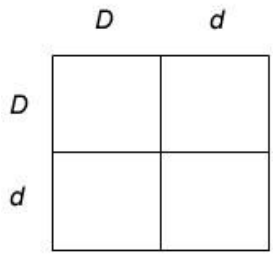
Name: _____ Period: _____ Date: _____

Hardy-Weinberg Equilibrium Gizmo

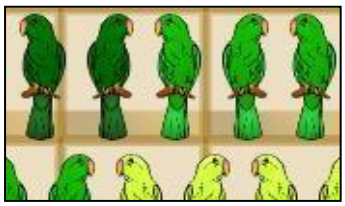
Prior Knowledge Questions (Do these BEFORE using the Gizmo.)



1. A bird's feather color is controlled by two **alleles**, *D* (dark feathers) and *d* (lighter feathers). Suppose two *Dd* birds mate. What percentages of *DD*, *Dd*, and *dd* offspring would you predict? Use the **Punnett square** at right to help determine your answer.

   DD _____ *Dd* _____ *dd* _____

2. In this situation, what ratio of **heterozygous** (*Dd*) to **homozygous** (*DD* and *dd*) offspring would you expect to find? _____



Gizmo Warm-up

Many factors—immigration, natural selection, hunting, etc—can influence the composition of a population. To determine if one of these factors is affecting a population, it is useful to know what a population looks like when *none* of these factors is present.

In 1908, Godfrey Hardy and Wilhelm Weinberg independently discovered the laws that govern such populations. These laws can be explored in the *Hardy-Weinberg Equilibrium* Gizmo™.

1. The parrots you see represent a population of 500 parrots. For these parrots, the *D* allele is **incompletely dominant** over *d*, which means that *Dd* parrots are intermediate between *DD* and *dd* parrots. In the Gizmo, select the TABLE tab. How many parrots of each **genotype** are in the initial population?

   DD _____ *Dd* _____ *dd* _____

2. Return to the DESCRIPTION tab. Click **Begin**, and then click **Breed**. What happens?

   _____

3. Click **Hatch**, and look on the TABLE tab. What are the parrot populations now?

   DD _____ *Dd* _____ *dd* _____

Activity A: **Alleles and genotypes**	Get the Gizmo ready: • On the DESCRIPTION tab, click **Reset**. • Check that ***DD*** is 50% and ***dd*** is 30%.	

Question: How will the proportion of genotypes and alleles change over time when mating is random and no natural selection is occurring?

1. How do you expect the proportions of *D* and *d* alleles to change over time?

_____

_____

2. Run a generation in the Gizmo. After clicking **Hatch**, fill in the allele and genotype percentages for generation 1. Repeat this process for 5 generations.

	Initial values	**Generation**				
		1	**2**	**3**	**4**	**5**
% *D* alleles	60					
% *d* alleles	40					
% of *DD* genotype	50					
% of *Dd* genotype	20					
% of *dd* genotype	30					

3. What patterns do you see in your data? _____

_____

_____

4. Select the ALLELE GRAPH tab. What does this graph show? _____

_____

5. Select the GENOTYPE GRAPH tab. What does this graph show? _____

_____

Activity A (continued from previous page)

6. On the DESCRIPTION tab, click **Reset**. Set ***DD*** and ***dd*** to any values you like. Fill in the initial values in the table below, and then run the Gizmo for five generations. Record the allele and genotype percentages for each generation in the table below.

	Initial values	**Generation**				
		1	**2**	**3**	**4**	**5**
% *D* alleles						
% *d* alleles						
% of *DD* genotype						
% of *Dd* genotype						
% of *dd* genotype						

7. Do the patterns you noticed in the first experiment appear in the second? Explain.

_____

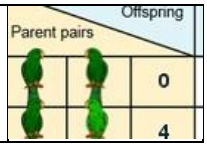
_____

8. The **Hardy-Weinberg principle** states that the proportions of alleles and genotypes in a population will remain stable as long as the following criteria are satisfied:

   - Mating is random.
   - There is no immigration or emigration.
   - No natural or artificial selection is occurring.
   - There is no mutation.
   - The population is relatively large.

   How well does the Hardy-Weinberg principle describe this population of parrots?

   Would you say that this parrot population is evolving? Explain.

Activity B: **Genotype ratios**	Get the Gizmo ready: • Click **Reset**. • Set ***DD*** to 30% and ***dd*** to 70%.	

Question: How do genotype percentages relate to allele percentages?

1. You can use the laws of probability to predict how many *DD*, *Dd*, and *dd* offspring will result from this parent population.

   A. What is the current percentage of *D* alleles in the population? _____

   B. What is the current percentage of *d* alleles in the population? _____

   C. What is the probability of inheriting a *D* allele from a parent? (Hint: Convert the percentage of *D* alleles to a decimal.) _____ Call this value *p*.

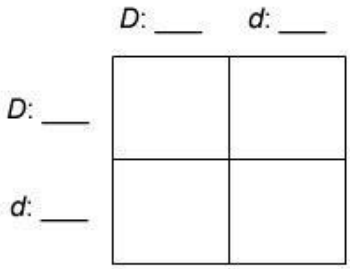
   D. What is the probability of inheriting a *d* allele? _____ Call this value *q*.

2. If a trait is determined by two alleles, the sum of *p* and *q* is 1. Why is this true?

   _____

   _____

3. Fill in the current *p* and *q* values next to the *D* and *d* alleles around the Punnett square at right. Then calculate the probability of each offspring genotype. Write these values into the individual squares.

   For example, the upper left box in the square represents the probability of a *DD* offspring. The probability of inheriting a *D* allele from each parent is *p*, so the probability of *DD* is p^2.

   What is the sum of the probabilities in the four squares? _____

4. Now determine an algebraic expression for the probability of each genotype in terms of *p* (the probability of inheriting *D*) and *q* (the probability of inheriting *d*). Use the Punnett square above as a guide.

   A. In terms of *p* and *q*, what is the probability of a *DD* offspring? _____

   B. In terms of *p* and *q*, what is the probability of a *dd* offspring? _____

   C. In terms of *p* and *q*, what is the probability of a *Dd* offspring? _____