## Genetic Probability

## 6974

## INTRODUCTION

Because the calculator deals with numbers more efficiently than with letters, we will use the number 1 to represent dominant allele (A) and the number 2 to represent recessive allele (a).

- For homozygous dominant individuals that are (AA), the alleles will be represented by the number 2 (because 1 + 1 = 2).
- For individuals that are heterozygous (Aa), the alleles will be represented by the number $3(1+2=3)$,
- For individuals that are homozygous recessive (aa), the alleles will be represented by $4(2+2=4)$.

A Punnett square for a cross between two heterozygous individuals normally looks like the square on the left. When numbers are used instead of letters, the Punnett square looks like the one on the right.

| GAMETES | A | a |
| :---: | :---: | :---: |
| $\mathbf{A}$ | AA | Aa |
| $\mathbf{a}$ | Aa | aa |


| GAMETES | $\mathbf{1}$ | $\mathbf{2}$ |
| :---: | :--- | :--- |
| $\mathbf{1}$ | $\mathbf{2}$ | 3 |
| $\mathbf{2}$ | 3 | 4 |

Based on the Punnett square above, we can make some predictions about the offspring of the cross.

- What percentage of offspring will be homozygous recessive?
- What percentage will be homozygous dominant?
- What percentage will be heterozygous?
- What percentage of offspring will have the same phenotype? List those genotypes.


## Activity Overview

## In this activity we will

- use the Sci Tools App to simulate a Punnett square
- make predictions about genetic crosses
- learn about the following concepts: genes, alleles, dominant alleles, recessive alleles, homozygous individuals, heterozygous individuals, phenotypes, and genotypes


## Approximate Total Time: 15 minutes

## Science Objective

Random "parent" alleles are generated and crossed to illustrate the variance in dominant and recessive alleles imparted to offspring.

## PROCEDURE

1
We are going to simulate a cross between two heterozygous individuals ( $\mathrm{Aa} \times \mathrm{Aa}$ ). To begin, use the following steps to tell the calculator to generate 200 random integers from 1 through 2. List L1 will contain one allele for each of the 200 gametes of one parent. Recall that the number 1 represents $A$, and the number 2 represents a. You will be generating 200 offspring from this cross.

## 2

Press STAT, ENTER. Highlight L1. Press MATH, 1. Highlight 5 :RAND INT( . Press ENTER. Enter $1, \square, 2, \square$, the number 200, then ENTER.

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Highlight L2 and repeat step 1. List L2 will contain one allele for each of the 200 gametes of the second parent.


## 4

Join the gametes from L1 and L2 to represent 200 offspring in L3. To do this, highlight L3 and enter the following: [nd, [L1], $⿴$, [2nd, [L2], ENTER. You have produced 200 offspring! Refer to the Punnett square above the Procedure section to remind yourself what the values in L3 represent.


Represent the different types of offspring produced with a histogram:
a) Press APPS. Highlight SCI TOOLS and press ENTER, ENTER. Highlight 3:DATA/GRAPH WIZARD. Press ENTER.
b) Press WINDOW to select PLOT DATA. Press TRACE to select HISTOGRAM.
c) Highlight L3 and press ENTER.
d) Press TRACE and use the arrow keys to move the cursor from bar to bar. Record the values for $\mathrm{n}=$. Each value is the number of individuals with one of the combinations of alleles. The first bar represents AA, the second bar Aa, and the third bar aa. Because the calculator generated alleles randomly, your graph may look slightly different from the one here.


## DATA ANALYSIS

1. If an individual is homozygous dominant, what is the probability that he or she will produce gametes carrying the dominant allele? What is the probability that he or she will produce gametes with the recessive allele?
2. What is the probability that a heterozygous individual will produce gametes carrying the recessive allele? The dominant allele?
3. In your cross of two heterozygous individuals, which combination of alleles occurred with the greatest frequency?
4. In the cross of two heterozygotes, what is the probability that an offspring will be heterozygous? What is the probability that an offspring will be homozygous dominant? Homozygous recessive?
5. Which two bars in the histogram represent offspring with the same phenotype?
6. Compare your histogram with your earlier predictions. Are the percentages of offspring similar? Explain why there may be some differences.
