

## Solving Dihybrid Punnett Squares with Coding Handout

### Engage: Feathers and Beak Introduction

Red feathers and long beaks are dominant in parrots, whereas blue feathers and short beaks are recessive in parrots. A parrot that is *heterozygous* for both alleles would have a *phenotype* that shows red feathers and a long beak possess the *genotype* FfDd. This parrot could provide either the *dominant allele*, F, or the *recessive allele*, f, and the *dominant allele*, D, or the *recessive allele*, d, to their offspring through the sex cells, also called *zygotes*.

You will be conducting this engagement exercise in partners. Find a partner and appoint one person Parrot A, and the other person Parrot B. Flip a coin to determine the genotypes of each partner. Heads will represent dominant, tails will represent recessive.

1. Flip a coin to determine Parrot A's (Partner A) 1<sup>st</sup> allele. *Circle One.*      F      or      f
2. Flip a coin to determine Parrot A's (Partner A) 2<sup>nd</sup> allele. *Circle One.*      F      or      f
3. Flip a coin to determine Parrot A's (Partner A) 3<sup>rd</sup> allele. *Circle One.*      D      or      d
4. Flip a coin to determine Parrot A's (Partner A) 4<sup>th</sup> allele. *Circle One.*      D      or      d
5. Determine Parrot A's (Partner A) genotype. \_\_\_\_\_
6. Determine Parrot A's (Partner A) phenotype. *Circle One of Each.*

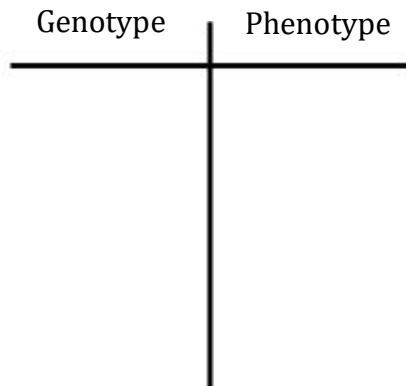
Red Feathers	or	Blue Feathers
Long Beak	or	Short Beak
7. Flip a coin to determine Parrot B's (Partner B) 1<sup>st</sup> allele. *Circle One.*      F      or      f
8. Flip a coin to determine Parrot B's (Partner B) 2<sup>nd</sup> allele. *Circle One.*      F      or      f
9. Flip a coin to determine Parrot B's (Partner B) 3<sup>rd</sup> allele. *Circle One.*      D      or      d
10. Flip a coin to determine Parrot B's (Partner B) 4<sup>th</sup> allele. *Circle One.*      D      or      d
11. Determine Parrot B's (Partner B) genotype. \_\_\_\_\_
12. Determine Parrot B's (Partner B) phenotype. *Circle One of Each.*

Red Feathers	or	Blue Feathers
Long Beak	or	Short Beak

**Explore: Dihybrid Scratch Inquiry**

Students will utilize the hands-on Scratch activity to explore the concept of genetic processes through dihybrid cross Punnett squares: <https://scratch.mit.edu/projects/277242403/>

1. Complete the Dihybrid Cross Simulation with the feathers and beak genotype information acquired above with your partner.
2. On the left of the Punnett Square, put Partner A's alleles. On the top, put Partner B's alleles.
3. Use the Punnett Square to determine the genotype of the offspring between Partner A and B.
4. Use the T-Chart to list the genotypes and the probability of each phenotype of the offspring.




5. Continue to explore the Dihybrid Cross Simulation, while attempting to make connections with the following words:
- Alleles
  - Dominant
  - Recessive
  - Heterozygous
  - Homozygous
  - Parent Genotype and Phenotype
  - Zygote
  - Offspring Genotype and Phenotype
  - Probability

**Explain**

Mendel had questions about how alleles separated during gamete formation, the product of meiosis.

- Does the segregation of one pair of alleles have any affect on the segregation of a different pair of alleles?

In other words, does the gene that determines whether a feather is red or blue have any effect on the gene for beak length?

