to 5 three more times to obtain data for a total of four generations.

Generation	Number of DD	Number of Dd	Number of dd	Total Number of Individuals
1				
2				
3				
4				

6. Use your data from to graph the genotype frequencies over four generations.



Part 2: Testing for Genetic Equilibrium

Hypothesis

Make a hypothesis about the effects of a recessive lethal allele on allele frequencies and genotype frequencies in a population over time.

____

____

____

Prediction

The proportions of corresponding alleles in a population are 48/80 for D (the dominant allele for a healthy phenotype) and 32/80 for d (the recessive lethal allele). Calculate the allele frequencies for d and D. Use the Hardy-Weinberg equation to predict the expected frequency of each genotype Dd, Dd, and dd. Then predict the allele and genotype frequencies for future generations.

Materials

• 3 paper cups (or similar containers) • 48 dark-coloured beads • 32 light-coloured beads

Procedure

1. Place your beads in the cups as you did in part, half male and half female, and pull one out of each cup as you did before and organize them as before.

2. Assume that the light-coloured bead (d) is the recessive lethal allele. Therefore, none of the organisms with the dd genotype will survive to reproduce. Remove the dd genotypes from the population on the table, and place them in a separate cup. You now have two columns of beads on the table: DD and Dd.

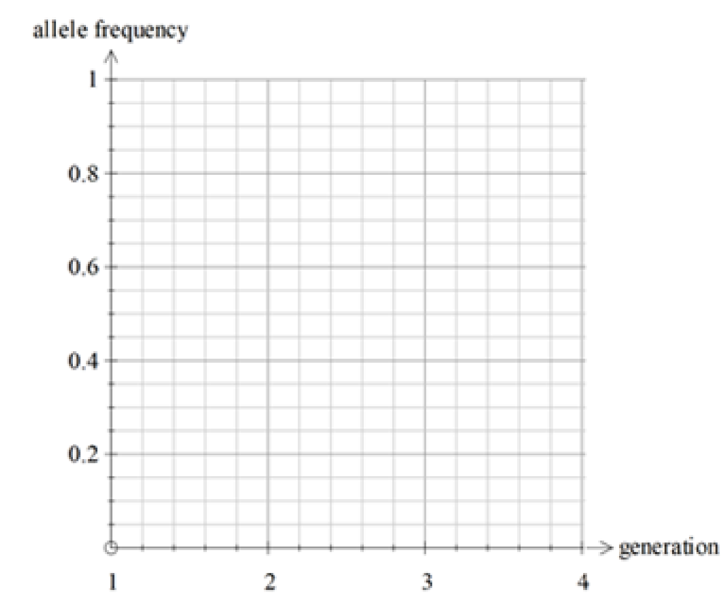
3. Place the remaining beads in the cups and complete the task 3 more times, recording it in your table, each time removing the light-coloured beads in your dd group.

Generation	Number of DD	Number of Dd	Number of dd	Total Number of Individuals
1				
2				
3				
4				

4. Use your table above to calculate the decimal value of each allele frequency.

Generation	DD	Dd	dd
1			
2			
3			
4			

5. Graph your allele frequency data below



6. Account for the allele and genotype frequencies observed over time in Part 1. Were the conditions of the Hardy-Weinberg principle met in this population? Explain your answer.

____

____

7. Account for the allele and genotype frequencies observed over time in Part 2. Were the conditions of the Hardy-Weinberg principle met in this population? Explain your answer.

____

____

8. What happened to the total number of alleles in the population over the course of the investigation in part 2? Did this affect the results of the investigation? Explain your answer.

____

____