# Punnett Squares **Walkthrough Worksheet**

## The creation of Punnett Squares

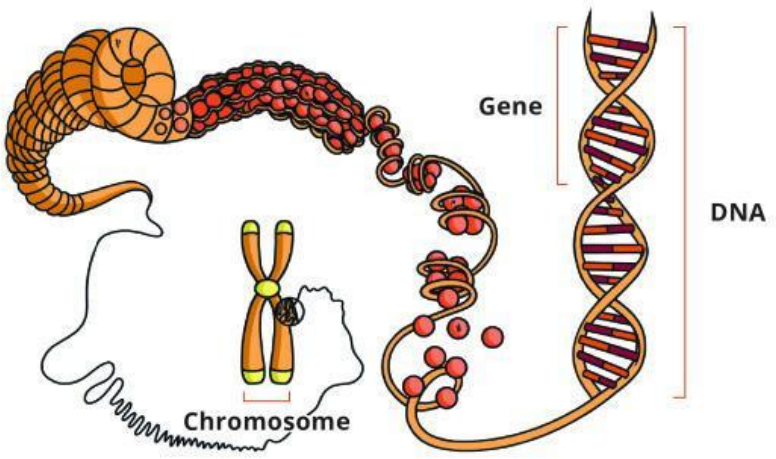
Punnett Squares were created by Reginald Crundall Punnett. He was looking for a way to predict how Mendelian traits are inherited. For every characteristic an organism has there are two versions of the same gene, these versions are called alleles. When two organisms sexually reproduce only one of each allele is given to the offspring. The Punnett square allows us to predict all the possible outcomes for a single trait when two organisms reproduce sexually.

| | |
|---|---|
| Gene | A section of DNA that codes for a trait. |
| Allele | A variation of a gene. For example, a brown eye gene or a blue eye gene. |
| Dominant Allele | An allele that has the ability to overpower the other allele. |
| Recessive Allele | An allele that can be overpowered by a dominant allele. |
| Phenotype | What trait is being physically presented. For example, brown hair. |
| Genotype | The combination of alleles presented. For example, heterozygous. |
| Homozygous | A genotype that has two of the same alleles presented. For example BB or bb. |
| Heterozygous | A genotype that has two different alleles presented. For example Bb. |

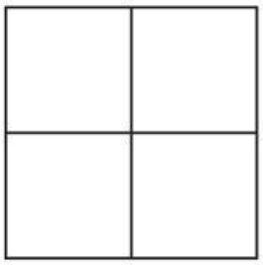
## Creating Punnett Squares

To understand Punnett squares, it is important to understand how genetics and inheritance works. Every cell in a multicellular organism contains DNA in the nucleus, this DNA exists in the form of chromosomes and each chromosome is made of sections of DNA called genes. In most organisms there are two copies of each chromosome, one from each parent, which means that there are two copies of each gene called alleles. Not all alleles are expressed in the same way. When a dominant allele is paired with a recessive allele the final result is the expression of the dominant allele.

For example, Emilia is heterozygous (Bb) for eye colour with an allele for blue eyes (b) and an allele for brown eyes (B). She marries Peter who is also heterozygous for eye colour with the same combination of alleles. They both have brown eyes but they wonder if it's possible for their children to have blue eyes, considering they both have a family history of blue eyes. They decide to create Punnett square.



To draw a Punnett square you must draw a square that is split into four even sections as shown below. Next, you must determine the key that will be used for the Punnett square. We use letters in Punnett squares to distinguish between dominant and recessive alleles, it doesn't matter what the letters are as long as the dominant allele is represented by the capital letter and the recessive allele is represented by the lowercase version of the same letter. An example of this would be Qq, where 'Q' represents the dominant allele and the 'q' represents the recessive allele. It can be helpful to choose letters that look different in each form to make your Punnett squares easier to interpret. With eye colour, brown is dominant so we will make a capital 'B' stand for brown, while blue is recessive so we will make lowercase 'b' stand for blue.

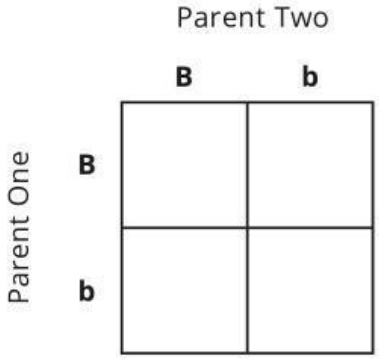


Key:

B- Brown eyes

b- Blue eyes

Now we need to determine the parents' genotype. Emilia and Peter are both heterozygous for eye colour, therefore we can determine that their genotypes are going to be Bb. So we add the genotype for one parent on the left hand side and the genotype for the second parent on the top of the square.

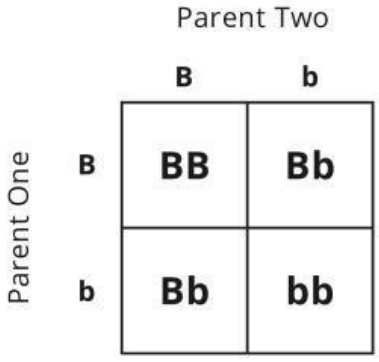



Key:

B- Brown eyes

b- Blue eyes

The design of the Punnett square allows us to see every possible combination of alleles for the offspring of the parents. To complete the Punnett square, each box is filled in from the letter above and to the left.




Key:

B- Brown eyes

b- Blue eyes

After completing the Punnett square, Emilia and Peter now know the four possible genotypes that their offspring could have for eye colour.

- One out of the four boxes resulted in 'BB' or homozygous dominant, this means that there is a 25% chance of this genotype occurring in their offspring.
- Two out of the four boxes resulted in 'Bb' or heterozygous, this means that there is a 50% chance of this genotype occurring in their offspring.
- One out of the four boxes resulted in 'bb' or homozygous recessive, this means that there is a 25% chance of this genotype occurring in their offspring.

They also can use their understanding of dominant and recessive alleles to determine the possible phenotypes, these are what is physically expressed.

- 'BB' only has brown eye alleles, so offspring with this genotype will have brown eyes.
- 'Bb' has a blue allele and a brown allele, however, as brown is dominant, offspring with this genotype will have brown eyes.
- 'bb' only has blue eye alleles, so offspring with this genotype will have blue eyes.

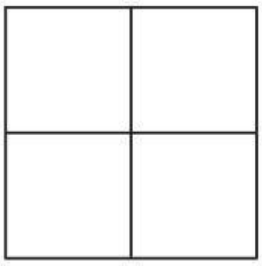
Only one box out of the four boxes have 'bb', which means there is a 25% chance of their offspring having blue eyes, while there are three boxes that have either 'BB' or 'Bb' which means there is a 75% chance of their offspring having brown eyes.

Emilia and Peter are shocked to see that two brown eyed people could have blue eyed offspring, however, this is a product of the dynamic between dominant and recessive genes. Recessive genes are able to skip generations as they need to be homozygous to be expressed.

## Questions:

Complete the following Punnett squares, identify the genotypes, phenotypes and calculate the possibility of each trait.

1. In pea plants, purple flowers (F) are dominant and white flowers (f) are recessive. Parent one is FF and parent two is Ff.



Key:

F- _____

f- _____

a. What are the genotypes of the parents? Hint: Are they homozygous dominant, homozygous recessive or heterozygous?

_____

b. What are the phenotypes of the parents?

_____

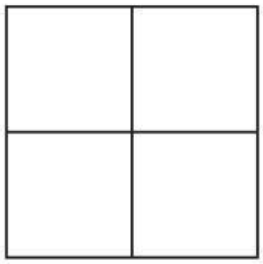
c. What is the probability of each genotype of the offspring?

_____

d. What is the probability of each phenotype of the offspring?

_____

2. In pea plants, yellow seeds are dominant (T) and green seeds are recessive (t). Parent one is Tt and parent two is tt.



Key:

T- _____

t- _____

a. What are the genotypes of the parents?

_____

b. What are the phenotypes of the parents?

_____

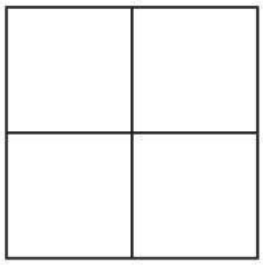
c. What is the probability of each genotype of the offspring?

_____

d. What is the probability of each phenotype of the offspring?

_____

3. In pea plants, round seeds are dominant (R) and wrinkled seeds are recessive (r). Parent one is RR and parent two is rr.



Key:

T- _____

t- _____

a. What are the genotypes of the parents?

_____

b. What are the phenotypes of the parents?

_____

c. What is the probability of each genotype of the offspring?

_____

d. What is the probability of each phenotype of the offspring?

_____