1. What do you think? Why? \_\_\_\_\_
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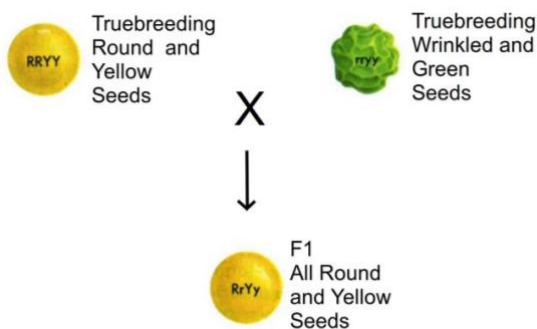
Mendel designed a second set of experiments to follow two different genes as they passed from parent to offspring.

Mendel used pea plants in his experiments; one parent plant had peas that were round and yellow, and the other parent plant had peas that were wrinkled and green. The round and yellow traits are dominant.

In the Dihybrid Cross, Mendel crossed true-breeding parents:

True-Breeding Parent 1	True-Breeding Parent 2
Round, Yellow Peas	Wrinkled, Green Peas

**If the round and yellow traits are dominant, what is the genotype and phenotype of all the F1 offspring? Discuss with a partner.**



Next, Mendel allowed the hybrid F1 offspring, RrYy, to self-pollinate, which resulted in the production of 556 seeds!

- 315 round, yellow (dominant, dominant)
- 105 round, green (dominant, recessive)
- 104 wrinkled, yellow (recessive, dominant)
- 32 wrinkled, green (recessive, recessive)

**2. What did this mean for alleles segregating during gamete formation? Discuss with a partner.**

The alleles for one gene had \_\_\_\_\_ on the alleles of another trait. This is known as \_\_\_\_\_

\_\_\_\_\_ states:

**Punnett Squares for Two-Factor or Dihybrid Cross**

- When two traits are being considered, Punnett square will need \_\_\_\_\_ squares.
- Each parent will pass one allele of each gene pair to the offspring
  - o Example, a parent with AaBb could pass 4 allele combinations on to their offspring
    - AB, Ab, aB, ab

**3. Given the following parental genotypes, what alleles could each parent pass to their offspring? Discuss with a partner.**

Parent Genotype	4 allele combinations it can pass to their offspring
FfDd	
Ffdd	
ffDd	
FFDD	

**4. With a partner, use the Punnett Square to cross Mendel’s True-Breeding Round and Yellow Plant x True-Breeding Wrinkled and Green Plant**

- a. What is the genotype of each parent? \_\_\_\_\_
- b. On the Punnett Square, input the allele combinations that can be passed from each parent to the offspring.
- c. Complete the Punnett Square to illustrate the possible genotypes for the offspring.
- d. Complete the T-Chart, stating the possible offspring genotypes and the probability that each genotype will occur.


Genotypes	Phenotypes

- e. Using full sentences, state the genotype for the offspring in this cross. Support your answer using correct terminology.

**5. If the offspring from the above cross are allowed to self-pollinate**

- a. What is the phenotype of each parent?
- b. What is the genotype of each parent?
- c. Complete the Punnett Square to illustrate the possible genotypes for the offspring.
- d. Complete the T-Chart, stating the possible offspring genotypes and the probability that each genotype will occur.


Genotypes	Phenotypes

- e. Using full sentences, state the probability that an offspring will be homozygous recessive for both traits, colour and texture. Support your answer using correct terminology.

### **Elaborate: Dihybrid Scratch Extension**

Extend/remix the Dihybrid Scratch program, <https://scratch.mit.edu/projects/277242403/>, by coding in various additional functions, such as but not limited to:

- Add an Introduction
- Change the Background
- Add a Sprite Character
- Add a Monohybrid Cross Question
- Label for Parent Genotypes
- Label for Parent Phenotypes
- Label for Zygotes
- Add Probability Calculator for Zygote Genotypes
- Add Probability Calculator for Zygote Phenotypes
- Add Explanation for What Has Occurred

Brainstorming Space: