

# Punnett squares

## Why do scientists use biotechnology? What are the advantages?

Use Punnett squares to show results from a hybrid cross and determine the genotypic ratios and phenotypic ratios of a hybrid. If a plant breeder is interested in creating a better corn plant, one with some traits from one variety and some traits from another, the traditional method is to cross these two varieties and look for the plants that exhibit the combination of traits desired.

### Instructions

Use the model (Carolina Biological Supply 17-6810 Monohybrid cross) to complete the activity below.

- Cross Colored Aleurone (RR) corn with Colorless Aleurone (rr), fill in the Punnett square below to show the F<sub>1</sub> results.

	R	R
r	<b>Rr</b>	<b>Rr</b>
r	<b>Rr</b>	<b>Rr</b>

**RR × rr**

- What are the resulting genotypes?

**100% Rr**

- What are the resulting phenotypes?

**100% Colored Aleurone**

- When you cross two of the offspring from above, what will be the result in the F<sub>2</sub> generation?

	R	r
R	<b>RR</b>	<b>Rr</b>
r	<b>Rr</b>	<b>rr</b>

**Rr × Rr**

- What are the resulting genotypes?

**1:2:1 RR: Rr: rr**  
**or 25% RR, 50% Rr, 25% rr**

- What are the resulting phenotypes?

**3:1 Colored Aleurone, Colorless Aleurone**  
**or 75% Colored, 25% Colorless**

- Count the kernels on the cob to see what the ratio is.

- If a cob resulted that had 600 total kernels, what amount of those kernels would you expect to be colored?

Use the model (Carolina Biological Supply 17-6900 Dihybrid cross) to complete the activity below.

3. Cross Colored Aleurone (RR), Starchy (SU/SU) corn with Colorless Aleurone (rr), Sweet Endosperm (su/su), fill in the Punnett square below to show the F<sub>1</sub> results.

	R Su	R Su	R Su	R Su
r su	<b>RrSU/su</b>	<b>RrSU/su</b>	<b>RrSU/su</b>	<b>RrSU/su</b>
r su	<b>RrSU/su</b>	<b>RrSU/su</b>	<b>RrSU/su</b>	<b>RrSU/su</b>
r su	<b>RrSU/su</b>	<b>RrSU/su</b>	<b>RrSU/su</b>	<b>RrSU/su</b>
r su	<b>RrSU/su</b>	<b>RrSU/su</b>	<b>RrSU/su</b>	<b>RrSU/su</b>

**RRSU/SU x rrsu/su**

- a. What are the resulting genotypes?

**100% RrSU/su**

- b. What are the resulting phenotypes?

**100% Colored Aleurone, Starchy**

4. When you cross two of the offspring from above, what will be the result in the F<sub>2</sub> generation?

	R SU	R su	r SU	r su
R SU	<b>RRSU SU</b>	<b>RRSU su</b>	<b>RrSU SU</b>	<b>RrSU su</b>
R su	<b>RRSU su</b>	<b>RRsu su</b>	<b>RrSU su</b>	<b>Rrsu su</b>
r SU	<b>RrSU SU</b>	<b>RrSU su</b>	<b>rrSU SU</b>	<b>rrSu su</b>
r su	<b>RrSU su</b>	<b>Rrsu su</b>	<b>rrSU su</b>	<b>rrsu su</b>

- a. What is the genotype ratio?

**6.25% RRSU SU, 12.5% RRSU su, 12.5% RrSU SU, 25% RrSU su, 6.25% RRsu su, 12.5% Rrsu su, 6.25% rrSU SU, 12.5% rrSU su, 6.25% rrsu su**

- b. What is the phenotype ratio?

**9:3:3:1 Colored Aleurone, Starchy; Colored Aleurone, Sweet; Colorless Aleurone, Starchy; Colorless Aleurone, Sweet**

If there are kernels on a resulting cob that are colorless, how might you explain this?

5. How long would it take for a farmer to accomplish this amount of crossing on his/her own?

**Answer: At least two growing seasons**

6. Look up seed chipping, a technique discovered by Monsanto. How much time does that take off of the typical hybridization cycle?

Possible website to check: [topcropmanager.com/seed-chipper-lets-breeders-take-a-peek-at-a-seeds-dna-5026/](http://topcropmanager.com/seed-chipper-lets-breeders-take-a-peek-at-a-seeds-dna-5026/)

Videos:

- Dekalb Breeding HQ: Seed chipping: [youtube.com/watch?v=gCb9TSpuxUU](https://www.youtube.com/watch?v=gCb9TSpuxUU)
- Robots speed the breeding of new crops: [youtube.com/watch?v=XFVU46mJCUE](https://www.youtube.com/watch?v=XFVU46mJCUE)

This removes the need for multiple growing seasons.

7. Look for other techniques being used to cut the time it takes to make new hybrids (i.e. DNA markers and genome mapping). Describe how these methods are helping reduce the time to create new lines that will have increased resistance to weed pressure, pests and drought.

**Answers will vary.**

Possible sites and videos:

- Molecular Breeding and Marker-Assisted Selection: [isaaa.org/resources/publications/pocketk/19/default.asp](http://isaaa.org/resources/publications/pocketk/19/default.asp)
- Genetic Modification: [youtube.com/watch?v=LSBnoGZoAHs](https://www.youtube.com/watch?v=LSBnoGZoAHs)

